The New Climate Advocates

From mayors and MBAs to lawyers and landscape architects, the face of climate change activism is changing. At Penn, a mix of pragmatic thinking and visionary ambition has sparked a sense that what is urgent might also be achievable.

Edited by Trey Popp

The 2019–2020 academic year was barely two weeks old when campus life seemed to undergo a silent but significant shift. In retrospect, the first hint came in August, when the McHarg Center announced a public symposium titled "Designing a Green New Deal," which quickly attracted enough registrants to justify Irvine Auditorium as its venue. But that was just the beginning. Next it was the Wharton Risk Center—hardly a bastion of eco-activism—publishing a 30-part report called *Climate Risk Solutions*. Then it was the Penn Institute for Urban Research and Perry World House cohosting a conversation on what the latest Intergovernmental Panel on Climate Change (IPCC) report means for city governments. Meanwhile, every Wednesday in September featured a lunch-hour slate of "1.5 Minute Climate Lectures" on College Green ["Gazetteer," Nov|Dec 2019].

This spate of climate change programming was not the result of a top-down University initiative, but the independent work of various schools and centers, each of which brought its own particular perspective to bear. Here is a sample of their offerings. Also included is a profile of artist Diane Burko GFA'69, whose climate-change-inspired paintings appear throughout.

Act Local

Cities will determine the fate of the climate. How can they get their hands on the tools—and money—to do what nations have not?

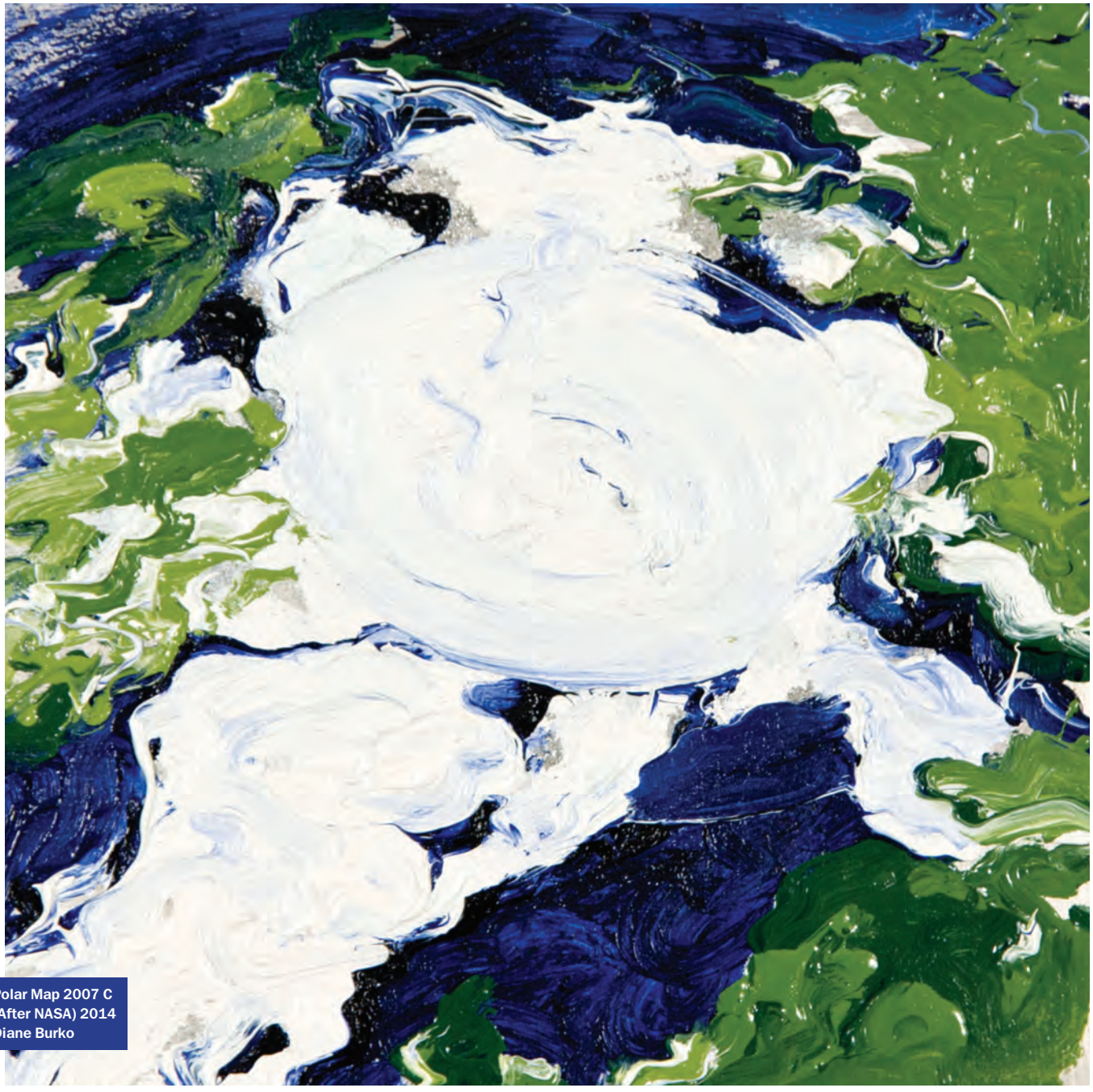
In October 2018, the IPCC published a special report on the potential impacts of a rise in global temperature of 1.5 degrees Celsius above pre-industrial levels. Had a soundtrack been issued, it might have approximated an air-raid siren blaring into a stadium amplifier. Drawing from more than 6,000 scientific studies, the IPCC concluded that the world could pass that temperature threshold in as little as 12 years, and that exceeding it by half a degree poses almost unimaginable risks. Drought could endanger 400 million city-dwellers. Rising sea levels could threaten land inhabited by 150 million people. Eight percent of humanity could lack sufficient freshwater. Eighteen percent of insects and 16 percent of plants could lose more than half of their current geographical range. Desertification in the Mediterranean biome could cause changes "unparalleled in the last 10,000 years." Ocean acidification, currently rising at a rate not seen for 65 million years, could undercut fisheries that supply the primary source of protein for more than 1 billion people.

Twelve months later, one of the report's 60 lead authors posed a stark question in a basement room in Meyerson Hall:

"So now, what's the point of the IPCC?" asked Seth Schultz, founder and CEO of the climate consultancy Urban Breakthroughs. The IPCC, created by the United Nations and the World Meteorological Organization in 1988 to provide policymakers with regular scientific assessments on climate change and its risks, has a very specific mandate. Its reports have to be "policy-relevant but not policy-prescriptive." In other words, it can't tell any of its 195 member nations what to do.

"National governments desperately want answers and solutions on how to take action," Schultz continued. "They're turning to the world's best scientists—but we can't tell them, because that's the rule." Meanwhile some national governments refuse to credit the IPCC at all. (In November President Donald Trump W'68 officially initiated the US's withdrawal from the UN Paris Climate Agreement, having previously reversed Obama-era policies designed to reduce greenhouse gas emis-

ARTWORK BY DIANE BURKO



Polar Map 2007 C (After NASA) 2014
Diane Burko

sions. The Trump administration also joined Russia, Saudi Arabia, and Kuwait to block the endorsement of the IPCC's scientific assessment at the 2018 UN Climate Change Conference in Poland.)

Patience, Schultz suggested, has ceased to be a virtue. "There's a certain amount of time with a certain amount of carbon budget, and a certain amount of project timeline to build things," he argued. "With the clock ticking, and the pathways getting more and more limited, it is time to be prescriptive."

The most promising way to move forward, he said, is to shift the focus from national governments to municipal ones. Cities account for 70 percent of greenhouse gas emissions and house half the global population. They have skin in the game, and, perhaps more importantly, room to maneuver.

"National governments are set up to defend their respective interests," Schultz said; it's hard to ask them to privilege supranational interests, or to cooperate with one another. "That's why cities are so exciting. Cities are one of the few organizational constructs in the world that are open to freely exchanging information. Think about that: companies don't exchange information—that's their competitive edge. National governments don't do it. Just go down the list. But cities do."

Mauricio Rodas G'02 G'03 served as mayor of Quito, Ecuador, from 2014 to 2019. A fellowship sponsored by the Penn Institute for Urban Research (IUR) and the Perry World House brought him back to campus this fall, to co-teach a

class on city-based climate resiliency and infrastructure financing.

When people ask him why he spent so much time in office interacting with foreign cities and mayors, Rodas likes to talk about where the rubber met the road in his home city.

"Quito is the second-highest capital city in the world," he said during the seminar discussion in Meyerson Hall. It's in the middle of the mountains and has steep roads. Rodas, who oversaw construction of the city's first subway as part of the city's climate agenda, also wanted to replace conventional buses with electric ones. "But there was not proven technology for articulated electric buses at high altitude. It's a very complicated topography, so you need proven technology. And in Ecuador, nobody knew about this." So he turned to the C40 Cities Climate Leadership Group, a network of 94 cities that have committed to deliver on the Paris Agreement goals at the local level. "I asked them for technical assistance to design the technical specifications for purchasing electrical buses in Quito," Rodas said. "And they did it—for free."

City diplomacy was a hard sell at the beginning of Rodas's tenure. "People understand why a president should be traveling, but not why a mayor should be doing so. They think that mayors should be fixing potholes and collecting garbage 24 hours a day. And they're right! So I was criticized for being so active internationally." But when he was able to point to practical benefits, like the city's climate-action plan and the procurement process for electric buses, he was able to turn a political liability into an advantage. (Rodas did not complete the purchase of buses by the end of his term, but says he hopes his successor will.)

Schultz, who was C40's director of research, measurement and planning from 2012 to 2018, noted that the organization has recently taken a more aggressive line with its member cities. "C40 cast off this 'We're going to try to herd you in the right direction' approach, and moved to, 'If you want to be a member of C40, you have to adopt a 1.5 degree target, and if you don't, you're out."

"Mayors run on different platforms and have different priorities, so coming in and assuming that climate is the number one priority for every single city is not smart, politically," he allowed. "But there is no viable solution to tackling climate change without cities in the center of it. More than just the numbers, it's also based on the mechanisms and the ability to share information and move ideas."

Ideas need money. This year Penn IUR launched a program that aims to help cities get more. City Climate Resilient Infrastructure Initiative (C2IFI) seeks to address fundamental mismatches between cities and the international financial system. For instance, the vast majority of loans by international development banks require national guarantees, which is both a practical and political impediment. In countries where one or two cities account for a large portion of the population, mayors are often viewed as contenders for national office—which incentivizes incumbent presidents to thwart mayoral achievements. (Related dynamics play out in the US, where the Trump administration is currently litigating to withdraw California's ability to set stricter vehicle emissions standards, and some state governments have sought to limit cities' abilities to act on a wide variety of issues.)

"That happened to me, with former president [Rafael] Correa," Rodas said in a subsequent interview with the *Gazette*. "We needed to borrow money to build a new water sanitation/supply project, and we managed to get financing from the French Development Agency (AFD) without the need of a national guarantee—which was the first time that happened in the country." Because Quito's municipal water company had a long and solid financial history, the AFD required only that the Ecuadorian government register the loan as public debt. "That didn't imply a guarantee," Rodas said. "It didn't imply anything for the government—it was just paperwork. But they never did. I had to wait until a new president came in.

"If we understand the importance of cities as the primary source to fight climate change," he concluded, "we need to rethink the international financial architecture."

Penn IUR codirector Eugenie Birch, the Lawrence C. Nussdorf Professor of Urban Research and Education—and co-teacher of Rodas's class—characterizes the C2IFI as a "clearinghouse-plus" for mayors and other city officials.

"We're surveying the public and private sector to look at instruments ranging from loans and bonds, to infrastructure investment trusts, to carbon pricing and capture and so forth," she said. "We're working with national governments to change regulations, to create the enabling environment, to make cities creditworthy … In other words, creating this whole guide that would be useful in informing mayors about all the possibilities that exist. The objective is ultimately to build capacity, while training our Penn students to work with mayors on how to access these things."

Rodas is also working on the C2IFI. "We have been making progress in terms of the supply side—developing new financing mechanisms, new funds, new bonds, etc.—but we are lagging behind on the demand side, in terms of cities lacking project-preparation capacity, or the credit worthiness, to develop bankable projects," he says. "So we want to work on that missing link."

Rodas stresses the non-ideological dimension of climate change mitigation and adaptation. Quito's elevation protects it from sea level rise, for example, but not from rain. "We are already experiencing increasingly severe natural phenomena, just like everywhere else," he said. "In the case of Quito, we are very much exposed to flooding."

"Cities aren't doing this because they're all great climate visionaries," Schultz said. "They're the world's greatest pragmatists. They've got to pick up the garbage, they've got to keep the streets clean, they've got to

keep the schools open. They've got to make decisions on a day-in-day-out basis, and they immediately see the impacts of what's happening" on a climatic level to make those tasks harder and costlier.

"Cities are grappling with this," he added, "because their impact is exceeding the geographical boundaries of their jurisdictions."—*TP*

Five Climate Policy Ideas You Won't Hear in the Debates

Wharton and Penn Law scholars propose actions that wouldn't require sweeping legislation—but could have major impacts.

Over the course of three presidential debates between Donald Trump and Hillary Clinton in 2016, the phrase "climate change" was uttered a total of three times. In the first debate, Clinton raised the issue in the most limited way possible. "Donald thinks that climate change is a hoax perpetrated by the Chinese. I think it's real," she said. To which Trump replied, "I did not. I did not. I do not say that." (He had, multiple times, in speeches and on Twitter, using the words *nonsense* and *bullshit* in addition to *hoax*.)

Clinton addressed climate change again in the second and third debates, each time calling it a "serious problem" while refraining from any specific policy proposal beyond a vague call for a "comprehensive energy policy" that would include "clean energy."

Fast forward to this September, when CNN hosted 10 back-to-back "Climate Crisis Town Hall" events with 2020 Democratic candidates. The seven-hour marathon covered an impressive range of issues—from farm policy to carbon cap-and-trade frameworks to fracking on federal land—yet even a viewer heartened by the sustained attention might have had a hard time identifying any concrete proposals that hit the sweet spot between soaring ambition (e.g. Bernie Sanders's $16 trillion overhaul of the energy and transportation sectors) and trifling distraction (like Kamala Harris's support for banning plastic straws).

A couple weeks later, Wharton's Risk Center stepped into that void. *30 Solutions to Climate Risks*—produced in partnership with the Kleinman Center for Energy Policy, the Penn Program on Regulation, and the Faculty Senate—collects ideas for how to mitigate climate change, adapt to it, and/or help businesses and communities "minimize the transition risks … as we shift to a carbon-free economy in the face of uncertainty."

According to Wharton Risk Center executive director Carolyn Kousky, the project germinated from two sources of frustration: that some actionable medium-scale ideas were being left out of the national conversation, and that climate change is often framed as a lefty concern that's distant from the minds of business managers and market makers. "That's not the case at all," Kousky says, adding that Wharton's current cohort of MBA students has been especially active—and demanding—about making sure that their training encompasses the risks and opportunities climate change is bringing to bear upon fields ranging from manufacturing to finance. By curating ideas from a part of the University whose reputation is decidedly distinct from the lofty liberalism that characterizes much of the ivory tower, Kousky hoped to push the conversation in fresh directions. Here are five.

1 Use the Insurance Industry to Capitalize Low-Carbon Tech

Alexander Braun, *Visiting Scholar at the Wharton Risk Center*

The average temperature on earth has increased by one degree centigrade since the industrial revolution. Anthropogenic emissions of greenhouse gases, such as carbon dioxide, are the major driver of this development. Extreme weather patterns, ocean acidification, polar cap melting, and desertification are just a few of the irreversible consequences Earth could be faced with if mankind fails to act quickly and decisively.

Clearly, a substantial transformation of power generation and manufacturing infrastructures will be necessary to limit the damages forecast if temperatures rise by another full degree. To accelerate this process, global capital flows should be redirected towards low-carbon technologies. The insurance industry could play a key role in this regard, as both an investor and an insurer. Under the classical insurance business model, premiums collected from policyholders in exchange for coverage are not kept idle but are put to work in the capital market. Consequently, insurance balance sheets essentially consist of two portfolios: the investment portfolio, which forms the asset side, and the underwriting portfolio, which, together with the equity capital, represents the liability side.

Recognizing their responsibility, numerous insurers and reinsurers have already been proactive and started climate-related engagements such as financing mangrove reforestation, advancing loss prevention, and promoting disaster-resilient and energy-efficient building practices. Evan Mills of the Lawrence Berkeley National Laboratory has catalogued 1,148 initiatives from 378 insurance companies in 51 countries.

Yet, it is unclear how effective these efforts really are. Some firms might simply be window dressing through small-scale investments, taking advantage of the positive reputation effects associated with sustainable business policies. A genuine impact, in contrast, will only be achievable if insurers strive for strict carbon-neutrality of their investment portfolios. This means that they should refrain from investing in the stocks and bonds of companies that generate high levels of direct carbon emissions. The latter are typically from the power production, heavy manufacturing, and transportation industries. Anecdotal evidence indicates that such a

change in investment philosophy would likely not be associated with a sacrifice in terms of expected returns.

The potential is huge: the global insurance sector holds an estimated $25 trillion in assets under management, which is more than 15 times bigger than the projected private sector gap that needs to be closed to achieve all 17 United Nations sustainable development goals by 2030. A mere partial redirection of this capital could be a substantial accelerator for the transition to a low-carbon economy.

Mechanisms already exist that could facilitate this change. Insurers could be obliged to publish figures describing their carbon exposure in their annual reports and their Solvency and Financial Condition Reports. Using asset pricing theory, it is possible to design a rapid test for carbon exposure in the investment portfolios of insurers. Stakeholders of the firm would thus have an easy and inexpensive way to evaluate the climate compatibility of stock-listed insurance firms. Finally, as a measure of last resort, regulators could contemplate a rebate in the capital charges for insurers with green balance sheets and a markup for those with significant carbon exposures. While an adjustment of risk-based capital standards based on mere political considerations is certainly debatable, the prospect of stricter carbon regulation could indeed change the risk profile of the stocks and bonds of heavy emitters in the medium to long run. After all, empirical research has already documented a comparable effect for companies in the tobacco, alcohol, and gambling businesses. Thus, integrating climate considerations into risk-based capital standards for insurance companies has an economic rationale, too.

Finally, the liability side of insurance balance sheets should be considered as well. Otherwise firms may appear to be climate friendly, since they run a low-carbon asset portfolio, while continuing to insure carbon-intensive facilities, such as coal plants. Hence, to mobilize an even greater capacity for the mitigation of climate change, the capital flows of both the investment and the underwriting portfolios must be redirected. The stakes are high, and the insurance sector has both the financial leverage and the pecuniary motive to make a meaningful difference.

2 Use the Federal Mortgage Finance System to Manage Climate Risk

Benjamin J. Keys, *Associate Professor of Real Estate at the Wharton School*

The public obligation to address climate change at the federal level can be uniquely addressed through the governmental mortgage market. As climate change has increased both the frequency and severity of storms and hurricanes, and forecasts of sea level rise have become more urgent, property owners and those who provide credit to develop and invest in physical structures should be aware of the risks they face. Fannie Mae, Freddie Mac, and the FHA/VA mortgage lending programs make up the majority of the current mortgage landscape, and likely face dramatic exposure to climate-induced losses on the long-term (frequently 30-year) mortgages they insure. While these agencies bear climate risk, they are currently doing little to manage three climate-related risks to property: (1) acute storm events, (2) declining values from diminished access due to nuisance flooding, and (3) gradual inundation from sea level rise.

The US mortgage finance system is unique among developed countries in the direct involvement of the government in the mortgage market, especially with Fannie Mae and Freddie Mac likely to remain in conservatorship for the foreseeable future. Mortgage-backed securities insured by the Federal Government through Fannie Mae, Freddie Mac, or FHA/VA programs account for over 60 percent of the outstanding residential mortgage debt in the US, totaling $6.7 trillion.

This remarkable degree of exposure to residential property markets should spur action on climate risk from these large public mortgage insurers. Although disaster-related losses have not yet been significant for these agencies, loans in areas affected by hurricanes have greatly elevated delinquency rates well after the storms have passed, and climate-related risks are likely to rise sharply over the next 30 years.

A thorough investigation of risk exposure to climate change would in all likelihood indicate that these government agencies are actively insuring mortgages in every coastal neighborhood in the US—but not differentially pricing heightened flood risk in these communities. The decision not to price flood risk by Fannie and Freddie is a political choice, and one that saddles all American taxpayers with costs generated by a fractional minority of property-owners.

The underwriting and lending decisions of Fannie Mae and Freddie Mac can be altered through its powerful regulator in conservatorship, the FHFA, rather than requiring the passage of legislation.

Accurately pricing loans' regional climate risk at a local level, using the most sophisticated statistical models available, would sharply increase the cost of borrowing in many coastal communities. The burdens of climate risk would fall more directly on those property owners willing to bear it, which will encourage adaptation and retreat. These rising mortgage costs would wisely promote managed retreat by steering lending and development away from the most exposed coasts. In sum, mortgage pricing can reflect true expected losses. Furthermore, by offering discounted rates for properties that are elevated, or meet certain construction standards, the federal mortgage agencies can provide incentives to make remaining structures more durable and communities more resilient.

3 Use an Import Tax to Promote Climate Progress

Howard F. Chang, *Earle Hepburn Professor at the University of Pennsylvania Carey Law School*

When nations adopt heterogeneous climate policies to reduce emissions of greenhouse gases, a nation that adopts a

more stringent policy than its trading partners may place its producers at a competitive disadvantage when imports come from nations in which emissions are subject to relatively lax regulations. Proponents of a carbon tax or a cap-and-trade system as a national climate policy often advocate a "border adjustment" as an instrument to address this disadvantage. A border adjustment may take the form of a tax imposed on imports that is designed to offset the competitive disadvantage imposed on domestic producers by national climate policies. Such a border adjustment would help mitigate climate change through at least two channels:

First, by offsetting the competitive disadvantage imposed by relatively ambitious climate policies, it would remove an incentive for consumers to shift their demand from domestic producers subject to strict regulations to foreign producers subject to more lax regulation. Without this border adjustment, domestic demand would shift toward imports, thereby expanding production in relatively unregulated economies and causing increased emissions abroad—a form of "carbon leakage" that would undermine the effectiveness of the importing country's climate policies. Second, by reducing the demand for exports from relatively unregulated countries, border adjustments may promote political support for more ambitious climate policies in those countries—because an import tax would reduce the incentive for those countries to enjoy a "free ride" on the more stringent policies adopted by their trading partners.

There is an obstacle. The General Agreement on Tariffs and Trade (GATT) imposes various legal restrictions on tariffs, including the tariff commitments in GATT Article II. Article II contains an exception, but using it to justify a border adjustment tax linked to carbon emissions is questionable as a legal matter. The World Trade Organization (WTO) should instead evaluate border adjustments for climate policies under the exception in GATT Article XX(g) for "conservation" measures, and importing countries should design border adjustments for climate policies with this exception in mind. WTO case law indicates that in order to justify a trade restriction as a measure to protect natural resources in the global commons under Article XX, the importing country must take into account "policies and measures that an exporting country may have adopted," so as not to discriminate against countries with environmental policies "comparable in effectiveness." Under this Article XX case law, the WTO should give its members broad leeway to impose import restrictions designed appropriately to promote reductions in greenhouse gas emissions in exporting countries.

4 Reform the Regulatory Takings Doctrine for the 21st Century

Mark Nevitt W'97, *the George Sharswood Fellow and a Lecturer-in-Law at Penn Law*

As climate change destabilizes the physical environment, longstanding legal doctrines are also ripe for destabilization. Chief among them is the regulatory takings doctrine, which is an obstacle to climate adaptation measures at the federal, state, and local level.

Under the US Constitution, the Fifth Amendment's Takings Clause states that private property "shall not be taken for public use without just compensation." Since the nation's founding, this has prevented the government from physically taking private property for "public use." But the scope of the Takings Clause greatly expanded in 1922 when the Supreme Court held that governmental *regulations* may also run afoul of the Takings Clause. In the Court's reasoning, a governmental regulation that goes "too far" in diminishing a property's value by a "certain magnitude" will constitute a compensable taking.

The seminal regulatory takings case, *Lucas v. South Carolina Coastal Commission*, decided in 1992, continues to cast a long shadow over forward-looking climate adaptation efforts in vulnerable coastal areas. In *Lucas*, the Supreme Court struck down a South Carolina restriction on building on a coastal barrier island, ruling that the regulation deprived the owner of all economically beneficial use of the land. Since then, state and local governments have been fearful of costly and time-consuming takings lawsuits, particularly for construction limitations on land vulnerable to climate change. Further, many municipalities in coastal areas have been reluctant to tackle beach erosion issues exacerbated by climate change-driven extreme weather. Yet recent advances in climate attribution science connects human activity, climate change, and extreme weather patterns. Our understanding of climate science has greatly evolved in the 27 years since *Lucas*. *Lucas*-style regulation will be needed now and in the foreseeable future as we confront sea level rise. But the mere threat of costly litigation may be enough to dissuade local governments from taking action, even if it ultimately passes constitutional muster. Further, it is not hard to envision state and local governments seeking to withhold municipal services or gradually disinvest from access roads and places uniquely vulnerable to climate change. But this, too, may be subject to a regulatory takings claim as homeowners assert that governmental disinvestment cuts their homes off from the broader community, diminishing their property's value. So governments must walk a legal tightrope between climate action and inaction.

Where do we go from here?

Governmental action on climate-related issues may be able to avoid regulatory takings liability for reasons of emergency or "actual necessity," as Justice Antonin Scalia put it in his majority opinion in *Lucas*. Although Congress has not (yet) designated climate change a national emergency, there is proposed legislation to do just that. And legislators at all levels can increasingly ground climate-related policies in the language of what is actually necessary to confront climate change's

multifaceted costs. By explicitly tying their actions to the public health, welfare, and safety of citizens, federal, state, and local legislators can maximize their chances of clearing the legal bar set in *Lucas*.

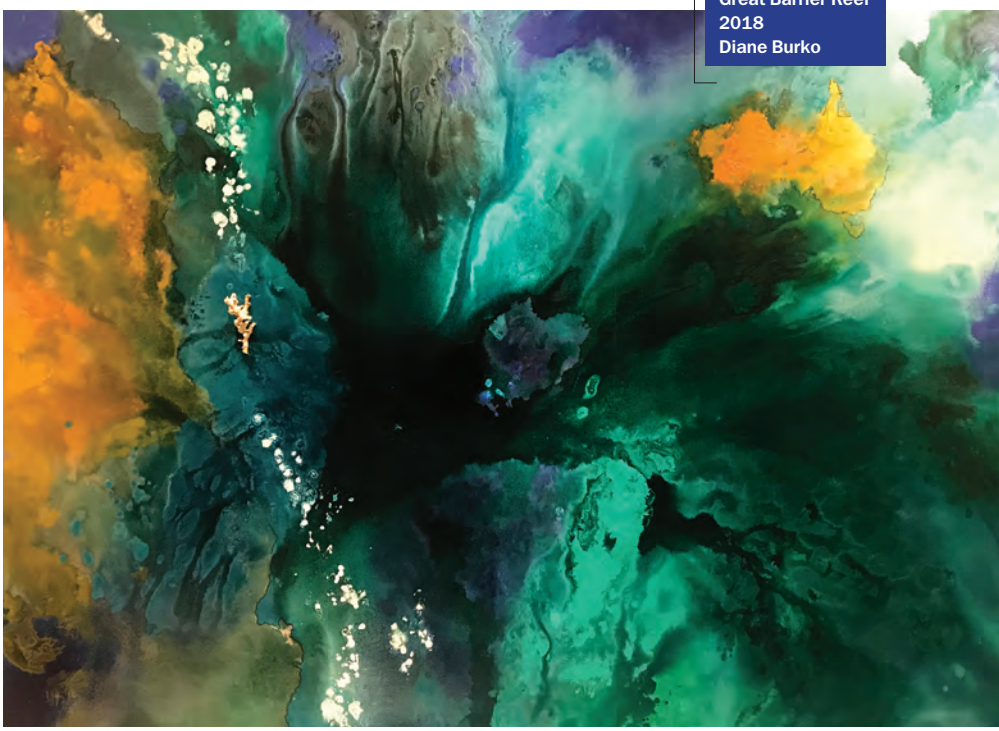
Yet US courts must also reevaluate this aspect of Fifth Amendment jurisprudence. Absent a doctrinal change, the regulatory takings doctrine will increasingly have a chilling effect on bold climate adaptation measures, discouraging courageous climate action. We must fundamentally rethink and reframe this doctrine to take into account our changing environment. Indeed, just as climate change will force communities to adapt, so, too, must the regulatory takings doctrine.

5 Legislate to Empower Ambitious State and Local Governments

Jean Galbraith, *Professor at Penn Law*

If the next election produces a more progressive Congress and president, one may hope for the enaction of strong climate-related laws and regulations. But history suggests that these progressive actors will be replaced in two, four, six, or eight years by less progressive ones. The cyclicality of US politics at the national level has brought home the importance of climate mitigation by state and local governments. One of the most important things that a progressive Congress could do is thus to legislate in support of state and local governments seeking to go beyond the federal minimum in their climate mitigation policies. Here are a few suggestions:

Congress could specify in legislation that federal law on climate is a floor rather than a ceiling. Some preexisting environmental laws have provisions along these lines; the Clean Air Act, for example, permits California to set vehicle emissions standards that are higher than federal ones as long as it gets a waiver from the executive branch permitting it to do so. Instead of requiring an executive branch waiver, a new climate law could be structured to omit such executive branch supervision entirely or to require that, in order to stop a state from



Great Barrier Reef
2018
Diane Burko

High Mercury View

Climate science and activism meld in the paintings of Diane Burko.

The landmark climate change documentary *An Inconvenient Truth* had just hit theaters when, in 2006, Diane Burko GFA'69 stood inside a museum and stared at one of her own paintings.

More than 8-and-a-half-feet wide and well over 5 feet tall, the supersized landscape showed a craggy European alp wrapped in snow. Burko had painted it in 1976, exactly 30 years earlier. *Thirty years*, she thought. *That's a long time.* At first her mind swirled through the events of her own life in those 30 years, but then a broader question bubbled up: Is the snow in that painting still there?

"That was the moment—my epiphany," she says now.

A former city kid from Brooklyn, Burko had been capturing landscapes and natural phenomena in her work ever since coming to Penn in the mid-1960s. But it was inside that 2006 exhibition of her own work that she began to wonder whether the stunning scenery she'd been painting all those years was now in serious danger.

"Climate change awareness was already in the air, but it wasn't all over the place yet," she says. "I decided I had to get into this."

Since then, Burko has racked up more than a dozen solo shows of her science-meets-art work—and been embraced by scientists and activists alike.

She began with repeat paintings, which show the same frosty landscape years apart, revealing the striking changes occurring. Then she moved on to painting glaciers with recessional lines and making works based on satellite images from NASA. Her latest series focuses on endangered coral reef

systems—from world maps of where they're located to pieces inspired by coral's life cycle.

"I realized that the only way I could continue being an artist in the 21st century is to do more than just make beautiful paintings that sell," Burko says. "I'm making good paintings, but the paintings have meaning and another layer to them."

You'll still notice the beauty and skill in her work first: the inky aquas and golden yellows that blend together in a Great Barrier Reef abstract; the delicate cracks and texture she achieves in a very large, satellite-view painting titled *Arctic Melting, July 2016*; the contrast and misty glow of a glacier landscape. But after she's "lured people in through the language of painting—which is the only language I know," she says, she hopes they'll pick up on her clues, read through the wall panels, and grasp the urgent message about climate change that she's shouting from each canvas.

Burko has been working closely with glaciologists and oceanographers for years now, seeking out their photographs and maps for reference, joining expeditions, and visiting research labs all over the world.

At the same time, scientists have been inviting her deeper into their professional communities. She has presented at a number of large scientific conferences, including the American Geophysical Union's annual meeting, and in 2018 the National Academy of Sciences hosted a six-month exhibition of her glacier and reef paintings.

She's instituted a rule that any venue exhibiting her work must also organize public programming on climate change to complement the show. The American Swedish Historical Museum in Philadelphia, which is currently hosting an exhibition of Burko's work titled *Nordic Changes* (on view through January 5, 2020), rounded up the city's director of sustainability, the director of innovation for its public transportation system, and Billy Fleming Gr'17—who worked on urban policy development with the White House Domestic Policy Council before becoming director of the McHarg Center at Penn's Stuart Weitzman School of Design—for a panel discussion at the show's opening reception.

"You never know who you're going to influence," Burko says, "especially in an art gallery situation, because people aren't expecting to learn anything about climate change there. Wall labels, interviews, panels, articles—they all contribute to the public engagement that I believe in."

Burko had established herself in the art world long before her latent passion for science popped out. Her first solo exhibition came only a few years after graduating from Penn's MFA program. At age 31, she landed representation with the Marion Locks Gallery in Philadelphia. Residencies in Giverny, France, and Bellagio, Italy, followed. In 1996, she won a $200,000 Public Art Commission to create a massive mural for the Philly Marriott Hotel's lobby that's still on view today.

Her work lives in collections at the Philadelphia Museum of Art, the Art Institute of Chicago, and the Pennsylvania Academy of the Fine Arts. But ever since the climate change theme, exhibitions have been adding up faster than ever, and Burko is continuously called on for lectures and public talks.

This past fall, the high-end winterwear brand Canada Goose launched a collection of limited-edition parkas that feature her glacier art. (Price tags: $1,495 to $2,795.) "I'm a crossover artist!" she exclaims. "I've never been so active as since my practice became redirected.

"I was a '60s person—an antiwar person, a feminist, an activist. That's in my blood. I know some people become more conservative, but I've become more political, not less. I've got grandchildren to worry about."

— Molly Petrilla C'06

exceeding the federal floor, the executive branch must prevail in court and prove certain specified statutory criteria.

Congress could also try to craft legislation that protects progressive local governments from state governments. In many states, populous cities are more progressive on climate than are the state legislatures. Congress cannot directly ban state legislatures from setting limits on their localities (because of a constitutional principle known as anti-commandeering). But Congress would be on stronger (though not ironclad) constitutional grounds if it legislated to say that local governments have the option of taking certain climate-protective steps "notwithstanding any provision of state law."

Finally, Congress could provide a blessing in general terms for state and local governments to enter into agreements with foreign counterparts with respect to climate mitigation. State and local governments are currently making these agreements anyway. But in order to ward off any lingering concerns about the constitutionality of these agreements under the Constitution's Compact Clause, a congressional signal of support for these endeavors would be valuable.

By taking such steps, a progressive Congress would increase the likelihood that climate mitigation actions will continue regardless of national political changes.

Green Dreams

What can the New Deal actually teach contemporary climate advocates?

By the time the fall semester was two weeks old, no fewer than 18 presidential candidates had announced plans to reduce net US greenhouse-gas emissions to zero by no later than 2050: 17 Democrats and Republican challenger Bill Weld. The details varied, but hanging over all of them was House Resolution 109, whose introduction in February substantially reset the

debate about climate policy. By calling for a "Green New Deal," it explicitly invited comparison to one of the most consequential—and contentious—legislative periods in American history.

In mid-September, about 1,400 people descended upon Irvine Auditorium for what is believed to be the largest climate-related event ever held at Penn. The historians, landscape architects, political scientists, and advocates who took part in "Designing the Green New Deal"—organized by the Ian L. McHarg Center and the Socio-Spatial Climate Collaborative—addressed subjects ranging from agrivoltaics and wetland restoration to labor policy and monetary theory. Some emphasized practical matters: how to transform old mines into pumped-storage hydroelectric facilities, for example, or how to minimize the inflationary risks posed by budgetary expansion or a federal jobs guarantee. But some of the presentations and panel discussions took up a question that could prove to be more politically significant: What lessons does the New Deal actually hold for contemporary climate advocates—and what perils?

Nancy Levinson, the editor of *Places* journal, argued that Franklin Roosevelt's legacy is well worth mining—but emphasized the experimental and piecemeal nature of the legislation behind it. The first 100 days of Roosevelt's presidency saw the creation of the Civilian Conservation Corps (CCC), the Tennessee Valley Authority (TVA), and the Public Works Administration (PWA). The Works Progress Administration (WPA), National Labor Relations Act, and Social Security joined the list during his first term. "These achievements were all the more remarkable because they were not for the most part the result of any detailed program that had been worked out in advance," Levinson observed.

For climate advocates convinced of the need for swift and sweeping action, the scale of work undertaken by some of the New Deal "alphabet agencies" represents a high-water mark of proactive self-government. The PWA constructed or contracted nearly 35,000 projects, including the Grand Coulee Dam, the Triborough Bridge, and airports by the dozen. Over the course of nine years, the CCC employed 3 million men, most of whom had been jobless, to plant some 3 billion trees and construct more than 800 state and national parks.

"Some of these alphabet agencies have attained a kind of epic status among designers and planners because of their profound impact on the built environment and the natural environment," Levinson said. "But there's another legacy that seems equally valuable though more elusive: a legacy that's not about the physical projects, but about the administrative creativity and bureaucratic talent that made these projects happen."

The CCC, for example, was conceived on March 9, 1933, four days after Roosevelt's inauguration, during a 4 p.m. meeting in the White House with six government officials. Draft legislation was on the president's desk by 9 p.m., according to the agency's final report, and passed by Congress three weeks later. By July 4, 275,000 men had been put to work. Levinson noted that this was not the product of a new stand-alone bureaucracy, but rather of an agency that worked across preexisting departments. And its impact on the landscape was rivaled by its impact on the men who took part. In a remarkable demonstration of what contemporary economists might call the power of human capital, the CCC hosted its 86th annual alumni and family reunion on September 28 of this year.

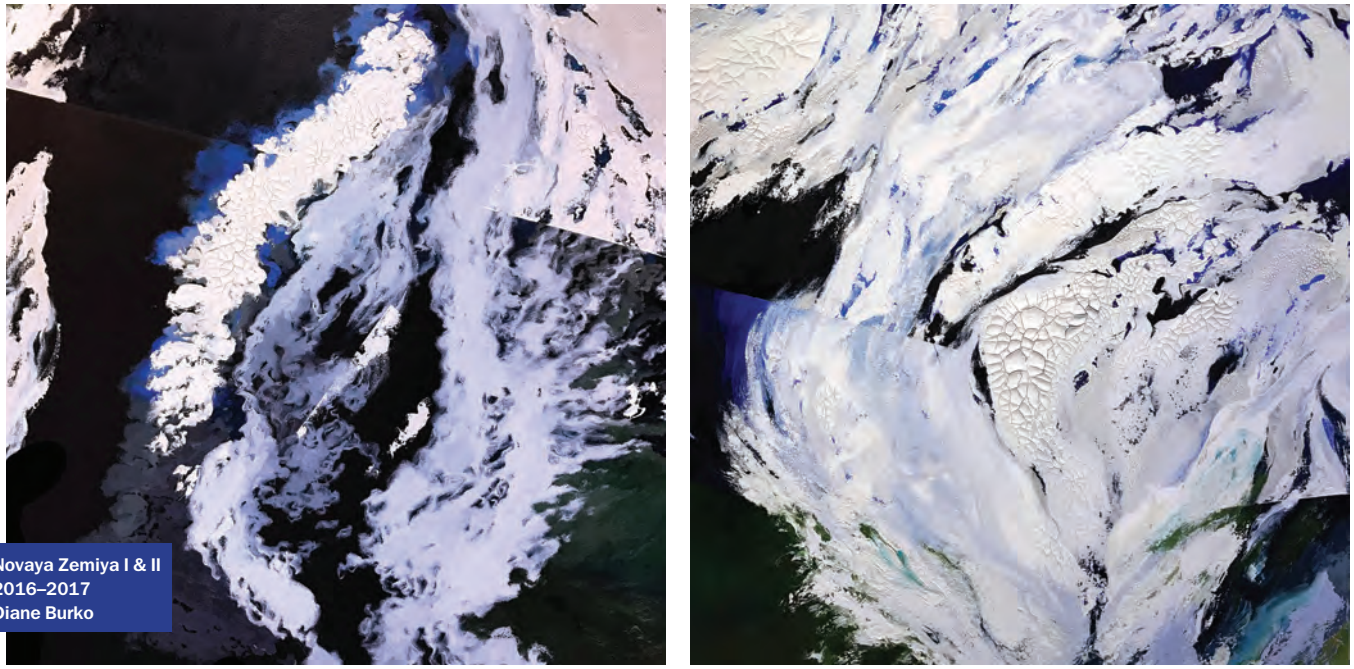
"To an American in 2019, this seems extraordinary—a tale not just from another time but almost another country," she exclaimed.

Nicholas Pevzner GLA'09, a senior lecturer in the Weitzman School of Design, argued that decarbonizing the economy will necessitate work on a similarly massive scale. Some New Deal programs can provide a template. "As with the CCC, there's a clear case to be made for the restoration of public lands through labor that benefits the workers and the public conservation ethos," he said. "[But it] would also need to have a clear focus on climate change adaptation and mitigation. Forest fire reduction seems like a no-brainer. But we can also imagine mine reclamation in Appalachia and in abandoned minelands across the West. Or potentially planting new forests as carbon sinks. Or coastal protection work, mitigation of wetlands for flood control, perhaps even wildlife-connectivity infrastructure."

The federal government has more recent experience undertaking such work, he added. "The US Forest Service, for example, which used to be heavily focused on 'getting out the cut'"—i.e., extracting timber—"has pivoted in some of its forests toward a focus on ecosystem restoration. In the late 1990s, prompted by lawsuits around spotted owl habitat in the northwest, the Forest Service figured out how to rewrite some of its contracts from prioritizing timber extraction and logging roads to performing ecological support services through payments for ecosystem services and river restoration."

Yet the CCC's swift rollout in 1933 has limits as a historical guide. For one thing, "restorative environmental work is rarely shovel-ready and it usually needs a whole lot of study," Pevzner cautioned, "especially on toxic legacy landscapes where we don't have as many good examples to work off of." Furthermore, sending Depression-stricken men to work in forests posed fewer problems than the prospect of sending today's underemployed and disadvantaged Americans to carcinogenic mine sites or post-industrial brownfields.

And a true transformation of the energy sector would extend far beyond such places. Since the energy density of renewable sources like wind and solar is dramatically lower than that of fossil fuels, "the Green New Deal implies a dramatic spatial reorganization of America's land use," Pevzner said. "Speaking purely in terms of physical space, renewable energy's much larger footprint on the landscape means



Novaya Zemiya I & II
2016–2017
Diane Burko

that as the grid decarbonizes, we won't be able to rely on massive centralized power plants located far away. And we also know that many of the sunny and windy low-hanging-fruit sites—those with the highest renewable-energy potential, or at least those closest to existing transmission lines and furthest from population centers—have already been built. So our energy will increasingly need to come from places where Americans live, work, and play—or at least be connected to them through vast new transmission networks."

He suggested that the physical challenge may pale next to the social and political constraints—and argued that landscape architects are well positioned to play a productive role. "Already, in some states, renewable energy has come into conflict with prime farmland or forest land. And in other places so-called 'green-on-green' conflicts between wildlife preservation advocates and climate hawks around energy development on public lands has sparked opposition to new projects. Such conflict can be reduced through careful design and planning, in which renewable energy is deployed across the landscape in a manner that coexists with other land uses and enhances rather than competes with them—but only if spatial planning and landscape design are considered early in the process."

That seems sensible enough, but Jennifer Light voiced a cautionary note. "Not every aspect of the New Deal should be seen as a model to duplicate," said the MIT professor of urban studies and planning, who is also a historian of science and technology. Light focused her remarks on how the New Deal helped city planners and the real estate industry consolidate their professional legitimacy and gain traction for their ideas, which blossomed in postwar urban-renewal projects. Those efforts have a decidedly mixed legacy. "Eminent domain and land clearance proved highly controversial in densely settled neighborhoods," Light observed, and "many programs that were theoretically supposed to improve both impoverished land areas and the lives of their inhabitants ended up, in implementation, basically as business development schemes."

The New Deal helped "bring new resources to address urban problems, in the form of policies, money, and prestige," she said. But she lamented that it too often resulted in a pattern that would become familiar in the 20th century: "These large-scale mobilizations around urban problem solving—even those that invite citizen participation—frequently better serve the interests of the urban professions than they address the problems at hand."

The New Deal has an even darker side. In order to secure support from Southern congressmen—whose electoral power derived directly from the disenfranchisement of African Americans—the legislation was often shaped by Faustian bargains. The Social Security Act's exclusion of farm workers and domestic staff ensured that the large majority of black men and women would not qualify for benefits. The CCC was segregated, and some Southern states excluded African Americans altogether on the basis that they were needed to harvest cotton (under sharecropping arrangements that some historians liken to indentured servitude). Anti-lynching bills stalled in Congress, and discriminatory poll taxes persisted.

"This too is a legacy," Nancy Levinson said, but one that the authors of the Green New Deal resolution "are keenly aware of." The document emphasizes the interests of minority populations, residents of deindustrialized areas and depopulated rural lands, and various other groups designated as "frontline and vulnerable communities."

David Roberts, a climate and energy reporter for *Vox*, raised a different drawback of modeling climate legislation—or even simply branding it—after the New Deal.

"There's a lot of polling that shows that Democratic primary voters are supportive

of green policy and of the Green New Deal. We're in a very heady moment, where it's very fun to talk about our visions for what could happen, and our aspirations for the world we want," he began. "But there's a danger of getting out over our skis … It's important to emphasize that the right hated the New Deal … It was passed over their reservations, and you can view the latter half of the 20th century as the right's long, coordinated, very well-funded effort to make sure that nothing like that ever happens again.

"And they have been really smart about attacking exactly the foundations on which the New Deal was built," he added, offering the decades-long campaign to disempower labor unions as an example.

The current labor market tests the limitations of the New Deal analogy in broader ways. "As diverse as the New Deal programs were, it was at a time when there was a 25 percent unemployment rate and priority one was getting people back to work quickly," said Francesca Ammon, an associate professor of city and regional planning in the Weitzman School of Design. (The urgency of that need presumably also served to soften opposition to New Deal programs whose long-term value was less clear, like federally sponsored theatrical troupes for out-of-work actors.) "The Green New Deal resolution has jobs as a central focus," she continued, but that element can hardly be expected to inspire the same urgency at a time when the official unemployment rate is under 4 percent.

Levinson submitted that this gap overstates public satisfaction with today's job market.

"I think there's widespread awareness in this country that unemployment may not be 25 percent," she said, "but conditions of employment for many, many people are difficult and precarious."

Roberts countered that this precarity actually discourages workers from demanding better terms. "There's not nearly as high unemployment" as during the 1930s, he said, but the "half-a-loaf" jobs that typify the service sector and the gig economy foster an anxiety that's harder to mobilize than abject joblessness. "And that precarity was designed," he contended. "It's on purpose: it's very difficult to get people who are anxious to keep the scraps they have to risk going for something bigger, or even to think that something bigger is possible."

The historical analogy chosen by today's climate vanguard may hold both promise and peril. But the truth is that little else in US history approaches the ambition of a "10-year national mobilization" whose goals range from a zero-emissions transportation infrastructure and sustainable agriculture to anti-monopoly enforcement and family-sustaining wages.

"The deepest legacy of the New Deal is not about the specific programs or policies; it's about the recalibration of the relationship between public and private," Levinson concluded. "The New Deal insisted that the federal government would be responsible for a vast array of public works and a whole new range of social welfare. The result was a new relationship, a new trust, and almost a new social contract between the government and the governed. So I would argue that the ultimate success of the Green New Deal will hinge on a similar recalibration."

Leah Stokes, a professor of political science at University of California–Santa Barbara, suggested that it may also hinge on heeding the American innovator who died two years before the New Deal began, but whose inventions and business ventures set the template for the very energy system today's climate advocates hope to reform.

"We have just begun to commence to get ready to find out about electricity," said Thomas Edison in 1910. "This scheme of combustion to get power makes me sick to think of—it is so wasteful," he continued. "We should utilize national forces and thus get all of our power. Sunshine is a form of energy, and the winds and the tides are manifestations of energy. Do we use them? Oh, no! We burn up wood and coal, as renters burn up the front fence for fuel. We live like squatters, not as if we owned the property."—*TP*

Flight Risk

How guilty should we really feel about air travel?

Late last summer Dan Hopkins took part in one of the most familiar rituals of academic life: he attended a professional conference. As an associate professor of political science at Penn, Hopkins traveled to Washington, DC, for the annual meeting of the American Political Science Association. Like several thousand of his colleagues, he'd also attended the previous year's meeting, in Boston. But when APSA holds its 2020 meeting in San Francisco, Hopkins is opting out. It's not the time commitment that bothers him, or dissatisfaction with conference programming. It's the 598 kilograms of carbon dioxide that would be emitted, per passenger, on his roundtrip flight from Philadelphia.

Calculating the CO2 pollution generated by a given flight is pretty straightforward. A journey requires a certain amount of jet fuel, and every gallon burned produces 9.57 kg of CO2. Making sense of the resulting number is trickier. The 598 kg Hopkins will save by not flying to San Francisco is roughly equivalent to driving 3,700 miles in the family Prius. That's a lot of soccer carpools—but it's a drop in the bucket next to other aspects of American life. The typical American adult eats about 55 pounds of beef in a year, the production of which emits methane and other greenhouse gases equivalent to 675 kg of CO2. Air-conditioning the typical Mid-Atlantic household during the summer (with conventional electricity) produces roughly the same CO2 emissions as that roundtrip flight to San Francisco. When you add it all up—heating, lighting, eating, commuting, all those Amazon packages delivered to your doorstep—the average American's carbon footprint is about 16.5 metric tons, according to World Bank figures.

So why obsess over a single flight? Indeed, considering that aviation only accounts for about 3.5 percent of human-caused climate change, why focus on flying at all? (The IPCC estimates that aviation accounts for about 2 percent of global greenhouse gas emissions, but the release of certain chemicals and particulates at high altitude is thought to amplify the effect.)

Answering that question requires a less comfortable set of comparisons. A cross-country roundtrip flight may amount to a mere two weeks of the average American's CO2 expenditure, but the average Spaniard takes a month and a half to create that much carbon pollution, according to the World Bank. (Not coincidentally, Spaniards fly less and take the train more.) The average Indian takes three-and-a-half months. In Ethiopia, a typical family of five lives an entire year without causing as much CO2 pollution as Hopkins would cause in a pair of six-hour flights to and from San Francisco. And to prevent severe global warming by 2050, the average human will have to emit more like today's Ethiopians than today's Americans. Scientists estimate that annual carbon emissions must fall to about two tons per person to keep the average global temperature within 2 degrees Celsius of its pre-industrial baseline.

Aviation is a particularly tough nut to crack for two reasons: it has become a standard element of commercial and recreational activity throughout the developed world, and there's no such thing as an eco-friendly way to fly. There's plenty Hopkins—or anyone—can do to decrease his individual carbon footprint. He walks to work. He has solar panels on his roof. Those things matter. But frequent flying will quickly cancel them out.

Megan Ryerson, the UPS Chair of Transportation and associate professor in the Weitzman School of Design, points out that we actually have a lot of ready solutions for shrinking some of the major components of our carbon footprints. They're just unpopular. "We could all stop eating meat and save a tremendous amount of emissions. But people don't want to do that. We could stop driving—or switch to electric cars. We've technically solved that problem, but cost issues or policy preferences are keeping us from doing it.

"Air transportation is completely different," she says, "in that the fundamental technical problems are not solved at all. The Boeing 787 has a lower weight by using composite materials, and American Airlines is legendary for getting excess weight off the aircraft—so there are moves, but they're very incremental. Alternative fuels for aviation are not available. They freeze at altitude and are hard to manufacture at any scale … We don't know how to reduce emissions in any meaningful way besides not flying."

Yet even as cities are implementing sustainability plans to limit CO2 emissions within their jurisdictions, many are simultaneously subsidizing airlines to provide more and more flights to their airports. In the late 1990s, the Federal Aviation Administration (FAA) prohibited local airport authorities from channeling excess revenues into general municipal budgets, which some had done to finance things like economic-development projects, police and fire services, and municipal operating costs. The FAA instead guided airports to funnel those revenues into "air service incentive programs" to induce airlines to launch new routes. In a 2016 analysis in the *Journal of the American Planning Association*, Ryerson concluded that 26 airports spent $171.5 million over a three-year period to recruit new routes—and that the receiving airlines dropped 40 percent of those routes as soon as the subsidy packages expired.

"Almost every new route at most airports in the US is now being subsidized by that airport," says Ryerson, who suggests that the FAA has effectively coaxed airlines to provide more flights—and CO2 pollution—than the market would otherwise bear.

Ryerson advocates for public investment in alternative modes of transportation like intercity rail and bus. She also calls for businesses and universities to invest in high-quality remote-conferencing software—"so we can feel connected, without having to take every single trip."

Hopkins is thinking along parallel lines. He proposed that APSA hold a regional satellite meeting at Penn, so that East Coast colleagues and graduate students could participate in conference programming—and still get a chance to network and job-hunt and engage mentors—without having to fly. His goal is to get 100 people to opt instead for a bus or train ride to Philadelphia. In November APSA announced that it would pilot regional satellite conferences in 2020. Hopkins expressed optimism that the status quo is on the cusp of changing.

"Whenever I talk about this, invariably my colleagues say it makes all the sense in the world," he says. "It kind of feels like all the penguins gathered at the edge of the ice floe—they all want to go fishing, but don't want to be the first to jump in and eaten by sharks. But I think that when a few people take the plunge, a lot more will follow."

It's a development Ryerson would welcome—especially since academic trips rarely top anyone's bucket list—yet Penn projects that in 2024 University-sponsored air travel will account for nearly 20 percent of Penn's CO2 footprint.

"I had a student from Hong Kong come to me after my talk," she recalls, "and they said, 'Oh my gosh, should I not go to Hong Kong to see my family over the break?' And I said, 'My goodness! Go see your family! We have to live our lives!'

"I think we just have too much air transportation. For me it's about cutting the fat, not getting rid of an entire industry," she says. "What I really want people to do is just scrutinize each trip. Is every trip worth it?"—*TP*