

Nicholas Institute

for Environmental Policy Solutions
Duke University

2015 ANNUAL REPORT

About

Established at Duke University in 2005, the Nicholas Institute for Environmental Policy Solutions helps decision makers create timely, effective, and economically practical solutions to the world's critical environmental challenges. Through its six programs, the Nicholas Institute mobilizes objective, rigorous research to confront the climate crisis, clarify the economics of limiting carbon pollution, harness emerging environmental markets, put the value of nature's benefits on the balance sheet, develop adaptive water management approaches, and identify other strategies to attain community resilience.

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Our Environmental Policy Impact



The Nicholas Institute for Environmental Policy Solutions' ability to provide unbiased evaluations of policy risks and rewards has led to a host of interdisciplinary environmental solutions in our first decade. These successes owe to the intellectual horsepower of our staff and our collaborators, the openness of those who work with us outside the university, our capacity to target research to problems and opportunities as they arise, and our competence to convene decision makers and stakeholders in policy-neutral settings to share analyses.

In this report, we celebrate our accomplishments in 2015—the launch of a new online guidebook for federal resource managers; the pending transition of the Fisheries Leadership & Sustainability Forum, which we have supported with several other institutions, to its new home at Duke; and the work of our Environmental Economics Program director on carbon pricing systems as a Fulbright Visiting Research Chair in Environment and Economy at the University of Ottawa.

We also reflect on how far we've come at this, our tenth anniversary. In this year's feature story, we present some of the most cutting-edge and influential projects in our vast portfolio of work. We advised California on several aspects of the design of the country's first economy-wide cap-and-trade program for greenhouse gases. Through the seminal report, *A Silent Tsunami*, we provided a material contribution to legislation aimed at dramatically improving access to clean water and sanitation

around the world. We brought attention to one of the world's most critical environmental problems by providing the first estimates of global carbon dioxide emissions from the destruction of coastal and marine ecosystems. And we served as a pioneer in recognizing the potential and finding practical strategies to use the Clean Air Act to address climate change.

These and the many other efforts, described in these pages, are how we help bring Duke University to the service of society. We hope you can use our accomplishments to consider how we might work together to have an even greater impact on environmental policy in years to come.

—Tim Profeta

Director, Nicholas Institute for Environmental Policy Solutions



Gina McCarthy, U.S. Environmental Protection Agency administrator, speaks about the Clean Power Plan during an event with U.S President Barack Obama in the White House. Obama announced sweeping rules aimed at reducing emissions from existing power plants.

A Decade of Policy Impact

The Nicholas Institute for Environmental Policy Solutions at Duke University has established a track record for leadership in addressing the most urgent environmental challenges and for helping key decision makers apply the best and most current knowledge to them. In honor of our tenth anniversary, we've highlighted examples of our impact in the environmental policy space across three themes: Our contribution to laws and initiatives, our ability to anticipate the critical questions just beyond the horizon of current policy discussions, and our capacity to provide unbiased evaluations of policy risks and rewards.

These themes span work in our six programs and are representative of our organization and mission.

CONTRIBUTING TO LAWS AND INITIATIVES

Law Improves Access to Clean Water, Sanitation

Turning on a faucet for a fresh, clean glass of water is something many in the United States wouldn't think twice about. But for one in three people on the planet, access to a glass of water can be a full day's work. What's more, there is no guarantee that glass of water will be safe to drink.

Providing foreign assistance to lift billions out of this type of extreme poverty—the lack of access to basic sanitation and clean water—became a priority for U.S. development aid only 10 years ago.

It was the convening power of two institutes—one newly formed at Duke University and the other well-established—that spurred this emerging emphasis with the seminal report, *A Silent Tsunami*.

“The report contained what some might consider fairly basic recommendations now,” said Gordon Binder, a senior fellow at the World Wildlife Fund and the Nicholas Institute and a co-author of the report. “At the time, however, water access and sanitation issues weren't

on the map. Though people, especially young children, were dying from diseases attributable to poor water, the connection in policy and development circles hadn't been made; the interventions were all about treating the diseases. *A Silent Tsunami* served as a testament to the fact that water, sanitation, and hygiene are fundamental, a key to so much else. The report recognized that improving access was a first step to helping to prevent child deaths, keep girls in school, reduce household poverty, and advance economic opportunity.”

The report's 10 recommendations—which came out of a 2005 forum convened by Duke's Nicholas Institute and the Aspen Institute—were frank: “Clean water and sanitation must become a higher priority because they are fundamental to human health and reducing poverty.” “For reasons of health, the economy, and environmental sustainability, governments must invest more in water infrastructure.”

These recommendations provided a material contribution to legislation aimed at dramatically improving access to clean water and sanitation around the world. The Paul Simon Water for the Poor Act was signed into law in late December 2005, making safe drinking water, sanitation and hygiene (WASH) a U.S. development policy priority. It introduced for the first time in U.S. law one of the United Nations Millennium

Development Goals, requiring that the United States do its part to reduce, by half, the proportion of the population living without sustainable access to safe drinking water and sanitation.

A Silent Tsunami served as a testament to the fact that water, sanitation, and hygiene are fundamental, a key to so much else.”

— Gordon Binder, senior fellow,
World Wildlife Fund

The act set various benchmarks for the U.S. Agency for International Development (USAID) and the State Department to create and implement a strategy to provide affordable and equitable access to safe water and sanitation in developing countries. It also provided the framework for specific annual appropriations by Congress for WASH, such as a yearly report describing changes in U.S. strategy and charting progress in achieving the above objectives.

“I think the report illuminated the landscape of the global extent and urgency of the problem,”

said David Douglas, head of the nonprofit Water Lines and former head of Water Advocates. “It suggested ways to respond to the problem very clearly and it has shown with time that many of suggestions posed have been in fact adopted.”

In the years since, the act has affected the lives of many through improved taps and toilets and other bi-lateral government efforts to meet water and sanitation needs. It has also spurred greater activity by U.S. companies, non-profits, and universities intent on addressing the challenge.

Work on water by the Nicholas Institute and the Aspen Institute didn't stop with *A Silent Tsunami*. In 2011, both organizations hosted a day-long forum to take stock of progress on WASH—a review documented in *A Silent Tsunami Revisited*.

The initial WASH forums gave way to the Aspen-Nicholas Water Forum, which focuses on water concerns in the United States. Held annually in May in Aspen, Colorado, this forum is guided by the understanding that water crises are not merely the result of climate change, population growth, financial constraints, and new contaminants—they reflect the combined realities of undervalued water and the lack of policies to preserve underfinanced and degraded water systems.

Tool Aids Design of Cap-and-Trade Programs

The death knell for greenhouse gas emissions trading appeared to have tolled in the United States when legislation for a federal cap-and-trade system failed in 2010.

But a pioneering element of this policy tool developed by Duke University—the allowance reserve—survived to play a critical role in two landmark emissions trading programs: the Northeast’s Regional Greenhouse Gas Initiative (RGGI)—the country’s first regional cap-and-trade program designed to reduce power plant emissions—and California’s cap-and-trade program, the country’s first to cover multiple economic sectors.

Tim Profeta, Brian Murray, and Billy Pizer of the Nicholas Institute and Richard Newell of the Duke University Energy Initiative were behind the allowance reserve concept, which helped to prevent emissions allowance prices in a cap-and-trade system from rising beyond the reach of potential purchasers.

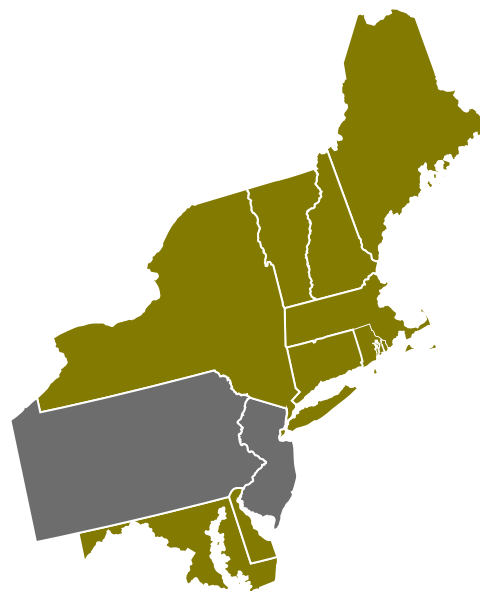
“It’s critical to keep prices in a comfortable range,” said Murray. “By setting aside a number of allowances (the reserve) and incorporating a supplemental auctioning process to distribute them when the price per emission begins to rise, you hold down price escalation.”

A hazard RGGI officials looked to avoid when they implemented a cost containment reserve after many discussions with the Nicholas Institute.

Since 2009, emissions of carbon dioxide and other pollutants in RGGI states have declined 40 percent. By 2020, power plant CO₂ pollution in the nine RGGI states is projected to be half of 2005 levels.

“Emissions trading programs can be customized to trade off price and emissions uncertainty, alleviating concerns about high or low prices by allowing for some variation in emissions,” said Pizer. “As the RGGI experience shows, more certainty about prices means less certainty about emissions—and vice versa. The ability of RGGI officials to tailor emissions certainty and price certainty, a key value of an allowance reserve structure, has been important to RGGI stakeholders. The allowance reserve has worked exactly as designed.”

This concept came into play again in 2012 when the Nicholas Institute was asked by the California Air Resources Board to provide recommendations on the design of an allowance reserve component for its cap-and-trade system—also adopting the reserve concept.



States (show in green) involved in the the Northeast’s Regional Greenhouse Gas Initiative (RGGI)

As states figure out how to comply with the U.S. Environmental Protection Agency’s Clean Power Plan there has been renewed interest in emissions trading. And, although no one has offered a specific proposal to use a carbon allowance reserve—a decision that would be left to individual states—there will still likely be interest in the balance between emissions reduction certainty and allowance price certainty that an allowance reserve can provide.

Work Frames International Carbon Credit Payment Processes

A key point of talks at the 2014 United Nations Twentieth Conference of the Parties (COP) in Lima, Peru, was ways to help developing countries reduce carbon emissions, including those due to deforestation and forest degradation—activities that account for nearly 17 percent of total global greenhouse gas emissions. In 2005, the United Nations Framework Convention on Climate Change (UNFCCC) first introduced Reducing Emissions from Deforestation and forest Degradation, or REDD, to the agenda for its COP meetings.

The core objective of what is now called REDD+ looks to encourage local stakeholders in developing countries to reduce emissions from forest clearings by placing a financial value on keeping forest-stored carbon in place. But the initiative left unanswered questions about the design of economic incentives for cutting deforestation rates. The Nicholas Institute tackled those questions, providing guidance to countries negotiating the UNFCCC and to parties developing REDD+ protocols in tropical developing countries.

An effective global REDD+ policy depends not only on policies that create the demand necessary to produce forest emissions reductions but also on a reliable source of finance to pay for those reductions. Nicholas Institute researchers, working with colleagues

outside Duke, analyzed compensation design options in light of several challenges, including establishing baseline emissions levels against which reductions can be calculated, ensuring the permanence of emissions reductions given natural disaster risk, and shifting of emissions to other unprotected forests through market-driven “leakage.” These challenges are further heightened by local variation in forest carbon project potential.

The payment design framework developed by the Nicholas Institute and partner organizations reflects the understanding that a one-size-fits-all model won’t work.

“We recommended that sourcing for payments remain flexible, whether it be a compliance process for countries that have mandatory emissions reductions caps, a non-market-specific transfer of funds to countries reaching emissions reduction goals, or a combination of these approaches,” said Christopher Galik, a senior policy associate at the Nicholas Institute.

Alongside partners, the Nicholas established that international forest carbon reductions through voluntary markets or emissions compliance markets could be created if policies created demand for a sufficient supply of reasonably priced carbon credits. “To ensure that we are paying for

additionality—that is, paying to avoid emissions that otherwise would have occurred—we established a baseline for crediting. This baseline is a point of reference for virtually every financing approach used for REDD+ activities,” said Brian Murray, director of the Nicholas Institute’s Environmental Economics Program. “Ensuring the additionality of emissions reductions from REDD+ payments is critical to the system’s integrity—a principal at the heart of the Nicholas Institute’s work on policy design.”

BRIAN MURRAY

on Reducing Emissions from Deforestation and Forest Degradation



<http://bit.ly/1NJ4pBN>

The Creeping Disaster That Led to a State Water Law

In 2007, North Carolina was facing a relentless drought resulting in mandatory statewide water restrictions. By the end of that year, all 100 counties were affected.

The crisis renewed attention to the importance of an assured water supply in the state. At the request of the North Carolina General Assembly, the Nicholas Institute co-led a study with the University of North Carolina examining ways to more effectively deal with water conflict, future scarcity, and drought. The [59-page document](#) detailed nine measures for the General Assembly to consider during the 2009 legislative session to ensure a secure water supply. Two of those recommendations would become law.

In 2010, legislation was enacted that directed the Department of Environment and Natural Resources to develop hydrological models or water budgets for the 17 major river basins in the state and to determine the flows needed to maintain the ecological integrity of surface waters for the major river basins in the state. The legislation created a scientific advisory board to develop criteria for that task.

“A key factor in long-range planning for water availability is the amount of water needed in a river or stream to maintain ecological integrity—the ecological flow,” said Bill Holman,

North Carolina Director of the Conservation Fund and co-author of the original report to the General Assembly. “At the time, the hydrological models that [were completed](#) not only allowed for closer examination of this flow with data based in science, but also led to more robust discussions and collaborations on water planning in the Triangle that would not have otherwise happened.”

The models allowed the state to simulate the flow of water in a river basin to predict which surface water systems may experience shortages during droughts and normal flow times.

To establish the ecological parameters for the models, the Ecological Flows Science Advisory Board was created. Nicholas Institute State Policy Program Director Amy Pickle, who was on the board, recalls the charge: “We were tasked with characterizing flow requirements and assessing the science around river and stream flows. Ultimately, by understanding how changes in flows affect the ecology, we could set reasonable expectations on how much water is available for water supply.”

Three years later, the board had a [recommended strategy](#): maintain between 80–90 percent of stream flow across the 17 river basins. Taking out more should signal

the Department of Environment and Natural Resources to take a closer look at potential impacts.

“At the time, the hydrological models that were completed not only allowed for closer examination of this flow with data based in science, but also led to more robust discussions and collaborations on water planning in the Triangle that would not have otherwise happened.”

—Bill Holman, North Carolina Director, Conservation Fund

“Absent our involvement, ecological flows would not have been part of the conversations around river basin planning,” Pickle said. “Our work helped to create a framework for evaluating water allocation policy that had been absent in North Carolina.”

ANTICIPATING THE CRITICAL QUESTIONS

Supporting the Sustainability of Federal Fisheries

In 2007, legislative reauthorization introduced substantial changes to the Magnuson-Stevens Fishery Conservation and Management Act, the primary federal law that governs the conservation of fisheries in U.S. federal waters. These changes—aimed at increasing economic and social benefits by ending overfishing and rebuilding fish stocks—had fisheries managers grappling with new terminology and a complex framework for determining the “right” amount of fish to catch.

“At the time, the rewrite of the Magnuson-Stevens Act was so confusing,” said Dale Myer, who recently completed his third appointment to the Pacific Fishery Management Council. “Everyone had a different idea of what the law really said.”

This confusion was exactly why the Fisheries Leadership & Sustainability Forum (Fisheries Forum), which provides policy-neutral support for the exploration of challenges and emerging issues facing our nation’s federal fishery managers, held a 2010 forum on the new terminology and methodology in the act. Myer was one of the council members in attendance.

Guidebook Connects Decisions to Things People Care About

“There were so many acronyms. The Fisheries Forum brought in experts to talk through the changes to the law, and how this new framework for setting harvest levels would account for different kinds of uncertainty. That took a lot of the mystique out of the rewrite,” Myer said, noting that after the in-depth dive he walked away with greater confidence in working through its mandates with his own council.

Myer’s experience illustrates one of the main goals of the Fisheries Forum—to provide opportunities to share ideas among and learn from the experiences of other members of the federal fisheries management community, which includes members and staff of eight regional fishery management councils across the country, the National Oceanic and Atmospheric Administration (NOAA)’s National Marine Fisheries Service, and a diverse group of experts in fisheries science and management.

Set to be housed exclusively within the Nicholas Institute for Environmental Policy Solutions’ Oceans and Coastal Policy Program in 2015, the Fisheries Forum was developed in 2008 as a partnership among four leading policy institutions: the Stanford Woods Institute for the Environment, the Center for Ocean Solutions, the Nicholas Institute, and the Environmental Defense Fund.

The Fisheries Forum helps fishery managers build their professional networks and work through challenging science and management topics with in-person meetings, policy research, and its Fisheries Forum Information Network.

“The federal fisheries management community is its own best resource,” said Katie Latanich, co-director of the Fisheries Forum. “One of the most fulfilling aspects of our work is the opportunity to help decision makers learn from experience, and learn from each other.”

The Fisheries Forum helps organize and facilitate forums, as well as regional and national workshops in collaboration with councils and NOAA Fisheries, to allow fishery managers to explore issues, together, across management regions.

Their latest forum explored risk-based management approaches for responding to uncertainty in fisheries science and management. Michelle Duval, vice chair of the South Atlantic Fishery Management Council and the state of North Carolina’s representative to the council, attended the meeting, where she learned about management strategy evaluation, a process for assessing the performance of different management strategies relative to management objectives.

The tool struck a chord.

“This was a tool the South Atlantic Fishery Management Council could use to make more educated decisions about risks to ensure our decision making is more proactive rather than reactive,” Duval said, noting she is exploring use of the tool as the council begins a strategic planning process for one of the region’s fisheries.

Like Duval, Myer finds each forum to be a resource. It is why he’s attended 12 of the 14 forums the Fisheries Forum has held in its seven years. Each one, Myers said, exposes him to a timely, relevant topic and gives him a chance to interact with other council members facing similar challenges.

“What I have always really appreciated about the Fisheries Leadership & Sustainability Forum is that it has a tendency to pick up topics that are hot or sensitive at the moment,” Myer said. “The Fisheries Forum isn’t telling you what to think. The forums are all about giving you the information to make a good decision.”

Its information that’s aided him—and many others—to wade through everything from the Magnuson-Stevens Act to habitat conservation and climate change and governance issues.

A few years ago, the U.S. Forest Service (USFS) did something that is changing the way the nation’s forests and grasslands are managed. What began as a mission to protect supplies of water and timber commodities—a matter of national security—and later to sustain provision of multiple products and services—think outdoor recreation and habitat protection, for example—has evolved into a directive to reflect in the agency’s performance measures and public engagement all the values provided by the national forest system’s regulating, supporting, and cultural services. In short, the agency has begun to incorporate consideration of ecosystem services in its planning and decision making.

The USFS is not the only federal agency thinking about the relationship between natural resources and people. Other agencies are now exploring how to explicitly link natural resource management choices to things people care about in a clear and analytically robust manner—a challenge recently taken on by the National Ecosystem Services Partnership (NESP), an initiative of the Nicholas Institute.

“One of the first things we learned is that the agencies felt that they lacked capacity and tools to assess ecosystem services,” said the Nicholas Institute’s Lydia Olander, who leads NESP. “We also discovered that there was some concern about incorporating the ecosystem services concept into planning and management

processes—mainly because methods and tools were new to managers. Are these methods and tools plausible and persuasive? Can they be consistently employed? How can they be shared, and how can their use be coordinated among agencies when there are institutional limits to this activity?”

The agency representatives requested guidance on developing a framework and methods for ecosystem services assessment as well as information about relevant tools and a mechanism to share best practices.

NESP answered with the launch of the Federal Resource Management and Ecosystem Services (FRMES) project, which in December 2014 published the *Federal Resource Management and Ecosystem Services Guidebook* (nespguidebook.com), an online resource that provides a framework and methodology to enhance the credibility and consistency of ecosystem services approaches to planning and management. The guidebook also explains the legal basis for these approaches, describes how federal agencies are exploring or applying them, and presents 13 case studies.

More than 150 individuals from agencies, universities, NGOs, and think tanks participated in the FRMES project—and more than 80 people contributed directly to the guidebook’s contents.

Olander coordinated the dozens of meetings that brought the experts together and spearheaded development of the user-friendly interface to their distilled knowledge.

“The guidebook is primarily written for federal resource agencies that undertake land and waters planning and management,” Olander said, “but its framework, methods, and examples can be applied broadly—for example, to inform rulemaking and permitting decisions as well as to inform natural resource management decisions by states, land trusts, corporations, and others who manage significant natural resources.”

Because many ecosystem services are not bought and sold in the marketplace, natural resource agencies possess no prices, inventories, sales volumes, or other data points that would highlight the services’ existence, their importance to people, and the purpose to which they should be managed. That’s the problem that the guidebook addresses by providing a framework and methodology for capturing the systemic effects of management decisions on ecological outcomes and for linking those outcomes to their social consequences. By helping decision makers more clearly and transparently assess tradeoffs, said Olander, an ecosystem services approach to resource management can help them identify options that yield the greatest benefits for local stakeholders and the public at large.

First Comprehensive Estimate of Blue Carbon Losses

When a Nicholas Institute-led [study](#) provided the first comprehensive estimates of global carbon dioxide emissions from the loss of coastal marine ecosystems, the world was alerted to a serious climate change threat.

Those emissions—as much as 1 billion tons of carbon dioxide equivalent per year—were potentially 10 times greater than previously thought and rivaled total national emissions from some developed countries.

The research, published in September 2012 in the journal *PLOS ONE*, highlighted the potential value of keeping in place so-called blue carbon—the carbon stored in the sediment below mangroves, sea grasses, and salt marshes.

Rather than focusing on quantifying carbon amounts in various ecosystems—as other studies to date had done—it examined what happens when these ecosystems are disturbed and stored carbon is released and whether protocols and methodologies could be implemented to offset carbon emissions.

sequestration and emissions rates to better understand the economic viability of blue carbon protection—the very need that they later helped address with the *PLOS ONE* study.

Nations Framework Convention on Climate Change’s (UNFCCC) process.

To preserve coastal habitats’ carbon sequestration and other ecosystem services, including storm buffering, pollutant filtering, and fisheries support, the *PLOS ONE* study authors pointed to the UNFCCC’s Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiative. They suggested that assignment of credits to carbon stored in coastal habitats through analogous international climate change mitigation programs might stem blue carbon losses.

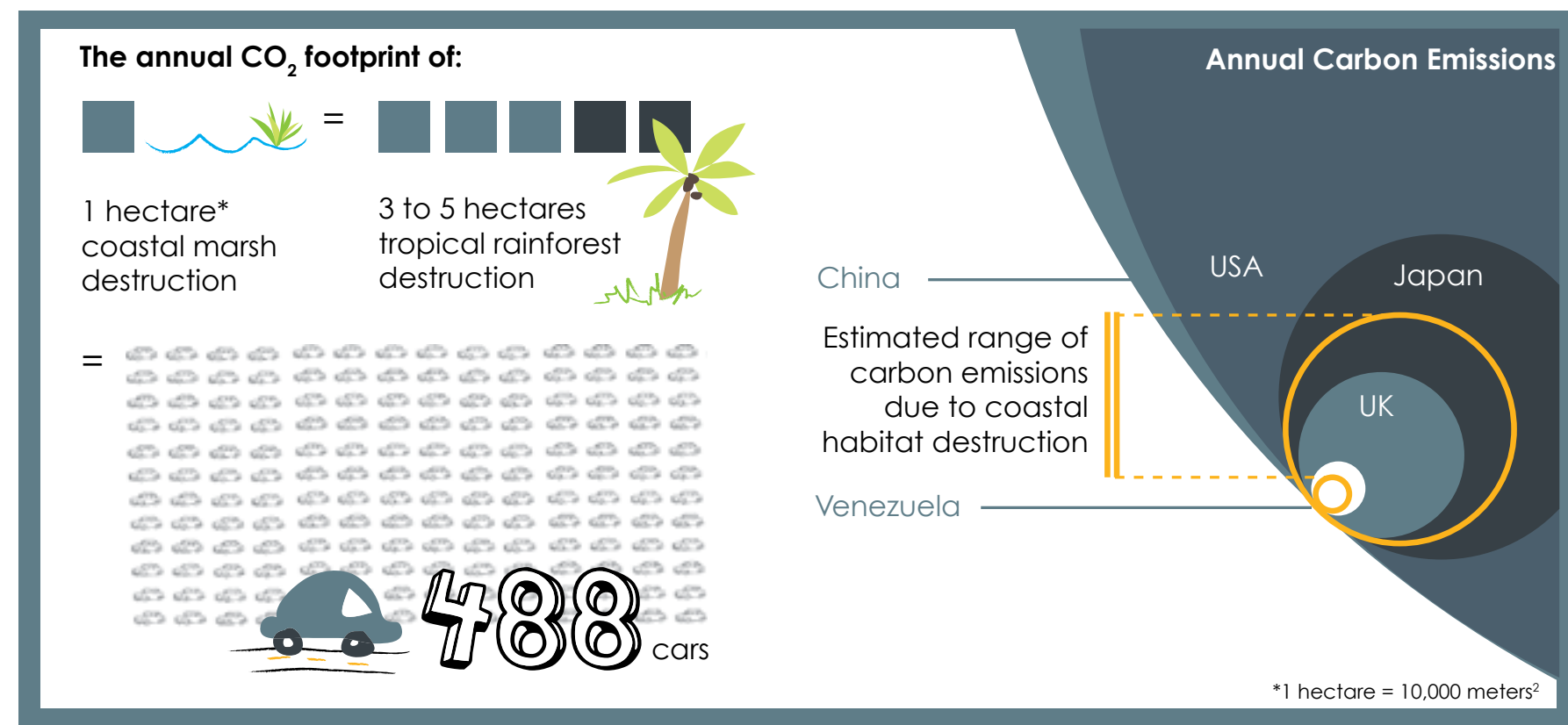
Even before they began work on that first study, Murray and Pendleton were addressing coastal habitat preservation as members of the International Blue Carbon Policy Working Group. The group’s initial work on a strategy to integrate mangrove, sea grass, and salt marsh preservation into biodiversity policies and global warming mitigation strategies was cataloged in [Blue Carbon Policy Framework](#). A Nicholas Institute [policy brief](#), published the same month as the *PLOS ONE* study, examined the evolution of blue carbon in the United

“Coastal ecosystems are a tiny ribbon of land, only 6 percent of the land area covered by tropical forest, but the emissions from their destruction are nearly one-fifth of those attributed to deforestation worldwide,” said Linwood Pendleton, the study’s lead author and now a senior scholar with the Nicholas Institute’s Ocean and Coastal Policy Program. “One hectare, or roughly two acres of coastal marsh, can contain the same amount of carbon as 488 cars produce in a year. Comparatively, destroying a hectare of mangroves could produce as much greenhouse gas emissions as cutting down three to five hectares of tropical forest.”

Blue carbon had received little notice when the Nicholas Institute first proposed payments for blue carbon protection in a 2010 [policy brief](#). In it, Nicholas Institute Environmental Economics Program director Brian Murray, Pendleton, and their co-authors suggested that coastal ecosystems could be an ideal target for carbon financing, while calling attention to the need for much more accurate estimates of carbon

“The article increased confidence in the technical and scientific underpinning of the blue carbon concept,” said study co-author Dorothee Herr of the International Union for Conservation of Nature Global Marine Program. “It was important to quantify the emissions from mismanagement of coastal ecosystems to get broad attention to this topic and to be able to develop appropriate policy and other responses.”

The study has helped advance those goals. Its results were cited in the Intergovernmental Panel on Climate Change’s *Fifth Assessment Report*, released in 2013, and have been used to develop long-term coastal habitat conservation policy options under the United Nations climate change agreement.



Destroyed Coastal Ecosystems Emit Massive Amounts of Carbon A 2012 *PLOS ONE* study by the Nicholas Institute found that destruction of coastal habitats may release as much as 1 billion tons of carbon dioxide into the atmosphere each year, 10 times higher than previously reported.

Did you know?



Average values of the data for coastal ecosystems contained in the Nicholas Institute study *State of the Science on Coastal Blue Carbon: A Summary for Policy Makers* were used to create the UNEP Carbon Calculator app, which helps users visualize their carbon footprint.

Using the Clean Air Act to Address Climate Change

In summer 2015, the U.S. Environmental Protection Agency (EPA) released the final version of its Clean Power Plan, which regulates carbon dioxide emissions from existing power plants under the Clean Air Act by establishing emissions targets unique to each state.

The goal—achieve a 32 percent cut from 2005 emissions levels by 2030.

Years before the rule—in the midst of the congressional climate debate—researchers at the Nicholas Institute partnered with faculty in the Duke School of Law to explore practical strategies to reduce greenhouse gas emissions using existing authority under the Clean Air Act.

These scholars were among the first to recognize that, should Congress fail to adopt a comprehensive bill addressing climate change, the U.S. Supreme Court decision *Massachusetts v. EPA* would likely require the EPA to take action to regulate such emissions under the 40-year-old law.

“The Clean Air Act grants the EPA and the states a significant amount of flexibility to address climate change,” said Jonas Monast, director of the Climate and Energy Program at the Nicholas Institute. “Since 2009, we

have used a combination of legal analysis, economic modeling, and stakeholder engagement to identify options for achieving meaningful emissions reductions in a cost-effective manner. Our early and ongoing work highlights Duke’s contribution to one of the most significant EPA rule makings in years.”

“The leadership that the Nicholas Institute has shown in initiating these discussions have proven invaluable in understanding the potential impacts and opportunities moving forward.”

—John Lyons, Assistant Secretary for Climate Policy, Kentucky Energy and Environment Cabinet

In 2009, the Nicholas Institute began holding stakeholder workshops to address outstanding legal questions presented by the broad statutory language of the Clean Air Act and its use to regulate the electricity sector,

which is responsible for 40 percent of U.S. carbon emissions.

Out of these workshops came roughly two dozen analyses of policy options and their risks and rewards under the law. One of the first—[Avoiding the Glorious Mess: A Sensible Approach to Climate Change and the Clean Air Act](#)—suggested that use of section 111(d) of the Clean Air Act could allow the EPA to design a flexible, cost-effective emissions reduction program. Another [analysis](#) examined compliance strategies providing multiple benefits for the electricity sector.

“One of the unique things that the Nicholas Institute has done through reports and meetings is to consider how clean energy and efficiency strategies can be used to help states achieve reductions of multiple pollutants, including pollutants like ozone and mercury as well as carbon pollution,” said Vicki Arroyo, executive director of the Georgetown Climate Center. “This work really helped highlight the multiple benefits of these strategies, which is important because different stakeholders may be focused on achieving one pollution reduction goal or another, but they may all still benefit from considering the same suite of strategies.”

John Lyons, assistant secretary for climate policy, Kentucky Energy and Environment Cabinet, called [one Nicholas Institute policy brief](#) “particularly compelling” that outlines how states whose compliance plans share common elements could allow power plant owners to transfer low-cost emissions reductions across state borders without the need for a formal emissions trading system.

“The exploration of the ‘common elements’ approach has caught national attention and is a recurring topic now being discussed by many states and organizations,” Lyons said.

In 2013, work to help state utility regulators think about uncertainty in the electricity sector evolved beyond analyses into a game called the Energy Risk Lab when the Nicholas Institute partnered with the National Association of Regulatory Utility Commissioners (NARUC) to make technical improvements in NARUC’s scenario-based role-playing game.

The game guides federal and state regulators and utility officials through a series of situations involving the EPA’s proposed Clean Power Plan and the Mercury and Air Toxics Standards—as well as other potential challenges such as suddenly high natural gas prices or an accident that forces the

shutdown of nuclear plants. In it, the critical policy and decision makers work alongside one another to make billion-dollar decisions that they may one day face in real life.

“There’s a real need for creative yet credible thinking,” said Tim Profeta, director of the Nicholas Institute, “and I think that’s what we’ve been able to bring to the table.”

The Nicholas Institute continues educating decision makers about their Clean Power



Plan compliance choices through timely, objective analysis.

Over time, the Nicholas Institute’s regular engagement with state environmental regulators and utility commissions has evolved into an ongoing series of workshops for Southeastern officials to explore compliance pathways and to weigh their tradeoffs.

The meetings, Lyons notes, have given the Southeast states a valuable platform to assess the Clean Power Plan.

“The value of these meetings are numerous but first and foremost, they have brought together regulators from the southeastern states to discuss our regional issues surrounding the Clean Power Plan,” Lyons said. “These states have many similarities in population, economy, manufacturing and heavy dependence on fossil-generated electricity, which results in our concerns on the 111(d) rule being very similar. The leadership that the Nicholas Institute has shown in initiating these discussions have proven invaluable in understanding the potential impacts and opportunities moving forward.”

PROVIDING UNBIASED EVALUATIONS OF POLICY RISKS AND REWARDS

Using Science to Inform Ag Policy, Carbon Markets

In 2008, the Nicholas Institute had just published a report weighing challenges and options for designing an offset policy that would reduce greenhouse gas emissions from two uncapped sectors of the economy—forestry and agriculture.

The [report](#) and an earlier [companion piece](#) that focused on how to create, measure, and verify greenhouse gas offsets from these sectors were meant to aid policy makers who were drafting a federal cap-and-trade bill. This bill increased the likelihood that energy and fuel prices could rise. This likelihood, coupled with uncertainty surrounding whether agricultural offsets would be viable, profitable and that voluntary offsets could turn into regulatory requirements in the future, sparked significant concern in the agriculture community.

“What was interesting about offsets was the possibility of tackling all of these concerns at once,” said Nicholas Institute Ecosystem Services Program director Lydia Olander. “Use of offsets in a cap-and-trade policy had the potential to reduce increases in energy and fuel prices and be profitable for farmers. And if farmers were to move voluntarily into offsets, there would be little need for future regulation of such activities. That’s

why we formed the Technical Working Group on Agricultural Greenhouse Gases (T-AGG)—to use science to inform this debate about the potential for offsets from the agricultural sector.”

That’s exactly what it did.

Over the course of several years, T-AGG synthesized relevant agricultural and economic research to inform agricultural policy and carbon markets. Its review of studies on greenhouse gas mitigation potential showed that changes in agricultural practice can contribute, significantly, to greenhouse gas emissions reductions and carbon storage in the soil. And the analysis confirmed the need for aggregation across larger landscapes to increase greenhouse gas reductions per acre.

The work also raised awareness of the need for better data on the impacts of many potentially beneficial agricultural practices so that decision makers can better weigh tradeoffs and arrive at the more efficient and economically favorable practices. T-AGG’s findings have been used by carbon market developers, foundations, state officials, and the U.S. Department of Agriculture to inform carbon offset programs, research priorities, and funding decisions. Further [assessment](#) was conducted for the California Air Resources Board to inform development of a scoping report focusing on its greenhouse gas mitigation strategy for agriculture.

“T-AGG’s 2011–12 synthesis report on GHG mitigation potential was significant as background to our report *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*,” said Marlen Eve, senior advisor for climate change, USDA Office of the Chief Scientist. “In that report we utilized the synthesis in our efforts to evaluate management practices and to determine the best methods to use to quantify their benefit.”

Not all T-AGG work has been focused in the United States. There’s also been an international component aimed at improving systems for quantifying greenhouse gas emissions in agriculture—particularly smallholder agriculture in developing countries. Some of this work was featured in a special issue of the journal [Environmental Research Letters](#), which explored not only the current state of agricultural greenhouse gas quantification methods, but also the potential for improving these methods.

Although the T-AGG project has ended, extensions of its analysis continue as explorations of the gaps in science related to nitrogen.

“We used some of what T-AGG learned about nitrogen management and did a more quantitatively intense meta-analysis of fertilizer management effects on air and water quality,” said Alison Eagle, a policy associate in the

Nicholas Institute’s Ecosystem Services Program.

Specifically, researchers looked at nitrogen management literature to determine the impact of 4R nutrient management—Right rate, Right timing, Right placement, and Right source—on total nitrogen losses relative to yields from corn-based cropping systems in North America. It showed that although there isn’t enough field data to make good recommendations in many regions, there are some consistent benefits associated with reducing fertilizer rates, applying fertilizer later in the season, and using nitrification inhibitors.

“The work done by Dr. Alison Eagle and Dr. Lydia Olander has shown that few corn cropping system research studies in the U.S. and southern Canada have simultaneously evaluated nitrate leaching and the subsurface drainage nitrate losses, while also measuring nitrous oxide emissions,” said Cliff Snyder, Nitrogen Program Director, International Plant Nutrition Institute. “As a consequence, there is large uncertainty in potential tradeoffs in 4R nitrogen management to reduce losses of nitrogen from farmer’s fields via these two pathways. Through Dr. Eagle’s work, the fertilizer industry, agribusiness, and farmers are realizing that much work remains to optimize economic crop production while reducing the risks of nitrogen losses from agricultural cropping systems.”

Custom Models Weigh Impacts of Choices

Imagine having to make billion dollar investments affecting millions of electricity consumers for at least 30 years in the midst of energy technology changes and impending emissions regulations to address global warming.

That’s the situation facing state regulators who’ve participated in decision-making workshops presented by the National Association of Regulatory Utility Commissioners (NARUC) and the Nicholas Institute.

“If we go back 10 years, no one was thinking that natural gas prices would be as low as they are today or that we’d be looking to regulate carbon emissions from electrical generating units under the Clean Air Act,” said Miles Keogh, NARUC’s research director. “Committing billions to go down one pathway or even multiple pathways—that can be a scary proposition. When there’s so much uncertainty about the future energy landscape, traditional scenario analysis may not always be the best tool for making decisions that minimize risk.”

Through a NARUC [training series](#), the Nicholas Institute’s David Hoppock and the Nicholas School of the Environment’s Dalia Patino-Echeverri are helping regulators move beyond such analysis by demonstrating how to determine the optimal investment decision(s)

with a model they co-created: PowerOptInvest. This model—publicly available to regulators and utility operators—can pinpoint hedging strategies, optimize expected value under

“Since our 2005 inception, we’ve recognized that decision makers need ways to systematically examine the environmental and economic consequences of contemplated large-scale policy changes. Figuring out the benefits and costs and warding off unintended consequences requires robust climate and energy models.”

—Brian Murray, Nicholas Institute Environmental Economics Program director

real-world uncertainty, and identify the options value of deferring major capital investments, Hoppock said.

As a developer of PowerOptInvest and other economic and energy models, the Nicholas Institute has helped policy makers assess a variety of complex energy and environment choices with sophisticated analyses of tradeoffs. For the last decade, it has used these models, some created by Nicholas Institute staff in collaboration with Duke University faculty and some available through strategic alliances with other research institutions, to investigate issues as diverse as the greenhouse gas (GHG) implications of bioenergy use, network optimization of the carbon dioxide pipeline, and carbon pricing—or how emissions trading and carbon taxes can induce changes in energy production, use, and emissions.

“Since our 2005 inception, we’ve recognized that decision makers need ways to systematically examine the environmental and economic consequences of contemplated large-scale policy changes,” said the Nicholas Institute’s Environmental Economics Program director Brian Murray. “Figuring out the benefits and costs and warding off unintended consequences requires robust climate and energy models.”

Initially, the Nicholas Institute collaborated with organizations outside Duke or used off-the-shelf public domain models to bring modeling to the discussion. More recently, said Murray, “we’ve seized opportunities for our own staff, sometimes working with Duke faculty, to develop models. That capability has allowed us to integrate our economic, legal, environmental science, and engineering expertise to be proactive and nimble in evaluating and contributing to policy solutions.”

As part of a multi-institutional team, Murray helped develop and use the Forest and Agriculture Sector Optimization Model with Greenhouse Gases (FASOMGHG) to examine the [net GHG effects of U.S. biofuel policies such as renewable fuels standards](#), estimating the influence of indirect land use change on GHG emissions.

The Nicholas Institute has since used FASOMGHG and another model to [explore the environmental and economic implications of renewable portfolio standard](#), which obligate electricity suppliers to produce a specified fraction of their electricity through purchases from certified renewable energy generators.

Since 2014, much of the Nicholas Institute’s modeling work has focused on [cost-effective ways to meet emissions reduction targets for](#)

[existing power plants under the Clean Power Plan \(CPP\)](#)—work relying on the Nicholas Institute-created Dynamic Integrated Economy/Energy/Emissions Model (DIEM). Nicholas Institute researchers have used DIEM to evaluate CPP compliance options both [nationwide](#) and [in the Southeast](#)—presenting findings at an ongoing series of workshops for regulatory officials in southeastern states.

Participant Keith Bentley, air protection branch chief at the Environmental Protection Division of the Georgia Department of Natural Resources, noted that DIEM analysis is helping his organization understand the economic impacts of calculating emissions targets using rate- or mass-based approaches.

“We don’t have economic modeling capability in house so this is critical info we didn’t have and can now bring into our decision making,” he said.

DIEM modeling has also helped regulators understand the implications of pursuing multistate versus unilateral CPP compliance.

In part because of the DIEM analysis, Myra Reece, bureau of air quality chief for the South Carolina Department of Health and Environmental Control (SCDHEC), said that she

and the Energy Coalition, a stakeholder group formed by SCDHEC to study compliance choices, are “investigating the multistate option and how this approach could help address cost and reliability concerns.”

Now that CPP rules are finalized, regulators and utility operators can use PowerOptInvest to create investment portfolios reflecting the rules and positioned to address foreseeable risks, such as market upsets.

In an example analysis, Hoppock and Echeverri used the model to examine the economics of constructing a new natural gas combined cycle plant with and without energy efficiency investments given uncertainty about the direction of natural gas prices. The researchers say that similar modeling exercises can be used—by utility regulators and ratepayer advocacy groups as well as profit-maximizing utility operators—to discover the potential cost of fuel price volatility and other uncertainties and to capture the value of risk-hedging investments.

Although conceived as a tool for the electricity sector, PowerOptInvest is in fact applicable to analysis of any major capital investment beyond the power sector.

A Trusted Voice on Bioenergy

Bioenergy is a growing source of alternative energy but has yet to emerge as a self-sustaining industry despite significant policy support. Future support may be shaped by the outcome of debates surrounding its production and use—involving everything from what’s classified as biomass and what its net impacts are on greenhouse gas (GHG) emissions to how it affects food security and forest resources.

Since 2006, the Nicholas Institute has been weighing the policy risks and rewards of expanded bioenergy markets, becoming a trusted adviser to government, non-profits, and industry on the likely implications of expanded energy markets.

Its work on the often-contentious issue of biomass energy [has been cited](#) by the U.S. Environmental Protection Agency and members of the Scientific Advisory Board on Biogenic Accounting as an example of the type of research necessary to develop workable approaches to track bioenergy carbon emissions.

The Nicholas Institute has compared the environmental, economic, and social effects of alternative policy options that encourage bioenergy production in the United States as well as identified gaps in liquid biofuels research and helped lawmakers understand

their options when considering integration of biofuels into a comprehensive climate policy.

“The Nicholas Institute’s work on bioenergy has provided some much needed quantitative analysis in what are often highly polarized data-free debates on the role and impact of bioenergy,” said Walt Reid, director of the Conservation and Science Program at the David & Lucile Packard Foundation.

Nicholas Institute researchers have been invited to serve on multiple external committees exploring biofuels and bioenergy issues. Brian Murray, director of the Nicholas Institute’s Environmental Economics Program, worked alongside 11 others on a National Academy of Sciences (NAS) committee [assessing how key elements of the current tax code affect the nation’s greenhouse gas](#) (GHG) emissions. At the request of Congress, the committee developed a report considering both energy-related provisions—such as subsidies for ethanol and tax credits for renewable energy—as well as other broad-based provisions that may have indirect effects on emissions.

“The current code attempts to achieve many things—revenue collection, investment incentives, and a wide range of social and economic goals—but it is not designed to lower greenhouse gases and so, unsurprisingly,

it does not,” said Murray. “In particular, the certain biofuel subsidies that were previously embedded in the federal tax code were shown to have little net greenhouse gas reduction benefit under current technology and market conditions. The NAS study did, however, note that there was room for more effective ways to incentivize GHG reductions and bioenergy through the tax code by placing a price on carbon emissions.”

The Nicholas Institute’s investigation of the GHG effects of U.S. biofuel policies was featured in the journal [Energy Policy](#). Using research partner International Institute for Applied System Analysis’s GLOBIOM model, it explored how emissions from land use and agriculture would change over the 2010–2030 period. It found that raising the U.S. renewable fuel standard would substantially increase the portion of agricultural land needed for biofuel feedstock production—decreasing U.S. exports of most agricultural products and leading to a globally higher rate of land conversion and nitrogen use. In total, ramping up the fuel standard could even lead to an increase in global GHG emissions through these indirect land use change effects unless land productivity increased substantially or more emphasis was placed on cellulosic ethanol alternatives, which have less of a land use displacement effect than conventional cornstarch ethanol.

EDUCATIONAL IMPACT

Fulbright Awardee Advises Canadian Governments on Carbon Pricing

This past winter, Environmental Economics Program director Brian Murray traded bike commutes in Durham for commutes by skates on Canada’s frozen Rideau Canal as a Fulbright Visiting Research Chair in Environment and Economy. There, Murray spent five months conducting research on carbon pricing systems at the University of Ottawa.

The visit happened to coincide with what would be a renewed focus on carbon pricing in Canada.

One of his first tasks: conduct high-level meetings with provincial government officials looking to design or refine cap-and-trade systems—programs providing economic incentives for achievement of a specified level of reduction in targeted emissions.

Work of Student Is Shaping Energy Policy in Bermuda

“Brian was seen as one of the top experts in the world on the design of carbon pricing systems by these officials,” said Stewart Elgie, director of the University of Ottawa’s Institute of the Environment and chair of Sustainable Prosperity. “For governments that are interested in designing or refining their systems, being able to draw on Brian’s expertise was incredibly helpful. He is one of those academics who move easily between the policy and academic world, which allowed him to speak to some of the real-world questions. The timing couldn’t have been better.”

Murray is among the original designers of the allowance price reserve approach for containing prices in carbon markets—an approach adopted by California and the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade programs. Throughout his career, he has produced more than 80 peer-reviewed publications on topics ranging from the design of market-based environmental policies and the effectiveness of renewable energy subsidies to the evaluation of programs to protect natural habitats such as forests and coastal and marine ecosystems.

While in Canada, he wrote several other papers, one of which reviewed and summarized all the research on the effectiveness of British Columbia’s carbon tax seven years after

implementation. Murray, and his University of Ottawa colleague Nicholas Rivers, found that the “textbook” carbon tax—an instrument designed “straight out of the economist’s playbook”—delivered clear emissions reductions without harming the province’s economy.

The assessment, Elgie said, was the first to pull together all the evidence about the effectiveness of the tax and provided a real value for academics and policy makers as provinces consider their own options for curbing carbon emissions.

For Murray, the Fulbright experience was “eye opening” and a chance for a true exchange of knowledge for both parties.

“With this experience you don’t go to just study,” Murray said. “It is a true exchange. The University of Ottawa helped me find people from Canada to share experiences. In my case, that was government officials—a natural fit. These officials gained, what I hope, was some guidance on how to move forward designing or refining their carbon-pricing systems. I learned subtle but important differences and interesting parallels in how both countries practice environmental policy.”



Brian Murray in front of Canada’s Parliament in Ottawa.

When Judith Landsberg began her master of environmental management degree at Duke, she had no idea how far-reaching the impact of her studies would be. Now her master’s thesis could influence several aspects of Bermuda’s energy policy.

In 2013, Landsberg became a member of the Bermuda Energy Working Group (BEWG) as a representative of the local sustainability non-governmental organization Greenrock. Her experience with energy efficiency education in the Bermuda community and as a member of BEWG inspired her to write her thesis on a long-term strategy for meeting Bermuda’s energy needs in a cost-efficient and environmentally responsible way.

When the BEWG was approached for comment on a preliminary energy policy crafted by consultants for the Bermuda Department of Energy, Landsberg quickly saw some critical omissions in the proposal.

“It represented a very traditional approach to energy policy based on a narrow cost-benefit analysis of alternatives, and the assumption that demand for fossil fuel-based electricity would continue to increase with some minor supplementation from renewables,” said Landsberg. “I wrote a detailed response, 80 percent of which was cut and pasted

from the draft of my masters’ project, to call attention to the need to incorporate demand-side management, to change the way electricity rates are set, and to take into account environmental externalities.”

The timing of her studies could not have been more ideal. A week previous, her thesis advisor, Jonas Monast, director of the Climate and Energy Program at the Nicholas Institute, had referenced just the support she needed for her argument.

“Jonas had mentioned FERC 745—it’s an order by the Federal Energy Regulatory Commission in the United States that’s designed to remove barriers to use of demand-side resources. I looked it up and cited it in my response,” said Landsberg. “I also cited a 2014 paper that Jonas co-authored on a [multi-benefit framework for cutting emissions and addressing electricity sector changes](#) to support the idea that we should be evaluating and managing long-term risk on a number of dimensions—an issue that the energy policy proposal had completely ignored.”

Landsberg’s paper received positive responses from the Department of Energy and from BEWG members.



She notes that her master’s project is “helping me take an active role in the policy discussion in Bermuda and in improving Bermuda’s long-term energy system. Work, Monast said, that is “a wonderful example of a student project with a direct policy application.”

Program Simplifies, Lowers Cost of Solar Installation



Michelle Nowlin, Jason Elliott, James Ferguson, Charles Adair, Daniel Ketyer, Ellis Baehr, and Jennifer Sekar at a Solarize Duke informational event.

A team of Duke University students, staff, and faculty are helping to advance the university's 2024 goal of carbon neutrality with a pilot program that connects Duke employees with vendors providing discounted rooftop solar installations.

The Solarize Duke program—open to locally based university employees—was borne out of an energy-themed Bass Connections project partnering the Nicholas Institute for Environmental Policy Solutions, Duke's Carbon Offsets Initiative, the Sanford School of Public Policy, and NextClimate.

"This pilot project is part of a greater effort by Duke to determine how residential solar may provide social and economic benefits to surrounding communities while creating emissions reductions that help to further the university's carbon neutrality goal," said Charles Adair, program manager, Duke Carbon Offsets Initiative.

During three months in spring 2015, the program connected some 200 employees with two top Triangle area solar installers—Southern Energy Management and Yes! Solar Solutions—to install discounted solar at employees' homes.

The program takes advantage of 2016 federal and 2015 state solar tax credits, combining them with vendor-provided group discounts to deliver price cuts of as much as 65 percent in many cases.

"This Bass Connections Solarize Duke project is a great example of how the Nicholas Institute not only brings its expertise to students, but also furthers Duke's sustainability endeavors," said Tim Profeta, director of the Nicholas Institute. "From rigorous research of the state's solar landscape, Duke students developed a pragmatic project that took advantage of tax credits, vetted solar installers, and gained university approvals to make deployment of a relatively climate-friendly energy technology a more affordable reality for university employees. Billy [Pizer] and I were excited to come along on their intellectual exploration."

Although the program runs through December 2015, Adair said the university has plans to ensure some remnants of it are more permanent.

"There is potential for the state tax credit to be renewed," Adair said. "If it is extended, we may be able to run a similar campaign next year. Even if the tax credit does go away, we

will find something more permanent, whether it's through the employee Perqs program or something similar."

For student partners like Ellis Baehr and Daniel Ketyer, the opportunity to gain experience outside the classroom through Bass Connections left a lasting impression.

"I can say without a doubt that Bass Connections was the best experience I had at Duke," said Baehr, who credits his involvement with helping him to secure his current job as an energy analyst at Jones Lang LaSalle. "Starting with a vague notion of what we wanted to accomplish and actually pushing it through is something to be proud of. I look forward to coming back in five or ten years and seeing the solar panels this project helped to install."

The most significant aspect of Ketyer's involvement was interacting with "the top faculty that study energy at Duke." Ketyer, a public policy undergraduate, added, "You can listen to a great professor in a lecture hall with 200 other students, but through this project I got the chance to be one of seven or eight people regularly sitting around a table with Tim Profeta and Billy Pizer, benefiting from the knowledge they had to share."

First Carbon Regulation Analysis of Petroleum Refinery Sector

Even before the U.S. Environmental Protection Agency (EPA) announced its plan, in June 2014, to regulate emissions from existing power plants, the door appeared to open for a similar effort in other sectors, including petroleum refining. Three Duke University students led by staff from the Nicholas Institute for Environmental Policy Solutions and Clean Energy Durham set out to investigate whether policies for regulating carbon emissions from electric-generating units (EGUs) might be translatable to a greenhouse gas (GHG) performance standard for refineries.

“The project actually began as an exploration of U.S. climate policy options given lack of appetite for climate change legislation,” said Allison Donnelly, then a senior undergraduate student and now a project consultant with Energy & Resource Solutions. “That means that emissions reductions have to come through existing regulations. EPA had started working on regulations for the power sector—the largest GHG emitter in the U.S.—so we wanted to look at the next largest emitters, petroleum refining and steel manufacturing, and how EPA could regulate them in a non-cost-prohibitive way. We ended up focusing on the petroleum refineries.”

The team’s research, including emissions data analysis by Yanyou Chen, a graduate economics student, revealed substantial differences between the power and petroleum refining industries. Moreover, according to Kristie Beaudoin, then an environmental law student, differences among individual refineries were significant.

“No two refineries have the same configuration or emissions profile,” Beaudoin, now an attorney at the law firm Gibson, Dunn & Crutcher, said. “It seemed clear to us that policies for regulating carbon emissions from electric-generating units might be translatable to a GHG performance standard for refineries,

but rulemaking for refineries would be far more complex than for EGUs.”

The Bass Connections team explained the rulemaking implications of the differences between the two industries in a policy brief. In a companion working paper, they analyzed some of the key questions the EPA would face in designing a performance standard for petroleum refineries—work informed by conversations with the agency, oil companies, and trade groups.

In a presentation of their findings at the EPA’s Research Triangle Park office, Donnelly, Beaudoin, and their Nicholas Institute team



The Bass Connections team meets with EPA representatives at the agency’s Research Triangle Park office.

members—senior policy associate Sarah Adair, Environmental Economics Program director Brian Murray, faculty fellow Billy Pizer, and Nicholas Institute director Tim Profeta—confirmed to EPA officials that a simple transfer of EGU compliance principles to the refining sector was impossible. They also detailed conclusions about potential regulatory formats on the basis of their research and stakeholder input.

“Interdisciplinary research was critical to our work,” Donnelly recalled. “When we discussed what actually goes into creating EPA regulations, we realized that the issue is far more complex than any one of our individual fields of study. It was only through pooling our expertise that we could gain enough understanding to be able to talk to industry experts and ultimately start a dialogue on the future of greenhouse gas regulations for the petroleum refining industry.”

Working with Donnelly, Beaudoin, and Chen was a rewarding experience for Pizer.

“It set the bar extremely high for future student collaborations,” he said. “I’ve had numerous people contact me and say that their work was extremely helpful—and really the only work out there—on this topic.”

By the Numbers

Between 2009 and 2015,

the Nicholas Institute used its expertise to shape minds both inside and outside Duke classrooms.

3,741

STUDENTS TAUGHT

341

STUDENTS WORKING ON RESEARCH

66

COURSES TAUGHT

Selected Publications



Using and Improving the Social Cost of Carbon

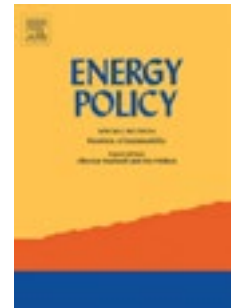
In this *Science* article, faculty fellow Billy Pizer and Environmental Economics Program director Brian Murray, along with other researchers, discuss a

standardized process to regularly evaluate the social cost of carbon (SCC), an estimate of the per-metric-ton dollar value of reducing climate change damages—a metric used in regulatory analysis. They contend that a regularly monitored process for gauging the SCC is critical not only for domestic policy making in the United States but also for international climate negotiations.

An Assessment of European Union Pellet

Woody biomass from the southeastern states is expected to play an important role in meeting European Union (EU) renewable energy targets and greenhouse emissions goals. This *Global Change Biology-Bioenergy* analysis increases understanding of interactions between policy targets and forest biomass markets by combining—for the first time—a model of those markets in the southeastern United States with spatially

explicit information on sensitive forestlands. Nicholas Institute senior policy associate Christopher Galik and his co-author found in modeled scenarios that future increases in wood pellets from the Southeast could meet EU sustainability guidelines, helping the EU meet its renewable energy and greenhouse gas emissions goals without decreasing U.S. forest inventories or diminishing U.S. carbon storage capacity.



Regulating Existing Power Plants under the U.S. Clean Air Act

This *Energy Policy* analysis attempted to answer one question not addressed in debate over air regulations for

existing coal plants—what if those regulations turn out to be inadequate to address future mitigation goals? It revealed that long-term consequences might leave a significant legacy for future policy revisions: Differentiated standards lead to relatively greater investment in coal retrofits and non-tradable standards lead to relatively greater retirement of coal capacity—all of which could affect costs for securing deeper greenhouse gas reductions in the future.



Optimizing the Scale of Markets for Water Quality Trading

This *Water Resources Research* analysis led by Water Policy Program director Martin Doyle found that allowing

polluters to buy, sell, or trade water-quality credits could reduce pollution in river basins and estuaries faster and at a lower cost than requiring facilities to meet compliance costs on their own. In fact, it showed that water-quality trading of any kind can significantly lower the costs of achieving Clean Water Act goals, pointing to the urgent need for implementation of such trading, no matter its scale or scope.

A Common Elements Approach to Capturing Low-Cost Emissions Reductions

This Nicholas Institute policy brief presented a Clean Power Plan compliance pathway allowing states to realize the advantages of multistate solutions and market-based solutions without mandating either strategy. It laid out a “common elements” approach, whereby states develop individual-state plans to achieve their unique emissions targets and give power plant owners the option to participate in cross-state emissions markets. Power plant owners can

transfer low-cost emissions reductions between states whose compliance plans share common elements—credits defined the same way—and mechanisms to protect against double counting. This approach lowers administrative hurdles to regional trading, leaves compliance choices to power companies, and maintains traditional regulatory roles.

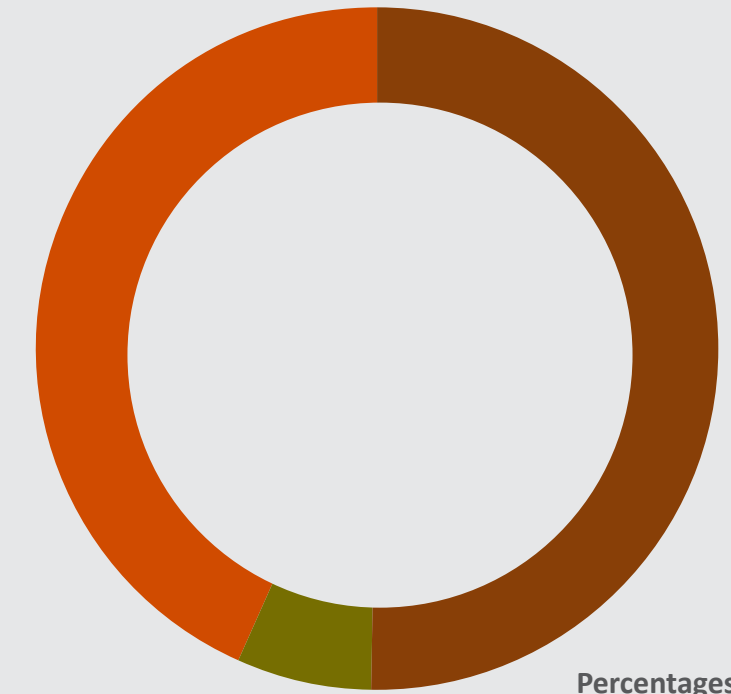


Get the Science Right When Paying for Nature's Services

In this *Science* article, Ecosystem Services Program director Lydia Olander, along with many other experts, proposed

guidelines and principles for ecosystem services provision payments to ecosystem owners and stewards. The recommendations address two obstacles to scaling up such payments: the weak scientific foundation for some payment projects and lack of evaluation of the projects’ effectiveness. The authors suggest that greater rigor with respect to the latter, in particular, is critical to understanding the importance of payments for ecosystem services provision as policy instruments and conservation tools.

Fiscal Year 2015 Operating Funds



Percentages

- University (Core): 50.4
- Gifts: 6.3
- Grants: 43.4

Of the 6.3% allotted in gifts, 5.9% was attributable to individuals and 0.4% to foundations. Foundations provided 32% of grant funding; government grants, 5.1%; and corporations, 6.2%.

Jim Rogers

In 2015, Jim Rogers became one of two inaugural fellows in the Duke University Rubenstein Academy—a program that brings prominent leaders to Durham to strengthen the connection between theory and practice in university classrooms. Already a member of the Nicholas Institute for Environmental Policy Solutions’ Advisory Board, the former Duke Energy CEO taught a graduate-level Duke course on renewable energy sources for the developing world alongside Nicholas Institute director Tim Profeta, published a book in August focused on bringing energy access to the 1.2 billion world’s poor, and is leading a new initiative on the same topic with Tatjana Vujic, associate director, Energy Access Project.

Tell us about what you learned in your role as a Duke University Rubenstein Fellow?

It was a great opportunity in so many different ways for me. To partner with Tim Profeta to co-teach a course was great fun. But when we started working together, I realized that I had no one to write my first draft for me as I had as a CEO. That was challenging in and of itself—but even more so because no one at Duke or any university had taught a course about renewables and rural poverty. We had to develop the material from scratch. To make it “real,” we broke the students into groups and asked them to put together a business plan for providing electricity to remote villages and poor parts of the world.

As a university fellow not tied to any one school but with the ability to work in all the schools, I was able to speak on a wide variety of topics, from energy in the law school to the future of U.S. renewables at the engineering school. The Rubenstein Fellows program is a great innovation by Duke. You get the opportunity to interact with students and faculty and really make a difference.

How did you first become interested in energy access in the developing world?

It was a series of circumstances that led me to this topic. My wife and I took four of our grandchildren to Kenya—a trip I wanted to make more than a safari experience. I wanted it to have a cultural element. So, we

ended up going to different villages. In one village I started talking through a translator to a guy with a cell phone: “I don’t see any power lines here. How do you charge your cell phone?” He said, “Well, usually I walk three hours and pay somebody to charge it and then I walk back to the village.” I thought that was pretty amazing. As I went from village to village, I realized nobody had access to electricity.

I was reminded of reading Robert Caro’s book about Lyndon Johnson. There’s a chapter about how the lives of some women in Texas were transformed by electricity access. It was a very moving story. All of a sudden, the figurative lights went on—I grew up with access to electricity by default. All of a sudden, as a young CEO, I now know what the mission is. I understood how transforming my business was. That burned the light for me.

What have you seen in your year at Duke that makes you think this university provides the right platform for your Energy Access Project?

Every university talks about breaking down silos and getting people to work across disciplines on projects, but Duke really does it. In corporations and in government, you have people from all different disciplines sitting around a table trying to solve a problem. I have been to other universities and the bottom line is that it is hard to achieve that cross-discipline approach. To solve this problem it is going to take business ideas, engineering, public policy. Duke is uniquely positioned to bring these elements together.

WATCH THE INTERVIEW

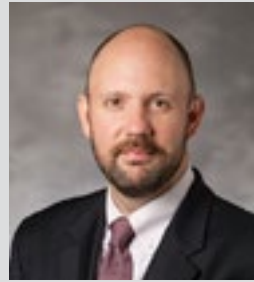


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Director
Nicholas Institute



Emerson Beyer
Associate Director
Corporate and Foundation
Relations



Martin Doyle
Director
Water Policy Program



Sheri Matthews
Associate Director
Finance and Administration



Jonas Monast
Director
Climate and Energy Program



Brian Murray
Director
Environmental Economics
Program



Lydia Olander
Director
Ecosystem Services Program



Amy Pickle
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State Policy Program



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Mark Tercek
President and CEO
The Nature Conservancy

Alan Townsend (Ex Officio)
Dean
Nicholas School of the Environment

Jeff Vincent (Ex Officio)
Clarence F. Korstian Professor of Forest
Economics and Management
Nicholas School of the Environment

Douglas Wheeler
Partner
Hogan Lovells US LLP



P.O. Box 90335
Duke University
Durham, North Carolina 27708

1201 New York Avenue NW
Suite 1110
Washington, D.C. 20005

135 Duke Marine Lab Road
Beaufort, North Carolina 28516

General Inquiries: 919.613.8709

Development: 919.613.7473

Media: 919.613.3652

E-mail: nicholasinstitute@duke.edu

Website: www.nicholasinstitute.duke.edu

Authors: Erin McKenzie and Melissa Edeburn

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