

An aerial photograph of a winding river in a dry, hilly landscape. The river is a vibrant blue, contrasting with the brown and tan earth. The terrain is characterized by rolling hills and valleys, with some sparse vegetation. In the distance, a city or town is visible on a flat plain. The overall scene suggests a semi-arid environment.

DUKE UNIVERSITY

Nicholas Institute

FOR ENVIRONMENTAL POLICY SOLUTIONS

2017 Annual Report

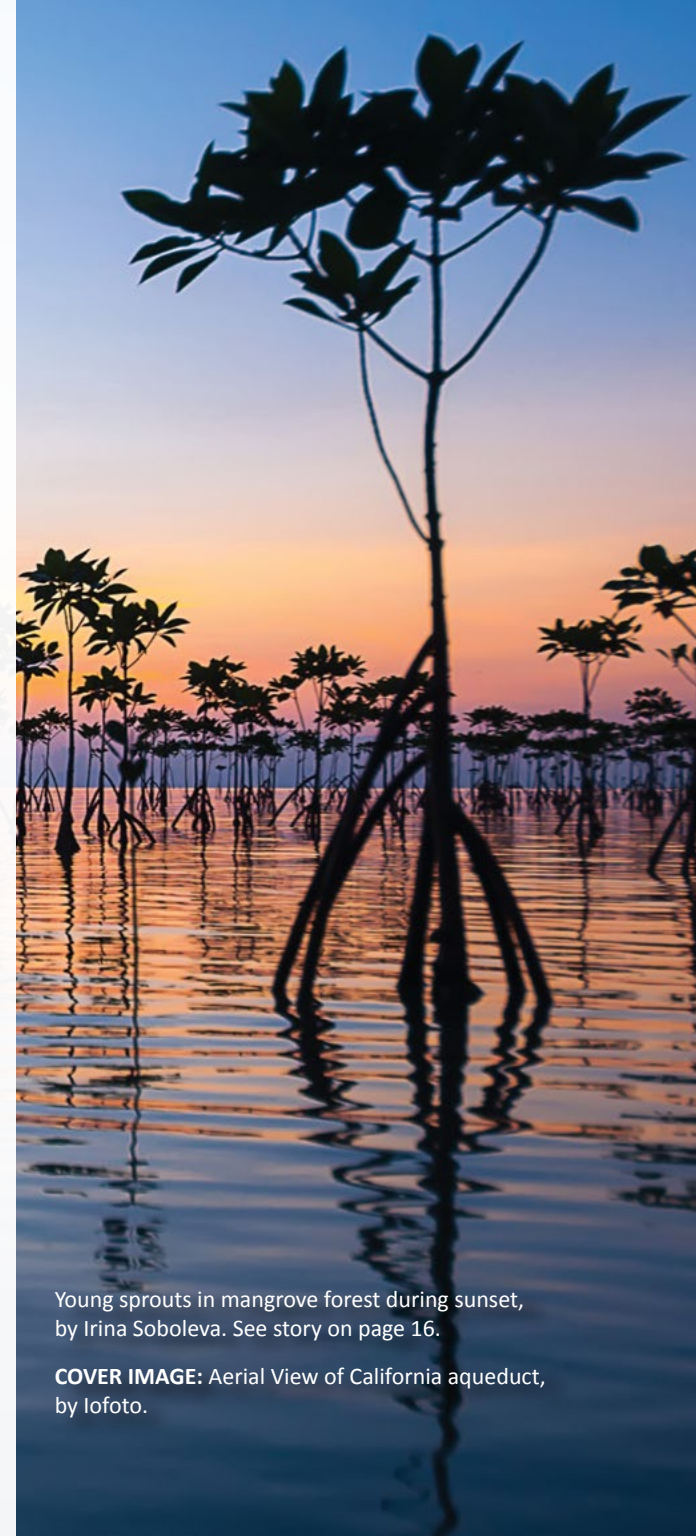
The Changing Environmental Policy Landscape

Electricity Uncertainty | Blue Economy | Water Data

CONTENTS

The Changing Environmental Policy Landscape	4
▶ Internet of Water Could Revolutionize Water Management	6
▶ Electricity Sector Uncertainty Calls for New Decision-Making Tools	11
▶ The Blue Economy Makes Waves in Policy Circles	16
Education	
▶ Games Give Students Look at Complexity of Real-World Decision Making	20
▶ Research Program Melds Economics and Environment	22
New Initiatives	
▶ Bridging Impacts: Finding Cross-Sector Solutions	24
▶ Fellow Explores Conservation in Rural America	26
▶ Catalyst Program Awards Funds for First Research Projects	28
Selected Publications	30
Fiscal Year 2017 Operating Funds	31
Legacy and Change: An Interview with Our Emeritus Board Member	32
Nicholas Institute Directors	34
Board of Advisors and Strategic Advisory Committee	35

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.



Young sprouts in mangrove forest during sunset, by Irina Soboleva. See story on page 16.

COVER IMAGE: Aerial View of California aqueduct, by Iofoto.

ADAPTING TO CHANGE

November 2016 brought a political earthquake that left many a policy approach on the cutting room floor. Few people on either side of the political spectrum foresaw Donald Trump's victory, and hence little thought was put into his likely effect on energy and environmental policy.

Nonetheless, the Nicholas Institute for Environmental Policy Solutions was positioned to adjust.

With our broad agenda of work, we have been able to recalibrate our efforts and redirect our attention to areas of research in which we already have partners, knowledge, and a pathway to improved policy. And with the creative engine of Duke University behind us, we have been able to quickly explore new topics that will breed future successful efforts to deploy policy solutions, perhaps even with the new federal administration.

In our feature section, we describe projects that take on the challenges of our changing environmental policy landscape. One project examines the growing and seemingly limitless capacity to industrialize the oceans and

reimagines how to monitor and sustainably manage this 71 percent of Earth's surface. Another project examines electricity sector changes that will force states and the Trump administration to make choices that shape the future of the electric grid. Yet another project explores how big data can help to create a more water-secure world.

With new and existing partners, we have launched two initiatives. The first, the Bridge Collaborative, aims to strengthen ties among the environment, health, and development sectors so that interdisciplinary solutions can more easily address today's complex and inter-connected challenges. It partners Duke and the Nicholas Institute with The Nature Conservancy, the International Food Policy Research Institute, and PATH. The second initiative, our Catalyst Program, aims to seed imaginative partnerships between Duke faculty and Nicholas Institute staff in areas ranging from Chinese infrastructure investments to environmental issues in rural America.



DUKE UNIVERSITY PHOTOGRAPHY

Amid the churn of Washington politics and the changing environmental policy landscape, we continue to do what we do well: produce objective research and tools to help decision makers better understand and weigh their short- and long-term policy choices. And there continues to be many a venue where this service is needed.

We hope you will consider how we might work together to assess your own environmental policy challenges.

— **Tim Profeta**
Director

Nicholas Institute for Environmental Policy Solutions

THE CHANGING ENVIRONMENTAL POLICY LANDSCAPE

In spring 2017, researchers at North Carolina State University (NCSU) and Duke University's Nicholas Institute for Environmental Policy Solutions set out to determine what and how a broad cross-section of thought leaders at private corporations, nonprofits, government agencies, and universities think about emerging environmental trends, risks, and opportunities.

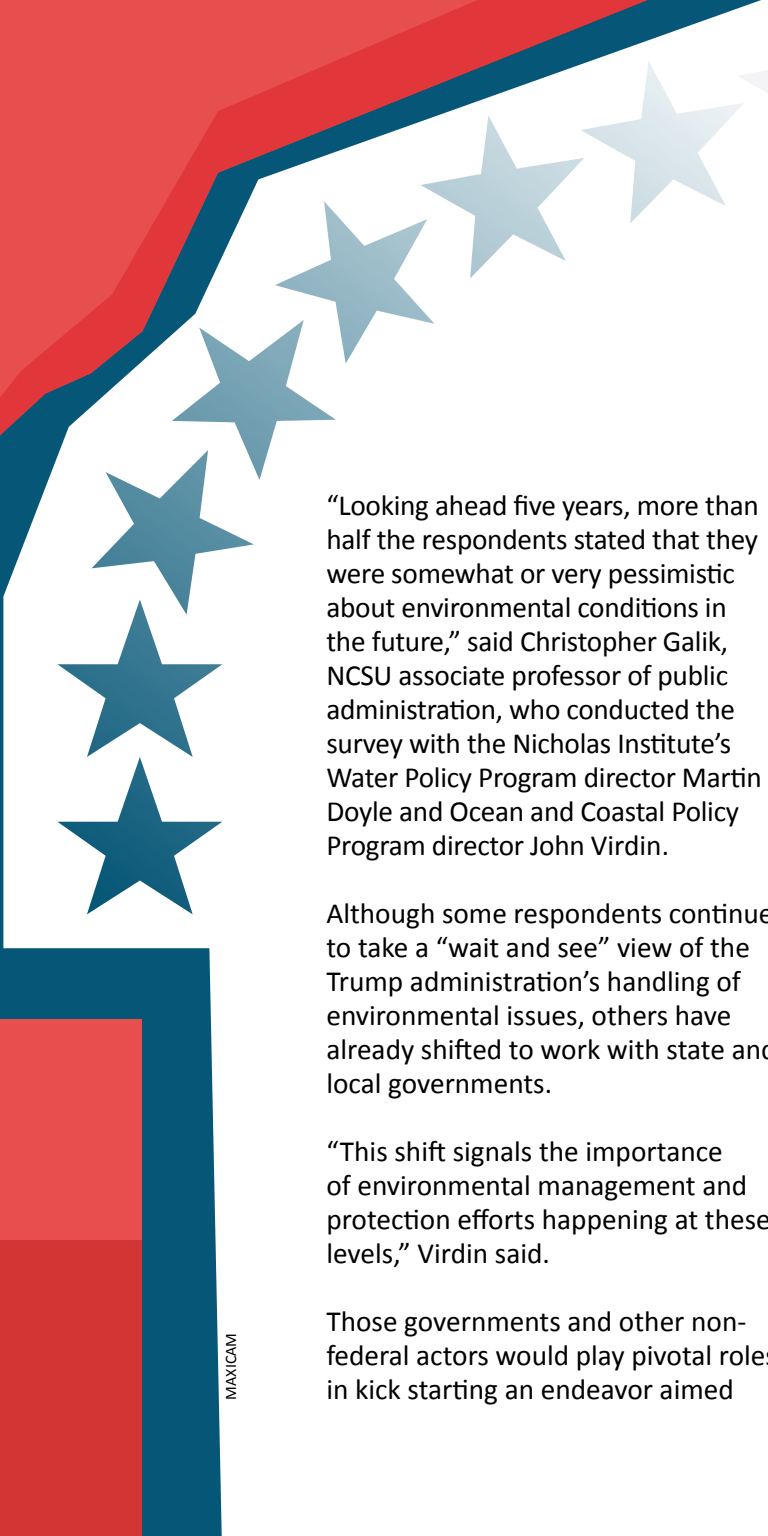
Through the Emerging Environmental Issues Survey, the researchers aimed to assess both the reach and the manageability of environmental change. Almost all of the more than three dozen respondents said that the recent election altered their strategy for engaging on environmental issues. They said the most important drivers of their new strategy are the Trump administration's moves to

deregulate and the increasing physical manifestations of climate change.

In the initial months of the Trump administration, almost half of survey respondents reported that they were at least somewhat optimistic about the general state of the environment. That perception changed when looking to the future.



Experts' Top Environmental Concerns

A decorative graphic on the left side of the page features a series of blue stars of varying sizes arranged in a diagonal line from the top right towards the bottom left. The background consists of red and blue stripes, with a thick blue vertical bar on the far left.

“Looking ahead five years, more than half the respondents stated that they were somewhat or very pessimistic about environmental conditions in the future,” said Christopher Galik, NCSU associate professor of public administration, who conducted the survey with the Nicholas Institute’s Water Policy Program director Martin Doyle and Ocean and Coastal Policy Program director John Viridin.

Although some respondents continue to take a “wait and see” view of the Trump administration’s handling of environmental issues, others have already shifted to work with state and local governments.

“This shift signals the importance of environmental management and protection efforts happening at these levels,” Viridin said.

Those governments and other non-federal actors would play pivotal roles in kick starting an endeavor aimed

at improving water management. In our feature, “Internet of Water Could Revolutionize Water Management,” we discuss a project to formulate a national water data and information policy framework for sharing, integrating, and disseminating public data to characterize and forecast the quantity, quality, and uses of water across the United States. We explore regional projects that use shared and integrated water data to solve near-term water management problems for key stakeholders.

And in the feature, “The Blue Economy Makes Waves in Policy Circles,” we introduce the blue economy concept—management of resources in and around coastlines for both increased economic growth and ocean ecosystem protection. We discuss how we are helping policy makers in North Carolina and parts of Africa and the Caribbean navigate the concept to improve their coastal resource management efforts.

A certain degree of adaptability and nimbleness, according to respondents of the Emerging Environmental Issues Survey, will be necessary to address environmental challenges.

For decision makers in the U.S. electricity sector, the shifting federal policy landscape has made adaptability critical. Utilities and their regulators will likely no longer have long-term emissions targets for power plants that were to be established under the Clean Power Plan to guide their investment in traditional and new generation sources. In the feature, “Electricity Sector Uncertainty Calls for New Decision-Making Tools,” we explore how Nicholas Institute legal analyses and modeling are helping policy makers in two groups of states navigate their own distinct decision-making challenges in light of deregulation, market changes, and technology advances.

Each of these feature stories illustrates how the Nicholas Institute is adapting its expertise to pivot to areas where environmental progress is possible in a changing environmental policy landscape.

—by Erin McKenzie





Internet of Water Could Revolutionize Water Management

The United States is awash in water data—the power of which has yet to be unleashed.

To realize the dormant value of the data, say some producers and users, would require making them widely shareable in standardized digital formats, thereby allowing their real-time aggregation for a host of purposes beyond those that spurred their original collection. They believe that opening the data and investing in water data infrastructure would set in motion a wave of innovation, leading to more sustainable management of our water resources. They envision nothing less than the creation of an Internet of Water.

That project is the brainchild of representatives from government agencies, non-governmental organizations, agriculture, utilities, energy firms, technology firms, and software

development firms working together through the auspices of the Aspen Institute Dialogue Series on Sharing and Integrating Water Data for Sustainability. Duke University's Nicholas Institute for Environmental Policy Solutions and the Aspen Institute partnered with the Redstone Strategy Group to convene the series in 2016 and 2017. The goal: to formulate a national digital water data and information policy framework for sharing, integrating, and disseminating public data to characterize and forecast the quantity, quality, and uses of water across the United States.

The Need for an Internet of Water

In the United States, water management is hindered by decision makers' inability to answer three fundamental questions about our water systems in a timely way: How much water is there? What is its quality? How is it used (withdrawn, consumed or returned for different purposes)?

“It’s not that the data aren’t being collected,” said Nicholas Institute policy associate Lauren Patterson, who co-authored a report on principles and recommendations for creating the proposed Internet of Water. “The problem is that the data are scattered across multiple platforms with different standards, making them unusable except for the purpose for which they were collected. Rarely are they transformed into information that supports real-time decision making on a broad scale.”

Put another way, existing state, regional, and national data collection efforts focus on portions of the water cycle or a specific geographic region—not whole water systems—and coordination of those efforts is stymied by institutional barriers and norms that discourage data sharing.

“Our water world is data rich, but information poor,” said Martin Doyle, director of the Nicholas Institute’s Water Policy Program and a driving force in shaping the water data dialogue series. “If water data were shared openly and then integrated in a common digital platform, there would be game-changing opportunities ranging from private citizens’ ability to gauge the quality of local water to public officials’ ability to warn populations of water-borne public health hazards.”

Doyle and Patterson liken the emerging value of water data to that of transportation data. Integrating federal road data with state and local road data and pairing the resulting public road dataset with GPS, another public dataset, has made possible the development of private applications such as Google Maps and Waze

that we use every day. The public data provides a context within which to incorporate non-governmental data and crowd-sourcing tools. Sharing and integrating water data could similarly revolutionize how we manage water resources.

Recommendations from the Dialogue Series

The dialogue series convened by the Nicholas Institute, the Aspen Institute, and Redstone culminated with three overarching findings that informed the proposed Internet of Water. First, water is undervalued—and water data even more so. Moving water from its source,

treating it, and delivering it to faucets has a cost. Similarly, collecting data, “cleaning” or standardizing them, and delivering them to an end user has a cost. But unlike water utilities, most public agencies know neither the full cost of their data infrastructure nor the water and cost savings of putting the data to timely use. This blind spot has discouraged public agencies from further investing in data infrastructure.

“If the benefits of sharing water data in terms of meeting an agency’s mission and providing a good return on investment aren’t articulated



Participants at the second convening of the Aspen Institute Dialogue Series on Sharing and Integrating Water Data for Sustainability in Aspen, Colorado.

NIKKI DEVIGNES/THE ASPEN INSTITUTE

for public agencies and organizations, they won't direct already-allocated funds to making the data available," said Patterson.

Second, there's a need to make existing public water data more accessible. The data's value in decision making is diminished if the data are hard to share across platforms. Thus, it is critically important that data, particularly at the local and state level, become more discoverable and usable. The problem is that many state and local governments lack the resources to invest in data infrastructure.

Third, the appropriate architecture for an Internet of Water is a federation of data producers, hubs, and users—entities often isolated from one another. Initially, some overarching governance structure is needed to intentionally connect data hubs and to help coordinate adoption of shared metadata and data standards to ensure that data hubs can talk to one another.

“ Our water world is data rich, but information poor. If water data were shared openly and then integrated in a common digital platform, there would be game-changing opportunities.

—Martin Doyle, director of the Nicholas Institute's Water Policy Program



Implementing the Internet of Water

Within the proposed framework, data relevant to sustainable water management would be shared by communities with specific roles and responsibilities. Data producers—from irrigation districts, to federal agencies, to industrial water users—would collect data according to their needs. Data hubs—data-sharing communities—would ensure data integrity is maintained. An umbrella governance structure would connect data hubs to one another as well as to data producers and users.

The resulting network would increase access to the data needed to create water budgets and thus improve water management.

Dialogue participants think a functioning Internet of Water could be created over the next few years if a compelling case can be made for investing in water data and integration. One way to illustrate the need is to highlight regional projects that use shared and integrated water data to solve near-term water management problems for key stakeholders.

Action Priorities for an Internet of Water

Quantify, document, and communicate the value of open, shared, and integrated water data to build the business case for investing in the sharing of data.

Further support existing water data-sharing communities with lessons and tools.

Develop a governance structure to connect regional data-sharing communities, reduce redundancy, and gain efficiencies.

In California, at least two projects have already done that. In the midst of the state's historic drought, the California Water Board created a [water conservation portal](#) to give the public and media access to information on how more than 400 water systems, serving 90 percent of the state's population, were doing in efforts to meet Governor Jerry Brown's call for a 25 percent reduction in water use. Public awareness of the severity of the drought is thought to have changed behaviors, contributing to a 24 percent reduction in statewide water use during the worst 12 months of the drought. The board is now using water data collection and aggregation in a [public health notification](#) effort whereby an interactive online map tracks coastal water algae blooms potentially hazardous to humans and animals. Public awareness of that danger is said to have risen considerably since the effort began.

For Steven Moore, vice chair of the California Environmental Protection Agency's State Water Resources Control Board (State Water Board), these projects clearly show the benefits of the kind of modern data management that could be made scalable by an Internet of Water.

"Easy-to-understand and easily accessible information about water resources can increase trust in water policy and spending and can encourage participation in conservation and public safety measures," said Moore, noting that reliable data, structured in a way that is sensible to members of the public as well as to water experts, would increase public confidence in water management efforts made increasingly critical by the impacts of climate change, population growth, and fluctuating water storage.

"With finite water resources and growing demand for them, we need open and accessible data to help us navigate tradeoffs," said Greg Gearheart, deputy director of the State Water Board's Office of Information Management and Analysis at the State Water Board.

States are the logical candidates, Patterson said, to start opening up data.

"States know the universe of local data within their boundaries and already have built relationships of trust with data providers," she said. "Plus, they often collate data from local entities like utilities and irrigation districts for state water management plans. But states need the help of data hubs to make these data accessible in usable formats to other potential users."

In turn, those data hubs will need resourcing to expand their mission and interconnections. Finally, a national governance organization must be created to structure and enable a system of federated data. Dialogue participants think that organization should be a nonprofit that has a cooperative agreement with a non-regulatory federal agency.

The dialogue series has set the Internet of Water in motion.

For starters, says David Monsma, executive director of the Aspen Institute's Energy and Environment Program, the series has introduced two data hubs—the Water Data Exchange Program (WaDE) at the Western States Water Council and the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)—that had been unaware of the other's existence. Now WADE is figuring out how it can share its water use data and CUAHSI, its water quantity and quality data for new uses.

"To develop a basin-wide water budget, you'd need to integrate both data sets," Monsma said. "An Internet of Water could provide the platform for doing that. Our goal is to identify additional regional data-sharing opportunities to begin building the Internet of Water."

—by Melissa Edeburn

Work on this project is supported by the S.D. Bechtel, Jr. Foundation, the Kingfisher Foundation, the Walton Family Foundation, and the Pisces Foundation.



Electricity Sector Uncertainty Calls for New Decision-Making Tools

Before it was stayed by the U.S. Supreme Court in February 2016, the Clean Power Plan offered state electric utilities and their regulators a degree of certainty as they confronted a rapidly changing market and technology landscape.

Although not all agreed with the U.S. Environmental Protection Agency's approach, the Clean Power Plan's predictable long-term emissions reduction targets provided clear goals to evaluate investments in traditional generation sources like coal and nuclear energy and resources on the rise like natural gas, wind, solar, and distributed generation.

Over roughly the last decade, market upheavals and the technological advances underpinning them have led to a rebalancing of generation sources and to more complex interactions between customers and the electric grid, creating significant uncertainty about existing business and regulatory models.

This combination of technology, market, and policy shifts is roiling the electricity sector as never before, sending utilities and regulators on the hunt for new frameworks and tools to support decision making.

Having worked with utilities, regulators, and other stakeholders to examine Clean Power Plan compliance options, researchers at Duke University's Nicholas Institute for Environmental Policy Solutions have developed a deep understanding of both the electricity sector's potential responses to regulatory, market, and technology changes and the emissions consequences of those responses. Our legal analyses and modeling have provided a solid foundation to help states address their own distinct decision-making challenges amid uncertainty that has only increased as the Trump administration looks to roll back Obama-era climate policies.

Demand and Nuclear Unknowns in the Southeast

For utilities and regulators in the Southeast, where utility-led integrated resource plans guide investments, climate policy uncertainty adds to the unknowns about future electricity demand and the role of nuclear energy. Although the region is expected to gain an additional 16 million residents by 2030, electricity demand growth is not inevitable, in part because of increasing energy efficiency and potential growth in behind-the-meter distributed generation. That demand uncertainty adds risk to investments in large, capital-intensive projects like nuclear power. As a supplier of approximately 25 percent



North Carolina's Shearon Harris nuclear plant.

of the region's energy generation, nuclear energy is by far the Southeast's largest zero-carbon generation source, but its future is unclear because plant operating licenses will expire after 2030, new nuclear plants will take more than a decade to build, and most next-generation plants exist only on paper.

For Southeast states, the question of whether to seek extensions of nuclear plant operating licenses or, alternatively, what to replace retiring units with is a critical one. As much as 90 percent of nuclear power could disappear over the next 30 years if existing units retire at 60 years of operation—the current maximum length of operating licenses.

“Efforts to better understand and balance risks could allow utilities and regulators to improve their investment decisions and integrated resource planning processes,” said Sarah Adair, a senior policy associate with the Nicholas Institute's Climate and Energy Program who has researched how the potential loss of existing nuclear power plants in the Southeast [interacts](#) with the region's other electricity sector challenges.

One of those challenges is managing carbon regulatory risk. Despite the uncertainty of short-term national limits on carbon dioxide emissions for the electricity sector, electricity planners tend to take a long-term view of potential climate regulation, given power plants' decades-long operating life. Concerted efforts to mitigate climate change could require carbon emissions reductions from the sector on the order of 80 percent or more—a magnitude of reductions nearly impossible without a major source of zero-carbon generation. Moreover, if retiring nuclear capacity was replaced by natural gas generation, carbon emissions would increase.

“The bottom line is that unanticipated nuclear retirements could make it more difficult for the Southeast to comply with future climate policies,” Adair said.

One venue for nuclear planning and emissions reduction strategizing is proceedings of utility commissions. These commissions regulate investor-owned utilities, approve (or disapprove) utility capital investments, and oversee integrated resource planning. Among other steps, they can take action to ensure

that integrated resource planning efforts look far enough into the future to capture potential retirements and that they include scenarios that reflect the range of potential futures for existing nuclear units. For this purpose, modeling through 2035 or 2040 is recommended.

Additionally, states might wish to consider the role of nuclear generation in state energy plans. These visions for energy policy and technology development and deployment help state governors, legislators, agencies, state utility regulators, and businesses to prioritize policy directives, regulatory actions, utility planning, and investments. Importantly, they typically reflect stakeholder engagement and consensus building and can include strategies to mitigate the effects of potential retirements by, for example, expressing a policy preference to retain existing nuclear



Efforts to better understand and balance risks could allow utilities and regulators to improve their investment decisions and integrated resource planning processes.

—Sarah Adair, Nicholas Institute senior policy associate

capacity that is safe to operate, increasing the use of other zero-emission resources, or establishing goals related to the deployment of advanced nuclear technologies.

Nicholas Institute researchers looked at how such planning efforts work in North Carolina, where the North Carolina Energy Policy Council is responsible for creating the state energy plan and the North Carolina Utilities Commission approves utility-developed integrated resource plans. In a [working paper](#), senior policy associate Kay Jowers and State

Policy Program director Amy Pickle described the stakeholder-engagement opportunities, forecasting requirements, and outcomes of each agency’s planning process. They concluded that robust electricity planning is based on a comprehensive and coordinated policy framework across agencies that creates strong stakeholder alignment—and that kind of planning, they say, offers multiple benefits, including increased regulatory certainty and clear understanding among stakeholders and decision makers of electricity generation, transmission, and distribution options.

“North Carolina has a range of options to improve comprehensive electricity planning to align with effective planning principles and build on some past successes,” said Jowers. “Equally clear is that without improvements to the process, the state might not be able to realize the full economic and public benefit presented by innovative technologies, say, for grid modernization and electricity storage.”

Jurisdictional Uncertainty in the PJM Interconnection

The role of nuclear energy also looms as a large uncertainty for the 13 states plus the District of Columbia that are covered in part or whole by the PJM Interconnection, one of several regional transmission organizations



Nicholas Institute directors discuss U.S. withdrawal from Paris climate agreement <http://nieps.org/1Byb30ch4a2>





The Southeast's Energy Challenges

- ⚡ Unknown future electricity demand
- ⚡ Uncertain nuclear power future
- ⚡ Uncertain carbon regulatory risk

(RTOs) that coordinate the movement of wholesale electricity. Those states are Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

In RTO states, the line between federal and state jurisdiction over the electricity sector is shifting. Regionalization of the electric grid and development of interstate markets for electricity, electric capacity, and transmission development have expanded the responsibilities of the Federal Energy

Regulatory Commission (FERC) even as states have retained jurisdiction over generation facilities and retail markets. The result has been skirmishes over state policies such as mandates for renewables and clean energy standards that include incentives for existing nuclear energy to remain in operation—skirmishes that may affect federally regulated wholesale markets.

A [report](#) co-authored with researchers from the University of North Carolina and Harvard Law School discusses these jurisdictional disputes and the role that the president might

play in them through FERC appointments and other mechanisms.

Some of the federal-state friction relates to issues that have broad implications regardless of a state's system of utility regulation, noted the authors, and some are pertinent to states with restructured electricity markets—like PJM states. Among the former issues are whether and how FERC could use its jurisdiction over interstate markets to influence the economics of nuclear power or to accommodate or preempt state's policies on nuclear power.

Beyond influencing FERC's oversight of wholesale markets, the Trump administration could affect the future of the existing nuclear fleet through its approach to climate policy. Although it appears to have little appetite to do so, it could price carbon through a carbon tax, an RTO carbon price, or another market-based policy, thereby giving value to nuclear-powered electricity's zero-carbon attribute.

Forecasting for Change

In October 2016, the Nicholas Institute and the Duke University Energy Initiative co-hosted a one-day workshop that brought together experts on the electricity sector in the Southeast—including representatives of electric utilities, other market participants, nonprofit organizations, and energy and environmental agencies—to discuss factors affecting the region's electricity sector. [We found](#) that participants' have a growing need for increasingly sophisticated models and forecasting tools to help them deal with new sources of uncertainty and rapid

CHINAFACE

rates of change. These tools, including some developed by the Nicholas Institute, have the potential to help utilities quantify the bounds of uncertainty under different policy and technology-adoption scenarios.



The bottom line is that unanticipated nuclear retirements could make it more difficult for the Southeast to comply with future climate policies.

—Sarah Adair, Nicholas Institute senior policy associate

“There’s no doubt that demand for these analytical tools is high among utilities and among regulatory and third-party groups,” Adair said. “It’s one way that institutions like ours can contribute to understanding of the potential future impacts of technological innovation.”

Acknowledging state policy makers’ difficulty in interpreting economic modeling of the electricity sector, the Nicholas Institute partnered with the Bipartisan Policy Center to present recent analyses by organizations that show how such modeling can be used

to simulate the various policy, market, and technology uncertainties facing states.

“This work was originally designed to help policy makers think through the impacts of the Clean Power Plan,” said Martin Ross, senior research economist at the Nicholas Institute. “But the value of the work extends to helping them understand how to best use economic models and interpret their results when grappling with the challenges and opportunities that this tremendously complex and changing sector presents.”

What models can’t do is predict the actual future—for example, they can’t capture real-world decision making, wherein decision makers must deal with information gaps and non-economic factors. But what these types of modeling analyses can do well, said Ross, is to “highlight findings that are robust under different sets of assumptions about the future, reveal the sensitivity of results to different assumptions, and identify least-cost compliance options.”

—by Melissa Edeburn

Work on these projects was supported by the Z. Smith Reynolds Foundation, the Energy Foundation, and the Merck Family Fund.



The Nicholas Institute and the Duke University Energy Initiative host the workshop, *The Future of the Electricity Sector in the Southeast*, in October 2016.



The Blue Economy Makes Waves in Policy Circles

Aerial of Ocracoke Island, North Carolina

Policy makers have known for years that activities capitalizing on the world's vast coastlines are significant drivers of the global economy.

In fact, the Organisation for Economic Co-operation and Development estimates that each year activities in the ocean make a contribution of roughly \$1.5 trillion in gross value—a contribution that is expected to grow at a rate faster than the global economy by 2030.

For that reason, the blue economy—the concept that resources in and around coastlines could be managed more intelligently to increase economic growth while protecting ocean ecosystems—has gained traction in policy circles in recent years.

The blue economy concept may be a fad, but could help policy makers more fully consider the marine environment together with economic growth to help meet the United Nation's oceans sustainable development goal, says John Virdin, director of the Ocean and Coastal Policy Program at Duke University's Nicholas Institute for Environmental Policy Solutions. He's studying how governments in the United States and abroad might apply the blue economy concept to increase rates of economic return without depleting or damaging ocean ecosystems, which would put not only natural resources but also jobs and economic growth at risk.

In January 2017, Virdin and several of Duke's Nicholas School of the Environment faculty, along with researchers from the World Bank, wrote a commentary in the [journal](#)

[Nature Ecology and Evolution](#) that offered recommendations to ensure economic return doesn't come at the cost of the natural environment.

The Crystal Coast

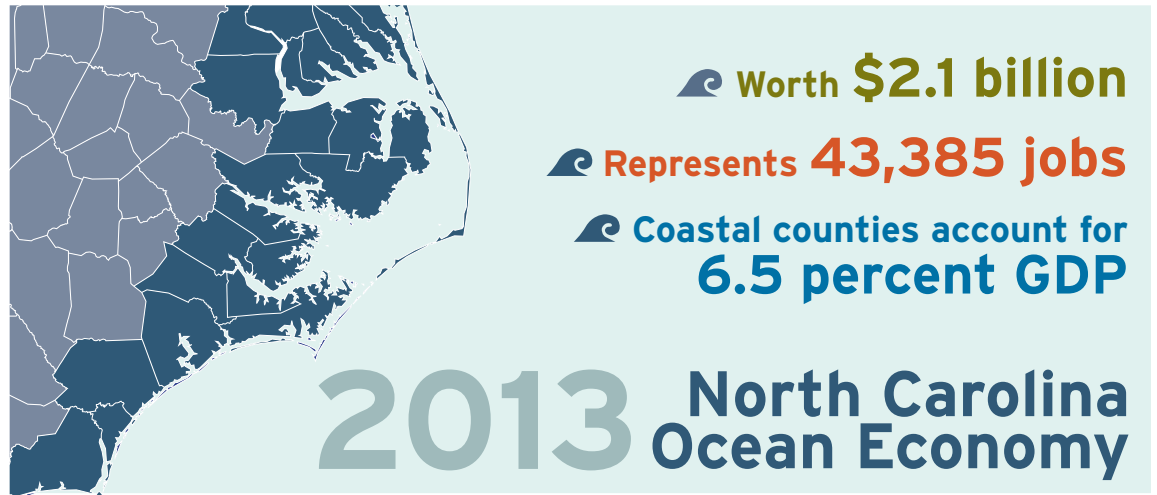
"Finding the right balance between pursuing economic activity in the ocean and protecting the natural systems underpinning that activity means mapping an ocean space and regulating its use on the basis of what the ecosystem can handle," Virdin said.

It's a process Virdin, Nicholas Institute State Policy Program director Amy Pickle, policy associate Tibor Vegh, and researchers at the North Carolina Sea Grant started for the state

of North Carolina. In late 2016, they published a [white paper](#) detailing the findings of an economic audit on the state's ocean economy. The study used data from the National Oceanic and Atmospheric Administration's National Ocean Watch dataset and employment information from the U.S. Department of Labor to generate a picture of the state's ocean economy in 2013, finding that it was worth \$2.1 billion and accounted for 43,385 jobs.

In North Carolina's coastal counties, 6.5 percent of the gross domestic product and 13 percent of employment was linked to ocean and coastal resources.

With policy makers in the United States and now in the Caribbean and Africa, Virdin and his partners at Duke and elsewhere are assessing ways to measure the value of nonmarket goods and services to provide a full accounting of the ocean economy—information that will help governments weigh policy risks and rewards.





Ocean and Coastal Policy Program director John Virdin speaks on the blue economy at the International Conference to Promote Blue Growth and Investment in St. George's, Grenada.

The Caribbean's Blue Vision

In a [September 2016 report](#), Virdin and co-authors at the World Bank aimed to provide a simple synthesis of the blue economy concept and its potential relevance to the Caribbean, in response to questions raised by the region's finance ministers in a 2015 dialogue connected to the G20.

"The report suggests a package of blue economy policies whereby Caribbean countries would measure the value of their ocean economics to better account for contributions received from nature, manage their ocean spaces as a whole rather than industry by industry, and invest in sustainable

industries," Virdin said. Ten principles for investment in a Caribbean blue economy were highlighted in the report to help policy makers create a smart policy that measures economic and environmental benefits.

Virdin spoke about the report and the blue economy at the Ocean Conference, the high-level United Nations conference convened in June 2017 in support of the implementation of United Nations Sustainable Development Goal 14 (SDG 14): Conserve and sustainably use the oceans, seas, and marine resources for sustainable development. At side events sponsored by Grenada, a Caribbean country adopting the blue economy vision, Virdin discussed how the blue economy concept

might aid small island developing states as well as help to achieve SDG 14.

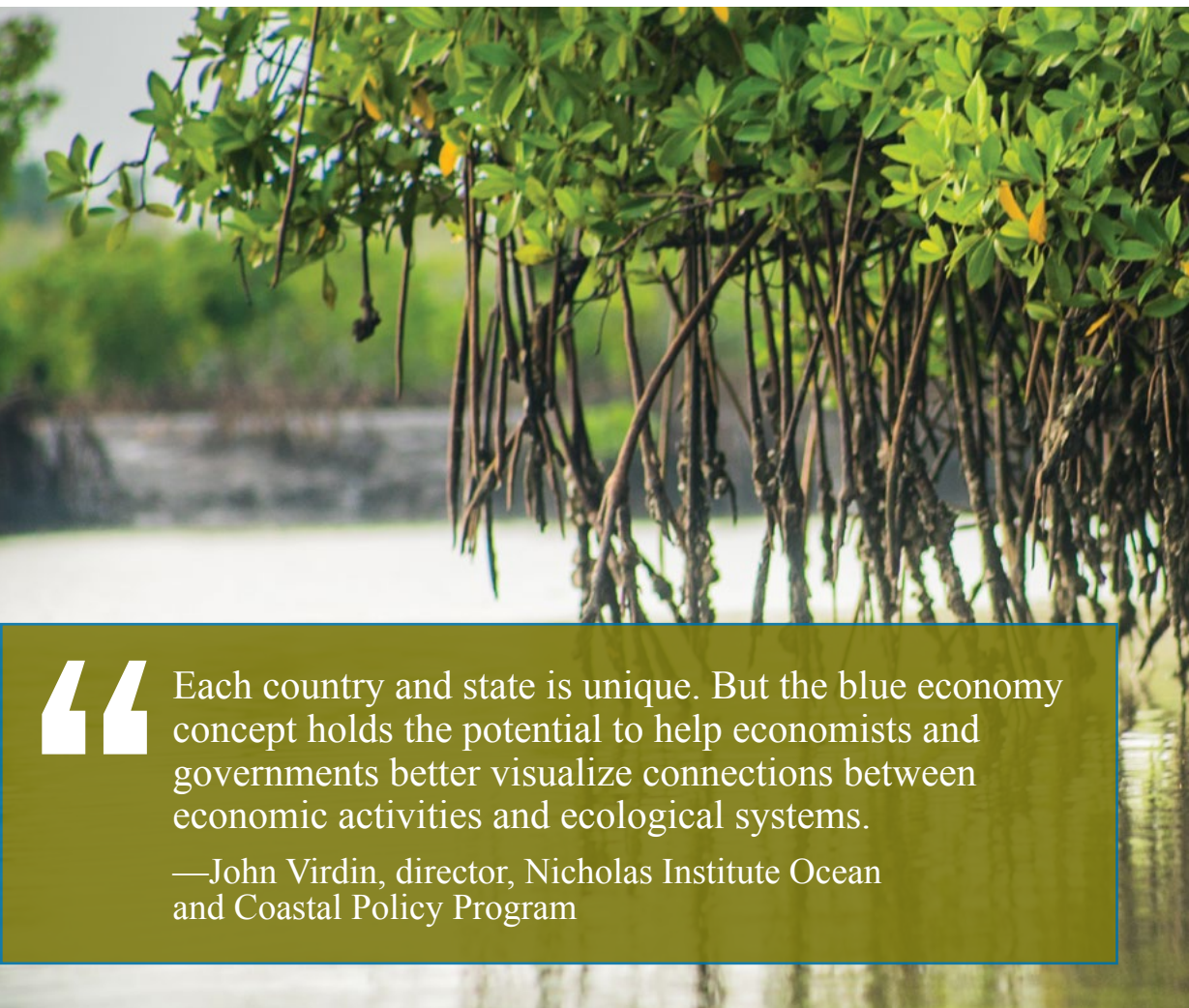
"Our Prime Minister has seen how important these tourism and fishing industries are for the people of Grenada and is committed to ensuring that our oceans and environment are protected," said Angus Friday, Grenada's ambassador to the United States, in a statement about the report's release.

Africa's Mangrove Forests

The blue economy concept is also beginning to trickle down to countries that are signatories to the Abidjan Convention. These Atlantic coast countries of west, central, and southern Africa are home to 14 percent of the world's mangroves, the stilt-like roots of which have adapted to grow in salty, sandy coastal intertidal zones, providing a natural line of defense against storms and sea-level rise.

Mangroves also serve to keep vast carbon sinks intact. Removing these maritime forests disturbs the carbon stored in sediment layers beneath them, leading to the emission of an estimated 240 million tons of carbon dioxide annually.

Preventing mangrove deforestation is one critical element of a bigger blue economy strategy and is the subject of a recent project by Nicholas Institute researchers Virdin and Vegh, along with other scholars at Duke University, the University of Ghana, and the Université Sorbonne. This year they completed a [feasibility study](#) assessing the potential of international carbon finance



“ Each country and state is unique. But the blue economy concept holds the potential to help economists and governments better visualize connections between economic activities and ecological systems.

—John Virdin, director, Nicholas Institute Ocean and Coastal Policy Program

mechanisms to help fund conservation of mangroves in Abidjan Convention countries.

“With this study we aimed to increase knowledge about blue carbon stocks in the region’s mangroves and the steps that interested communities and countries in the

region could take to secure international payments for their conservation and avoided greenhouse gas emissions,” said Vegh.

The Abidjan Convention Secretariat is using the report to evaluate the feasibility of mangrove conservation projects in the region.

“This report builds on the longstanding role of both the Abidjan Convention and the United Nations Environment Programme, along with its community of international partners, to support countries in raising awareness and devising policies and concrete actions that acknowledge and integrate the importance of ‘blue carbon’ habitats like mangroves,” said Erik Solheim, United Nations Environment Programme executive director. “Catalyzing the financial, socio-cultural, and natural value of ‘blue carbon’ systems such as the mangrove forests of west, central, and southern Africa is an impressive opportunity for a region so well-endowed with such habitats.”

Given the growing and seemingly limitless capacity to industrialize the oceans, “there is a need to reimagine how to effectively measure, monitor, and sustainably manage this 71 percent of the Earth’s surface,” Virdin said. “Each country and state is unique. But the blue economy concept holds the potential to help economists and governments better visualize connections between economic activities and ecological systems. Understanding these links could very well help improve decisions for those who depend on ocean and coastal resources.”

—by Erin McKenzie

Work on these projects was supported by the North Carolina Sea Grant, GRID-Arendal, the World Bank

JORGE HERNÁNDEZ PÉREZ

EDUCATION



The Nicholas Institute's Sarah Adair helps students navigate an exercise in assessment of energy portfolios meant to simulate real-world decisions surrounding air quality and environmental issues.

Games Give Students Look at Complexity of Real-World Decision Making

As the sun shines on the Suzhou Gaoxin District of China the air appears almost smoky. Inside of 999 Taihu Avenue, the hazy smog isn't lost on 30 ninth through twelfth grade students huddled in groups around computers. It's the focus of an exercise to address air pollution challenges.

Led by Sarah Adair, senior policy associate at the Nicholas Institute for Environmental Policy Solutions, and several Duke University colleagues—Pratt School of Engineering Professor Marc Deshusses, post-doctoral student Jiele Xu and Duke Carbon Offsets Initiative Program Manager Charles Adair—the students are considering tradeoffs that electricity sector regulators face daily.

That is: how exactly do you weigh cost, environmental rules, and goals such as reliability or energy source diversity to make



investment decisions that reduce harmful air pollution such as smog, haze, mercury, and carbon dioxide?

It's but one exercise in the three-day, hands-on DCOI Research Camp, sponsored by the Duke Carbon Offsets Initiative, that's designed to build critical thinking skills and introduce the students to Duke's interdisciplinary approach to climate and energy issues.

"One goal was to engage with these students on real-world air quality and environmental issues that are important to Chinese society right now," said Sarah Adair.

Her exercise in assessment of energy portfolios was an abbreviated version of a "risk lab" the Nicholas Institute has conducted with the National Association of Regulatory Utility Commissioners to help American electricity sector stakeholders—from all sides of the table and across states—weigh their choices despite uncertainty about future environmental regulation, fuel prices, technology innovation, and a host of other factors in a changing electricity sector.

“ Chinese students normally perform well on standard exams but usually lack training in developing research skills. This research camp provided an environment requiring more critical thinking, creativity, and team work, and it gave them a chance to apply the knowledge they learned to real projects right away in the classroom.

—Jiele Xu, post-doctoral student

Just like the risk lab game is used to teach real-world concepts to electricity sector decision makers, the Carbon Offsets Initiative's Charles Adair often leads Duke students and employees through a card game calling for them to decide where opportunities exist to make tradeoffs that could reduce emissions that help the university to meet its goal of carbon neutrality by 2024. At the research camp, students played this same game in which they learned where their own emissions come from using Duke's Greenhouse Gas Inventory as an example.

Marc Deshusses helped the students relate advances in environmental technologies to their own lives.

"I talked about some of my research in the area of air pollution control using biological filters, the lack of proper sanitation in developing countries and managing fecal sludge with novel treatment methods, and our personal energy footprint," Deshusses said.

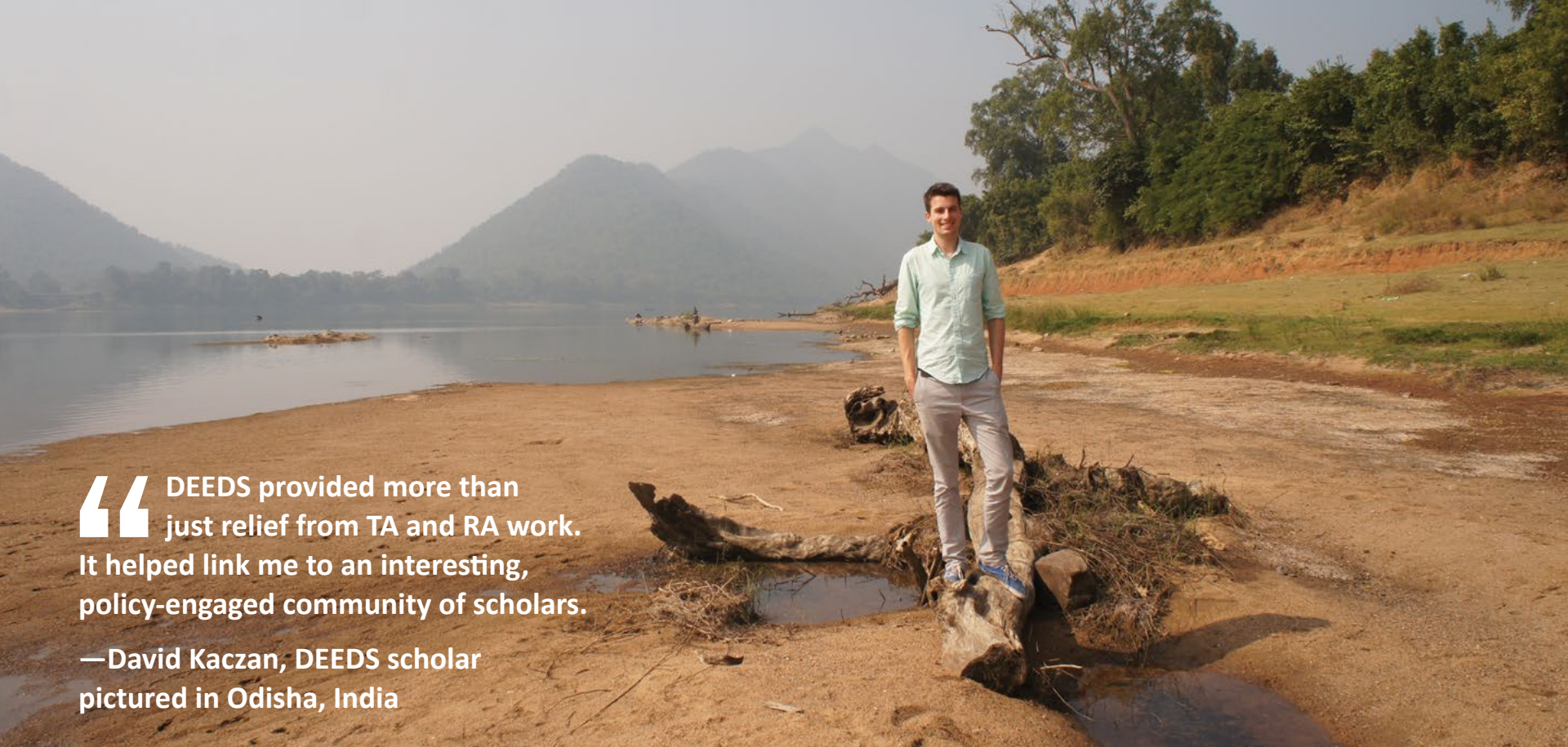
What made this research camp so unique was its interactive, interdisciplinary teaching

approach that Chinese students were not regularly exposed to in their classrooms.

"This research camp in China provided students with a great opportunity to learn basic concepts of sustainable development, carbon offsets, and environmental engineering in a way that was new to them," said Xu, a post-doctoral who works with Deshusses and who helped to present the research camp. "Chinese students normally perform well on standard exams but usually lack training in developing research skills. This research camp provided an environment requiring more critical thinking, creativity, and team work, and it gave them a chance to apply the knowledge they learned to real projects right away in the classroom."

At the end of the three days, the students made it clear the camp had impact. As one student put it: we are going to be the decision makers in the future, so it's important to pay attention to ensure you see the complexity as well as the possible approaches to the issues we'll face.

—by Erin McKenzie



“ DEEDS provided more than just relief from TA and RA work. It helped link me to an interesting, policy-engaged community of scholars.

—David Kaczan, DEEDS scholar pictured in Odisha, India

Research Program Melds Economics and Environment

Profit, price, and value are not often the first words associated with nature. For four years, the Duke Environmental Economics Doctoral Scholars (DEEDS) Program has sought to provide Ph.D. students with the opportunity to explore the intersection of policy, economics, environmental science, and management around environmental topics.

“DEEDS gives students a sense of what it is like to conduct an independent research project that is directly relevant to policy processes,” said Brian Murray, director of the Nicholas Institute for Environmental Policy Solution’s Environmental Economics Program.

Rather than get paid to teach or assist someone in their research, DEEDS scholars—the program chooses one to two students a year—carry out their own research idea under the supervision of Duke faculty in environmental economics. Now in its fourth year, six DEEDS scholars have been through the program.

The program has allowed students to take a deep dive into research necessary to shed light on policy solutions, many of direct interest to the Nicholas Institute, said Murray. This research is buoyed by close interactions with senior staff at the Nicholas Institute whose job it is to directly and engage in policy processes.

“DEEDS introduced me to the people and activities at the Nicholas Institute,” said David Kaczan, a DEEDS scholar and Ph.D. student in Duke’s Environmental Policy Program. “It provided more than just relief from TA and RA work. It helped link me to an interesting, policy-engaged community of scholars.”

The program’s only two-time DEEDS scholar, Kaczan initially used program resources to focus on the design of ecosystem services markets. He concentrated on the issue of “stacking” — the notion that landowners can be incentivized to produce multiple ecosystem services on the same land parcel. With compensation, landowners, who are usually directly regulated by government, will adjust their land management to provide services such as habitat protection, water filtration, or carbon sequestration.

According to Murray, this research provides insights into conditions under which payments can be made for multiple ecosystem services without “double-paying,” that is to say, unnecessarily paying for the same land management action twice. Most recently, Kaczan has begun looking at the impact of roads on forests in India. Rapid economic development has driven a boom in rural road building. In many parts of the world, there is a direct correlation between new roads and

deforestation. However, Kaczan has observed that in India, you don’t necessarily see the same connection. Although sometimes deforestation is the outcome, at other times roads have actually led to increased tree cover. This work, Kaczan hopes, “could help Indian policy makers prioritize road construction in ways that reduce negative land cover change impacts.”

“In lower-income settings, environmental goals are often in conflict with much needed economic

development,” Kaczan added. “Rigorous social science can inform policy about ways to minimize or even avoid those tradeoffs in some circumstances. Because economic development is so important in places of poverty, and because development processes have large impacts on the natural environment, research that helps us balance development and conservation imperatives is, in my view, extremely necessary.”

—by Micaela Unda



A road carved into the hills of Himachal Pradesh, India.

Bridging Impacts: Finding Cross-Sector Solutions



In September 2015, world leaders signed off on the United Nations 17 sustainable development goals (SDGs)—a roadmap to tackling climate change, eliminating poverty and hunger, and putting in place sustainable energy sources, water, and industry by 2030. To achieve these goals and the 169 targets underpinning them, decision makers can no longer undertake problem solving in the context of single sectors.

A new initiative—the Bridge Collaborative—works to solve the many, often interconnected, problems that touch the sectors of health, development, and environment.

“Our ability to achieve the Sustainable Development goals hinge on a how we approach some of the world’s most complex challenges,” said Lydia Olander, director of the Ecosystem Services Program at Duke University’s Nicholas Institute for Environmental Policy Solutions and a member of the initiative’s founding Secretariat. “Through the Bridge Collaborative, we are developing a common language, framework, and evidence base for shared cross-sector solutions.”

For the last year, experts from the Bridge Collaborative’s partnering organizations—The Nature Conservancy, PATH, Duke University, and the International Food Policy Research Institute—along with 150 experts from both practitioner and academic organizations have been developing common approaches to problem solving that the three sectors could agree to and use.



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What they’ve found this first year is that each sector already uses some form of evidence-based research design and action planning, but that methods vary and ideas about the strength of evidence differ, erecting obstacles to creation of cross-sector impact.

“To help these sectors ‘talk’ to one another, we’ve been working to create shared principles that not only align problem solving strategies across the health, development, and environment sectors, but also allow a shared assessment of evidence in order to agree on what makes good evidence for all,” Olander said. “Common approaches for two linked areas of practice—strategic logic models and evidence grading—could unlock cross-sector collaboration.”

A public launch of the initiative is planned in October 2017 in London, where publications that capture principles developed by the Bridge Collaborative and guidance for creating comparable results chains across sectors and evaluating evidence from multiple sectors in common terms will be discussed.

In the next two years, the initiative will focus on aligning priorities for cross-sector action, testing the shared problem-solving approach in real-world scenarios, and expanding the network of experts engaged in cross-sector dialogue and problem solving.

—by Erin McKenzie

Work on this project is funded by The Nature Conservancy. For more information on the Bridge Collaborative, visit nieps.org/kl1730eaoBf.

Fellow Explores Conservation in Rural America

Bonnie Partners on Research Projects with Nicholas Institute Staff

Robert Bonnie, a Nicholas School of the Environment alumnus and former Under Secretary for Natural Resources and Environment at the U.S. Department of Agriculture, returns to Duke University as a Rubenstein Fellow to address issues related to climate change and natural resource conservation in rural America.

Bonnie is the fifth expert to join Duke's Rubenstein Fellows Academy, which brings leaders with deep expertise in issues of global importance to campus each year for in-depth engagement with students and faculty.

"Given that Duke has played such an important role in my career, I am pleased to have the opportunity to interact with students as they launch their careers," said Bonnie.

His 12-month term began April 3.

As a Rubenstein Fellow, Bonnie is working with students, staff, and faculty in the Nicholas Institute for Environmental Policy Solutions, the Nicholas School, and the Sanford School of Public Policy to develop strategies to tackle conservation challenges for rural America—strategies that rely on collaboration and



incentives to address environmental issues while providing economic opportunity. Bonnie is also sharing his experiences in environmental policy making with students through seminars and career advising sessions.

From August 2013 to January 2017, Bonnie was the Under Secretary for Natural Resources and Environment at the U.S. Department of Agriculture (USDA). In this role, Bonnie oversaw the U.S. Forest Service and the Natural Resources Conservation Service and was responsible for management of the 193 million acre National Forest and Grassland System; implementation of Farm Bill conservation programs on America's farms, ranches, and forests; and climate

change. Prior to joining the USDA, Bonnie was vice president for land conservation at the Environmental Defense Fund, where he focused on developing incentives to reward farmers, ranchers, and forest owners for stewardship activities on private lands.

Bonnie graduated from Duke's Nicholas School with master's degrees in forestry and environmental management in 1994.

"Robert's work has helped pave the way for innovative new public-private partnerships and programs that are revolutionizing how we conserve and sustainably manage natural resources that are vital to both human livelihoods and ecological health," said Jeff Vincent, Stanback Dean of the Nicholas School. "We are fortunate to have him back on campus, sharing this expertise and inspiring the next generation of environmental leaders."

As the Under Secretary for Natural Resources and Environment, Bonnie developed collaborative, landscape-scale conservation approaches to address ecosystem restoration, climate change, endangered species conservation, and watershed protection. In working with farmers, ranchers, and forest landowners, Bonnie found that many of these rural constituencies perceive traditional environmental policies as top-down, costly, and unnecessarily prescriptive.

With this in mind, Bonnie worked to develop collaborative approaches to environmental policy that would benefit both rural constituencies and environmental protection by, for example, working with western ranchers to conserve millions of acres of sage grouse habitat on private working lands through incentive based approaches, thereby helping to avoid a listing of that bird under the Endangered Species Act.

Bonnie also led efforts to accelerate the pace and scale of forest restoration on the National Forests to improve their ecological health while increasing wood supply to timber mills.



I am delighted to be returning to Duke to work with the Nicholas Institute, the Nicholas School, and the Sanford School to develop environmental policies that work for both our natural resources and rural communities.

—Robert Bonnie, Rubenstein Fellow

“Robert has put his finger on the societal and political schism between the cities and the country that frustrates our ability to solve environmental challenges,” said Tim Profeta, director of the Nicholas Institute. “We could have no one better come to Duke and help us tackle the issue of conservation in rural America.”

Bonnie joins current Rubenstein fellows General Martin Dempsey, former Deputy Secretary of the U.S. Department of the Treasury Sarah Bloom Raskin, and former U.S. Ambassador Jack Matlock in the program, which launched at Duke in 2014.

—by Laura Howes

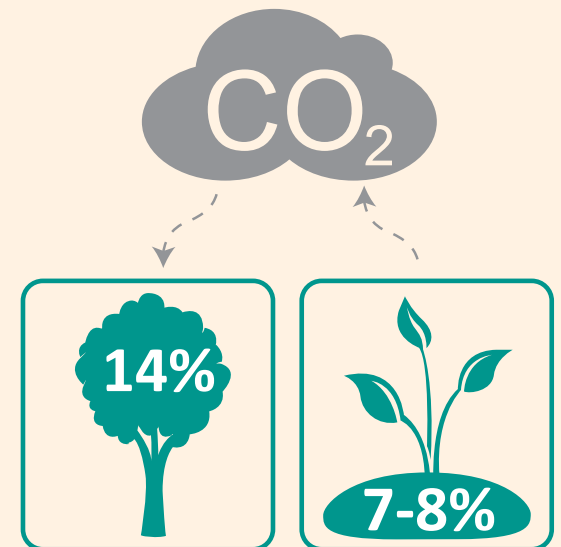
Researching a Mid-Century Strategy for Deep Decarbonization

Climate change is an important issue facing society and policy makers. In the United States, forests are a net sink, sequestering some 14 percent of carbon dioxide emissions annually. Agriculture accounts for about 7–8 percent of emissions.

Robert Bonnie is leading a Duke University Bass Connections project, partnering university faculty and students, that explores how the Mid-Century Decarbonization Strategy could be turned into concrete policy for U.S. forests and agriculture. Released in November 2016, the strategy details the critical role that forests and agriculture play in long-term efforts to dramatically reduce net greenhouse gas emissions. Conserving and expanding forests, enhancing carbon sequestration in agricultural soils, conserving

wetlands, and reducing nitrous oxide and methane emissions from agriculture could be strategies to reduce atmospheric greenhouse gas concentrations in the United States. However, the Mid-Century Decarbonization Strategy left unanswered the specific policy measures and the financial resources required to meet the forest and agricultural goals outlined.

Under Bonnie’s leadership, the Bass Connections team will develop environmentally sound and politically feasible policy proposals for carbon sequestration and greenhouse gas emissions reductions in U.S. forests, agricultural lands, and wetlands in the United States based on the goals outlined in the Mid-Century Decarbonization Strategy.



Catalyst Program Awards Funds for First Research Projects

Six projects proposed by Duke faculty and staff have received funding from the Nicholas Institute for Environmental Policy Solutions Catalyst Program.

Launched this year, the program aims to prompt and support expansions of existing partnerships between Duke faculty and Nicholas Institute staff on research and workshops. Projects connect Nicholas Institute senior staff with Duke faculty to develop new or emergent ideas related to environmental policy challenges at the federal, state, and local level, and they build on the core competencies of researchers involved.

“The University is awash in opportunity to bring faculty from all over campus together

to tackle the critical environmental questions of the day, but often we just don’t have the needed focus to pull the teams together,” said Tim Profeta, director of the Nicholas Institute. “Through the Catalyst Program’s yearly awards, we hope to lower these barriers and allow our staff and faculty colleagues to explore latent opportunities to ideas that create innovative policy solutions.”

Funded in the Catalyst Program’s first year are:

Does Rural Energy Access Promote Economic Development through Improved Food and Water Access?

Despite a widespread belief among policy makers that energy access and reliability are critical for economic development in rural areas, empirical literature elucidating the mechanisms of a connection is mixed and limited. This project will pilot test methods to overcome the remarkable absence of evidence concerning the link between energy and economic development in rural areas by analyzing temporal and spatial co-variation in satellite and survey-based measures of the extension of energy infrastructure.

Collaborators: Marc Jeuland of the Global Health Institute; Mark Borsuk, Jordan Malof, and Leslie Collins of the Pratt School of Engineering; Kyle Bradbury of the Duke University Energy Initiative; and Lydia Olander of the Nicholas Institute

Developing Improved Small-Scale Fisheries Policies, and Building a Core Sustainable Seafood Policy Competency at the Duke World Food Policy Center

The newly launched Duke World Food Policy Center seeks to partner with the Nicholas Institute and the Nicholas School to launch a project exploring the intersection of sustainable seafood, food security, and nutrition, thereby laying the foundation for a sustainable seafood policy program embedded in the center in perpetuity.

Collaborators: John Virdin of the Nicholas Institute, Kelly Brownell of the Sanford School of Public Policy, Xavier Basurto of the Nicholas School of the Environment, and Sarah Zoubek of the World Food Policy Center

New Collaborations in Environmental Health

This project seeks to catalyze new collaborations that combine the environmental health expertise at the Nicholas School, Pratt School of Engineering, Superfund Research Center, and Center for the Environmental Implications of NanoTechnology with the environmental policy expertise at the Nicholas Institute to create policy-relevant applied-research projects that promote environmental health and human well-being.

Collaborators: Richard Di Giulio, Heather Stapleton, and Christopher Timmins of the Nicholas School of the Environment; Lydia Olander and Amy Pickle of the Nicholas Institute; Steve Roady of the Duke Law School and the Nicholas Institute; and Mark Wiesner of the Pratt School of Engineering



LE PICTORIUM

One Belt, One Road, How Much Biodiversity?

One of Beijing's most ambitious foreign economic development initiatives aims to recreate the legendary Silk Road. Originally nicknamed the One Belt One Road Initiative, the project looks to create conservation priority-setting tools that will inform and evaluate the impact of infrastructure investment on biodiversity in tropical Asia, one of the areas covered by the initiative.

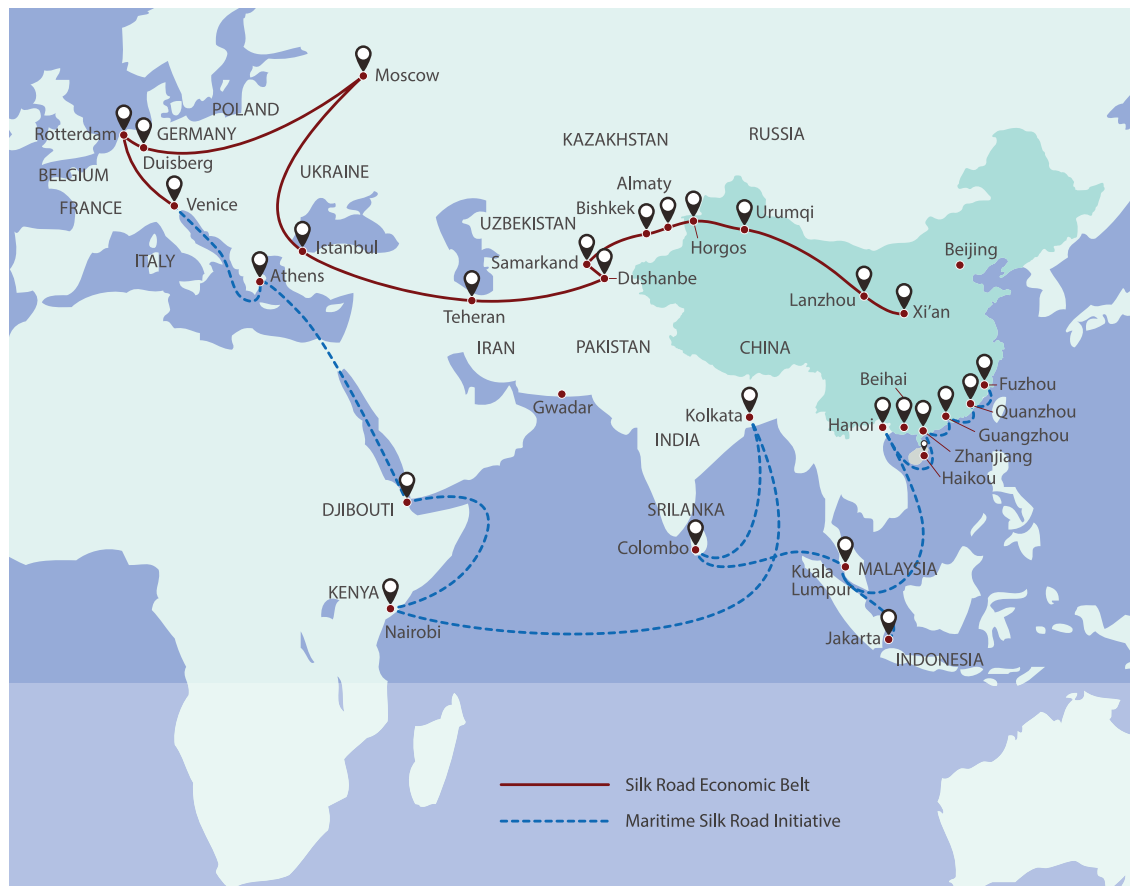
Collaborators: Binbin Li of Duke Kunshan University; Elizabeth Losos, John Virdin, and Lydia Olander of the Nicholas Institute; and Stuart Pimm and Jennifer Swenson of the Nicholas School of the Environment

Building a Conservation Agenda That Works with and for Rural America

Protecting the environment in the United States depends on rural America. Ecosystems,

clean water, wildlife, clean energy, healthy agricultural and forestlands, and public lands are overwhelmingly rural and therefore depend on the actions of rural residents. This project seeks to build a conservation agenda for rural America that not only protects the environment but also has the potential to garner significant support from rural constituencies.

Collaborators: Robert Bonnie, Rubenstein Fellow; Fritz Mayer of the Sanford School of Public Policy; Megan Mullin of the Nicholas School; Steve Roady of the Duke Law School and Nicholas Institute; Jed Purdy of the Duke Law School; and Lydia Olander, Amy Pickle, and Kay Jowers of the Nicholas Institute



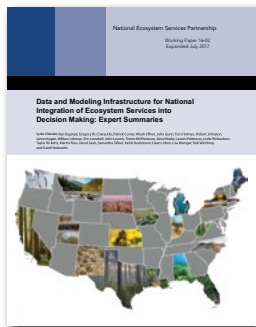
Financial Regionalization for Assisting Low-Resource Water and Wastewater Systems

The deteriorating condition of the nation's drinking water infrastructure calls for increased attention to policy instruments that can provide access to financing for necessary capital improvements. This project will develop a blueprint for the institutional design and implementation of financial regionalization to improve access to capital for small, low-resource water and wastewater utilities.

Collaborators: Megan Mullin of the Nicholas School of the Environment, Ryke Longest of the Duke School of Law, Jeff Hughes of the University of North Carolina, and Martin Doyle and Lauren Patterson of the Nicholas Institute

SELECTED PUBLICATIONS

National Integration of Ecosystem Services into Decision Making



Incorporating ecosystem services into decision processes provides a means for increasing public engagement and generating more transparent consideration of tradeoffs that may help

to garner buy-in from communities and avoid unintended consequences. A 2015 White House memorandum from the Council on Environmental Quality, Office of Management and Budget, and Office of Science Technology and Policy acknowledged these benefits and asked all federal agencies to incorporate ecosystem services into their decision making. This working paper describes the ecological and social data and models available for quantifying the production and value of many ecosystem services across the United States.

Unconventional Oil and Gas Spill Risk

This analysis in the journal *Environmental Science & Technology* characterizes spills associated with unconventional oil and gas development at 31,481 wells hydraulically fractured in four states between 2005 and 2014. It concludes that making state spill data more uniform and accessible could provide stakeholders with important information on where to target efforts for locating and

preventing future spills. However, reporting requirements differ across states, requiring considerable effort to make the data usable for analysis.

Increasing Emissions Certainty under a Carbon Tax

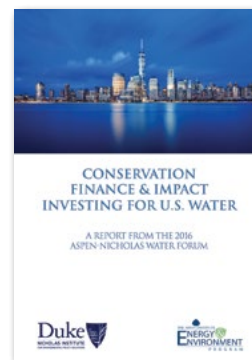
Various organizations and individuals have proposed that the United States consider use of a carbon tax as the primary federal policy to reduce greenhouse gas emissions. But a carbon tax does not ensure that the nation will achieve a specific emissions goal because the economy's response to such a tax is unknown in advance. Ultimately, there is an underlying tradeoff between certainty about emissions and certainty about prices and costs. This symposium article in the *Harvard Environmental Law Review* describes a range of mechanisms that could increase emissions certainty under a carbon tax and offers ideas for initiating these mechanisms, either through some automated or discretionary procedure.

Coral Reefs and People in a High CO₂ World

Increasing levels of carbon dioxide in the atmosphere put shallow, warm-water coral reef ecosystems, and the people who depend on them, at risk from ocean acidification and from elevated sea surface temperature. This study in the journal *PLOS ONE* projects that the countries most likely to experience severe ocean acidification are those at the upper and lower latitudinal bounds of coral reef distribution such as Baja California (Mexico),

Japan, China, and southern Australia. It finds that countries in western Oceania would be among the first affected by carbon dioxide-driven coral reef stress, followed by Southeast Asian countries. Many of the countries that are most dependent on coral reefs are also the countries for which data are least robust, requiring international and regional efforts to fill that data gap.

Conservation Finance and Impact Investing for U.S. Water



The 2016 Aspen-Nicholas Water Forum focused on the shifting role of public and private financing for water infrastructure and the new universe of innovative financing solutions to create impacts in the water sector. This report

highlights the forum's key findings: business-as-usual water management in the United States is unsustainable, regionalization and integration of water management efforts are needed, there are significant barriers to impactful and innovative financing, government regulation and public education can elicit public support for improved water management while supporting social equity, and leadership is one of the prime movers for innovative finance projects in the water space.

FISCAL YEAR 2017 Operating Funds

What's the Damage from Climate Change?

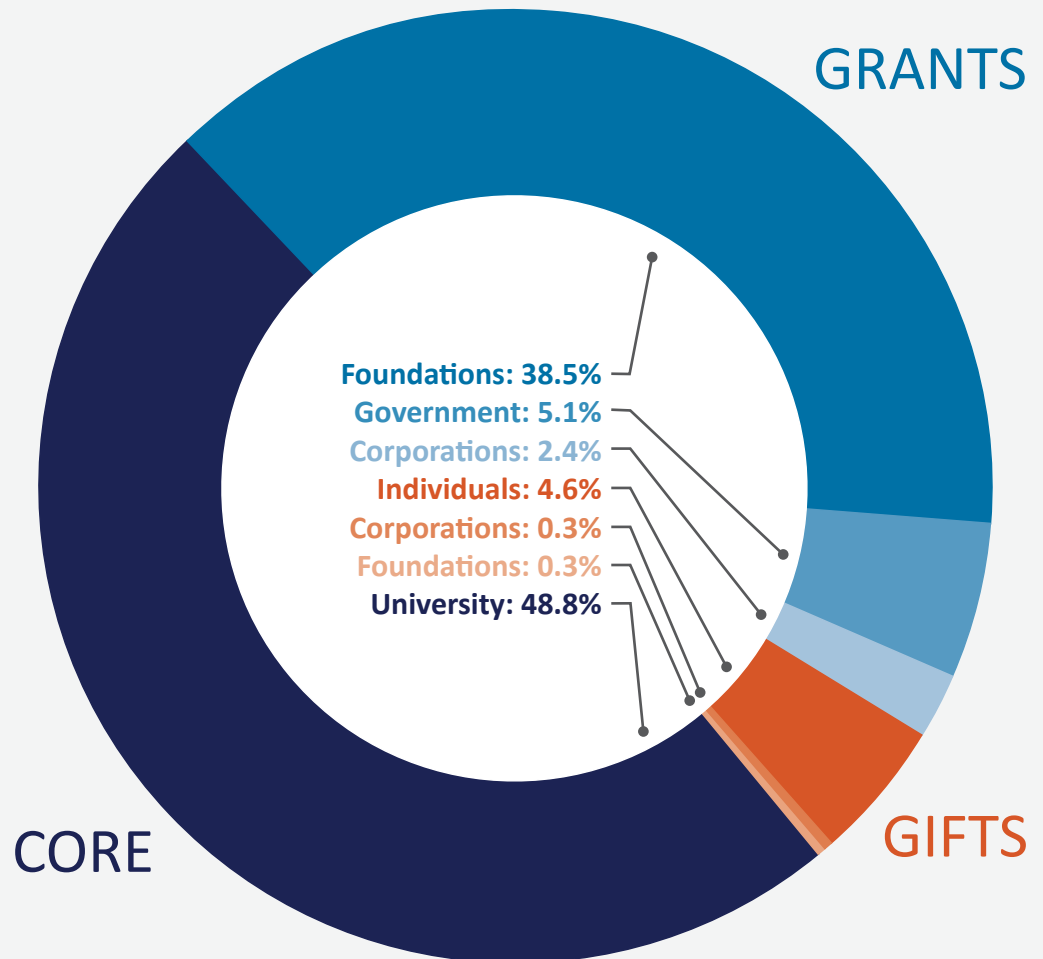


This contribution to *Science* underscores the importance of work to update estimates of the cost of carbon dioxide emissions, a cost that pervades government policy making. It explains the efforts of an interagency

group charged with improving estimates of the so-called social cost of carbon—the dollar value of damage associated with 1 ton of additional emissions—and hence its equivalent, the benefit of avoided damage. It also contextualizes an improved damage model architecture for the United States.

Energy Policy and the Next Administration

This report published on the eve of the 2016 presidential election describes the U.S. electricity sector's rapid market and regulatory change and upcoming policy considerations due to statutory deadlines, pending lawsuits, and agency rulemakings. It provides an overview of each of the six key areas of federal policy and, for each area, identifies the decision points—in time or circumstances—that will force the new administration to make choices that shape the future of the electric grid. For each decision point, the report explores the president's options.



LEGACY & CHANGE



An Interview with Our Emeritus Board Member

The namesake of Duke University's Nicholas Institute for Environmental Policy Solutions, **Pete Nicholas**, discusses how the Nicholas Institute has evolved to be the organization envisioned by Duke and the Nicholas family 12 years ago.

► **What has changed since the Nicholas Institute was founded in 2005?**

The conversations about energy and the environment have become inextricably intertwined. Ten years ago, the energy conversation centered mostly around oil depletion and scarcity and American energy dependence on the Middle East. Now, with the surfeit of newly discovered gas and oil, the world is less pessimistic about the availability of carbon-based fossil fuels and more concerned about the harmful effects carbon-based energy has, for example, on the atmosphere and oceans. In reality, the subject of energy production and use and the environment has been at the heart of the Nicholas Institute's work almost from the beginning. Although the discussion has evolved, the challenge remains the same: to find how they can co-exist in ways that represent a win-win.

► **What impact do you think the Nicholas Institute has had on the university?**

The Nicholas Institute was founded because we thought Duke could become more engaged with global audiences—in a more organized and institutionalized way—by bringing amazing science at Duke as well as from other organizations to bear on the great environmental challenges facing society. The Nicholas Institute, like other university institutes, was chartered by the university to utilize science and fact-based information to help develop politically unbiased policies and solutions to real-world problems in its field. It has accomplished this by collaborating with faculty, students, and others both inside and outside Duke. Furthermore, a great by-product of the Nicholas Institute has been the creation of enriching conversations and research projects within the Duke community that might otherwise not have happened.

► **What aspects of the Nicholas Institute's design have kept it effective and relevant?**

The Nicholas Institute's agenda has been driven by big issues and ideas and, through its charter, it has actively collaborated with Duke students and faculty as well as with external players to facilitate problem solving and policy generation. As intended, the Nicholas Institute's governance continues to facilitate a board composed of voluntary leaders of major environmental organizations, senior global business executives, faculty, and other leaders who help ensure that it remains focused on a disciplined agenda of issues that really matter. Finally, the Nicholas Institute utilizes collaborations as an opportunity rather than as a cost, and it encourages them throughout and beyond the university.

► **One of the biggest environmental news stories this summer is President Donald Trump's announcement that he intends to withdraw the United States from the Paris Agreement. What do you think that move means for our work?**

The Nicholas Institute is convening conversations about how this development changes the state of play. What the president has done is effectively withdrawn the moral support of our government, but the power of the agreement has always resided elsewhere anyway. The players who are going to make the emissions reductions outlined in the agreement are the states, corporations, and other public and private institutions that have always been proactive but now will become more visible leaders. It's already happening.

—by Emerson Beyer

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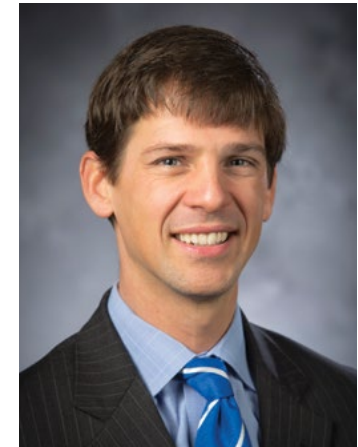
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