Nicholas Institute for
Environmental Policy Solutions

Potential Pathways: Future of the Electricity Sector in the Southeast

Workshop Summary
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Danielle A. Arostegui

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CONTENTS

Introduction	2
Session 1: Exploring the Uncertainty of Future Demand	3
Session 2: How Technology Innovation Could Affect Business Models and Regulatory Structures	5
Session 3: The Role of Nuclear Energy	7
Identifying Top Issues for Future Consideration	9

Author Affiliation
*Nicholas Institute for Environmental Policy Solutions, Duke University

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Review
This proceedings was reviewed by experts inside and outside the Nicholas Institute for Environmental Policy Solutions. However, it has not undergone a formal review process as it is intended to stimulate discussion and inform debate on emerging issues.

SUMMARY

The electricity sector is rapidly changing due to the shale gas revolution, a precipitous decline in coal generation, steep declines in the cost of solar generation, the proliferation of smart grid technologies, and a suite of new environmental regulations. On October 5, 2016, Duke University's Nicholas Institute for Environmental Policy Solutions 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. The main topics were future demand uncertainty, the ways that technology innovation could affect business models and regulatory structures, and the role of nuclear energy in the Southeast's electricity future. This proceedings describes the main ideas that emerged from the workshop. It concludes with issues ripe for future research.

INTRODUCTION

The electricity sector is rapidly changing. Since 2009, the shale gas revolution and a suite of new environmental regulations have contributed to a precipitous decline in coal generation (nearly 23% nationally) and a similarly sharp increase in natural gas generation (nearly 45% nationally).[1] At the same time, steep declines in the cost of distributed solar generation, dynamic retail pricing, and the proliferation of smart grid technologies are revolutionizing the way consumers interact with the grid. Adding to this dynamic are possibly increased demand due to electrification of the transportation sector and the grid management potential of advanced energy storage. Meanwhile, future climate policy remains unknown given the Supreme Court's decision to stay the Environmental Protection Agency's (EPA) Clean Power Plan and President-elect Donald Trump's stated opposition to the Obama Administration's climate commitments. These and other forces are combining to create significant uncertainty about the future of the electricity sector.

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[1] U.S. Energy Information Administration, Electricity Data Browser, Net Generation for all sectors, annual; http://www.eia.gov/electricity/data/browser.

SESSION 1: EXPLORING THE UNCERTAINTY OF FUTURE DEMAND

Opening Presentation:	**Discussants:**
David Hoppock, Senior Policy Associate, Nicholas Institute for Environmental Policy Solutions	Erin Boedecker, Team Leader, U.S. Energy Information Administration
	Gary Brinkworth, IRP Manager, Tennessee Valley Authority
Moderator:	Caroline Golin, Founder & CEO, Greenlink Group
Brian Murray, Interim Director, Duke University Energy Initiative; Director, Environmental Economics Program, Nicholas Institute for Environmental Policy Solutions	Kenneth Shiver, Director of Planning and Regulatory Support, Southern Company
	Glen Snider, Director of Resource Planning, Duke Energy

Expectations about future electricity demand drive decision makers' choices about investing in long-lived generation and transmission resources. Changes in the post-recession economy and the disruptive potential of new technologies such as rooftop solar generation may contribute to declining electricity sales over the long term. However, efforts to electrify the transportation sector and residential heating and to reduce greenhouse gas emissions could contribute to new electricity demand. In this session, leading experts covered sources of uncertainty about future electricity demand in the Southeast and identified areas for research.

The session opened with a discussion of both the regional and national factors that affect electricity demand uncertainty in the Southeast, which has experienced little demand growth since 2007 and where the residential and commercial sectors have largely driven that growth. Despite economic recovery from the recession, the industrial sector's electricity demand has continued to decline as service-oriented industries have increased in market share. Energy efficiency improvements have contributed to a decrease in energy per unit output, a trend projected to continue even as the Southeast is expected to add sixteen million residents by 2030.

Competing Trends Affecting Long-Term Electricity Demand

A central question identified by the panel is whether energy efficiency improvements and changing economic composition will continue to eclipse demand generated by economic and population growth. The answer to this question may depend on public policy choices related not only to energy efficiency and distributed energy resources, but also to economic and finance policies that affect the level and sectoral nature of economic growth.

Shifting Consumption Patterns

In addition to regional economic trends, broader national shifts—such as increased adoption of distributed solar generation and changes in smart grid technology—will increasingly enable consumers to minimize their electricity demand and shift grid electricity purchases away from peak hours. Panelists representing utilities emphasized that utilities must plan to serve customers during the highest-demand hour of the year and therefore carry excess capacity for most of the year. While air conditioning use on a hot summer day has historically driven peak demand, increased extreme cold weather events as well as solar integration have raised the importance of planning to meet peak winter electricity demand.

Potential Sources of Additional Demand

In addition to the potential impacts of demand-reducing technologies, panelists discussed possible crosscutting effects of new electricity demand sources, such as electric vehicles. A rapid increase in electric vehicle use could raise demand for electricity and shift peak demand. Panelists noted how peak hours could be affected by incentives for consumers to charge their vehicles during periods that would benefit the utility from a load-balancing perspective, and some noted that car sellers can teach customers charging best practices at the point of sale. Although transportation electrification has the potential to alter future demand, some panelists suggested that the trend toward urbanization among Millennials—which tends to decrease demand because multifamily dwellings use less electricity per person than single-family homes—will affect energy demand more than electric vehicle adoption in the near term. Both factors are the result of behavior shifts, which panelists agreed are keys to understanding future demand.

Demand for Data and Analytics

Difficulties in obtaining data, much of which is proprietary and thus not available to third-party analysts, further complicate the quest to understand the effects of complex, often countervailing, trends. Panelists outlined the need for increasingly complex and responsive energy demand forecasting and modeling tools. Stochastic modeling and increased reliance on scenario analysis in demand forecast models can help quantify uncertainty and place bounds on it. However, the panelists noted that greater access to relevant data would improve modeling efforts. For example, electricity use happens at the building level, but modeling occurs at the community level, causing discrepancies between modeling results and actual electricity use. Thus, there is a need for analysis of end-user needs and changes in consumer demand, but not all relevant data are readily available.

SESSION 2: HOW TECHNOLOGY INNOVATION COULD AFFECT BUSINESS MODELS AND REGULATORY STRUCTURES

Opening Presentation:	**Discussants:**
Bryan Bollinger, Assistant Professor, Fuqua School of Business, Duke University	Patrick Bean, Deputy Director of Policy and Electricity Markets, Solar City
	Danny Kassis, Vice President of Customer Service, SCANA Corporation
Moderator:	Maria Robinson, Associate Director of Energy Policy and Analysis, Advanced Energy Economy
Billy Pizer, Faculty Fellow, Nicholas Institute for Environmental Policy Solutions; Professor, Sanford School of Public Policy, Duke University	Tanja Vujic, Director of the Southeast Clean Energy Program, Environmental Defense Fund

Technological innovation—such as the advent of smart grid technologies, advanced energy storage, rooftop solar, and electric vehicles—is allowing consumers to interact with the grid in new ways that do not fit neatly into the traditional relationship between monopoly electricity providers and their territorial customers. Furthermore, it is a driving force of the demand uncertainty increasingly faced by utilities. At the workshop, experts explored the implications of technology innovation for traditional business and regulatory models as well as for the evolving relationship between utilities and their customers.

The session opened with a discussion highlighting new and emerging technologies and the ways in which their implementation creates both challenges and opportunities for the electricity sector. Each new technology has the potential to shift a utility's breakeven calculation. For example, increasing rooftop solar adoption presents a unique challenge for utilities, which have traditionally recouped costs through volumetric rates; reduced sales to solar customers could lead utilities to increase rates to offset the lost revenue, thereby improving the economics of rooftop solar and leading more customers to install panels. Other technologies, such as Lidar and satellite data, offer valuable opportunities for utilities and analysts to improve their studies of customer adoption patterns.

Adapting the Utility Business Model

As multiple panelists noted, the traditional utility business model has historically paired with relatively steady load growth and was built in a world of large capital investments. However, as discussed in Session 1, future load growth is increasingly uncertain, as is the need for large generation plants versus distributed technologies. Thus, utilities, regulators, and other stakeholders may need to determine how to allow utilities to recoup costs for existing infrastructure and to price distributed generation in a way that preserves the viability of the utility's business.

Several panelists suggested that utilities could benefit from a customer-centric approach to technology integration, given the importance of customer preferences as a driver of change. They pointed to innovative customer service approaches to technology integration, such as a San Antonio, Texas, program for utilities to lease rooftop space from customers for the purpose of installing the utility-owned solar technology and equipment of the utility's choice. The program was extremely popular with customers, who submitted about 1,200 applications within the first 48 hours,[2] and it allowed the utility to share in the

[2] David Hendricks, "CPS Energy's Solar Rent-a-roof Program Has Big Appeal," *San Antonio Express News* (September 8, 2015), http://www.expressnews.com/business/business_columnists/david_hendricks/article/CPS-Energy-s-solar-rent-a-roof-program-has-big-6490747.php.

profits of distributed generation. Another example came from Hawaii, where utilities bundle and provide rooftop solar, Nest thermostats, and solar water heaters to customers. With respect to non-utility providers, panelists suggested that solar companies could provide voltage management and other services to utilities, a benefit to both parties.

Panelists also noted that collaborative legislative solutions could go further to address the long-term challenges of integrating new technologies than the current approach of addressing issues of technology integration in narrow, adversarial regulatory proceedings.

Consumer-Driven Change

Panelists from different sectors agreed that customer demand is driving, and will continue to drive, shifts in electricity generation and policy in the Southeast. Customer demand for new and emerging technologies, such as electric vehicles, rooftop solar, and programmable thermostats, is driving utilities and utility regulators to reevaluate the range of services and choices that utilities provide to customers. Although low electricity prices have contributed to relatively slow customer adoption of innovative distributed energy technologies in the Southeast, the region's rapid population growth could increase demand as customers relocate there from other regions. However, not all customers have access to emerging technologies. Panelists also discussed the need to consider how infrastructure development in rural areas without reliable Internet access will be necessary before these customers can take advantage of Internet-enabled technologies.

Technology-Data Connection

New technologies could have a role in improving data. Technologies such as programmable thermostats can aggregate user data for utilities to analyze and better understand customer needs and subsequently avoid unnecessary costs. Similarly, services that collect and analyze customer data can help customers to understand and prevent waste. Panelists suggested that utilities might capitalize on their core competencies of investing in infrastructure by investing in the technological capacity necessary to improve data collection as well as in communications and analysis personnel who could more accurately target existing energy efficiency programs.

In addition to increasing the availability of data to improve end-use energy efficiency and projections of future demand, panelists also noted opportunities for data to facilitate technology adoption. For example, data-sharing agreements could allow solar developers and utilities to work together to identify areas with transmission or distribution congestion—areas where incentivizing solar adoption could benefit both parties.

SESSION 3: THE ROLE OF NUCLEAR ENERGY

Opening Presentation:	**Discussants:**
Dalia Patino-Echeverri, Professor at the Nicholas School of the Environment, Duke University	Armond Cohen, Executive Director, Clean Air Task Force Gabe Kwok, Principal, Evolved Energy Research. Ann Loomis, Director of Federal Regulatory Policy, Dominion
Moderator:	Luis Martinez, Senior Attorney, Natural Resources Defense Council
Sarah Adair, Senior Policy Associate, Nicholas Institute for Environmental Policy Solutions	

Nuclear energy is by far the Southeast's largest source of emissions-free power, and the Southeast is the only region currently building new reactors. Tennessee Valley Authority's Watts Bar Unit 2—the first new reactor in two decades—entered commercial operation in the second half of 2016. Four additional units are under construction in South Carolina and Georgia, but they have faced delays and cost increases. Meanwhile, some existing unit owners are beginning to consider a second operating license extension that would allow up to 80 years of operation, while others in competitive markets are facing economic headwinds. On-the-horizon technologies—small modular reactors and non-light water reactors—promise increased safety and flexibility, but they face their own set of challenges. At the workshop, experts considered the role of nuclear energy in the Southeast's energy future.

The session opened with a discussion of the risk-risk and benefit-cost tradeoffs inherent in utilizing nuclear power compared with other generation options. Nuclear power has historically supplied approximately 25% of energy generation in the Southeast, but nuclear power in the region could decline as much as 90% over the next 30 years if existing units retire at 60 years of operation, which is the current maximum length of operating licenses. It is difficult to model when the components of nuclear plants will fail, making it a challenge to determine whether relicensing is economic. Uncertainties facing new plants loom even larger: numerous applications have been cancelled, suspended, or abandoned. The decisions to relicense, retire, or replace these plants have major implications for the future of energy production in the Southeast.

Possible benefits of retiring existing reactors include reduced nuclear plant safety concerns, decreased generation of new nuclear waste, and increased ramping flexibility on the system, whereas possible risks include challenges in complying with future climate policies, increased reliance on natural gas, and the potentially high cost of replacement generation.

Costs, Benefits, and Emissions Implications of Plant Relicensing

Discussion focused on the costs, benefits, and emissions implications of nuclear plant retirements and relicensing. Those strongly in favor of relicensing emphasized that nuclear generation is a large, dispatchable baseload power source with rate stability—one that provides an important source of fuel diversity as coal generation continues to decline. Furthermore, panelists observed that emissions could increase if nuclear plants retire and are replaced in large part with natural gas. Panelists also suggested that existing nuclear plants—like all existing plants—have "options value," or value in preserving flexibility to respond to future uncertain conditions, and that this value could be quantified to help operators and regulators determine whether to keep existing reactors online or, if possible, to mothball them.

Other panelists expressed concern about maintaining aging reactors, arguing that nuclear plants are increasingly expensive to maintain. A better strategy, in this view, would be to increase investment in efficiency and renewable energy to replace retiring nuclear capacity. Panelists pointed to the subsidization of nuclear power plants in New York as an indicator that nuclear power is increasingly uncompetitive as the costs of other generation sources continue to fall. Another reason for concern is the lack of progress on developing a permanent repository for nuclear waste.

Panelists unanimously agreed that nuclear power's largest benefit is its lack of carbon emissions. Its largest risks, in their view, are its long lead times, high costs—especially for new units—and complex regulatory framework.

Role of Nuclear in a Low-Carbon Future

Several panelists argued that nuclear is necessary to achieve long-term climate goals, especially in the Southeast, where nuclear comprises a quarter of generation and where conditions may not be favorable to high penetration of renewables. Over the long term, if every existing plant's license were extended to 80 years, nuclear generation would remain more or less flat absent significant changes in technology, cost, or policy. Most analyses of the options for meeting long-term carbon goals involve electrification of large portions of the buildings and the transportation sectors, potentially increasing electricity demand and the need for emissions-free power.

Acknowledging concerns about the high upfront costs and long lead times for construction of new facilities using current technology, panelists in favor of a long-term role for nuclear power conceded that the existing fleet and currently available nuclear technologies must be transitional—more flexible and more cost-effective technologies are needed beyond the 2030s. Nascent technologies include modular reactors than can be built in increments of 50–200 megawatts and reactors that use molten salt or liquid metals instead of water as a coolant. But these technologies are not readily available and must surmount demonstration and commercialization obstacles.

IDENTIFYING TOP ISSUES FOR FUTURE CONSIDERATION

At the close of the workshop, a facilitated discussion outlined key topics for future consideration. Collectively, workshop participants identified three areas for additional analysis and discussion.

Data for Innovation

As decision makers face new sources of uncertainty and rapid rates of change, the need for more sophisticated models and forecasting tools has grown. These tools have the potential to help utilities quantify the bounds of uncertainty under different policy- and technology-adoption scenarios, and they require robust data to be effective. The demand for these analytical services is high, both among utilities and among regulatory and third-party groups, and it stands out as an area in which universities and third-party researchers can contribute meaningfully to the understanding of the potential future impacts of technological innovation.

Incremental Steps toward a New Business Model

Another area of agreement was the importance of finding incremental business model steps and earning opportunities for utilities to adapt to an industry in transformation. Participants suggested conducting research focused on earning incentives mechanisms and pricing models that would allow for technological innovation while preserving the fiscal health of utilities.

Quantifying Risk-Risk Tradeoffs

Finally, participants voiced interest in efforts to better define and quantify the risk-risk tradeoffs inherent in energy decision making. As the discussion of nuclear power's future revealed, there are many risks and costs associated with investment decisions in long-term energy infrastructure. Efforts to better understand and balance these risks could allow utilities and regulators to improve their investment decisions and integrated resource planning processes.

Nicholas Institute for Environmental Policy Solutions

The Nicholas Institute for Environmental Policy Solutions at Duke University is a nonpartisan institute founded in 2005 to help decision makers in government, the private sector, and the nonprofit community address critical environmental challenges. The Nicholas Institute responds to the demand for high-quality and timely data and acts as an "honest broker" in policy debates by convening and fostering open, ongoing dialogue between stakeholders on all sides of the issues and providing policy-relevant analysis based on academic research. The Nicholas Institute's leadership and staff leverage the broad expertise of Duke University as well as public and private partners worldwide. Since its inception, the Nicholas Institute has earned a distinguished reputation for its innovative approach to developing multilateral, nonpartisan, and economically viable solutions to pressing environmental challenges.

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

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

Duke Marine Lab Road
Beaufort, North Carolina 28516

919.613.8709 phone
919.613.8712 fax
nicholasinstitute@duke.edu
www.nicholasinstitute.duke.edu