VASEM

Virginia Academy of Science, Engineering, and Medicine

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VASEM Virginia Academy of Science, Engineering, and Medicine

Bridging the Gap

Charting the Future of Sustainable Energy in Virginia

October 28–29, 2024

Virginia Academy of Science, Engineering, and Medicine

The Virginia Academy of Science, Engineering, and Medicine is a nonprofit organization consisting of members of the National Academies of Science, Engineering, and Medicine who reside or work in Virginia as well as Virginians who are leaders in these fields. Through its nonpartisan network of experts, the Virginia Academy provides rigorous analytical, technical, and scientific support to inform policy on issues critical to the Commonwealth.

The Virginia Academy also promotes research, fosters interchange among individuals and organizations, and recognizes and honors Virginians who have made major contributions to science, engineering, and medicine.

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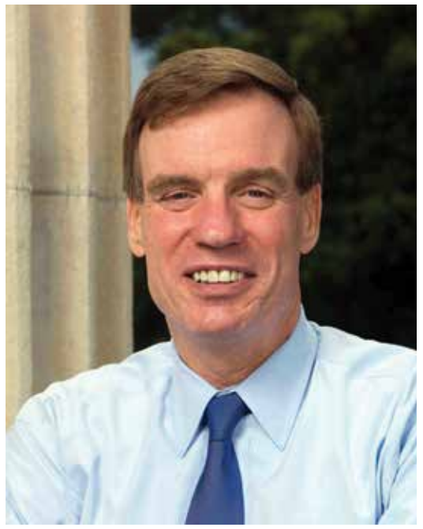
Senator Mark Warner

This summit on energy is particularly timely because abundant sustainable energy is critical to U.S. global technological leadership and, therefore, to our national security.

More than 10 years ago, I convened a meeting of National Academy members from Virginia and presidents of the Commonwealth's premier research institutions. Our purpose was to address the need for an independent body of experts to provide nonpartisan technical insight for state policymakers on complicated policy issues. These conversations led to the formation of the Virginia Academy.

I am proud that VASEM has done so much to advance public policy in Virginia, and these annual summits are an important part of that effort. This summit on energy is particularly timely because abundant sustainable energy is critical to U.S. global technological leadership and, therefore, to our national security.

The summit coincides with work I have been doing in the Senate to accelerate the development of advanced nuclear energy, which I believe will provide the foundation for our energy future. No state in the nation is as well positioned as Virginia to drive this effort. Over 30 percent of the Commonwealth's power comes from Virginia's nuclear reactors; we are home to some of the most innovative companies working on nuclear energy; and we have a best-in-the-industry workforce pipeline. The Virginia Academy is contributing by providing state officials with objective information that can help them develop advanced nuclear power wisely.



I look forward to seeing where the conversation and ideas from this year's summit go and, as always, to continuing to support the efforts of the Virginia Academy.

Mark R. Warner
United States Senator

James Aylor

The Virginia Academy focuses its annual summits on topics that are critical to the future of the Commonwealth. Examples include our 2017 summit on infectious diseases and our 2021 summit on restoring public trust in science.

Our choice of energy as this year's topic is no different. The Commonwealth's demand for electricity is rising at its fastest rate in years, driven by robust economic growth, the adoption of technologies that replace fossil fuels, and Virginia's global leadership in data centers. Even with significant increases in renewable energy and greater conservation, the challenges of meeting Virginia's future energy needs remain substantial. Our summit is just one of many conversations currently occurring across the state on how best to meet this challenge.

Even with significant increases in renewable energy and greater conservation, the challenges of meeting Virginia's future energy needs remain substantial.

We were fortunate to have assembled an outstanding group of experts from business, government, and universities to share their perspectives. Their remarks are summarized in this summit publication. I would like to thank Dominion Energy Virginia for hosting these discussions and Glenn Davis, director of Virginia's Department of Energy, for again addressing a VASEM summit. Their participation is a vote of confidence in the ability of the Virginia Academy to serve as a source of nonpartisan, accurate information for the Commonwealth's policymakers.

James Aylor
President, Virginia Academy of Science, Engineering, and Medicine

WELCOME

DOMINION'S PLANS FOR ASSURING OUR ENERGY FUTURE

There is perhaps no one who has a more comprehensive view of Virginia's energy challenges than Dominion Energy's **Ed Baine**, president of utility operations and Dominion Energy Virginia. After welcoming the summit to the company's Innsbrook Technical Center, Baine shared his perspective on the factors driving unprecedented load growth in Virginia and detailed Dominion's efforts to meet this challenge while providing reliable, affordable, and increasingly clean energy to its customers.

Baine noted that demand is currently growing at levels Virginia hasn't seen since the end of WWII. "We have reached a demand peak each summer for the last five years," he said. "In 2024, we hit not just one peak but a series of them. Six of the 10 highest peaks we have ever seen took place in a two-week period in the summer of 2024." Over the next 15 years, he said, economic growth, data center expansion, and the electrification of many sectors of the economy are expected to boost the Commonwealth's power needs by 85 percent.

Data centers, Baine noted, are responsible for the bulk of this increase, and the shift to energy-intensive artificial intelligence applications means that they will remain the dominant driver for at least the next decade. Since 2013, Dominion Energy has connected an average of 15 new data center facilities a year. During that same time, the average size of each facility has grown from 10 megawatts to nearly 100 megawatts—and more data center campuses using even more power are being proposed and approved.

RELIABILITY

Baine pledged that Dominion Energy will not sacrifice reliability to meet this demand. He noted that with the exception of major storms, Dominion's customers have power 99.98 percent of the time, a rate higher than the national average. "It's not an exaggeration to say that if we don't execute our mission, people around the Commonwealth and many other places will not be able to execute theirs either," he said. "As a company, we take this responsibility very seriously."

Thanks to cooperation with regulators and policymakers over the last decade, Dominion has been able to build several highly efficient gas-fired plants in Greensville, Brunswick, Warren, and Buckingham counties. Those plants, along with Dominion Energy's nuclear fleet and other generating units, have been critical to maintaining reliability and will be in the future, but more capacity will be needed. "If we're to maintain the reliable service that our customers depend on, we need to add more generation, more transmission, and more distribution," Baine said. "This will include renewable energy sources as well as other forms of generation that can provide power during periods when solar and wind energy aren't available as well as during periods of high demand such as extreme cold and heat waves."

Baine singled out small modular reactors as a promising source of this new capacity. He noted that in July 2024, Dominion Energy issued a request for proposals for a possible small modular reactor (SMR) at its North Anna Power Station. And just a few weeks before the summit, Dominion Energy and Amazon entered into an agreement to explore innovative development structures that would help advance SMR development in Virginia.

Baine also noted that Dominion Energy is making historic investments to expand the transmission grid. In the first half of 2024, it completed 123 new transmission projects, including nearly 90 miles of new and rebuilt transmission lines and 13 new substations. It is also making significant investments in the distribution grid to reduce storm-related outages and shorten power restoration times. Over the last several years, Dominion Energy has buried over 2,500 miles of overhead distribution lines in outage-prone areas and, since 2019, has hardened over 265 miles of main distribution lines.

AFFORDABILITY

Even as Dominion Energy explores building out its infrastructure to meet demand, Baine maintained that affordability remains a priority as it has been in the past. Since 2010, its residential and commercial rates have grown at an average of 1.2 percent and 0.9 percent per year respectively, less than half of the general inflation rate of approximately 2.6 percent. "This is an area that we should be proud of but never satisfied," Baine said. "There are many customers who are financially challenged and make difficult decisions about where they can spend their money each and every day. We need to stay focused on being efficient and cost effective so that we provide the best possible value for our customers."

SUSTAINABILITY

Baine also stressed Dominion Energy's commitment to sustainability and underlined its target of net zero carbon emissions by 2050. One part of its strategy to meet this goal is cutting emissions. He noted that Dominion reduced its scope 1 carbon emissions from power generation by 53 percent between 2005 and 2023. Another element is focusing on renewables. He noted that Dominion now has one of the largest solar portfolios in the country owned by a utility—and its Coastal Virginia Offshore Wind project (CVOW) is the largest such project under construction in the United States, designed to produce 2.6 gigawatts of capacity when completed.

Baine emphasized that CVOW is an important driver of economic growth. "Already 800 Virginia-based workers, including more than 650 in the Hampton Roads region, are engaged directly with the project or with businesses that support offshore wind development," he said. "Once it's fully operational, CVOW will support 1,100 jobs annually in Hampton Roads."

A DECISIVE MOMENT

Baine concluded by looking at such important moments in Dominion Energy's history as the decision to build the North Anna and Surry nuclear power plants, which now provide 30 percent of the generation in Virginia, or to build the Bath County Pumped Storage Facility, one of the largest in the world. He believes that the current moment is equally significant. "When people look back 10 or 15 years from now at the choices we are making today and the plans we are executing," he said, "this era will also be seen as a defining moment in our history."

KEYNOTE ADDRESS

AN ALL-OF-THE-ABOVE APPROACH

In the three years since Governor Glenn Youngkin took office in 2022, Virginia added over $7 billion to its economy, was named "Silicon Valley East" by *Business Traveler*, and was ranked by CNBC as America's Top State for Business in 2024. "With growth come challenges," said Virginia Department of Energy Director Glenn Davis. "We need to make sure that we have the energy necessary to power a flourishing economy far into the future."

In his keynote address to the Virginia Academy summit, Davis enumerated some of the steps Gov. Youngkin has taken to ensure Virginia has sufficient energy to meet this challenge. The governor successfully advocated for legislation that restored the State Corporation Commission's (SCC's) authority to set rates. By 2027, the SCC will have full discretion to establish a utility's return on equity. He also signed legislation restoring biennial rate reviews. "The SCC is now working closely with Virginia's utilities, ensuring that they're financially stable without unfairly burdening ratepayers," Davis said.

Davis noted that the governor has also taken a closer look at the Regional Greenhouse Gas Initiative (RGGI), a regional cap-and-trade program designed to reduce carbon dioxide emissions from power plants. In 2020, Virginia became the first southern state to join RGGI, but in 2023, Gov. Youngkin withdrew the Commonwealth from the initiative, citing higher energy costs for ratepayers. This decision was overturned by the courts, but the administration has appealed. "We believe that the governor has the authority to make this decision," Davis said.

Youngkin has also scrapped electric vehicle mandates. Although the Virginia General Assembly passed legislation authorizing Virginia's Air Board to adopt California's Advanced Clean Cars I regulation, the Youngkin administration determined that the state was not obligated to follow the new Advanced Clean Cars II regulation, which would require 100 percent of new cars sold in model year 2035 to be electric vehicles. "Our position is that we should not be following regulations set elsewhere that interfere with our citizens' ability to buy a vehicle of their choice," Davis said.

AN ALL-OF-THE-ABOVE ENERGY PLAN

The cornerstone of these and other initiatives, Davis said, was Youngkin's 2022 Virginia Energy Plan. The governor has been a proponent of clean energy, Davis explained, and has consistently pushed for Dominion Energy's Coastal Virginia Offshore Wind project (CVOW) to be on time and on budget.

But adding renewable energy to the grid does not mean the Commonwealth can afford to immediately retire reliable, baseload sources. Renewables are intermittent. The Commonwealth needs a way to generate electricity when the weather does not cooperate. Furthermore, the need for energy has exploded since the Virginia Clean Economy Act was passed in 2020. At that time, load growth was estimated at 1 percent to 2 percent a year. Currently, Davis said, it is projected to be between 6 percent and 7 percent.

> **"We're not quite** there yet but long-term battery storge will change the way we think about renewables."

To address both these issues, the Youngkin administration developed an all-of-the-above energy plan. "We need nuclear, natural gas, thermal, hydrogen, carbon capture, and batteries as well as wind and solar," Davis said. "The range of sources in this plan means that Virginia can reduce its carbon footprint even further, support economic development, and meet the challenges of growth while making sure that electricity remains reliable and affordable.

As an example, Davis spoke about recent developments that may set the stage for additional nuclear power. These include bills passed by the General Assembly that allow utilities to expedite recovery of some of the costs associated with siting small modular reactors (SMRs), Dominion Energy's recent request for proposals from leading SMR vendors to place an SMR at its North Anna nuclear power station, a memorandum of understanding signed by Dominion and Amazon Web Services to explore deployment of a 300 MW X-Energy SMR at North Anna, and the announcement that the world's first commercial fusion reactor will be built in Chesterfield County.

Another exciting area where Virginia is taking the lead is battery storage. Dominion Energy has received approval to test new battery technologies, including one that can discharge power for up to 100 hours. "We're not quite there yet," Davis said, "but long-term battery storge will change the way we think about renewables."

FUNDING INNOVATION

Support for this kind of innovation is a key element in the governor's energy plan. Davis highlighted a number of recent initiatives designed not only to promote innovation but also to ensure that innovative technologies are created in the Commonwealth. Virginia provided $10 million to fund the Virginia Clean Energy Innovation Bank. Establishing a bank enables Virginia to qualify for $300 million in federal loans authorized by the Inflation Reduction Act as well as apply for private grants and loans. The bank has attracted widespread interest, Davis said. He mentioned that earlier in the day he had talked to companies working on clean hydrogen and carbon sequestration projects that are interested in additional support.

Another initiative is the Virginia Power Innovation program, designed to support Virginia companies conducting research and development of such technologies as nuclear, hydrogen, carbon capture and utilization, and energy storage. Davis reported that in a 45-day application period for $3 million in available funding, the program received over 34 grant applications totaling $26 million. "We're really excited about some of the initiatives we can foster to help spur innovation across the Commonwealth," Davis said.

FOCUSING ON THE INTERIM WHILE PLANNING FOR THE FUTURE

Adding new sources of generation and expanding generation will take time, Davis said, noting that the first SMR may not be operational for a decade. The challenge for the Commonwealth is providing reliable, affordable power in the interim in the face of rising demand. The most sustainable solution, he believes, is natural gas. "There's only one thing that's going to keep those lights on for us, and that's natural gas," he said. "We have to make sure we have this option open to us as we transition to a new energy future. If we can meet our immediate challenges while working on those we will be facing a decade into the future, we can depend on Virginia remaining a top state for business and continuing to offer exceptional opportunity for our citizens."

PANEL

THE ENERGY VIEW FROM UTILITY LEADERS

The Virginia Academy called on Mark Lauby, a National Academy of Engineering member and senior vice president, chief engineer, and chief reliability officer at the North American Electric Reliability Corporation (NERC), to moderate a panel with leaders of the Commonwealth's utilities. They included Dominion Energy's Ed Baine, president of utility operations and Dominion Energy Virginia; Chris Cosby, chief operating officer (now chief executive officer) of the Old Dominion Electric Cooperative (ODEC); David Schleicher, president and CEO (now retired) of the Northern Virginia Electric Cooperative (NOVEC); and Aaron Walker, president and chief operating officer of Appalachian Power.

Lauby set the stage by tracing the evolution of the modern utility grid starting with the Northeast blackout of 1965, which led to the creation of the Electric Power Research Institute and NERC. He spoke about such developments as the spread of large, centralized power generation, the restructuring of the power industry, and the incorporation of renewable energy sources. He then opened the floor to the utility executives to highlight some of the challenges facing their utility and the utility industry as a whole.

A RAPIDLY EVOLVING ENVIRONMENT FOR UTILITIES

ODEC's Cosby pointed out that Virginia's utilities operate under the auspices of PJM, a regional transmission organization (RTO) and independent system operator (ISO). PJM manages the electric grid for parts of 13 states and the District of Columbia, ensuring reliable and safe wholesale electricity transmission. Over the last decade, PJM has faced the retirement of a significant amount of dispatchable generation, including many coal facilities as well as some nuclear and older gas power stations, while intermittent energy sources like wind and solar were coming online. This is causing PJM, Cosby noted, to revise its planning methodology for reliability.

Cosby explained that this transition has required PJM to reconsider its loss-of-load-expectation goal, which had been one day in 10 years. Cosby cited PJM's adoption of effective load-carrying capacity (ELCC) as a step in the right direction. ELCC measures a resource's ability to reliably produce energy during periods of high demand or grid stress. In effect, ELCC measures the power that is likely to be available in given circumstances, for instance, from intermittent resources such as solar or dispatchable resources such as nuclear sources, rather than their nameplate capacity. "This is a positive development because it provides situational awareness to start framing the challenge of meeting energy demand more accurately," he said.

The transition to renewables also affects reliability in another way, according to Dominion Energy's Baine: it changes the topology of the network. "When you go from managing tens of sites to hundreds of sites, you add complexity," he said. "The amount of visibility you need, the amount of flexibility you require, and the quality of the technology you deploy become exponentially greater."

Another issue that some utilities must contend with is different state laws. As president and COO of Appalachian Power, Walker is responsible for a territory that includes parts of West Virginia, Virginia, and Tennessee. He pointed out that policies in Virginia, which is embracing renewables, and those in West Virginia, which has a long history of coal-fired generation, are almost polar opposites. "As a company operating in both those jurisdictions, we have to make sure we are aligned with each state," he said.

But an even greater challenge for Walker is the explosion of demand. "It took 110 years for us to build the infrastructure to support our current demand," he said. "We have to double that over the next 10 years."

For a distribution-only company like NOVEC, the financial consequences of an imbalance between supply and demand that may emerge during the renewable transition are a major cause for concern. Regional transmission organizations like PJM hold auctions to determine the cost of power to companies like NOVEC or those that are experiencing a shortage of power. "NOVEC is projecting 8 percent to 10 percent year-over-year increases in power supply costs," Schleicher said. "We need to find a better solution than the one we have right now for energy policy in Virginia."

BRINGING MORE ELECTRICITY ONLINE FASTER

Lauby noted that each panelist, in his own way, was underscoring the gap between capacity and demand, both in the short and long term. He asked them for their thoughts on how the industry might ensure adequate reliable power.

Both ODEC's Cosby and Dominion Energy's Baine spoke about short-term solutions. Cosby stressed that to ensure reliability over the next five years, utilities need to maintain the generation they have on hand and add high-load-factor generation, primarily natural gas, until they can close the gap with more ambitious, technologically advanced solutions.

Baine pointed to a three-part strategy. He argued for continued investment in the transmission grid to remove constraints that limit the ability to move power from states with excess generation to those that need it. Like Cosby, he argued that utilities should not retire units and should fast-track shovel-ready projects that can be completed in five years. Finally, he argued that it is important to incentivize customers to be more energy efficient.

Schleicher said that it is particularly imperative for NOVEC, as a transmission- and generation-dependent company, for these solutions to be enacted. "We welcome business in Virginia, but when you attract 12,000 megawatts of load without a corresponding plan for generation, that's problematic," he said.

"We need to find a better solution than the one we have right now for energy policy in Virginia."

Walker took on long-term systemic obstacles. The first is the lack of a national long-term energy policy. "It is not helpful for a utility that's looking to make decisions that are going to affect us for 100 years to change what that policy looks like every four or six years," he said. He also highlighted the need for PJM to reduce the number of projects awaiting approval in the interconnection queue. And he advocated for efforts to remove impediments to advanced nuclear solutions.

A JOINT EFFORT

Lauby concluded the panel by acknowledging how difficult the challenges are and stressing the need for the utility industry to build relationships with stakeholders to devise mutually satisfactory solutions. "We need to find middle ground," he said. "I think we have a lot of smart people in Virginia who can help solve these issues, but we all have to be willing to move a bit from our established positions to do so."

PANEL

DATA CENTERS, ENERGY FORECAST, INFRASTRUCTURE IMPACTS

There are more data centers in Virginia by far than in any other place in the world—and they are now an integral part of the Virginia economy. The Virginia Joint Legislative Audit and Review Committee estimates that data centers contribute $9.1 billion in GDP to Virginia's economy each year, and, in 2023, they generated $2.3 billion in state and local tax revenue.

Because they are so energy intensive, data centers have dramatically changed Virginia's energy profile. They now account for 26 percent of Dominion Energy Virginia's total electric load, a percentage that will only increase over time. Accelerating data center demand is the major reason that PJM, the regional transmission organization that includes the Commonwealth, projects Virginia's peak annual load growing an average of 6.3 percent over the next ten years. For Dominion, this means that electrical usage in the Commonwealth will more than double by 2040. Meeting that demand will be a difficult challenge.

To detail the factors driving the need for new data centers and explore the implications for Virginia, the Virginia Academy hosted a panel designed, in the words of moderator Robbie Wright, vice president of strategic partnerships at Dominion Energy Virginia, "to focus on data centers, the trends and forecasts we are seeing, and the impacts on the grid and infrastructure planning."

THE DATA CENTER INDUSTRY VIEW

Two members of the panel were from the data center industry. Nick Blessing is the director of public policy and economic development for QTS Data Centers, which develops, owns, and operates colocation data centers. QTS provides powered, secure, resilient facilities to tenants who then house and maintain their own computer equipment onsite.

Blessing pointed to a number of factors driving data center growth. They include the jump in the number of connected devices used by consumers and businesses, the advent of technology like 5G that enables these devices to send increasingly dense packets of information, and the proliferation of compelling, complex applications such as ride services or credit card approvals that are built on scores of computer-to-computer interactions. "The aggregation, efficiency, and economy of scale that these applications require would simply not be possible without commercial data centers," he said.

Looking ahead, Blessing sees artificial intelligence (AI) increasing this demand exponentially. "The advent of AI has ignited a race to develop ever more innovative applications—and this will necessitate even more powerful data centers requiring even more energy," he said.

Blessing was joined by Kate Smiley, another data center industry representative. Smiley is director of government affairs for the Data Center Coalition, a trade association representing 32 member companies, both colocators like QTS and hyperscalers, companies that build and manage vast data centers capable of delivering cloud services. Smiley stressed that data centers are fundamental to both our economy and way of life. She cited healthcare as an example. "Physicians' ability to have their patients' complete medical records at their fingertips depends on having the immediate access to information that data centers provide," she said.

THE CHALLENGE FOR REGIONAL TRANSMISSION ORGANIZATIONS

Rounding out the panel was Paul McGlynn, vice president of planning (now retired) for PJM, the regional transmission organization (RTO) in the Mid-Atlantic. "AT PJM, we have three major functions," McGlynn explained. "We conduct infrastructure planning. We're responsible for the real-time operation of the grid. And we have a markets organization intended to incentivize people to take steps to keep the grid reliable." Among other responsibilities, McGlynn oversaw PJM's interconnection queue, a list of projects awaiting evaluation to determine how they may be added to the electricity grid in a safe and orderly manner.

McGlynn was in an ideal position to track the energy demand created by data centers. "We're seeing load growth rates now that we haven't seen since right after World War II," he said. "In our 2024 load forecast, we found that data centers will account for about 20 gigawatts of new load by 2030." According to its most recent estimate, PJM projects a summer peak load of about 154,000 megawatts across its territory in 2025. It estimates that this will rise to more than 220,000 megawatts by 2040.

One way PJM is addressing this need is by reconfiguring the interconnection queue. McGlynn noted that ten years ago, the queue consisted mainly of applications for large combined-cycle generators with a capacity of between 1,000 and 1,500 megawatts. Today, the queue is dominated by smaller, primarily renewable resources. "Instead of applications for a single 1,500-megawatt combined cycle gas plant, we now have proposals for scores of 50- to 100-megawatt renewable sources," he said.

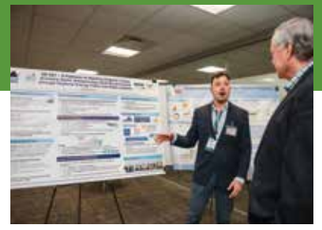
A first-in, first-out system was appropriate when there were fewer, larger projects in the queue. As projects became smaller, PJM found it was falling behind, so it changed its methodology. "We've adopted a cluster approach for renewable resources, which we believe will enable us to handle over 200,000 megawatts of interconnection requests over the next few years," McGlynn said.

PJM has also adopted a new approach to reliability. In the past, PJM adhered to a one-in-10 standard—the equivalent of one day's loss-of-load every 10 years—based on nameplate capacity. Now, to evaluate reliability it looks at the effective load-carrying capability (ELCC) of the resources on its grid at different times and under different conditions. For instance, in the winter, the grid is under most stress in the early morning and evening. This is precisely the time when solar resources have a low ELCC. "Understanding the resources we have, how the grid is evolving, and how we should accredit our resources to make sure we have sufficient energy to keep lights on is an ongoing process," McGlynn said. PJM has begun prioritizing projects with a higher ELCC in its interconnection queue to ensure grid reliability over the short term.

COLLABORATING FOR A BETTER FUTURE

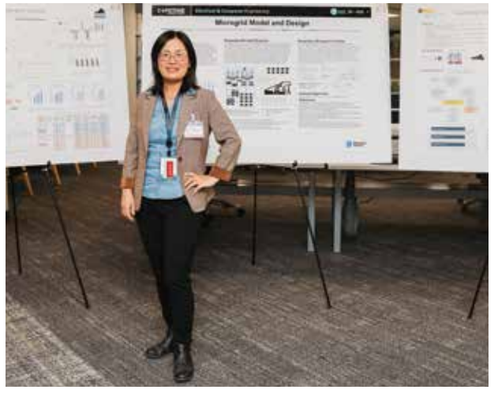
In addition to the new approaches that PJM is making, there are a number of other steps, the panelists said, that could help ensure that Virginia's growing data center industry has the energy it needs to expand and flourish. Blessing emphasized the need for data center developers to provide accurate responsible load forecasts to help utilities and RTOs plan accurately and appropriately. Smiley highlighted need to remove regulatory uncertainty at the state level and to establish more uniformity at the local level, where data center providers now face a variety of different jurisdictional rules and regulations. And they both talked about steps underway to make data centers more energy efficient. Ultimately, they said, communication and collaboration with PJM and Virginia's utilities, policymakers, and communities will go a long way to ensure that Virginia enjoys the benefits of a growing data center industry.











Poster Presentations

Laura Akesson*
George Mason University
Clean Energy Policy in Virginia

Pavan Chaitanya*
Virginia Commonwealth University
Harnessing Small Modular Reactor (SMR) and Hydrogen Technologies for a Sustainable Energy Future

Jidapa Chalermkit
Virginia Tech
Cyber Security of the Distribution Grids

Saikat Das
Virginia Commonwealth University
Cascading Failure Risk Analysis of Electrical Power Grid

Impacts of Data Integrity Attacks on a Microgrid Energy Management System

Luke Goodman*
Virginia Tech
A Pathway to Meeting Virginia's Clean Economy Goals: Empowering Local Governments through Regional Energy Plans and State Liaisons

Darryle C. Jackson
Virginia State University
Vehicle Electrification Using Brushless DC (BLDC) Motor and AI-Enabled Advanced Driver Assistance Systems

Kamiar Khayambashi, Bill Shobe, Andres Clarens, Negin Alemazkoor
University of Virginia
Identifying Key Uncertainties in Energy Transitions

Kylor Kerns*
University of Virginia
Understanding HB 206 and Its Role in Virginia's Solar Energy Expansion

Aparna Kishore, Swapna Thorve, Arun Phadke, Virgilio Centeno, Vince Poor, Rounak Meyur, Achla Marathe, Samarth Swarup, Henning Mortveit, Anil Vullikanti, Madhav Marathe
University of Virginia
Digital Twins of Energy Systems and Their Applications

William B. Luelf
George Mason University
Small Modular Reactors for Powering Data Centers

Faizan Manzoor
Virginia Tech
Zero-Day Attack Detection in Digital Substations Using In-Context Learning

Amanda Onoff
Virginia Commonwealth University
Dominion-Sponsored Capstone Project: Microgrid Model and Design

Naser Souri
Virginia Tech
Harnessing Green Energies for Data Center: An Agrivoltaics Approach

Randall Stamper
Virginia Community College System
Central Virginia Community College Associate of Applied Science in Nuclear Technology

Northern Virginia Community College Associate of Applied Science in Data Center Operations

Christopher J. Stauber
George Mason University
Energy Efficient Diamond LEED-Certified Data Centers

** A recipient of VASEM's Commonwealth of Virginia Engineering & Science Policy Fellowship*

PANEL

GENERATION NEEDED IN THE COMMONWEALTH

Moderator Robert Carritte, a former principal officer at the specialty engineering and management services firm MPR Associates, set the stage for the panel with a wide-ranging discussion of the energy transformation underway—and shared his enthusiasm for change. "I can't think of a better time to be a power engineer," he said. "The innovations engineers create will ultimately determine what route we follow as we transition to renewable energy while meeting surging demand and will govern how fast we get there."

Carritte pointed to the substantial shift in the kind of generation added to the U.S. grid over the past 20 years, noting that a record 34.6 gigawatts of utility-scale solar was scheduled to be added in 2024, almost twice that of the preceding year. It is important to keep in mind, he cautioned, that there are fundamental differences in the effective amount of electricity that different types of generation facilities produce. For example, in 2023, wind, solar, and hydroelectric made up about 28 percent of this country's utility-scale generation capacity but produced only 21 percent of its electricity. By contrast, nuclear power accounted for just 9 percent of the installed generation capacity but produced 18 percent of the nation's electricity. He concluded that, given the operating characteristics of intermittent energy sources, utilities will need multiple megawatts of capacity of wind or solar to replace a single megawatt of nuclear. In addition, they will require backup sources for times when the weather is not favorable for renewables.

He noted that renewables also bring with them a series of risks, some of which are "unknown unknowns" that cannot be anticipated. He cited a recent North American Electric Reliability Corporation assessment that projects high levels of risk for the bulk electric system over major parts of Canada and the United States during the coming four years.

Carritte reiterated that the energy transition is gaining momentum at the precise moment that demand is rising faster than it has for decades. "New electric load growth is back—and more electrification is coming," he said. He then laid out five imperatives for a nondisruptive energy transition. They include scalability, reliability, sustainability, resiliency, and affordability. But he stressed that even when these imperatives are met, "the ultimate arbiters of a sound technical design are the laws of physics and nature's uncertainties."

THE RATIONALE FOR NUCLEAR ENERGY

Carritte turned to panelist John Kotek for insight into the role nuclear energy might play in reducing greenhouse gases while meeting growing demand. Kotek is senior vice president of policy development and public affairs at the Nuclear Energy Institute (NEI), an industry trade association. He noted that the 94 nuclear reactors currently in operation at 53 plants in the United States meet almost 20 percent of the nation's energy needs and account for roughly half of its carbon-free generation. Dominion's four reactors in Virginia are the mainstay of its energy supply, running at 92.2 percent capacity while reducing the Commonwealth's carbon footprint by an estimated 13.4 million metric tons annually. "We already benefit substantially from existing nuclear power," Kotek said. "We are now starting to see bipartisan interest in nuclear as a way to meet our needs and aspirations."

Nuclear plants also make substantial contributions to the GDP of states where they are located. In Virginia, for instance, reactor operations and the supply chain that supports them add $2.3 billion to the state's economy. The presence of Virginia's reactors is one reason the Commonwealth has a number of companies at the forefront of nuclear development. They include Bechtel, BWXT, Framatome, Hitachi, Lightbridge, and MPR.

Kotek noted that the majority of utilities around the country have pledged to decarbonize, aiming for no carbon emissions or net-zero carbon emissions by 2050. To reach these goals, he believes, nuclear must be part of the effort. He pointed to data from the United Nations Economic Commission for Europe showing that nuclear energy produces lower greenhouse gas emissions over its lifecycle than any other energy technology including wind and solar. He cited findings from MIT that demonstrate that adding nuclear to the mix of renewables and battery storage will allow the world to arrive at a carbon-free future faster and at less cost than if it relies on renewables and storage alone. "The fact that nuclear is a price-stable source of reliable dispatchable generation power makes it essential when planning for the future," he said.

> **"The ultimate arbiters** of a sound technical design are the laws of physics and nature's uncertainties."

And nuclear energy, Kotek noted, is about to become even more versatile and efficient. NEI members are collectively bringing a wide range of innovative technologies to the market. As an example, he cited TerraPower's Natrium reactor, which uses liquid sodium as a coolant. This allows for higher operating temperatures and faster neutron speeds, leading to more efficient fuel utilization.

Policymakers at the state and federal levels have realized the potential of nuclear energy. Among other initiatives, they have introduced tax credits for new and existing plants and loan guarantees that reduce the cost of borrowing to build nuclear capacity. "We have seen support for nuclear begin to gel over the last six to eight years in ways I never could have imagined when I started in this industry 35 years ago," Kotek said.

DOMINION'S EXPERIENCE WITH NUCLEAR ENERGY

The last panelist, Emil Avram, Dominion Energy's vice president for business development, followed up on Kotek's presentation by stressing that nuclear energy is critical to a clean energy future—and that Dominion is well positioned to deploy nuclear resources to help Virginia through this transition. He noted that Dominion owns and operates four reactors in Virginia as well as reactors in Connecticut and South Carolina, all of which have 80-year operating licenses either approved or in process. The experience that Dominion has gained operating its nuclear fleet is critical, Avram emphasized, because its Virginia service area is forecast to have the highest electric load growth in the nation. "In the next 15 years, we are going to have to double what it's taken us 115 years to build," he said. "It's a daunting prospect, but we are up to the task."

As Dominion explains in its latest integrated resource plan, making this leap cannot occur without nuclear power. The company plans to add 1,340 megawatts of nuclear power by 2039, which, because of its high effective load-carrying capability, will produce the same amount of energy as 6,000 megawatts of solar.

Like Kotek, Avram was heartened by the pace of innovation in nuclear technology, citing the new cooling methods being developed—including liquid sodium, high-temperature helium, and molten salt—that overcome the limitations of traditional light-water reactor designs, which ramp up slowly to full power. Their fast response time gives these new technologies some of the operating characteristics of gas-turbine peaking plants and will be especially valuable when paired with intermittent sources like solar and wind generation.

Avram also pointed to a growing consensus around nuclear. "Customers and communities are coming to us looking to participate in this effort," he said. "They understand that we can't meet the Commonwealth's electricity needs without nuclear."

PANEL

POLICIES AFFECTING THE FUTURE OF ENERGY

The United Nations Environment Programme issued its 2024 Emissions Gap Report a few days before the Virginia Academy welcomed guests to its annual summit. Moderator Cale Jaffe referred to the report as a way of framing the panel's discussion of policy initiatives required to meet essential greenhouse gas goals.

A professor of law at the University of Virginia and director of its Program in Law, Communities, and the Environment as well as its Environmental Law and Community Engagement Clinic, Jaffe underscored the lack of progress meeting the Paris Agreement target of 2.0°C global warming above preindustrial levels. According to the emissions gap report, the world is on track to reach 3.1°C of warming by 2100—and current pledges will only reduce warming to, at best, 2.6°C. "So how do we get from where we are now to where we need to be?" he asked. "That's going to require changes in policy."

POLICIES THAT ADVANCE THE NUCLEAR AGENDA

Each of the panelists took a turn describing policy changes that might help accelerate progress. Jay Silberg, an energy partner at Pillsbury Law specializing in nuclear power, talked about steps that could be taken to benefit from the current surge of interest in advanced nuclear reactors under development, what he termed "a nuclear renaissance." Silberg described a number of policy issues that are being addressed that will increase the likelihood of these innovative reactors being built.

Licensing was the first among these. The Nuclear Regulatory Commission has been working to develop more streamlined procedures for licensing small modular reactors while assuring their safety. "The NRC commissioners, the Department of Energy, and the White House and Congress are acutely aware that the regulatory system needs to move smoothly while not overlooking risks," he said. "There are many savings available to cut both time and costs from the process."

Silberg also noted that while financing had been a problem in the past, there has been a shift in investor sentiment. "Not in my lifetime would I have expected Bill Gates and large entities like Amazon to be putting real money into the pot," he said. "Will it be enough to carry us over the finish line? I certainly hope so."

Silberg highlighted an issue, waste disposal, that has long been an obstacle to nuclear power. He maintained that the storage technology is mature, noted that several European countries are currently developing permanent disposal facilities, and categorized public

sentiment in the United States as more understanding of the need for permanent disposal than it has been in decades. "It's possible that the public will continue to object to nuclear power until we have a permanent disposition for our waste, but I think this is much less likely than in the past," he said. "I think the policy environment will begin to change."

POLICIES TO PROMOTE RENEWABLES

Although Apex Clean Energy, a leading U.S. renewable energy company, does not include nuclear power in its portfolio, it does pursue utility-scale solar, wind, and storage projects. Hannah Coman, Apex's senior associate general counsel, pointed to the Inflation Reduction Act (IRA) passed in 2022 as a major step forward in enabling companies like hers to build more renewable resources. She highlighted the changes the IRA made to sustainable energy tax credits as an example. "Before the IRA became law, production and investment tax credits for sustainable energy were renewed at three- or five-year intervals," she said. "The IRA extended them for at least 10 more years, giving developers the certainty they need to embark on renewable energy projects." In addition, the production and investment tax credits are scheduled to be converted to neutral tax credits that can be applied to any technology. The law also has a number of provisions that increase credits distributed for projects with social benefits, for instance those that have wage and apprenticeship programs or are built on brownfield sites.

Apex is particularly excited by the IRA's establishment of a clean hydrogen production tax credit. Clean hydrogen, produced using renewable or low-carbon energy sources, may play a crucial role in reducing carbon emissions by offering a fuel alternative for sectors such as heavy industry and long-distance transport that are difficult to decarbonize. Coman believes, however, that more must be done for hydrogen to become a viable alternative as a replacement fuel for natural gas. "We are going to need more policies and more incentives," she said.

As had participants in other panels, Coman touched on the PJM interconnection queue as an obstacle to commissioning more renewable projects. "We need to see the regional transmission organizations across the country work together to create a comprehensive transmission program to make the clean transition work," she said.

POLICIES ADOPTED BY THE VIRGINIA DEPARTMENT OF ENERGY

The third panelist, Larry Corkey, manager for policy and planning at the Virginia Department of Energy, explained what the department is doing to meet Virginia Clean Economy Act (VCEA) targets and rising demand. The department provides advice on energy policy to the governor and administers energy programs, including those created by the IRA and the Bipartisan Infrastructure Law, which was passed in 2021. For instance, it assisted Gov. Youngkin in developing his all-of-the-above energy plan and promotes new technologies through the Virginia Power Innovation Program, which provides grants for research and development in a range of areas including hydrogen and carbon capture. It also helped establish the Clean Energy Innovation Bank, which is being used to mobilize public and private capital to address critical financing gaps for energy projects. These can include initial capital investment in nuclear projects or onshoring the supply chain for solar power. Corkey noted that the bank is a federally designated qualified state energy-financing institution, which means it is in a position to draw down federal funds.

Corkey emphasized that more needs to be done. "Meeting VCEA targets during a decade of surging demand will be a substantial challenge," he said. "But if we move forward with nuclear, renewables, and the other elements of the governor's all-of-the-above plan and create policy solutions that eliminate roadblocks in a responsible manner, we will have a good chance of limiting increases in greenhouse gases."

PANEL

ENERGY EDUCATION IN THE COMMONWEALTH

In his keynote address to the summit, Virginia Secretary of Energy Glenn Davis emphasized the importance of the state's colleges and universities in preparing the workforce needed to help guide the Commonwealth through its energy transition and bridge the gap between its current capacity and projected demand. National Academy of Engineering member Chen-Ching Liu, the American Electric Power Research Professor at Virginia Tech and director emeritus of its Power and Energy Center, moderated a panel that enabled educators from some of the state's institutions of higher education to spotlight their efforts to train the next generation of power engineers. "There has been a resurgence of enthusiasm in power engineering among students," he said. "They understand that it is a field where you can make a real difference in mitigating global warming."

VIRGINIA TECH

Before introducing faculty leaders from five other Virginia colleges and universities, Liu talked about the power engineering program at Virginia Tech. He stressed the longevity of Virginia Tech's Power and Energy Center, the size and quality of its faculty, and its substantial funding and distinguished research record. Liu also pointed out that the power and energy faculty are continuously modernizing the curriculum, having recently added courses in distribution systems, alternative energy systems, microgrids, high-voltage direct-current transmission, flexible alternating-current transmission, and renewables.

One unique aspect of the Virginia Tech program is the special relationship it has with the Virginia Tech Electric Service, a distribution system serving the Blacksburg campus and sections of the local community. "We can collect real-time data from the power system, download it into our digital twin, and analyze it," he said.

Liu then introduced the leaders of power engineering efforts at George Mason University, Virginia State University, the Virginia Community College System, Virginia Commonwealth University, and the University of Virginia.

GEORGE MASON UNIVERSITY

Associate Professor Liling Huang traced the development of the power and energy program at George Mason University (GMU), which began in 2018 and has grown to include multiple concentrations, minors, certificates, and a PhD program. The program has gained strong support from industry, whose representatives on its Power Engineering Program Advisory Board are helping to shape the curriculum. These partners also provide guest lecturers and adjunct instructors, host field visits, and sponsor internships, research, scholarships and fellowships.

GMU currently offers nine undergraduate courses, two advanced labs, and six graduate-level courses, with two additional courses and a lab in development. The curriculum covers core power system theory and extends to emerging areas such as cybersecurity and data analytics applied to modern power systems. A distinctive feature of the program is its two dedicated labs: the Power System Protection Lab at GMU's Fairfax campus and the 4,500-square-foot Smart Grid and Renewable Energy Lab at its Arlington campus. "These labs reflect the university's strong commitment to the program," Huang said.

VIRGINIA STATE UNIVERSITY

Virginia State University (VSU), a historically black college and university, launched its Power and Energy Concentration five years ago. This followed a visit from Dominion Energy executives, who recognized the potential for collaborating with VSU to address the increasing demand for specialists in the power and energy sectors.

"We offered several robust engineering and engineering technology programs, but none of them had a specific track or concentration in energy and power," said Dawit Haile, dean of the College of Engineering & Technology. "Our collaboration with Dominion Energy allowed us to create targeted foundational courses specifically tailored for students aspiring to enter the power industry. These courses uniquely combine academic instruction from our university faculty with real-world insights from experienced Dominion industry professionals."

A significant portion of the classes for the Power and Energy Concentration is conducted at Dominion Energy's Chester Training Center, providing students with hands-on experience using industry-grade resources and facilities. This strategic approach has significantly enhanced student preparation and employability, directly aligning their academic experiences with industry expectations.

Haile highlighted the program's exceptional record: "All 35 students who have successfully completed the concentration have already secured employment with leading power and energy companies, underscoring the effectiveness and industry relevance of this partnership-driven approach."

VIRGINIA COMMUNITY COLLEGE SYSTEM

The Virginia Community College System (VCCS) is statutorily charged "with primary responsibility for coordinating workforce training at the postsecondary through the associate degree level." The innovative FastForward program is one way that VCCS is fulfilling this mission. As described by Randy Stamper, VCCS associate vice chancellor for career education and workforce programs, FastForward is a short, affordable training program designed to provide Virginians with competency-based, third-party-validated, high-demand credentials, such as licenses and certifications, that are valued by industry.

Students pay for one-third of the program's tuition (need-based financial aid is available) while the state pays the second third when the student successfully

completes the workforce class. When students earn an established industry credential, the state reimburses the college for the final third. “This is our fastest growing program, increasing 20 percent every year,” Stamper said. Participants have earned over 62,000 credentials to date and seen their wages grow by an average of $12,000 each. Since 2016, the state has invested $96 million in the program, and FastForward graduates have earned over $6 billion in wages. He emphasized that many of the certifications have been in the energy sector and in skilled trades and information technology fields that are applicable to energy.

VIRGINIA COMMONWEALTH UNIVERSITY

Interest in sustainable energy has been growing at Virginia Commonwealth University, according to Zhifang Wang, an associate professor of electrical engineering. Last year, VCU established the Institute of Sustainable Energy and Environment, which brings together faculty members and students from multiple departments to pursue innovative scientific, technological, policy, and social justice solutions in response to the climate and energy crisis. This includes power system issues.

VCU also offers power and energy courses for undergraduates and graduate students through the Department of Electrical and Computer Engineering and the Department of Mechanical and Nuclear Engineering. The Department of Electrical and Computer Engineering is working closely with Dominion Energy to create a power track curriculum that will include courses on power system analysis, electric machines, power system protection, and smart grids and renewable energy. “We also actively involve undergraduates in our research with vertically integrated projects, giving them hands-on exposure to cutting edge power- and energy-related challenges,” Wang said.

UNIVERSITY OF VIRGINIA

Although the University of Virginia does not have an integrated power systems initiative, it has programs that span many aspects of power system development, from energy policy and energy economics to cyberphysical systems and interdependent infrastructures. Madhav Marathe, professor of computer science, distinguished professor of biocomplexity, and executive director of the Biocomplexity Institute, explained that UVA also has extensive collaborations with researchers at other institutions, including Virginia Tech, Princeton, and Los Alamos National Laboratory.

Marathe singled out UVA’s expertise in artificial intelligence (AI) as a distinguishing characteristic. “While AI will be a driver of significant energy demand in the future, it will also play a substantial role in the design, operation, and management of energy systems,” he said. Another issue UVA is taking on is the development of digital twins, a virtual representation of a social-technical system. “By creating a digital twin for an entire energy system and focusing on community issues, we will be able to develop and analyze complex issues such as optimizing electric vehicle adoption and charging and harnessing solar, wind, and nuclear to meet growing energy needs,” he said.

PARTICIPANT BIOGRAPHIES

Emil Avram is vice president for business development at Dominion Energy. He is responsible for the growth and development of Dominion Energy Virginia’s regulated utility power generation portfolio as well as other affiliate businesses, including development of nuclear, fossil fuel, renewable energy, and energy storage facilities. He has led the development and construction of over $20 billion in energy, gas pipeline, and power-generation projects.

Ed Baine is president of Dominion Energy’s utility operations and Dominion Energy Virginia. He is responsible for all facets of the utility’s business operations, including Dominion Energy Virginia, a vertically integrated electric utility with generation, transmission, and distribution assets that provides electric service to 2.8 million customer accounts in Virginia and northeastern North Carolina, and Dominion Energy South Carolina, which serves 800,000 electric utility customer accounts and 500,000 gas utility customers in South Carolina.

Nick Blessing is the director of public policy and economic development at QTS Data Centers, a leading global provider of colocation data center services and technology infrastructure. He has created and grown QTS’ multi-state government affairs practice and has been responsible for the implementation of various public-private workforce development programs, sustainability initiatives, community partnerships, and pro-industry legislative policies across the country.

Robert Carritte served as a principal officer at MPR Associates. He has participated in numerous design, procurement, and construction projects including entire power plants, substations, and transmission interconnects. He has also supervised and managed a wide variety of major projects involving different types of facilities and technologies, including nuclear, coal-, and gas-fired power plants, large-scale wind farms, switchyards and substations, liquid natural gas facilities, petrochemical and steel facilities, and naval vessels.

Hannah Coman is senior associate general counsel at Apex Clean Energy, one of the largest clean energy companies in the United States. She works closely with business development to negotiate off-take agreements for wind, solar, and storage projects across the country. Coman previously worked at the Southern Environmental Law Center in Charlottesville as the Virginia solar attorney, where she advocated for effective solar policy in Virginia and across the Southeast.

Larry Corkey is manager for policy and planning at the Virginia Department of Energy. He has also served on the Virginia Nuclear Energy Consortium Authority. Corkey has long been involved in state energy policymaking and is a graduate of the Virginia Natural Resources Leadership Institute.

Chris Cosby is CEO of Old Dominion Electric Cooperative (ODEC). He joined ODEC in 2018 as vice president of regulatory affairs and subsequently served as director of asset management, senior vice president of power supply, and chief operating officer. Before joining ODEC, he served in positions of increasing responsibility in the utility industry, including positions with Dominion Energy, General Electric, and Alstom Power.

Glenn Davis is director of the Virginia Department of Energy. Before being appointed by Governor Glenn Youngkin, he represented Virginia’s 84th District in the Virginia House of Delegates from 2014 to 2023, serving as chairman of the House Education Committee and subcommittee chairman of the House Appropriations Committee. Davis also served as vice chairman of the Joint Commission on Technology and Science, where he led the cybersecurity and blockchain subcommittees.

Dawit Haile is dean of the College of Engineering & Technology at Virginia State University and interim vice provost for academic affairs. As chair of the University’s Department of Mathematics and Computer Science, he led the development of undergraduate and graduate programs in computer science and helped establish the department’s research capabilities in machine learning, data mining, and cybersecurity. His research and teaching interests include combinatorics, graph theory, networks, and data mining.

Liling Huang is an associate professor in the Department of Electrical and Computer Engineering at George Mason University and the Dominion Energy Faculty Fellow in Power and Energy Systems. She initiated the Mason Power Community and established the Power Engineering Program Advisory Board. Her research interests include power systems protection and stability, microgrids, energy management, and smart building technology.

Cale Jaffe is a professor of law at the University of Virginia, director of its Program in Law, Communities, and the Environment, and director of its Environmental Law and Community Engagement Clinic. Through his work with the clinic, Jaffe has represented a diverse array of public-interest clients, from a community group working to preserve an early 20th-century Black schoolhouse in Cumberland County, Virginia, to local governments filing amicus briefs in the Supreme Court of the United States.

John Kotek, Sr., is senior vice president of policy development and public affairs at the Nuclear Energy Institute. He was formerly assistant secretary for nuclear energy in the Department of Energy, responsible for overseeing research on nuclear energy systems, maintaining the government's nuclear energy research infrastructure, establishing a path forward for the nation's spent nuclear fuel and high-level nuclear waste management program, and a host of other national priorities.

Mark Lauby, Sr., is senior vice president, chief engineer, and chief reliability officer at North American Electric Reliability Corporation (NERC). He joined NERC in January 2007 after working for the Electric Power Research Institute for 20 years. He is a member of the National Academy of Engineering, a fellow of the Institute of Electrical and Electronics Engineers (IEEE), and a winner of the IEEE Power and Energy Society's Roy Billinton Power System Reliability Award.

Chen-Ching Liu is the American Electric Power Research Professor and director emeritus of the Power and Energy Center at Virginia Tech. He is member of the National Academy of Engineering and a fellow of the Institute of Electrical and Electronics Engineers (IEEE). He received an IEEE Third Millennium Medal and the Power and Energy Society's Outstanding Power Engineering Educator Award.

Madhav Marathe is an endowed distinguished professor of biocomplexity, executive director of the Biocomplexity Institute, and a professor of computer science at the University of Virginia. His areas of expertise include digital twins, network science, artificial intelligence, multi-agent systems, high-performance computing, computational epidemiology, biological and socially coupled systems, and data analytics.

Paul McGlynn recently retired as vice president of planning for PJM. In that position he was responsible for activities related to resource adequacy, generation interconnection, and interregional and transmission planning, including the development of the Regional Transmission Expansion Plan (RTEP). Previously, McGlynn was PJM's executive director of system operations, ensuring the secure, reliable, economic, and coordinated operation of the system.

David Schleicher recently retired as president and CEO of the Northern Virginia Electric Cooperative (NOVEC). During his tenure, NOVEC achieved the lowest regulated residential rates and best reliability metrics in Virginia. He joined NOVEC in February 2017 and served as its chief operating officer and vice president of administration, substations, and telecommunications. Schleicher also held leadership positions at EnergyUnited EMC in North Carolina and PPL Electric Utilities in Pennsylvania.

Jay Silberg is an energy partner at Pillsbury Law. He advises clients on all aspects of nuclear law, including licensing, trial and appellate litigation, M&A and contracting, and policy development and compliance. He has regularly advocated for clients before the Nuclear Regulatory Commission, the U.S. Department of Energy, state regulatory commissions, Congress, and federal, state, and appellate courts.

Kate Smiley is the director of Virginia government affairs for the Data Center Coalition. She served as chief of staff to House Democratic Caucus Chairman Rip Sullivan and has lobbied state and local governments as an assistant vice president at McGuireWoods Consulting.

Randy Stamper is the assistant vice chancellor for grants and workforce programs with the Virginia Community College System. He leads administration and strategic planning for programs and initiatives including postsecondary Perkins, noncredit workforce training and credentialing, economic development projects, and multiple publicly and privately funded special initiatives.

Aaron Walker is president and chief operating officer of Appalachian Power and is responsible for all aspects of electric service for its more than 1 million customers. This includes distribution operations, safety, customer service, communications, external affairs, and regulatory affairs. He also is responsible for technical and operational support for Appalachian Power's generating fleet as well as Indiana Michigan Power and Kentucky Power generating assets.

Zhifang Wang is an associate professor of electrical engineering at Virginia Commonwealth University. She received the Donald G. Fink Prize Paper Award from the Institute of Electrical and Electronics Engineers. Her research interests include smart grid communications, large-scale system analysis, cascading failures, and real-time controls of electric power grids.

Robert S. Wright, Jr., is vice president–strategic partnerships, Dominion Energy Virginia. He leads the company's Strategic Partnerships team, which focuses on meeting the needs of its largest commercial, industrial, governmental, and electric wholesale customers. He also heads its Data Center Practice, Rural Broadband, and Energy Conservation organizations.

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