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A Growing Partnership

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A Growing Partnership

Climate READi has spawned impactful collaboration between EPRI and national laboratories.

By Chris Warren

As the director of Argonne National Laboratory's Center for Climate Resilience & Decision Science (CCRDS), Tom Wall devotes a lot of time to translating climate science and data into something society can use. It's a challenging task. "The output of a climate model is useless to anybody except climate scientists," Wall said.

Finding ways to make climate science and data usable is particularly important in the utility industry. After all, utilities need to make long-term decisions and investments to harden grids against climate-related extreme weather events and understand how climate change can potentially impact the demand for electricity and the output of thermal and renewable power plants.

Fortunately, Wall and his colleagues have made progress in bridging the understanding gap between climate science and specific utility industry needs. "We've gotten really good at both translating that data into something people can use and taking the next step and putting it into power grid models or power system vulnerability analyses," Wall said.

The growing collaboration of Argonne and the electric power industry is just one example of the research and educational partnership between EPRI and U.S. Department of Energy (DOE) National Laboratories as part of Climate READi (REsilience and ADaptation initiative).

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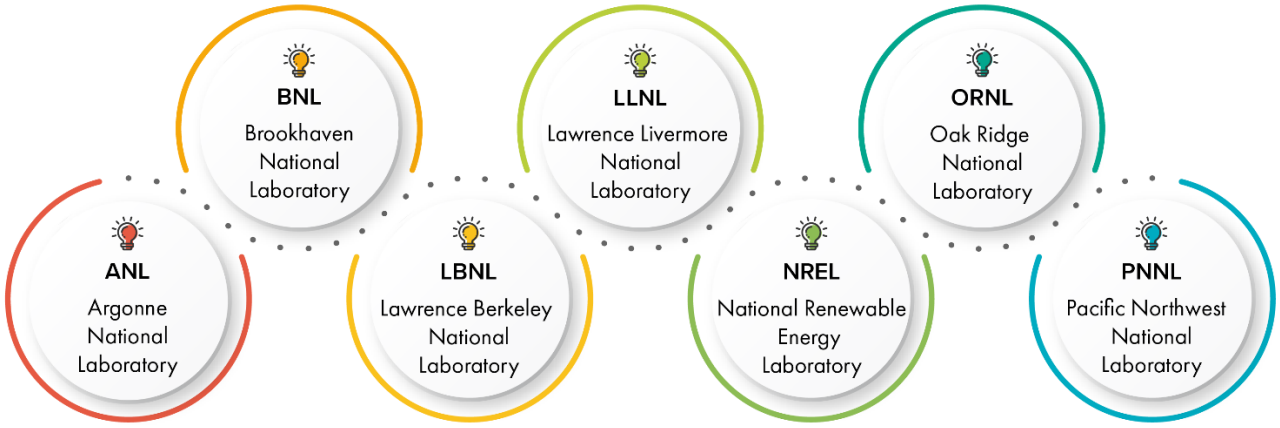
Seven Labs are Part of EPRI's Climate READi Affinity Group (CRAG)



The group brings together representatives from non-governmental organizations, insurance and finance, government and regulatory bodies, and academia to provide expertise and insights to bolster energy sector resilience and adaptation.

The partnership between EPRI and the national labs takes many forms. For example, EPRI has hosted a series of regional Climate READi workshops in collaboration with the laboratories. Each focused on topics that addressed the specific climate hazards the region may be exposed to and leveraged the unique research expertise of the labs. For example, the Southeast Regional Workshop held in April of 2024 with Tennessee's Oak Ridge National Laboratory explored the impacts of hurricanes and extreme cold on the power system, as well as the lab's super computing capabilities and its application to analyzing climate conditions.

This past August, EPRI and the Brookhaven National Laboratory in New York hosted a workshop at John F. Kennedy International Airport that examined the power system impacts of flooding and cloud development. These two workshops followed the success of the two workshops hosted in 2023 with Argonne and Pacific Northwest National Labs.

BETTER TOGETHER

EPRI and the national laboratories have a powerfully symbiotic relationship.

"The labs have strong scientific and regional capabilities. They're advancing research that can make a big difference globally, nationally, and in the regions where they are located," said Morgan Scott, director of Climate READi, sustainability, and ecosystem stewardship at EPRI. "EPRI brings expertise and perspective on practical application for the energy system. By working together, we can get their work into the hands of utility practitioners and accelerate impact."

The four regional Climate READi workshops provided a unique opportunity to share knowledge, experience, and insight. That was the case at the most recent workshop in New York, which occurred after an August 2024 weekend of torrential storms and flooding in the region. An initial day of training on the principles of climate hazard, exposure, and vulnerability assessment was followed by a series of presentations from experts on the impacts of clouds and flooding on the power system.

This is an area of particular expertise at BNL. "We know more about clouds, aerosols, and storms than most, and they're a big issue for utilities," said David Manning, who heads up BNL's Stakeholders Relations Office. "We are very focused on sharing as much of that understanding with utilities as possible, and the workshop was an opportunity to do that efficiently."

At the conference, attendees also heard from local New York organizations about their experience preparing for and responding to strong storms, including 2012's Superstorm Sandy. Con Edison engineer Mike Ragona and Eric Wilson, who leads climate resilience for New York's Metropolitan Transportation Authority (MTA), described how Sandy and other storms flooded neighborhoods and subway stations and led to power outages. They also shared plans for maintaining power and transportation during storms, including integrating equipment that can withstand underwater submersion and relocating critical infrastructure.

Attendees also learned about the New York Climate Exchange, a unique hub for policymakers, academics, researchers, industry, and students to collaborate on climate solutions that will be located on Governor's Island. "BNL was able to introduce EPRI's membership to this groundbreaking project in terms of the future of climate change study," said Elspeth McSweeney, Director of the Energy and Photon Science Growth Office at BNL. "There's a big educational component to it, but research is also a big focus, and it's something EPRI members should be aware of and potentially participate in."

While the knowledge sharing possible at Climate READi workshops is valuable, McSweeney notes that the events spawn new opportunities to collaborate.

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"We're now engaging on a much broader level than just Climate READi," McSweeney said. "We've connected on hydrogen, community engagement, and quantum, all really diverse connections." One of the benefits of working more closely with EPRI is that it provides BNL with connections to original equipment manufacturers (OEM) with which EPRI is already engaged in research.

ORIGINAL RESEARCH

Climate READi has also birthed specific research efforts that combine the unique research capabilities of the national labs and EPRI. For example, in February 2024, EPRI and Argonne released a READi Insights publication about downscaling global climate model outputs.

Historically, global climate models, as their name indicates, simulate the earth's climate at a global scale. This means that these models, typically run at daily time steps with a coarse spatial resolution of around 100 kilometers, lack granular temporal and spatial resolution relevant to power system modeling. Argonne's expertise in climate science and modeling helps produce climate models that consider local conditions, which makes them more useful to utilities and other organizations making grid resilience and other decisions. The transformation of coarse data to granular, locally relevant information is known as downscaling.

"Argonne has expertise in climate science and modeling. We combine that supercomputing to run these regional climate models of the future," Wall said. "We don't just model the entire globe's climate. We focus on North America and much smaller spatial domains to do much more detailed modeling."

This approach also bolsters the local relevance of climate science by layering in many more factors than is the norm. For instance, most climate data is generated through a process called statistical downscaling, which takes data from a global climate model and builds a statistical relationship with historical records of a small number of data points, like rainfall and temperature.

"That's how you get to estimate local impacts, but it's only for a couple of variables, and it's usually only daily values," Wall said. "We can model 60 different climate variables. I can tell you about future solar irradiance in different parts of the country and wind activity, both of which are relevant to renewable generation. We can also look at changes in extremes, like the combination of temperature and humidity, to look at the heat index. We have a lot of flexibility in projecting unique and relevant climate impact variables into the future."

Collaborating with EPRI on the publication also helped Argonne educate people who eventually use climate data to make decisions. By developing and distributing the downscaling report, Argonne and EPRI provide an overview of how climate data is made and the different tools needed to produce it. "This makes it accessible in a way that someone at a power utility could understand the data and gain greater confidence in what the data is telling them," Wall said.

Another Climate READi example of EPRI and a national lab combining expertise is the production of a map showing how hurricane-related power outages may change under different climate scenarios. The work was developed jointly by EPRI and PNNL and combined EPRI's expertise about the power system and outages with the lab's understanding of hurricanes.

Climate READi has catalyzed many new and mutually beneficial areas of collaboration between EPRI and the national labs. But these initial engagements are just the beginning of a deeper and more productive partnership.

"As a springboard for future collaboration, Climate READi has already been a wild success, and I hope that type of collaboration will only continue in the future," Wall said. Wall sees opportunities to produce climate data that more specifically meets the needs of utilities. More generally, he believes the increasingly apparent impacts of climate change will only accelerate the need to work together.

"The industry is going to continue pursuing climate resilience work. They see the financial benefit of it from a capital perspective because the impacts are getting more expensive," Wall said. "There are so many ways we can combine the expertise of the labs and EPRI to provide value to the industry and society."

Climate READi will culminate next spring with the publication of the *Climate READI: Power Framework*, which provides another opportunity to underscore the collaboration of EPRI and the national labs. The framework's launch event will take place at the *Battelle Innovations in Climate Resilience Conference* hosted in Washington, DC, April 21-23, 2025.

Battelle is the managing entity of nine national labs, including several CRAG participants. "The Battelle conference is going to be an incredible celebration of three years of hard work, and we are excited to be launching at an event where we can not just announce the finalization of the framework but have three days of important sessions to explore the future of climate resilience solutions," Scott said. "We look forward to bringing together our Climate READi team, national lab collaborators, member companies, and other CRAG participants in DC to continue the meaningful conversations we've been facilitating for the past three years—and will undoubtedly continue to explore together for years to come."

EPRI TECHNICAL EXPERT

Morgan Scott

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A Marriage of Sun, Farmland, and Technology

How artificial intelligence (AI) can boost community support, financial returns, and performance of agrivoltaics projects

By Chris Warrenc

Agrivoltaics may be a relatively new concept, but many of its benefits are based on concepts farmers have grasped for centuries. Agrivoltaics is when solar photovoltaic (PV) panels are installed above crops so that the same land can be simultaneously used for energy and food production. When panels provide partial shade to crops, the shade reduces water evaporation and bolsters soil moisture levels by protecting the soil's microbiome and productive capacity. Some crops can also increase solar production through increased albedo (reflected sunlight) and evaporative cooling.

Long before anyone imagined agrivoltaics, farmers planted shade trees, mixed tall and short crops to provide shade, and used cloths and nets to limit exposure to sunlight. While the basic concepts behind agrivoltaics are nothing new, technological advances can improve everything from where projects are sited to the day-to-day operations and potential long-term value of co-locating farming and solar energy production.

A recent EPRI technology innovation spotlight, *Artificial Intelligence and Agrivoltaics*, examined how AI and machine learning (ML) can help pinpoint communities likely to welcome projects and optimize their energy and food production once built.

Already, AI is being deployed to improve the production of individual solar power plants. This is no surprise: AI has extraordinary power to comb through massive data sets and pick out valuable trends and insights. For example, AI can analyze meteorological data and forecasts to adjust solar panels installed on a tracker to maximize energy production based on factors like temperature, cloud cover, and the intensity of sunlight. AI and ML can also bolster predictive maintenance by monitoring data for signs of everything from wiring problems to panel degradation and failure to inverter problems. By detecting potential problems before they materialize, AI and ML can trigger proactive maintenance that allows a solar generation facility to avoid disruptions that reduce its power output and revenue.

Similarly, AI and ML are being applied widely to improve agriculture production. For example, when combined with sensors that collect data on a farm, AI and ML can guide decisions about irrigation, planting, and harvesting based on soil quality and the health of crops. A recent study by the consulting firm McKinsey & Company estimates that AI can drive about $250 billion in value by improving crop yields, reducing costs for labor and inputs like fertilizers and pesticides, and by increasing sales and overall operational efficiencies.

UNIQUELY SUITED TO COMPLEX DATA PROBLEMS

If AI can benefit solar and agriculture individually, can it also be helpful when the two are combined in agrivoltaics projects? Bailie Neary, an energy systems and climate analysis engineer at EPRI, investigated that question to produce a technological innovation spotlight. Going into the project, Neary thought it reasonable that AI could be helpful to agrivoltaics. “Agrivoltaics and AI makes sense because it’s a complex optimization problem,” Neary said. “It felt like AI could benefit deployment.”

In researching the topic, however, Neary could not find any specific examples of real-world projects combining AI and agrivoltaics. However, AI’s potential to improve agrivoltaics has attracted the interest of the U.S. Department of Energy (DOE). Earlier this year, the DOE issued the report, *AI for Energy*. The report identified a wide range of areas where AI could accelerate decarbonization and grid resilience, including its capacity to forecast renewable energy production and streamline planning and permitting for transmission and other projects.

The DOE report identified the co-location of renewables and agriculture as one promising use for AI. “One specific example of such co-location is agrivoltaics, the combination of solar and agriculture, but other examples may include co-location with wind or geothermal or the use of agriculture for biofuels,” the report said. “AI can also translate land use challenges, from siting, permitting, and optimizing how to incorporate other economic uses, into opportunity maps for renewable energy developers.”

A TOOL FOR SCALING AGRIVOLTAICS

Agrivoltaics could use the potential boost AI offers. “True agrivoltaics where you have crop production—and that could be specialty crops, food crops, herbs—is difficult to scale to the size of traditional utility-scale solar facilities,” said Terry Jennings, an EPRI principal team leader whose research focuses on addressing environmental challenges of large-scale renewable energy development. “You see it mostly at what I would call commercial and industrial (C&I) scale projects. They’re typically five megawatts or less.”

Scaling agrivoltaics means tackling several challenges, including reducing upfront project costs, finding sites where communities will welcome projects, and operating sites to balance energy and agriculture production properly.

Here’s how AI could be beneficial at different stages of an agrivoltaics project:

Site Selection

Improve initial site selection for agrivoltaics projects and boost the likelihood of successful community engagement.

Business Case & Finance

Help assess the financial viability of agrivoltaic projects by considering electricity demand, wholesale market prices, and revenue sharing among stakeholders.

Project Development & Operations

Accelerate and improve combing through large amounts of collected data to better inform operational decisions.

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Site selection. One of the main barriers to expanded renewable energy development is community opposition. According to researchers at the Massachusetts Institute of Technology (MIT), 53 utility-scale wind, solar, and geothermal projects in 28 states were delayed or blocked between 2008 and 2021 due to various opposition sources. EPRI collaborated with Louisville Gas & Electric-Kentucky Utilities (LG&E-KU) to research potential vegetation management savings from grazing sheep at agrivoltaics facilities. The work was partly driven by a desire to address community concerns that solar degraded local ecosystems and made land less suitable for agriculture.

Proactively addressing community concerns and working together to ensure solar projects benefit citizens can be a good approach for project developers. However, AI could also potentially improve the initial site selection for agrivoltaics projects and boost the likelihood of successful community engagement. “It would be possible to have some data that allows us to determine which sites might be best based on some sort of census tract level social acceptance or availability of farmland,” Neary said. “It could be a way to filter many potential site options and come up with a map of the most promising sites.”

Building a business case and attracting financing. Project financing is a challenge for any solar project. But when solar is combined with agriculture, modeling the financial returns investors, farmers, and solar developers want to see becomes extremely complex. AI can be used to assess the financial viability of an agrivoltaics project by considering electricity demand, wholesale market prices, and how revenues can be shared equitably among stakeholders to ensure long-term collaboration.

Part of building a business case for agrivoltaics also relates to site selection. AI can help evaluate a potential site based on metrics of potential community support and can also factor in agricultural economics. “This is very site and region-specific,” Jennings said. “You could combine some form of AI or ML into a GIS tool and look at the market value of crops in that area to help identify potential sites.”

Project development and operation. Limiting the capital and operational expenses of agrivoltaics projects while maximizing their energy and food production is critical to their financial viability. Decisions about project design, equipment selection, and day-to-day operations involve combing through large amounts of data, a process that can be accelerated and improved with the help of AI.

For example, agrivoltaics projects can take advantage of sensors to provide a steady stream of real-time data. Because solar and crop production can be improved by adjusting to changing weather, soil, and other conditions, applying AI to all that collected data can inform better operational

decisions. For example, temperature monitors could trigger a shift in tracking panels when an array is overheated and producing less electricity; that movement of the panels could benefit crops by allowing needed sunlight to reach plants.

"Already, agrivoltaics research sites have installed sensors to track soil moisture, evaporative cooling, solar irradiance, and power production," Neary said. "The next step would be to analyze the data with AI and ML and use the insights to inform and possibly automate real-time decisions that improve the site's performance."

In 2023, EPRI collaborated with the New York Power Authority (NYPA) to identify leading practices in developing agrivoltaics projects. Among the main findings of the research was that a major hurdle to agrivoltaics projects is the fear among farmers of losing valuable food-producing land.

Without the support of farmers, agrivoltaics projects will be rare. AI and ML, however, provide an opportunity to proactively address the concerns of farmers and communities and support the development of high-performing projects that deliver financial benefits to everyone involved.

"Agrivoltaics is still in its infancy, and lots of people are trying to figure out the best way to pursue these projects to benefit everyone," Jennings said. "So much data needs to be understood and acted on to site, build, and operate these projects in the best way possible. I think that is where AI can really help."

EPRI TECHNICAL EXPERT

Bailie Neary

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Local Engagement, Global Impact

The many benefits of expanding EPRI's presence around the world

By Chris Warren

Last November's gathering of the 29th Conference of the Parties (COP29) of the United Nations Framework Convention on Climate Change brought together government, industry, non-profit, and other stakeholders from across the globe. EPRI had a strong presence at COP29, which was held in Baku, Azerbaijan, including participation in several panel discussions about topics such as the challenges of meeting net zero goals in a period of rising electricity demand and how artificial intelligence (AI) can accelerate the deployment of small modular nuclear reactors (SMRs).

The U.S. Department of State's Bureau of International Security and Nonproliferation used COP as the venue to announce a grant to EPRI supporting the Foundational Infrastructure for the Responsible Use of Small Modular Reactor Technology (FIRST) program. As part of FIRST's Project Phoenix, EPRI's Advanced Nuclear Technology staff will conduct assessments to evaluate the possible conversion of existing coal plants in Ukraine to SMRs.

The work will include mapping suitable SMR technologies to specific sites, evaluating existing equipment and technology for possible reuse, analyzing environmental issues, and developing guidance for both engaging communities and transitioning workers to new roles. EPRI will work closely with stakeholders in Ukraine's energy sector and expects to complete its assessment by the end of 2025. The project in Ukraine is part of a larger global effort to speed commercial deployment of SMRs—which was a topic of intense interest in Baku.

A LOCAL PRESENCE

EPRI's participation at last year's COP29 is part of a larger institutional commitment to build broader and deeper engagements across the globe. There are myriad reasons for EPRI to enhance its global presence, including the opportunity to share best practices and technology solutions in structured collaborations around the world.

"Countries want their economies and their capabilities to rise as a result of smart energy investments," said Neil Wilmshurst, who led EPRI's

COP29 delegation and is EPRI's Chief Nuclear Strategy Officer and Managing Director, EPRI Gulf. "They want to see a greater local presence. To play our role in helping regions secure reliable, affordable power, we're going to take our global approach deeper to have a local presence and local capabilities."

With more than 400 member companies in 45 countries, EPRI has bolstered global partnerships to build its local capacity. Besides participating at global forums like COP, EPRI has international offices in Dubai, United Arab Emirates, and Dublin, Ireland, international employees in Latin America and Asia, and is increasingly active at events, such as the "Powering the Future Toward Net Zero" forum in Saudi Arabia. EPRI co-hosted the forum with the GCC Interconnection Authority (GCCIA), a regional organization whose mission is to manage an interconnected power grid among member states of the Gulf Cooperation Council, the International Association of Large Grid Operators, GO15, and the Mediterranean Transmission System Operators Association (MED-TSO).

While these sorts of collaborations are important, EPRI also understands that true global engagement demands consistent, on-the-ground effort to build knowledge and trust within individual nations. For Wilmshurst, that means being grounded in how EPRI provides knowledge and expertise around the world, including insights and experience provided by local technical experts.

"To be successful in transferring knowledge and technology, you must be very aware of the local context you're working in," Wilmshurst said. "Every region is different and will need nuanced approaches."

EXPANDED OPPORTUNITIES FOR COLLABORATION

Expanding EPRI's capacity to support members in nations and communities around the world is the most effective strategy to make a more profound, beneficial impact.

Here's why: Collaboration is core to EPRI's work. Whether it's partnering with national research laboratories, member utilities, universities, or companies, the value of EPRI's research multiplies

EPRI's Neil Wilmshurst and EPRI Gulf's Zaid al-Ansari at COP 29

when it includes myriad stakeholders with unique experience and expertise. And the benefits collaboration can deliver deepen and expand when it includes a broader set of partners.

"There's a huge amount going on outside the U.S. that everyone can learn from. If you're present in Japan, Korea, Italy, and Africa, you can see what they're doing, provide input, and bring lessons back," Wilmshurst said. "If you have a bigger network, everyone moves faster."

WHY EVENTS LIKE COP29 MATTER

Participating in events like COP29 that bring together policymakers, regulators, academics, companies, and others is an important tool for expanding potential partnership opportunities. In part, that's the result of formal and informal face-to-face engagement with people you would otherwise have no reason to meet. However, global forums like COP29 can also be an important starting point for understanding the nuanced local challenges and opportunities nations face as they contemplate energy technologies, policy, and investments.

This was exactly the case at COP29 in Baku. Indeed, on one level, Wilmshurst was struck by how much focus was devoted to data centers and artificial

intelligence (AI). For many participants, a central challenge of the energy transition is finding ways to power energy-hungry data centers without derailing ambitions to achieve net-zero carbon emissions targets. “Is AI a challenge or an opportunity? This is the question that is posed again and again,” Wilmshurst said.

COP attendees from emerging economies, however, were having very different conversations. Instead of contemplating the necessity of keeping coal plants operating to run data centers or how quickly new nuclear capacity could be brought online, emerging economy participants focused on the potential renewable energy has to solve pressing societal problems.

“It’s about getting reliable electricity to communities where access has long been a challenge – where energy is not just a climate issue, but a matter of equity and survival,” Wilmshurst said. “It reminds us that a truly global energy transition must account for vastly different starting points, ambitions, and challenges.”

TURNING ENGAGEMENT INTO ACTION

Gatherings like COP29 provide insights that EPRI can use to guide future partnerships and research. For example, a prevalent theme of discussion in Baku was about the broader impacts of clean energy technologies. “There was a lot of talk about the environmental impact of what we're doing to address climate change,” Wilmshurst said. “We need lithium for EV batteries, but what environmental impact does that have on communities where the mines are? We can build solar panels that cover the whole of California. But is there a better way to do this?”

They also highlight areas where EPRI’s existing knowledge and expertise can deliver immediate value. For example, in Baku—unlike previous COPs—there was less of a focus on pinpointing a magical technology that can solve the world’s energy and climate challenges. “What changed in Baku was the conversation became more pragmatic. It’s actually about trying to build stuff,” Wilmshurst said. “That was a discernable change from past COPs.”

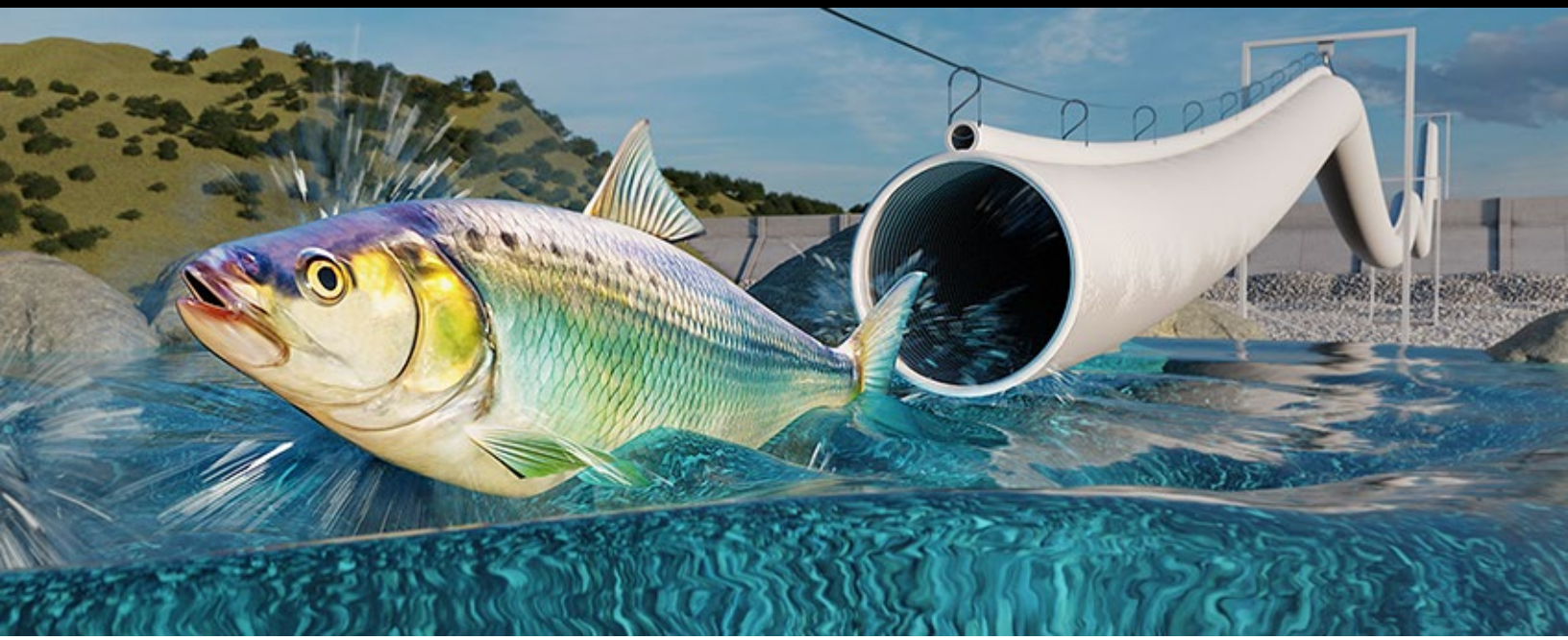
Photo courtesy: EPRI Staff

EPRI’s depth of research about everything from grid-enhancing technologies (GETs) to materials to license extensions for nuclear power plants can all help support global efforts to increase the supply of electricity from low-carbon sources.

For Wilmshurst, COP29 was also a reminder of how much EPRI’s fundamental mission aligns with and can support the various goals within world energy systems. This was reinforced when he spoke with a past chair of a COP. “He said people have been fixated too long on finding the cheapest solution to meeting the world’s energy needs and reducing emissions. They now need to find the *right* solution,” Wilmshurst said. “It’s about finding the right balance of what’s right for society, what’s right for the economy, and what’s right for the environment. I think EPRI can bring a lot to that.”

EPRI TECHNICAL EXPERT

Neil Wilmshurst



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Fish Tech

EPRI and Santee Cooper pilot new technologies to improve fish survivability

By Chris Warren

New technology to help fish scale dams and reach their spawning grounds isn't typically destined for pop culture fame. But that is exactly what happened when the Whooshh Passage Portal was first introduced in 2019. Meant to serve as an alternative to fish ladders and lifts, the portal uses a combination of piping, suction, and mist to whisk fish up and over dams.

The technology, also dubbed the fish cannon, was sufficiently novel to catch the attention of comedian Stephen Colbert, who featured it on his late-night show in a segment dubbed "Big News In Fish Transport." Colbert even offered up a few alternative names for the portal, including the "trout spout" and "flinging Nemo."

Clearly, though, the makers of the portal didn't create the technology to be meme-worthy; it was developed to solve a real-world challenge. "There are fish species that need to get upstream to spawn; that's part of their life cycle," said Jon Black, an EPRI technical executive who manages the Aquatic Resource Protection Program. "Fish ladders and fish lifts, which are like elevators for fish, are super expensive. They are made of concrete and steel and require a big engineering process. And there's no guarantee that they're going to be attractive to fish, so you run the risk of putting in a ladder or a lift that doesn't get many fish over the dam."

SANTEE COOPER PILOTS THE WHOOSHH PASSAGE PORTAL

Real-world testing is necessary to gauge the viability of new technologies like the portal. South Carolina-based utility Santee Cooper recently received an EPRI Technology Transfer Award for piloting the Whooshh Passage Portal along with two other technologies aimed at enhancing fish survival near the utility's generation facilities.

Santee Cooper's origins are decidedly aquatic. The Santee Cooper Power and Navigation Project was the largest earth-moving project in American history when it was built between 1939 and 1942. By creating Lake Moultrie and Lake Marion, the project made hydroelectric power generation possible, which delivered much-needed electricity to Depression-era rural South Carolina.

According to Will Stevick, Santee Cooper's director of construction services management, regulatory compliance, cost, and environmental stewardship drove the utility's willingness to test the portal to see if it could help American shad in the Santee River get up and over a 40-foot-high spillway at one of its hydropower facilities.

"As part of our FERC (Federal Energy Regulatory Commission) licensing for the dams and dikes involved in generating hydropower, we are required to recommend a method to get migratory fish over the St. Stephen spillway structure at Lake Marion," Stevick said. "We are going to do whatever it takes to be compliant with all FERC regulations."

The utility had reasons beyond regulatory compliance to investigate the portal. The area's economy benefits from healthy populations of shad and herring for commercial and sport fishing. "Environmental stewardship is one of our corporate values," Stevick said. "We are going to do what it takes to operate the lakes and our hydropower facilities in an environmentally responsible manner. With or without regulatory oversight, it's the right thing to do to make sure that the shad are as uninhibited as possible."

THE PORTAL'S UNIQUE CAPABILITIES

One of the most innovative features of the Whooshh Passage Portal is its simple, removable design, allowing it to be easily taken out of the water when there's a risk of ice or flood damage. This is made possible by the portal's floating barge, which houses an entryway where fish swim in and ascend a short fish ladder before being gently propelled through the tube by air pressure, safely transporting them over the dam.

While fish ladders are designed to accommodate the swimming capabilities of specific species, the portal can potentially benefit a wider range of fish. "In the case of this technology, if you can collect the fish at the bottom, you can transport them passively up through the tube," said Paul Jacobson, an EPRI technical executive. "This allows you to help a much wider range of species with different swimming capabilities." Fish also expend a lot of energy to climb ladders. The portal allows them to conserve energy for the final swim to spawning areas.

Photo courtesy: Santee Cooper

Areas beyond fish spawning can benefit from the portal. For example, before being transported through the portal's tube, the fish pass a camera equipped with artificial intelligence (AI). The camera can instantly identify the species of each fish, which can help contain invasive species that damage ecosystems. "You can divert the invasive species that you don't want to pass above the dam. They can be shunted into a tank for removal or sent back to the tailwater," Jacobson said. "The dam then remains a barrier to the spread of invasive, unwanted species."

LESSONS LEARNED AND A NEW PILOT

Santee Cooper's test of the Whooshh Passage Portal failed to transport American shad over the utility's dam. The portal functioned as expected; the problem was that the deployment was not ideally suited to the behavior of the fish. "The system has worked very well with salmon, which are very aggressive, strong upstream swimmers," Jacobson said. "While certainly capable of vigorous upstream movement, the American shad is not as capable a swimmer as the salmon, and they require different conditions at the entrance to the fishway."

In the spring of 2024, Santee Cooper and EPRI tested a different fish transport technology. Like the Whooshh portal, the Fishheart system includes a floating entryway and tubing that carries fish over dams. However, the Fishheart system does not require fish to climb a short ladder, which may deter some from entering.

Santee Cooper's trial of the technology was successful in transporting many fish species over the dam. The percentage of fish at the bottom of the dam that chose to enter the Fishheart is not yet

clear. Regardless, the pilots, which were both funded by the U.S. Department of Energy's (DOE) Water Power Technologies Office, will help inform Santee Cooper as it evaluates different ways to help local fish reach their spawning areas upstream. "We knew very little going into this, and we learned a lot," Stevick said. "We're looking for a cost-effective solution, and these tests will help us evaluate options and provide insights to inform other utilities."

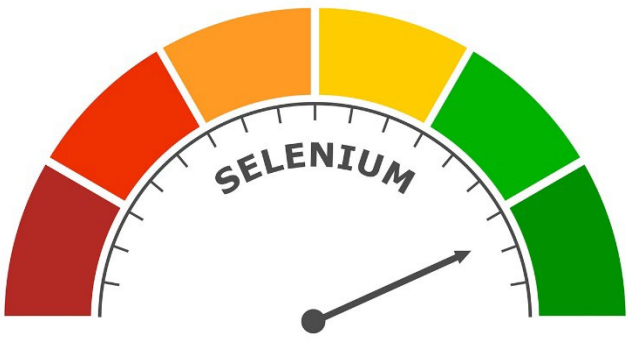
MEASURING AND MITIGATING THE IMPACT OF SELENIUM

EPRI and Santee Cooper piloted two other novel technologies designed to improve fish survivability. Both technologies seek to better protect fish from selenium, a known fish biotoxin produced at coal power plants.

Taken together, the technologies aim to accelerate the speed of selenium measurements and increase the effectiveness of treatment. Santee Cooper tested both the OndaVia Selenium Sensor and the Montrose Selenium Removal system for several months at its Cross Generating Station in Pineville, South Carolina.

Testing selenium concentrations in waterways has typically been a slow process. "Currently, you have to take a sample, put it on ice, send it to a laboratory, and then wait at least two weeks to get your results," said Jason Monnell, a principal technical leader in EPRI's Water Management Technology Program.

The long delay between sending samples to be tested and receiving results can limit the effectiveness of remediation efforts because plant operating conditions that impact selenium concentrations can change dramatically.



For example, biological treatment techniques can include the use of microorganisms that accumulate selenium as they grow. However, if there are long lags between taking samples and learning results, the first indication that selenium concentrations are too high could be insect mortality. "If you go from being in compliance to being 20 times out of compliance with selenium concentrations, you won't know for two or more weeks," Monnell said. "And you won't know that your bugs aren't happy until your bugs die."

The OndaVia Selenium Sensor, by contrast, provides results under 30 minutes. The ability to test frequently and get results means that treatment and removal measures can be responsive to current plant conditions. Real-time information about changing plant operations allows for quick adjustments to treatment and removal. "

At Santee Cooper, the accuracy of the OndaVia measurements were encouraging. Additional developments to harden the technology for use in the field, improve efficiency, and use the correct proportion of reagents are ongoing. However, the results indicate that the sensor could be valuable for utilities, mining, pharmaceuticals, oil refining, and semiconductors.

Santee Cooper and EPRI also tested the Montrose selenium removal system at the Cross Generating Station. Like the OndaVia sensor, the system represents a sharp departure from how selenium is typically removed from water. "A conventional selenium biological wastewater treatment plant right now runs on hundreds of amps and 480 volts because it needs huge pumps to convey 300 gallons a minute through it at pressure to go through anoxic conditions needed to remove selenium," Monnell said.

By contrast, the Montrose selenium removal system runs on just 120 volts and just a few amps. It relies on biologically active absorptive media, meaning a substance designed to attract and bind selenium from water. The system is equipped with telemetry that allows it to be controlled remotely. In the pilot, the system was able to remove selenium to meet effluent limits and other frequently regulated metals. The project identified ways to improve the system that are being implemented.

The fact that the system needs little power and can be controlled by off-site operators could make it especially suitable for remote locations and facilities no longer generating power. Significant cost savings are possible because the system removes the need to have an employee overseeing an on-site thermal wastewater treatment system. The economic benefit of remote-controlled wastewater treatment over 30 to 50 years is significant when considering the cost of personnel alone.

EPRI and its members will continue to develop passive treatment methods for treating water that has low power needs and minimal operator involvement. Future pilots and demonstrations that remove selenium, arsenic, mercury, and other toxins are being developed. “We are going to take these lessons learned and figure out how you apply it to the next iteration of technologies,” Monnell said.

EPRI TECHNICAL EXPERT

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