SANDIA LABNEWS
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SANDIA CELEBRATES EARTH MONTH

Electric vehicle battery safety in the front seat

By **Kristen Meub**

A Sandia-led team is working to test and predict the safety of advanced batteries, including solid-state and lithium-metal, while they are still under development. The goal is to create more affordable, convenient, efficient and resilient electric vehicle batteries.

The team, which includes UL Research Institutes, the University of Maryland and Purdue University, received $3.7 million from DOE's Advanced Research Projects Agency-Energy's Electric Vehicles for

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HEATING UP — Chemical engineer Loraine Torres-Castro, right, analyzes data as chemical engineer Alex Bates places samples into a differential scanning calorimeter. Analysis like this is part of a project to help make electric vehicle batteries safer. **Photo by Craig Fritz**

Enhancing advanced nuclear reactor analysis

RED HOT — Sandia engineers Kyle Clavier, left, and Dan Clayton have developed a standardized screening method to determine the most important radioactive isotopes produced by an advanced nuclear reactor in the unlikely event of an incident. **Photo by Craig Fritz**

Standardized screening aids NRC risk assessment in advanced reactor licensing

By **Mollie Rappe**

Nuclear power is a significant source of steady carbon-neutral electricity, and advanced reactors can add more of it to the U.S. grid, which is vital for the environment and economy.

For decades, Sandia has supported the Nuclear Regulatory Commission in its role of regulating and licensing nuclear reactors. With many advanced nuclear reactor designs being developed for potential licensing, this support is as important as ever, said Sandia geosciences engineer Kyle Clavier.

One of Sandia's newest aids for NRC licensing efforts is a standardized screening method to determine the most important radioactive isotopes that could leave an advanced reactor site in the unlikely event of an accident. The Sandia team recently applied it to a conceptual design for a heat pipe reactor and shared the results with the commission and greater scientific community.

Radioactive isotopes are unstable forms of elements that release energy in various forms of potentially harmful radiation as part of the process of becoming more stable isotopes. For example, naturally occurring radon-222 is a product of the decay of uranium and in turn decays into

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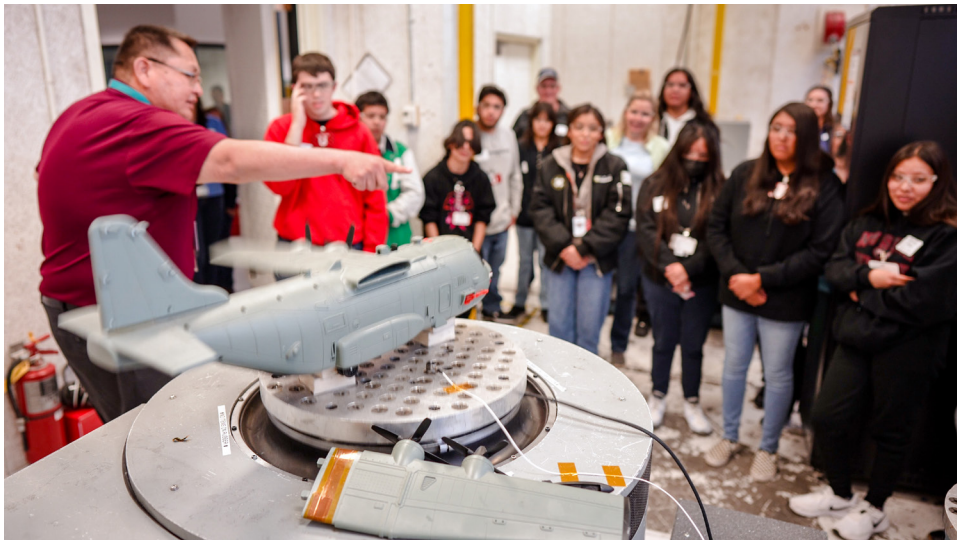

THE FEEL OF HOME — Mechanical engineer Fernando Bitsie, who attended the same high school in Gallup, New Mexico, as many of the students on the tour, shares his career story and conducts a vibration simulation at a Sandia environmental test lab. **Photo by Craig Fritz**

Inspiring the next generation of Sandia scientists

By **Kim Vallez Quintana**

"What high school do you think I went to?" asked Sandia engineer Fernando Bitsie to a group of students who visited a Sandia environmental test lab on March 30. The group, a little perplexed, looked at each other, unsure of how to respond.

"Let's try this again," Fernando said. He directed their attention to one student, wearing a Gallup High School letterman jacket and asked, "What school do you go to?"

The girl hesitantly answered, "Gallup High School?"

"Yes," Fernando said. "I grew up in the same place you did, a tiny town on the Navajo Nation."

The students' faces changed, each realizing Fernando's point: They have a lot in common with this longtime Sandia engineer and could one day be standing where he is.

This is one of many inspiring stories that the group of 40 students from Gallup, Grants and Hiroshi Miyamura high schools heard during their visit to the Labs. The majority of these students are already on track for STEM careers, taking part in the STEM Core program at their school. This program exposes students to advanced math classes, introduction to technical courses, skill development, intern preparation and employer visits. STEM Core is also part of the Successful Training and Effective Pipelines to National Laboratories, or STEP2NL, program, a partnership between minority-serving institutions and national laboratories to increase STEM degrees among minority students and a future workforce at the national laboratories.

THE ENORMITY OF SCIENCE — At 160 feet above ground, mechanical engineer Ken Armijo, wearing a green hard hat, shows students the interior of the 200-foot concentrated solar tower and the large lift that carries experiments to the top. **Photo by Craig Fritz**

Learning about STEM careers is one thing; seeing them firsthand is another.

"I am interested in being an engineer. I want the kind of job where I get to work on cutting-edge technology. The stuff we saw today was really cool and makes me more interested in an engineering career," said Alex Keller, a senior at Miyamura High School in Gallup, during the visit.

Exploring the solar tower

One of those cool things is Sandia's National Solar Thermal Test Facility — a tour stop that took students to new heights, literally. Students ascended many flights of stairs to the control tower that oversees the heliostat field and looked in awe as they learned about the 218 mirrored devices that harness and redirect the sun's energy.

"It's just amazing," said student Lukas Colburn.

"I didn't know these facilities existed out here, almost in the middle of nowhere," said student Ryan Tortalita.

High school senior Antonio Enriques described his amazement when visiting Sandia's solar furnace, which can generate up to 16 kilowatts of thermal power. "The towers and dishes and how that one big satellite can burn a hole right through a fire brick. I use fire bricks for welding. That is just crazy to me how it can burn right through."

The students then got to take a trip to the solar tower itself, but their journey was different than most. On this blustery, windy day, they took the trip underground. The students walked through a cement tunnel, lined on each side by cables and conduit and only wide enough for the group to walk in a single file. A quarter mile later, which felt like an eternity to the students, daylight emerged, and the students took an elevator up the 200-foot tower. Once inside, the students lined a metal railing and looked down the large shaft that houses a massive lift capable of carrying 100 tons of equipment to the top of the tower for testing. While peering down the shaft, students listened to stories that illustrated the enormous impact of the work that happens at Sandia.

"They're the future. They're going to be the ones working on this in 20 or 30 years," said chemist Andrea Ambrosini, who led part of the tour. "So, they know that they have options and that there are many types of interesting research."

Paving the way for STEM students

The students' next stop was the Thunderbird Café for a career conversation lunch where they met with other Sandians, many of whom were of Native American and Hispanic descent. Among them was Maxine Norton, who grew up in Pinedale, New Mexico. After lunch, Maxine led the students to the environmental test lab where she works and told them how she got there 30 years ago.

"I came in as a secretary," she said. "I worked in an office. After 15 years, I decided I wanted to do something different, so I took a soldering class at CNM."

Before she knew it, Maxine was on a new journey. She is now a technologist at Sandia. She advised the students to "stay in school and finish before you start a career. It's tough to go back to school, so focus on your education now."

Michael Arviso, another native New Mexican who shares a

similar background with the students, accompanied the group.

"I grew up on the Navajo Nation herding sheep and branding cattle, but I always said I wanted to be an electrical engineer," he said.

Michael told a story of how he first applied for a job at Sandia's Structural Dynamics Lab, which consisted of a team of mechanical engineers. Michael, who had an electrical engineering degree, thought there was no way he would get the job. "I applied anyway. I thought, why not try? All they can say is no. I've now worked here for 34 years," he said.

The stories shared during the visit inspired the students, many who might be the first in their family to go to college, to keep dreaming, push themselves and believe they can do something great.

"The reason I wanted to come on this trip was that I wanted to get another idea of what I can do after high school. I was sort of interested in engineering. Based on what I saw on this trip, I want to become a mechanical engineer. I'm going to UNM," senior Devan Zepeda said.

Stories like these demonstrate the success of these visits at a place where people are encouraged to try new things and test the limits, not just with science but within themselves.

A RARE VISIT — New Mexico high school students from Grants, Gallup and Hiroshi Miyamura high schools walk through the quarter-mile-long tunnel beneath the heliostat field at the National Solar Thermal Test Facility during a STEM tour. **Photo by Craig Fritz**

Battery safety

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American Low-carbon Living program. Their aim is to develop a combined experimental methodology and modeling framework approach to improve safety in battery development. The project will result in a publicly available, multiscale testing manual and modeling tool to predict a battery's safety profile.

"We want to understand how batteries fail and why they fail," said Loraine Torres-Castro, chemical engineer and project co-lead. "It's critical to characterize battery safety hazards early in the design process. This is the first time a funding opportunity has safety taking the front seat for battery research."

Most battery safety research happens after the battery has been developed and is close to commercialization, Loraine said. However, that approach takes a lot of research and development, funding and manufacturing time.

"You don't typically see thermal runaway at small scales," said Alex Bates, chemical engineer and project co-lead. "That's a big issue with the traditional way of studying battery safety. The safety profile can significantly change as the cell size is scaled up to a commercial size, and that takes a lot of time and investment."

Instead, the team will work to link the small-scale characteristics from calorimetry and materials-level analysis of various battery materials to a large-scale response through predictive modeling.

To do this, the team will assemble microcells of battery materials, which are tiny stacks of the components that go inside the larger battery cell, heat them up and study how heat releases from the material. Data from these experiments, combined with materials characterization, will be used in a modeling framework to predict the safety of larger cells.

SAFETY FIRST — Chemical engineer Alex Bates places a sample into a differential scanning calorimeter. He's part of a Sandia-led team working to predict the safety of advanced batteries while they are still under development. **Photo by Craig Fritz**

"If the materials are reactive, you'll see an exothermic event, with more heat releasing than what was put in, even at the materials level," Alex said. "That kind of reaction, when scaled up to a full-size battery, could potentially cause a fire."

Kyle Fenton, the power sources manager, said the Battery Abuse Testing Lab has focused on understanding battery mechanisms, safety and fundamentals for the last 20 years.

"We have lots of expertise in this area of research, but EVs4ALL is one of the biggest opportunities we've had to focus on the fundamentals and safety of emerging energy storage technologies."

Nuclear reactor analysis

CONTINUED FROM PAGE 1

polonium-218, releasing alpha radiation. This decay process is particularly harmful if it occurs in someone's lungs, which is why the Environmental Protection Agency urges homeowners to test for the buildup of radon gas in their houses.

"We're having a nuclear renaissance right now, where quite a few new reactor designs are coming out that promise to have more passive safety features, be more modular and have other advantages over conventional nuclear reactors," said Kyle, who has worked on the method and applying it to an example reactor design. "We are working to provide the NRC the tools it needs to make sure that when these new advanced reactors are licensed, the NRC can accurately quantify the potential risks and thus ensure that the reactors are safe for operation."

A heat pipe reactor is an advanced design that uses a substance such as an inert gas or liquid metal to cool the core. This means that the reactor could potentially need a lot less water than light-water reactors, which use normal water to cool the nuclear fuel and produce steam to generate electricity, said Dan Clayton, a Sandia nuclear engineer also heavily involved in the project. Light-water reactors are the most common type of nuclear power plant design.

Additionally, the fluid in the heat pipes does not need any moving parts, such as valves or pumps, to regulate the core's temperature, which means they do not require electricity to ensure the safety of the reactor.

Winnowing down the list

The team's screening method starts with an inventory of potentially thousands of radioactive isotopes produced by a nuclear reactor and sorts them to determine the radioactive isotopes that pose the most risk to humans and the environment in the unlikely case of an accident.

In the example of a heat pipe reactor, they started with Oak Ridge National Laboratory's preliminary list of more than 1,200 radioactive isotopes predicted to be generated by this kind of reactor. First, they removed the isotopes that decay very quickly, said Kyle.

For example, rhodium-106, a form of the element rhodium with 45 protons and 61 neutrons, has a half-life of 29.9 seconds. This means that after 30 seconds, half of the initial amount of rhodium-106 will have become palladium-106 — a stable metallic element with 46 protons and 60 neutrons — releasing beta radiation. After a minute, only a quarter of the initial amount of rhodium-106 will remain. Even if an accident were to occur rapidly, very little rhodium-106 would remain to affect people or the environment.

Then the team pared down the list by removing very rare isotopes, specifically isotopes that comprised less than 0.0001% of the total radioactivity of the inventory.

"One of the reasons behind this screening method is to identify the isotopes that are actually important because we have limited resources," Dan said. "We want to be able to focus on the new radioactive isotopes that might need to be studied further to ensure the NRC can appropriately and efficiently review safety applications. By screening out the rare isotopes, we can decrease the cost and time needed to evaluate these new reactors without compromising safety."

These first two screening methods were selected to be similar to those used in the 1970s and 1980s to determine the radioactive isotopes of interest for light-water reactors, said Kyle. Using these two screenings, the team produced a targeted list of 110 radioactive isotopes for further study.

Quantifying health impacts

The team then took a set amount of each of the radioactive isotopes and determined the resulting radiation doses using values from an EPA report. The dose is a numerical representation of the health impacts of exposure from that radioactive isotope, Kyle said. Specifically, they were able to use advanced computer codes like Maccs to calculate the transport of radioactive isotopes through the environment and the hazard posed by the isotopes of interest on the bone marrow and the lungs — two organs that provide a good picture of the overall health impacts of radiation exposure.

Combining these dose values from a set amount of radioactive isotope with the proportion of that isotope present in the heat pipe reactor inventory, they were able to calculate both short-term and long-term health impacts of the studied radioactive

isotopes. Then they compared these dose values with equivalent doses of iodine-131 and cesium-137.

Iodine-131 is the radioactive isotope that poses the most short-term risk from an accident at conventional nuclear power reactors. Therefore, potassium iodide tablets — which block the body's intake of radioactive iodine — are distributed near U.S. nuclear power plants just in case. Cesium-137 is the isotope that provides a good representation of the long-term risk from an accident at conventional nuclear power reactor, Kyle said.

They found over a dozen radioactive isotopes present in the heat pipe reactor inventory that could pose short-term health risks on par with iodine-131. Four radioactive isotopes present in the heat pipe reactor inventory could pose long-term health risks on par with cesium-137.

While this research suggests that these isotopes may be important for future consequence assessment of heat pipe reactors, more research is needed to refine the heat pipe reactor inventory and determine the proportions of isotopes that could be released during a possible accident, Kyle said.

In the future, scientists from Sandia and the NRC will be able to use this transparent and traceable method to determine targeted lists of radioactive isotopes of concern from the inventories of other advanced nuclear reactor designs, said Kyle and Dan.

"We found a number of radioactive isotopes, beyond those we already consider for light-water reactors, that are important for consequence analysis," Kyle said. "However, the purpose of the study was to develop a methodology that you could apply to any reactor design, as the information on the inventories of those reactors become available. The heat pipe reactor was chosen to demonstrate the method. It's exciting to be able to use our expertise to assist U.S. regulatory agencies in preparing for licensing new reactors."

2023 Environmental Excellence Awards winners announced

By **Dan Ware**

Sandians perform work every day that impacts the environment. This work includes reducing negative impacts as much as possible. The Environmental Management System's annual Environmental Excellence Awards recognize projects done by staff that reduce waste, prevent pollution, conserve energy and save costs. The awards ceremony will take place at noon today and is part of Sandia's Earth Month 2023, hosted by Sandia's Environment, Safety and Health, and Employee Health Services programs.

Projects and activities will be awarded in three categories: Greenie, Sequoia and Resource Conservation.

Greenie Award

Computer scientist Patrick Martin developed and launched DeCARbonize, a monthly event that promotes and celebrates the use of alternative transportation methods, like bike, bus and scooter, for commuting on-site. The initiative includes group rides with other Sandia cyclists and provides resources to cyclists as they begin bicycle commuting. It is supported by the existing Sandia cycling community and other Albuquerque cycling groups, and it helps enhance a culture of alternative commuting.

Sequoia Award

A multidivision team significantly reduced sulfur hexafluoride emissions from the HERMES and SATURN accelerator facilities. The upgrades and improvements they made resulted in an annual emissions reduction of the equivalent of 40,000 metric tons of carbon dioxide.

Team members include Debra Kirschner, Laurel Jones, Colton Gibney, Jeffery Tunnell, Benjamin Hughes, Guillermo Archuleta, Lewis Hill, Joseph Gallegos, Kevin Dussart, Penny Avery, Cameron Tunell and John Santillanes.

Resource Conservation

A cross-division team increased environmental efficiencies at a new high-performance computing facility. Their work during the construction phase of the facility resulted in saving more than 30 million kilowatt-hours of energy use and 9 million gallons of water. Additionally, their efforts saved $200,000 in annual operating costs.

Team members include David Martinez, Tom Klitsner, David Smith, Anthony Duran, Casiano Armenta, Ronald Rymarz and Robin Jones.

"The need to reduce our impact on the environment is taken into consideration with all the work we do at Sandia," said Environmental Excellence Awards program coordinator Ben Henning. "This year's awards show our dedication and skill to constantly and consistently develop novel and innovative ways to protect our natural resources and serve as examples for others of how to create a culture of sustainable science."

On-site sustainability efforts reduce energy usage

By **João Oliveira and Diana Hackenburg**

It takes a lot of energy to run a large, multimission national laboratory like Sandia. In fiscal year 2022, Sandia's Albuquerque and Livermore campuses used the same amount of electricity as approximately 30,000 American households. During that period, Sandia's natural gas usage produced as much greenhouse gas emissions as 4,255 gasoline-powered passenger vehicles.

As part of Sandia's commitment to operate our facilities in a safe and sustainable way, the Energy Management team is collaborating with other departments to raise awareness about best practices and implement energy and water conservation measures. Several recent efforts demonstrate Sandia's leadership in environmental stewardship in the face of climate change.

SUSTAINABILITY CHAMPIONS — The Energy Management team works to decarbonize and ensure the resilience of Sandia's operations. **Photo by Michael Flores**

Energy-saving efforts at the Labs

Net-zero studies at the Albuquerque and Livermore sites will be used to develop plans for zero-emissions campuses that are both sustainable and resilient.

The Energy Management team has developed a monitoring-based commissioning program to maintain and continuously improve building performance. In fiscal year 2022, this program helped Sandia avoid releasing the equivalent of 1,000 metric tons of carbon dioxide by fixing operational issues that impact energy usage.

A team of facilities' controls and mechanical engineers are currently working to lower supply temperatures in on-site boiler heating systems by at least 40 degrees Fahrenheit. In addition to improving system efficiency, these experiments show promising results for future use of carbon pollution-free heat sources, such as heat recovery chillers, as replacements, while still maintaining thermal comfort levels across different buildings at Sandia.

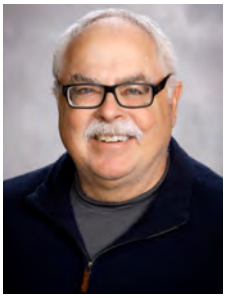
Sandia is implementing the DOE 50001 Ready program, which provides standards and step-by-step guidance for implementing energy improvements. This program will help advance collaboration across Sandia to promote best energy practices and increase energy efficiency.

Beginning with Building 897, the Smart Labs pilot program will enable safe and efficient world-class science to occur in laboratories using high-efficiency exhaust systems.

Through these and other efforts, Sandia is committed to meeting and exceeding federal sustainability guidelines by achieving net-zero emissions at the Livermore site by 2040 and the Albuquerque site by 2045.

Learn more about Sandia's efforts to model sustainability and advance climate security.

Mileposts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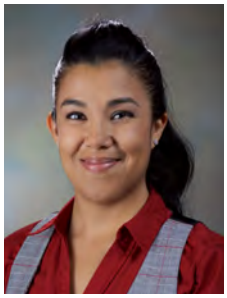
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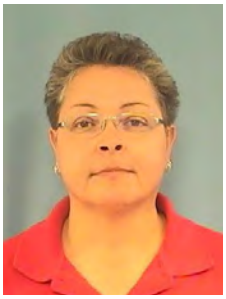
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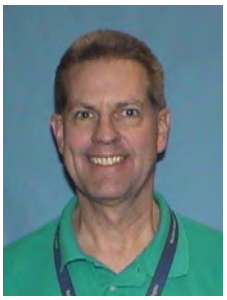
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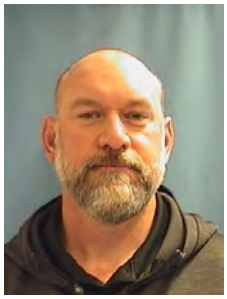
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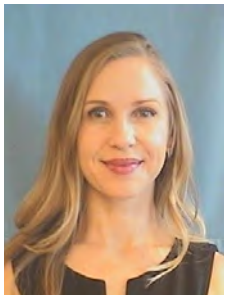
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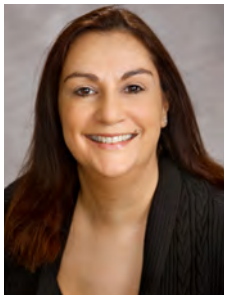
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Building a climate action toolbox

Sandia hosts national security expert for Earth Month

By **Steve Scott**

As the impacts of climate change become clearer, more organizations recognize that the changing climate poses threats to both national and global security. These threats and how the national security community can prepare for a warming world are the focus of Erin Sikorsky's work as director of the Center for Climate and Security and the International Military Council on Climate and Security.

Lab News recently sat down with Erin to discuss her thoughts on the national security implications of climate change and what Sandians can expect from her upcoming Earth Month presentation at Sandia.

Lab News: As an organization focused on addressing emerging national security issues, Sandia is strategically working to advance not just climate science but climate security. As an expert in this field, how do you define 'climate security'?

Erin Sikorsky: What I think about with that definition is, what does it mean for Americans, for the United States, to live and operate in a climate-secure world? How do we keep Americans safe, not only from the hazards that climate change poses, but also the national security risks that derive from those climate hazards? Those hazards can be anything, from instability and conflict risk in other countries to geopolitical competition over access to resources.

Because there's really nothing, frankly, in the national security and foreign policy field that isn't touched in some way by climate change. So, I often talk about bringing a climate-change lens to foreign and security policy.

LN: You've written recently about the competition among international powers to set the terms for governance of border-crossing, climate-related issues. In competing for strategic leadership, how important is it for the U.S. to maintain technical science and engineering leadership?

ES: It's absolutely critical to be a leader on the technical and engineering side of all of this. It's really important for the United States to invest in its scientific and technical leadership on all sorts of different climate-related things, whether it's clean-energy investments or understanding technologies for managing or intervening in the climate. To show that strategic leadership, you need to have the technical and scientific expertise behind it.

What's really important too, is to make sure that we're marrying that technical and scientific leadership with the security policy, understanding and apparatus. The two go, I think, hand in hand.

LN: Much of Sandia's climate-related work involves development of accurate climate models. How important is this type of predictive capability in developing an appropriate climate-security strategy?

ES: The more accurate the models, the more granular the models, the better the input is for the national security community. What's also really important is making sure the national security community knows how to use the models and understand the models. And again, this is a theme I will, I think, reiterate a lot. And in my talk, I address that need for partnership, and for building bridges between the scientific and the national security community.

Photo courtesy of Erin Sikorsky

But better models are critical, I think, especially for other parts of the world — where we don't have as much data or understanding — that are important national security areas of concern.

LN: You mentioned clean energy. From a security perspective, are there other areas of climate-related technical development that should be prioritized?

ES: Yes. I also mentioned this earlier, and it goes by different names — geoengineering, solar radiation management, climate intervention — things we can do to keep the planet cool. I think this is a really important area of investigation and research. Not necessarily because we should deploy it; I think there are a lot of important questions around that. But certainly, we need to know more about it.

Also, understanding of early warning systems and adaptation technologies.

Join the event

Sandians are invited to Erin Sikorsky's presentation, "Analysis to action: Developing a climate security toolbox," on Monday, April 24, at 10:30-11:30 a.m. MT in the Steve Schiff Auditorium or virtu-ally. A Livestream link is available on the Climate Security's Earth Day 2023 page; Environment, Safety and Health's Earth Month page; and in Sandia Daily News.

This Earth Month event is sponsored by the National Security Speaker Series in collaboration with the Climate Speaker Series.

How can communities adapt to the warming that's already baked into the atmosphere? And other approaches like carbon-capture technologies.

We really need all the tools in our toolbox, right? There are a lot of different things we need to explore.

LN: At a conference on climate resilience last month, you talked about the need for a whole-of-government approach to climate action, with stronger partnerships between national security and science agencies. Can you say more about why that's so important?

ES: The climate threat is so different, in many ways, from traditional national security issues where you see the state as the actor. Our international architecture — the U.N., a lot of the International Monetary Fund, the World Bank and our government itself — are all structured around this idea that states are the main actor and challenge. But now we're moving into a world in which there are also what some folks call "actorless risks" from climate hazards and impacts.

And so, we need different tools. We need a different approach to be able to address that. And that includes leveraging the experience, knowledge and deep research capabilities within the U.S. federal scientific community in a way that I think haven't quite been leveraged before by the national security community. There needs to be more interaction and partnerships and regularly ongoing communications.

Obviously, places like Sandia have a huge legacy of this. But I think it needs to be much broader than that now with climate issues. When I say whole-of-government, it's not just the scientific community and the security community, like DOD, or the intelligence community. It's also the Department of the Interior, right? It's the Federal Emergency Management Agency, it's the U.S. Agency for International Development and the State Department. There are all sorts of agencies that have a role to play in managing climate hazards and sharing information and sharing ways of working so that they better understand each other.

LN: The announcement for your Sandia talk says you'll be discussing a climate-security "toolbox," and you used that term just a moment ago. Without giving too much away, can you share a preview of what that means?

ES: I come at this from the perspective of a former intelligence analyst. When I sat down at my desk every day to analyze risks of instability and conflict in parts of the world, what did I rely on? What kind of tools did I use? Ten years ago, when I started my job, I certainly didn't use any tools related to climate issues. And I think that's where it needs to change.

What tools does the average intelligence analyst or the average State Department Foreign Service officer or the DOD have when they're engaging in the country in which they operate? How do they know who to turn to within the government to ask questions about climate risks in these places and then when they want to pursue some kind of policy option? What tools do they have that they can deploy? Do we have things we can share with allies and partners like risk-assessment tools? Do we have, you know, new technologies in clean energy or in adaptation that we can share? So that's what I think about when I when I talk about a toolbox.

Carlsbad staff gives back

CLEANUP IN CARLSBAD — Sandia volunteers and their family and friends Catrina Carrillo, Josiah Carrillo, Paul Docherty, Caleb McCarty, Gavin Peeler, Michael Feng, Eva Cruz and Jennifer Long cleaned up litter along the Pecos River in Carlsbad, New Mexico, during Riverblitz 2023.

Photo courtesy of Eva Cruz

Chemist researches nuclear fuel cycle, critical metals to fight climate change

By **Sarah Jewel Johnson**

Andrew Knight, a chemist who specializes in nuclear fuel storage and transportation at Sandia, thinks a key to addressing the challenge of climate change is to incorporate the topic into everyday conversation. Andrew began at Sandia in 2017 as a postdoc in the geochemistry group. During his tenure at Sandia, Andrew has focused most of his research on the back end of the nuclear fuel cycle, sourcing critical metals and environmental contamination linked to per- and polyfluoroalkyl substances, or PFAS, which are synthetic chemical compounds known to cause long-term negative health effects.

Andrew received his bachelor's degree in chemistry in 2012 from Luther College in Decorah, Iowa, and a doctorate from the University of Iowa. Prior to working at Sandia, he completed internships at both Savannah River and Argonne national laboratories.

Read Andrew's interview to learn why empathetic communication is a powerful tool and how nuclear energy could strengthen the fight against climate change.

Lab News: Why are you passionate about climate change?

Andrew Knight: We are very fortunate to live on a planet where we can grow food, have shelter and keep warm. We exist because of the Earth, and we must do our job to respect the Earth so that future generations can enjoy it as well. There isn't an alternative. Unchecked climate change will lead to a situation that would be very dire.

LN: What does climate security mean to you?

AK: For me, climate security would be to maintain a stable global climate to prevent mass global disruptions. As the climate becomes more unpredictable, societies will have to find ways to cope — which could very easily lead to conflict. I think it is really important to bear in mind those places that are disproportionately affected by climate change. Now is definitely the time to engage and have empathetic communication in order for a global collective effort to fight climate change. Without a collective effort, issues related to climate security would be hard to avoid.

LN: What climate-related challenge are you most excited to work on?

AK: I think water is key. Now, living in the Southwest after moving from the Midwest, the importance of water cannot be understated. Globally, this is the case too. Water keeps us alive; it grows our crops, maintains biodiversity and drives our energy systems. I think if there was one area to focus on, establishing long-term solutions for water availability is a big one for me.

I think another important aspect is individual and corporate environmental stewardship. As Sandians, we must try to do our part to minimize our impact and we must push other Sandians — and Sandia as a lab — to continue to make changes to be more conscious of our impact. There are definitely signs of progress, but there is a long way to go.

LN: How does your work at Sandia advance climate security?

AK: I work on many different projects that have various ties to climate security. The main work I do is related to the back end of the nuclear fuel cycle; however, without solutions to the back end of the fuel cycle, nuclear's role can only be limited. I am also involved in research to extract critical metals from unconventional sources to reduce our need on foreign supplies of the materials that will be critical to electrify everything. Lastly, I have been working to push Sandia to expand research on environmental contamination, specifically PFAS. As I mentioned before, water is important to me, and it is clear that widespread PFAS contamination is rapidly jeopardizing water for many parts of the United States and the world.

LN: What perspective or capabilities does Sandia bring to addressing climate security?

AK: The overall brain trust at Sandia is huge. Sandia has been involved in major scientific and engineering solutions to address the needs of the past, and now Sandia has to play an active role in the current climate crisis.

CLIMATE STEWARD — Chemist Andrew Knight is committed to slowing the pace of climate change through this work and daily interactions. In his free time, Andrew enjoys hiking in the New Mexico mountains.

Photo courtesy of Andrew Knight

LN: What do the nation and world look like in the future if we are successful in addressing climate change?

AK: I am not really sure. I think managing our impact on the world has always been — and will always be — something to be cognizant of. I think we may have lost touch with it for a long while as we industrialized the planet. I don't think there is a metric of success that the climate needs to meet. Instead, I think the metrics of success would be how people see their role in maintaining a healthy planet.

LN: What's your vision for integrating energy equity and environmental justice into Sandia's climate security efforts?

AK: I think a greater effort to understand what may most benefit those disadvantaged or disproportionately affected by climate change will be very important. I think as a nation we are starting to be more aware of the inequities that exist, but we must be diligent in how we combat climate change in a

way that doesn't increase those inequities. I think in New Mexico we have an opportunity to engage with those across the state and really take a holistic approach to aid communities that need help. I would love to see a climate action program that allows for communities to submit climate-related action items, similar to the New Mexico Small Business Assistance concept.

LN: If you were trying to recruit or inspire somebody to work on the problem of climate change, what would you say to them?

AK: I would tell them that they could be a part of addressing the most significant challenges life on Earth has faced. The more people who are focused on addressing climate change, the most likely we will be able to manage its effects and prevent further damage.

LN: How can we educate and involve more people in addressing climate change?

AK: I think conversation in everyday life is important. Formal education on the topic is definitely very important, but it shouldn't feel like a research topic. The climate crisis is something that affects everyone all the time, and we should think about it throughout our day. There are small decisions that we can make that can go a long way — in addition to holding ourselves accountable, we should also hold corporations and nation states accountable for their impact on the climate. It is a collective effort, it is an existential crisis, and it is one that will persist throughout our lifetimes so we must engage with it on all levels.

Watershed models offer learning moments

By **Katrina Wagner**

A team of water quality and environmental professionals from Environment, Safety and Health planned and provided hands-on education in 40 fifth-grade classrooms at 22 Albuquerque-area schools this year. The group joined RiverXchange to teach students the importance of preventing water pollution. RiverXchange is an organization that educates the public about life in a watershed and provides elementary teachers with curriculum and activities to explore water resource topics with students.

"These presentations help Sandia meet EPA permit requirements for public outreach and education, so it's really gratifying to be able to do that while also giving a little back to the community," stormwater program lead John Kay said.

TAKE A SWIM — Students at San Antonio Elementary School polluted the watershed model to show how soil, animal waste, pesticides and trash can impact wildlife that relies on rivers and lakes to live. About 1,000 students were impacted by the Sandia education outreach effort in partnership with RiverXchange. **Photo by Craig Fritz**

HANDS-ON LEARNING — Students at San Antonio Elementary School pollute a watershed model with coffee grounds that represent animal waste, soy sauce that represents motor oil and cake sprinkles that represent trash. They use spray bottles to simulate rain to learn how they can help keep rivers and lakes clean. "It's fun interacting with the kids and seeing them excited about learning," stormwater program lead John Kay said. **Photo by Craig Fritz**