

CAMPUS CONNECTIONS

Winter 2025



It's Groundbreaking! South Table Mountain's Newest Building.

Are Mushrooms the Next Green Building Material?





Director's Note

Welcome to the inaugural issue of **Campus Connections**, a twice-yearly publication intended, as the name suggests, to build and strengthen connections across the laboratory.

The National Renewable Energy Laboratory is a diverse and complex organization, and we continue to grow in so many ways. Just six years ago, in Fiscal Year 2018, we counted fewer than 2,000 employees. Now we have a workforce more than 4,000 strong. Our research spans the entire spectrum of established and emerging clean energy technologies. The laboratory sets new records for partnerships every year. We are expanding our physical footprint, putting up new buildings, and continuously advancing our technical capabilities.

This past fiscal year, we crossed the \$1 billion threshold for business volume—an amazing milestone you should be proud of. Our entire laboratory is working on the diverse components of our mission, all pulling in the same direction, and this is maximizing our impact.

This growth—and the fact that we are all so busy—also means it's a little more difficult to know what everyone else is doing. That's something we hope to address with the publication you have in your hands. We can all benefit from having a fuller picture of NREL.

I know you are all incredibly focused on your work. Thank you. That's what we need to achieve our mission of

a clean energy future for the world. It's also important to celebrate the accomplishments of our colleagues, which show that we are on the right track and motivate us to continue our vital work despite challenges that come our way.

And who knows? Maybe something you read here or in a future issue sparks inspiration, leading to a game-changing innovation.

That opportunity for discovery and surprise is one reason I advocated for this print publication. We look at our screens all day, and sometimes it's just nice to have a quiet moment somewhere on our beautiful campus and leaf through something tangible. You can carry this around, peruse it at your leisure, and then, when you're done, maybe pass it along to colleagues, friends, or family with an article recommendation. It's a simple and easy way to help spread the word.

We talk a lot about partnerships here at NREL, and we recognize how valuable they are to achieving our vision. Already, so much collaboration has gone into this project, and I know that thread will continue in the editions to come.

I hope you enjoy this issue of *Campus Connections* and that you look forward, as I certainly do, to discovering more about our laboratory. Happy reading! □

Martin Keller



Pardon Our Dust

On Sept. 16, 2024, NREL broke ground on the newest addition to the beautiful South Table Mountain Campus: the Energy Materials and Processing at Scale (EMAPS) facility. (cont.)

Pardon Our Dust

The 127,000-square-foot multidisciplinary laboratory at the east end of campus will enable collaboration with industry partners, universities, and other DOE laboratories to accelerate process scale-up and market adoption of advanced energy materials needed for a clean energy transition.

“We are excited to be on our way to building our new EMAPS facility,” Director Martin Keller said. “The new capabilities we will gain from EMAPS will accelerate innovations in materials and processes that are essential to clean energy technologies, allowing NREL to dig deeper into our current research while also pursuing exciting new avenues.”

Earlier this year, NREL selected JE Dunn Construction and its design partner SmithGroup to design and build the new laboratory, which will be completed in 2027. The two companies collaborated 10 years ago on NREL’s Energy Systems Integration Facility.

The EMAPS building will facilitate materials and process innovations in energy storage, advanced

manufacturing, technologies for grid modernization, sustainable chemicals, and fuels for transportation and industrial applications. It will also help address end-of-life and circularity challenges across multiple energy technology platforms with a focus on polymers, packaging, and waste streams during and after production.

EMAPS is intended to achieve a minimum Leadership in Energy and Environmental Design (LEED) Gold certification with its sustainable, high-performance design and advanced energy efficiency approaches like reclaiming gray water, building heat reclaim technologies, and using electricity in lieu of natural gas to support campus decarbonization efforts.

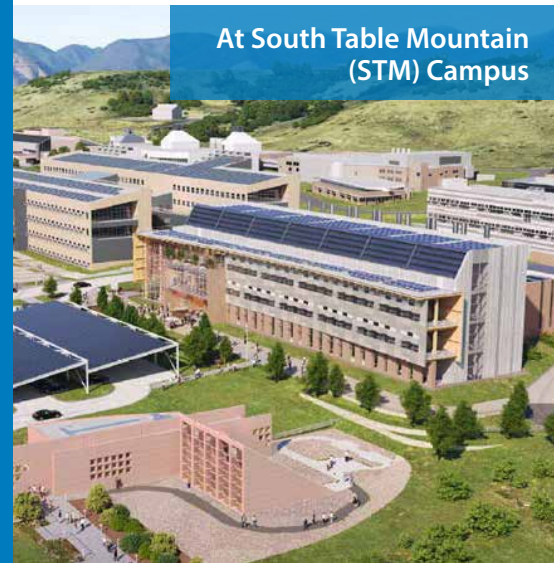
The building’s design includes modern, open, and flexible spaces that support rapid experiment configuration by integrating laboratory capabilities and enabling researchers and engineers to collaborate in a multidisciplinary setting.

To stay up to date on campus construction activities at NREL, head to [nrel.gov/about/construction](https://www.nrel.gov/about/construction). For those looking for a front-row seat to the action, the third- and fourth-floor balconies on the east side of the Research Support Facility offer great views of the construction site. □

Growing Green

It’s a phrase heard everywhere at NREL: **We’re growing, and fast.**

Earlier this year, Director Martin Keller announced a \$565 million investment for renovations and new construction at the South Table Mountain and Flatirons campuses over the next five years. Since 2020, NREL has doubled its business volume and grown to more than 4,000 employees—these new projects will address this growth and increase new lab space by 76% by 2027.



- Construction has started on the EMAPS facility that will accelerate lab-scale innovations for scale-up and industry adoption.
- The new Integrated Biorefinery Research Facility pilot plant will speed up work on the development of sustainable aviation fuels.
- Lab space will increase by over 100,000 square feet with major renovations and new labs.
- In partnership with the State Historic Preservation Office, a campus master plan is in progress for the South Table Mountain Energy Park (formerly a section of Camp George West), south of the STM Campus.

- The new Control Center Facility will be a 9,000-square-foot, two-story operational control and monitoring building.
- A critical waterline and wastewater management system is being installed to enable campus growth and support more research work involving hydrogen.
- By mid-FY2025, Flatirons will be the first net-zero emissions campus decarbonized on federally owned property.
- Improvements are underway to the Advanced Research on Integrated Energy Systems (ARIES) platform, which supports grid integration with high amounts of renewables and energy storage. (cont.)



(Growing Green cont.) As **NREL** expands, we're focused on growing our footprint in a responsible and sustainable manner. Buildings use bird-frittered glass and down-turned lighting to avoid bird collisions, and construction is paused in periods of high winds to reduce the generation of airborne particulates and improve air quality. And new landscaping uses native plants and pollinator seed mixes to preserve local ecosystems. To learn more about the laboratory's environmental management activities, scan the QR code to the right to read our Annual Site Environmental Report.



www.nrel.gov/docs/fy24osti/91420.pdf

NREL's campus expansion investments will have a \$685 million impact on Jefferson County's economy through contracts with local suppliers, business-to-business relationships, and interactions with local, small businesses. Just as impressive, our investments will directly and indirectly support an estimated 4,688 construction jobs over the next five years, representing an annual projected average of 938 jobs being supported in the local community.

There's a lot to be excited about and a lot more on the horizon. With these investments to our campuses, NREL is creating real-world solutions needed for the clean energy future, protecting our habitat and wildlife, and supporting our local economy with good-paying jobs.

Life-Size Learnings

By Kathleen Morton

The Flatirons Campus got a little more color this fall with the installation of striking wall visuals to supplement on-site tours. These murals give visitors a peak into the past and look into the future by highlighting the campus' history and the exciting work being done within its boundaries.



▲ Digital real-time simulators are key to emulating thousands of power grid devices, creating precise digital twins of real-world environments at real-time steps.

◀ ARIES comprises three pillars networked together to provide an interconnected and scalable research platform: the Energy Systems Integration Facility at NREL's South Table Mountain Campus; the Flatirons Campus, which allows researchers to work at higher voltages and scales; and the Virtual Emulation Environment, which amplifies the platform further. □



By Kiersten Becht

RAIL Is on Track

Noticed a new building on the South Table Mountain Campus? That's the Research and Innovation Laboratory (RAIL) that opened in April 2024.

With an award-winning modular design that can be reconfigured to support growing cross-disciplinary research, the facility provides approximately 15,000 square feet of multiprogram wet laboratory space for chemical, biological, and materials synthesis.

RAIL's potential to enhance collaboration across research teams is a huge opportunity.

Paul King, Physical Biochemistry group manager who is focused on harnessing solar energy to convert it into chemical energy for ammonia production, said, "There's a lot of sciences integrated across the campus, so RAIL is sort of a microcosm of that community; it's a communal type of environment." (cont.)



▲ **Jonathan Humphreys** (left) and **Cara Lubner** (right), work in a glovebox at the RAIL facility.



▲ **Bret Cummock** (second to left), Site Operations Project Management & Construction (PMC) Program Director and **Saeng Mallek** (second to right), Site Operations Project Manager accept their awards from the Design-Build Institute of America committee.

Winner, Winner!

On Nov. 7, NREL, in partnership with the Mortenson/Davis Partnership Architects design-build team, received four awards from the Design-Build Institute of America for the Research and Innovation Laboratory (RAIL) facility. The award categories include:

- Award of Excellence in Industrial, Process and/or Research
- Award of Merit in Industrial, Process and/or Research
- Best In Process-Best Value
- Enlightened Owner

Congratulations to everyone who contributed to the design and construction of the facility! □

(*Rail is on Track cont.*) The BioEconomy and Sustainable Transportation directorate was the first to begin research activities in the facility; the Materials, Chemical, and Computational Science and Mechanical and Thermal Engineering Sciences directorates will soon follow. At RAIL, groups can work side by side, fostering a stronger sense of camaraderie and facilitating more spontaneous brainstorming sessions.

Here are some interesting activities researchers at RAIL are currently working on:

- Postdoctoral researchers **Seth Wiley** and **Saad Imran** are tapping into enzymes to increase the efficiency of biofuel production through the phenomenon known as “electron bifurcation.” Similarly, Director’s Fellow **Greg Vansuch** is researching electron bifurcation to help develop systems for efficient and cost-effective electrocatalytic and solar-driven fuel processing.
- The Physical Biochemistry and Photosynthesis group is researching biohybrid devices to directly convert sunlight to electricity and create viable and scalable solar energy harvesting technology. **Nate Brady**, a Director’s Fellow, brings a new type of polymer-bound nanodisc containing photosystem I reaction center to be used in next-generation solar panels.
- Researcher **Michael Dawson** is investigating a class of enzymes termed hydrogenases, which catalyze the reversible activation of molecular hydrogen (H₂) from protons and electrons. Understanding the underlying structural features that govern how these enzymes function is expected to inspire new design principles for H₂ production catalysts that don’t rely on costly precious metals.
- **Effie Kisgeropoulos**, a researcher in Paul’s group, is especially excited about the increased access to anaerobic chambers, commonly known by their brand name, *MBrauns* (aka the crazy-looking rubber glove machines). Since moving to RAIL, the number of available MBrauns for researchers has more than doubled.

There is no shortage of work being done by NRELians to support our vision of transforming today’s energy challenges into tomorrow’s solutions. As more groups move into RAIL, we can look forward to even more clean energy breakthroughs on the horizon. □



Meet Environment, Safety, Health, and Quality Point of Contact **Kyle Root**

By **Caleigh Avramis**

Kyle Root wants to hear your questions—all of them. As an Environment, Safety, Health, and Quality point of contact for RAIL, he assists researchers with safety protocols for new projects or responsibilities. But that’s just the formal job title. We sat down with Kyle to learn more about his role and what excites him to show up to work each day.

What does your day to day look like at the laboratory?

- While every day looks different, most of my responsibilities focus on safety. We might create work authorizations for vendors coming in to fix equipment, process hazard assessments, or visit lab spaces as a second set of eyes for laboratory inspections. Depending on where I’m going that day, it might also involve working through safety assessments on bioreactors or heating, ventilating, and air-conditioning equipment.

What do you most look forward to when coming into work?

- My favorite part of my job is supporting researchers. It’s important to assist staff with their research so they understand the safety, paperwork, and control requirements needed to perform their daily duties. I also love interacting with different people on a day-to-day basis and seeing all the amazing and diverse work the staff does across the laboratory.

What are some lessons learned from working in a brand-new building?

- Since the early stages of RAIL’s expansion, I have been involved in

developing safety protocols to figure out how to let researchers settle into the laboratory and begin their work. Through this process, I’ve learned to have open dialogues and discussions about actions that need to take place when researchers are conducting new projects. It’s best to come to me early on with any questions or concerns.

What has been your biggest accomplishment while working in RAIL?

- Working with the RAIL team to get safety assessments completed for moving to this new laboratory. Being able to help staff with these assessments, support the researchers, and integrate with the Work Planning Control team has been an important learning and teaching experience.

What are some ways staff can better enforce safety at the laboratory?

- It’s important to raise questions or concerns early on. We want to be aware of any problems beforehand because they can be more difficult to fix once we have started the project. This will reduce any danger and enable us to do our jobs effectively. □

From the Ground Up

Karlin Swearingen reached into a large mixing bowl to stir a foamy, bread-dough-like concoction of spruce tree pulp. He added liquid that contained tiny white mushroom spores and turned the mixer on.



The mushroom spores, called mycelium, grow naturally on wood piles all over the world. But Karlin and other researchers at NREL's Alaska Campus are using it for a different purpose: adding it to spruce cellulose to create a new kind of insulation that is as thermally efficient as foam board.

"We're using the standing dead beetle-kill spruce we have all over Alaska to not only reduce wildfire risk but also create building materials that are biodegradable," said **Robbin Garber-Slaght**, the NREL research engineer leading the project in partnership with the U.S. Forest Service's Forest Products Lab and the University of Alaska Anchorage.

With a \$2.5 million award from DOE's Advanced Research Projects Agency - Energy, NREL researchers hope this technology can be used in thousands of homes in rural Alaska, where poor building techniques have created a housing stock that is cold, moldy, and very expensive to heat. Due to the cost of importing materials, building new housing is prohibitively expensive.

"We want to create a way for rural communities to grow their own insulation, then use it to retrofit their homes," Robbin said.

Once the mycelium had been whipped with the cellulose into a thick foam, Karlin poured it into a two-by-two-foot wooden frame. Using a long metal spatula, Robbin smoothed the surface. Next, they sucked the moisture out with a vacuum and carried the square of insulation to the humidity chamber—a walk-in freezer kept at 70 degrees and 80% humidity—where it would sit and grow for the next week.

"This mycelium binds the cellulose together and creates a material that's strong and resilient and can last the lifetime of a building," said Phillippe Amstislavski, a mycologist and public health researcher at the University of Alaska Anchorage.

Seven days later, Robbin removed a sheet of rigid insulation from

the humidity chamber. Like foam board, it was full of little pockets that trap air to slow heat loss. Yet instead of being manufactured from petroleum, it was made from the forests outside the lab. After heating up the boards to halt the growth of mycelium, Robbin's team installed them on the mobile test lab trailer to evaluate their performance over the winter. As NREL's Alaska Campus looks to expand, celium is just one of many building technologies that can be evaluated on-site.

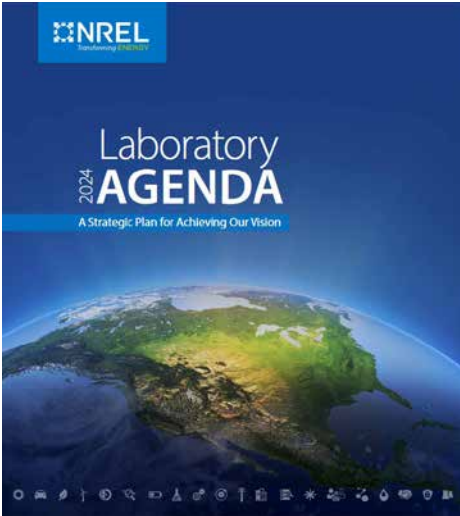
She's excited to see this technology take off. "My dream is that we can actually grow houses one day." □



Phillippe Amstislavski, a co-principal investigator from the University of Alaska Anchorage.

How Do We Actually 'Grow' Insulation?

The mycelium fungi "eats" the cellulose from the spruce tree, digesting it as it grows and creating a three-dimensional structure with lots of air pockets. These air pockets are what provide insulation value. The cellulose gets valorized, which makes the material more rigid and waterproof than cellulose, a great absorber of water.

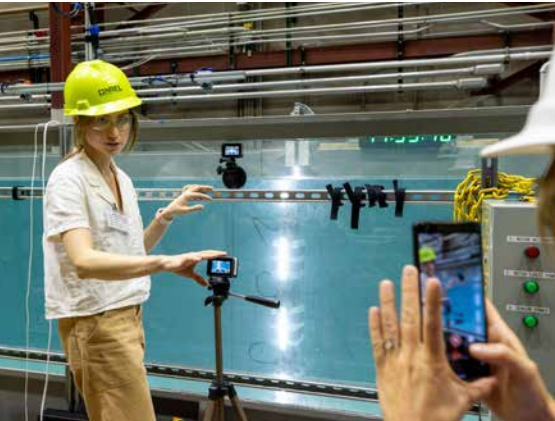


The Lab Agenda provides a clear picture of where the laboratory is going, why, and what we need to do to get there. Visit [NREL Strategy](#) on theSOURCE to download a copy.

Transforming Our Campuses Is Part of NREL's Operations Goal

Our campuses, facilities, and equipment not only help us execute our mission, but they also help us attract talented staff and strategic partners. Building new facilities is exciting, but it's also great that we're able to bring older labs and facilities to the state of the art and repurpose existing lab space. During the next decade, you'll see big transformations at both the South Table Mountain and Flatirons campuses—all part of a big plan to achieve our long-term vision.

Our many campus expansion and renovation projects are great examples of how we are working towards achieving Goal 12, Operations, in NREL's Lab Agenda.








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