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The U.S. Department of Energy (DOE) Office of Science has announced $264 million in funding for 29 projects to develop clean energy solutions that will pave the way to achieving a net-zero-carbon economy by 2050. This funding is part of DOE"s Energy Earthshots Initiative, an effort designed to accelerate breakthroughs of more abundant, affordable, and reliable clean energy solutions within the decade.

"We are delighted to be an important part of the new Energy Earthshots program in the Office of Science," said Bill Tumas, NREL associate laboratory director for Materials, Chemical, and Computational Science and NREL"s Basic Energy Sciences point of contact. "Our significant engagement reflects our commitment and contributions to use-inspired basic research by addressing key science questions and technological challenges through fundamental science in areas where we also have substantial strength in applied research."

"The Energy Earthshot awards are incredibly exciting for the laboratory," said Johney Green, associate laboratory director for the Mechanical and Thermal Engineering Sciences Directorate at NREL, which will be leading the two NREL Energy Earthshot Research Centers. "These initiatives were chosen because they are tackling some of the most challenging barriers of deploying clean energy technologies at scale. Our success and participation reflects our researchers" innovation, teamwork, and diverse perspectives, and I am excited to see where these projects lead."

This task is complex. Offshore wind turbines are the largest rotating machines in the world, with heights of 260 meters and rotors 220 meters in diameter. These turbines must have manageable loads when they are operating--but they also need to be able to withstand extreme events, like hurricanes. Researchers also need to be able to give better predictions about how climate change will affect wind resources in different parts of the ocean environment.

"We"re doing what we call high-fidelity modeling, so we"re trying to adhere to first principles as much as we can," Sprague explained. "The idea is that the advances we achieve with these high-fidelity models can be used to train lower-fidelity models, which scientists, researchers, and engineers can then use to create new turbine designs. This approach is going to require world-class supercomputers."

"DOE has put a massive challenge in front of us, and the importance of this challenge in light of climate change is difficult to overstate," Sprague said. "The opportunity for impact here is very exciting."

NREL"s other EERC, Degradation Reactions in Electrothermal Energy Storage (DEGREES), focuses on a different challenge: advancing our fundamental understanding of the degradation mechanisms of materials for electrothermal long-duration energy storage (LDES). LDES is a critical piece of a resilient, flexible, and decarbonized electric grid, as it allows for the efficient storage of excess clean energy from renewables like wind and solar.

"NREL is the lab for integration. We work well together, and we aren"t siloed--there is so much support here. That"s one of the things that made this EERC proposal successful," said Judith Vidal, manager of the Building Thermal Energy Science group at NREL and director of the DEGREES EERC along with associate director Katie Jungjohann. "External partnerships have also been key. I"ve had a long relationship with several of our partners on this proposal, and when it came time to put the proposal together, they were eager to collaborate. That trust is key."

One of those partners is Akanksha Menon, an assistant professor at Georgia Tech who also has a joint appointment at NREL. Menon received a separate award for lower-temperature industrial and building thermal energy storage applications.

A major aim of the project is developing the necessary understanding, characterization tools, and modeling capabilities to enable designers and engineers to create feasible thermal energy storage components that are cost-effective, durable, reliable, and dispatchable.

"We started this proposal from applied research, and that research helped us understand which fundamental questions are important to answer," Vidal explained. "That was another thing that made our proposal successful. We have the expertise to do research at low technology readiness levels but also to translate that knowledge quickly and in a reliable, low-cost way."

In addition to leading two EERCs, NREL is also involved in three university-led Science Foundations for Energy Earthshots projects. The first of these awards, led by New York University (NYU), is focused on leveraging mathematical methods to reduce data storage needs--enabling, fast, on-the-fly modeling for key clean energy applications. This project addresses two of DOE"s Energy Earthshots: the Floating Offshore Wind Shot and the Carbon Negative Shot.