Statement of Thomas Zacharia

Director, Oak Ridge National Laboratory

Before the

Committee on Energy and Natural Resources

U.S. Senate

August 5, 2021

Hearing on The Role of and Programs within the Department of Energy's Office of Science

Chairman Manchin, Ranking Member Barrasso, and members of the Committee: Thank you for the opportunity to appear before you today. It is an honor to provide this testimony about the role and programs of the Department of Energy's Office of Science.

My name is Thomas Zacharia and, since 2017, I have served as the director of Oak Ridge National Laboratory, where I began work as a postdoctoral researcher in 1987. The Department of Energy's 17 National Laboratories support the department's missions of energy, scientific discovery, national security, and environmental management.

The DOE Office of Science, as the nation's largest funder of the physical sciences, oversees 10 of the National Laboratories, including Oak Ridge. We are the largest Science Laboratory, but we also play key roles in applied energy and national security because many of the breakthroughs we pursue in basic science have important applications across government and the private sector.

The scientific discoveries of the National Laboratories are an engine for American innovation and economic growth, and I thank the Members of this Committee for recognizing the importance of the Office of Science and its Laboratories. Recent legislation introduced or passed in Congress demonstrates the priority you place on our competitiveness and on creating economic opportunities while addressing climate and ensuring our national security.

The Office of Science's $7 billion budget provides direct funding for scientific research and fosters technology development. It also funds construction and operation of the User Facilities and laboratory infrastructure that hosts over 36,000 scientists and engineers from laboratories, universities, and industry each year. Continued investments in facilities and infrastructure are necessary for the United States to address climate change, grow important technical industries, and remain an international leader in areas such as high-performance computing, materials science, fusion energy, quantum science, biology, the frontiers of physics, and critical materials and minerals.

Across the Office of Science, there are 28 User Facilities in total. It is important to note that these facilities—which include supercomputing centers, advanced light and neutron sources, particle accelerators, and specialized facilities for nanoscience, genomics, and other disciplines essential for sustaining U.S. leadership in research and development—are available for use by researchers outside the Department of Energy and its laboratories. While the Office of Science provides National Laboratories with the funding to maintain and operate the facilities, universities and industry routinely use them to conduct research with broad application and benefit.

This leads to a great deal of collaboration among the National Laboratories, universities, and industry. Each sector of the U.S. innovation ecosystem brings unique and important strengths. Academia focuses on fundamental research and the advancement of knowledge. Industry is primarily concerned with the near-term development and application of research outcomes. National Laboratories serve as integrators, spanning the full spectrum from fundamental to applied research as well as the demonstration and deployment of technologies. The Labs provide a bridge over the so-called “Valley of Death” between innovative ideas and prototype technologies on one side and the scale necessary for commercial success and societal impact on the other.

The Office of Science also sponsors workforce training programs for students and educators that promote careers in the sciences, technology, engineering, and mathematics (STEM). With that support, the National Laboratories provide unique opportunities for STEM workforce development, including programs that increase engagement from underrepresented communities. The Labs offer direct access to leading scientists, world-class scientific User Facilities and instrumentation, and large-scale, multidisciplinary research programs unavailable in universities or industry. The Labs’ programs annually serve over 250,000 K-12 students, 22,000 K-12 educators, 4,000 undergraduate interns, 3,000 graduate students, and 1,600 postdoctoral researchers.

Our system is effective and is the envy of other nations. Unfortunately, we are seeing more and more that our competitors and adversaries are copying our model.

For example, we know other nations such as China are constructing research centers that mirror our National Laboratories, in a bid to outpace us. They seek to build more powerful equipment than ours, and they are recruiting scientists worldwide by promising the latest technology and capabilities.

If the United States is to continue to be the destination of choice for STEM careers, we must ensure consistent, strategic investment in the infrastructure, programs, and partnerships of the Office of Science. This is an important and effective mechanism for keeping talented scientists and engineers working here to make us more competitive.

By leveraging our world-leading facilities, assembling large multi-disciplinary teams across institutions, and pursuing use-inspired, mission-driven research, the National Laboratories offer our best and brightest the opportunity to translate fundamental discoveries into impactful applications that address the most pressing scientific and technical challenges facing the nation.

This has always been the National Laboratories' role.

Our first scientists, engineers, and technicians applied new discoveries in fundamental physics to harness the atom during the Manhattan Project. They worked with an urgency prompted by uncertainty about the technological progress being made in Germany, where atomic fission had been discovered. After the existential threat of World War II was past, the technical staff who understood the physics, chemistry, and engineering necessary to pursue nuclear technology quickly recognized a variety of new uses with broad benefits for society, from large-scale production of isotopes for medical treatments, research, and industry; to tools for studying and improving materials; to research in biology and ecology essential for protecting people and the environment. These were in addition to the (emission-free) nuclear energy that would soon power a significant proportion of U.S. homes and businesses as well as the U.S. fleet of submarines and aircraft carriers—the nuclear Navy.

From the very beginning, then, the National Laboratories brought together the best in scientific discovery and technical expertise from government, industry, and academia to solve the most important and most difficult challenges of the day. The work of the National Laboratories has given rise to innovations in materials, manufacturing, medicine, space exploration, transportation, and a host of other fields.

This is a role the National Laboratories and the Office of Science continue to fulfill today. We stand ready to help solve the world's most urgent problems. Here are a few examples:

COVID-19 Response

In March 2020, the Department of Energy established the National Virtual Biotechnology Laboratory in response to the COVID-19 pandemic. The NVBL connected scientists and engineers across the National Laboratory System who offered deep expertise for multiple fronts of the war against COVID-19. The NVBL's work—conducted in partnership with industry, academia, and other federal agencies—included development of analytical technologies and trace detection; design and discovery of antiviral drugs and vaccines; predictive modeling for emergency response and epidemiology; and molecular and structural biology.

In a matter of weeks, the NVBL helped drive research that mitigated shortages in medical supplies; modeled and predicted pandemic spread; improved and validated testing procedures; assessed the transmittal of the virus in buildings; and supported the development of new antiviral drugs.

At Oak Ridge, the contributions of the DOE's Office of Science were evident.

Oak Ridge reallocated all available neutron scattering resources at the High Flux Isotope Reactor (HFIR) and Spallation Neutron Source (SNS) to combat COVID-19. HFIR and the SNS are User

Facilities in the Office of Science's Basic Energy Sciences (BES) program and were quickly mobilized to study crucial components of SARS-CoV-2, the virus that causes COVID-19. They provided novel insights into the virus's main protease, the enzyme responsible for enabling the virus to reproduce; the spike protein, a barb-like structural protein that covers the surface of the virus and triggers the infection process; and the interactions, or docking, of COVID-19 drug candidates with the virus to better understand how these molecules might behave in human cells.

The data collected from neutron scattering experiments also supported university research related to drug docking simulations performed on the Summit supercomputer at the Oak Ridge Leadership Computing Facility, a User Facility of the Office of Science's Advanced Scientific Computing Research (ASCR) program. Oak Ridge was just one of the National Laboratories, federal agencies, industry, and academic leaders providing access to the world's most powerful high-performance computing resources through the Office of Science's COVID-19 High-Performance Computing Consortium.

Among applications of Office of Science computing power, researchers used Summit to simulate the virus' spike protein in numerous environments, including within the SARS-CoV-2 viral envelope, comprising 305 million atoms—the most comprehensive simulation of the COVID-19–causing virus performed to date. The results have led to discoveries of one of the mechanisms the virus uses to evade detection as well as a characterization of interactions between the spike protein and the protein that the virus takes advantage of in human cells.

At Oak Ridge, we also worked with medical suppliers and the manufacturing supply chain to speed and expand production capabilities for test kits and personal protective equipment. We applied the materials expertise from our Office of Science X-ray, neutron, and nanoscience facilities to the production of material for N95 masks that could filter out the virus. Two industry partners—Cummins and DemeTECH—put the national labs' discovery to work producing millions of masks used throughout the U.S., as well as adding thousands of jobs.

Advancing Secure Manufacturing

In addition to the Office of Science's User Facilities, at Oak Ridge we host User Facilities such as the Manufacturing Demonstration Facility and Carbon Fiber Technology Facility, both managed by DOE's Office of Energy Efficiency and Renewable Energy. These facilities allow us to leverage the Laboratory's Office of Science expertise in materials, manufacturing, and high-performance computing to improve the way we design and build virtually anything—from buildings to nuclear reactors to automobiles to components for the Air Force and Navy.

We have highly leveraged these capabilities, with MDF supporting some 30 startups and more than 100 industry fellows, working with 200 U.S. companies and 50 universities, and helping to establish seven U.S. companies in the new industry of large-scale additive manufacturing. For example, we have a partnership with the University of Maine Advanced Structures and Composites Center to 3D print with wood products, creating a new market for Maine's forest products industry.

Among private-sector examples is a five-year agreement with General Electric to apply the Lab's research to development of products including a turboprop engine that includes a dozen 3D-printed parts and can be printed as a single unit, instead of assembled from some 800 pieces.

Because U.S. manufacturers are one of the top targets for cyber criminals and nation-state adversaries, Oak Ridge is also a partner in the University of Texas at San Antonio's Cybersecurity Manufacturing Innovation Institute (CyManII). Integration across the supply chain network and an increased use of automation applied in manufacturing processes can make industrial infrastructures vulnerable to cyber-attacks, impacting production of energy technologies such as electric vehicles, solar panels, and wind turbines. By leveraging deep expertise based on Office of Science capabilities, in areas such as digital manufacturing, cyber-physical security, sensing, and predictive AI, CyManII will not only make manufacturers more energy efficient but will help them to become more resilient and globally competitive against our nation's adversaries.

Finally, applying National Laboratories' fundamental research to the recycling and reuse of plastics and composite waste material holds significant benefit both for the environment and industry. According to DOE, 5.7 billion metric tons of discarded plastic have never been recycled. The vast amount of discarded waste presents a critical need for new technology in the area of plastics recycling. In addition, Environmental Protection Agency (EPA) data indicates that 75 percent of plastic waste is sent to landfills, representing almost one-fifth of all landfilled solid waste, with the rest incinerated. Today's composite waste materials can become tomorrow's valuable raw materials, and researchers at Oak Ridge are deploying new processes based on fundamental chemical and biological research that convert feedstocks used in advanced manufacturing into reusable materials.

The Energy-Climate-Water Nexus

The United States cannot meet the goal of net-zero greenhouse gas emissions by 2050 merely by pursuing existing technologies more aggressively. To reverse current climate trends, we need breakthrough discoveries of new phenomena and materials—new discoveries that will add to our understanding of the materials and processes of the physical world. The National Laboratories and the Office of Science, through grant programs and its world-class research centers, are designed to tackle such complex problems.

Areas in which Office of Science programs and the National Laboratories offer significant resources and expertise include:

- Critical and sustainable materials discovery to advance clean energy technologies such as batteries, solar, and clean hydrogen, as well as advanced carbon capture and utilization at scale.
- Experimentally measuring and modeling the earth's climate system to provide a fuller understanding of the challenge and to better inform the delivery of innovative solutions at scale.

- Engineering biology and biotechnology to develop clean solutions to difficult challenges such as drop-in sustainable aviation fuel, bioproducts that sequester carbon indefinitely, and sustainable replacements for plastics and other environmentally harmful products.

In the area of biological and environmental systems science, the Office of Science's Biological and Environmental Research (BER) program supports scientific User Facilities to understand complex biological, earth, and environmental systems and ensure energy and infrastructure security, energy independence, and economic prosperity.

This program also supports four Bioenergy Research Centers aimed at removing barriers to a vibrant and economically viable domestic bioenergy industry. They are led by National Laboratories or universities and pursue national goals for reducing carbon emissions through conversion of abundant non-food plant resources into affordable transportation fuels for light-duty vehicles and aviation. Their work translating fundamental research for applied energy applications helps to ensure processes can be scaled from fundamental discoveries to industrial-scale applications. The centers bring together diverse experts from across the Office of Science complex, academia, and industry, and each center takes a distinctive approach, from developing high-yielding bioenergy crops to engineering microbes to efficiently convert plants into valuable fuels and chemicals. West Virginia University, the University of Colorado and Colorado State, Oklahoma's Noble Research Institute, and Oregon's GreenWood Resources are among partners in ORNL's Center for Bioenergy Innovation, supporting long-term research projects that have resulted in multiple licensing agreements related to the development of more efficient biofuels through a better understanding of plant genetics.

The Office of Science also sponsors large-scale field experiments in the Arctic (NGEE-Arctic), the tropics (NGEE-Tropics), and in the forests of Minnesota (SPRUCE) to study and predict the effects of climate change. Data from the field is critical to reducing uncertainty and informs Earth System Models that predict the future of our planet. Oak Ridge manages the data center for the Office of Science's Atmospheric Radiation Measurement (ARM) User Facility, which curates millions of measurements of sunlight, cloud characteristics, particles in the air and other atmospheric phenomena influencing global climate, gathered by sensors from the Americas to the Azores. ARM makes the data available to atmospheric scientists through a Data Discovery tool that facilitates the accurate representation of clouds and cloud physics in atmospheric models, including the DOE Energy Exascale Earth System Model (E3SM).

At Oak Ridge, we established the Climate Change Science Institute (CCSI) in 2009 to apply multidisciplinary expertise and big science capabilities—including world-class supercomputers—to predict the future of our changing planet and to evaluate potential solutions at the intersection of climate, clean energy, national security, and environmental justice.

Finally, the Office of Science and its laboratories are leading contributors in the effort to dramatically increase secure, affordable, energy efficient supplies of clean water. The multi-lab National Alliance for Water Innovation (NAWI), headquartered at Berkeley Lab, brings together a world-class team of industry and academic partners to examine the critical technical barriers and research needed to radically lower the cost and energy of desalination. NAWI's focus is on early-stage research on desalination and associated water-treatment technologies.

Technologies of the Future

The Office of Science and the National Laboratories are at the forefront of advancing emerging technologies and doing so with the experience, talent, and mechanisms necessary to protect national interests. The National Laboratories operate with strict protocols regarding development, review, and sharing of new technologies as well as analysis of dual use implications, consideration of counterintelligence risks, and the involvement of foreign scientists or companies. This includes our obligation to alert authorities and policymakers to over-the-horizon technical threats that may impact American lives and undermine future U.S. economic competitiveness.

Among the specialized technical areas in which the DOE Office of Science and its laboratories are making important contributions:

Quantum: In quantum computing and information systems, the Office of Science and its National Laboratories are leading five National Quantum Information Science Research Hubs—each with diverse members that include American industry, universities, and National Laboratories. DOE funds the hubs thanks to bipartisan congressional support for the National Quantum Initiative and subsequent appropriations. These centers are part of a coordinated, multi-agency effort with the National Science Foundation and National Institute for Standards and Technology and serve as an excellent example of a complementary, multi-agency approach to ensuring U.S. leadership in an emerging field. Better understanding of the laws of quantum mechanics, discovery of new materials, and development of new quantum computing, sensing, and networking technologies could have revolutionary implications for data storage and the secure transfer of information over long distances. This research could also lead to unprecedented improvements in the accuracy and efficiency of quantum algorithms, quantum-classical operations, and even quantum computers.

Computing: The National Laboratories operate two of the world's three fastest supercomputers, and ORNL will deliver the first Exascale computer later this year, Frontier, which is expected to be the new fastest computer in the world. By nature of their design, exascale systems will also be the most powerful artificial intelligence machines in the world, and the National Laboratories are aggressively engaging U.S. industry and other government agencies including NSF, NASA, NOAA, NIH, and DoD regarding project scope and requirements, technical approaches and progress, technology outreach and adoption, and strategic directions.

In addition to the supercomputers themselves, the National Laboratories employ some of the world's leading experts in computer science and advanced mathematics, which is crucial to leveraging each new generation of bigger and better computing capabilities through advanced software development. The Office of Science laboratories that are home to its most powerful computers—including Oak Ridge, Argonne, and Berkeley Lab—collaborate extensively with university and industry partners, as well as other National Laboratories, to license laboratory-developed software and hardware for applications such as advanced manufacturing, biomanufacturing, buildings, chemical separation, grid modernization, quantum information science, and storage.

Summit, located at Oak Ridge, is the fastest computer in the United States. Here are a few examples of Summit's impact in a variety of fields.

- General Electric is using Summit to simulate combustion in gas-powered turbines. The use of computer simulations gives researchers more designs to evaluate, which means they can make leaps in turbine efficiency that translate to millions of dollars in saved fuel and millions of tons of reduced carbon pollution.

- A team from Lawrence Berkeley National Laboratory is using Summit to study copper-based superconductors to understand the interactions between the particles in these materials. Superconductors have zero electrical resistance when they reach sufficiently low temperatures and might be useful for technologies such as magnets for MRIs, fusion devices, and particle accelerators.

- General Motors recently received the first commercial license for the use of MENNDL, a powerful artificial intelligence system developed by Oak Ridge to recognize patterns in datasets of text, images, or sounds, to accelerate advanced driver assistance systems technology and design. Last year, in a project with the Stony Brook Cancer Center at Stony Brook University in New York, MENNDL was used on Summit to create neural networks that can detect cancer markers in biopsy images much faster than doctors.

Biology: In biotechnology, genomics, and synthetic biology, the National Laboratories possess one of the world's greatest collections of research facilities, international scientific leadership, and other assets focused on non-human biology for energy, environmental sustainability, and biomanufacturing. The Joint Genome Institute (JGI) at Lawrence Berkeley National Laboratory and the Environmental Molecular Sciences Laboratory (EMSL) at Pacific Northwest National Laboratory are among the world's most sophisticated research facilities focused on biology by design to address climate change, clean energy, and environmental sustainability. These facilities are utilized annually by thousands of users and tens of thousands of researchers access and use the data they generate.

Coal and Carbon Capture: The challenge of capturing carbon from the atmosphere illustrates the benefits of the Office of Science approach. Carbon capture requires diverse expertise, from geochemistry to chemical separations, plus engineers who can make materials and devices that work economically and effectively. At the Center for Nanophase Materials Sciences—an Office of Science User Facility at Oak Ridge—staff researched how to convert carbon dioxide to ethanol using common elements. They discovered an electrocatalyst that converts CO_2 efficiently to ethanol using graphene—a form of carbon, an abundant element—along with small amounts of copper. Our experts worked with multiple Energy Department programs as well as industry, and the catalyst has been licensed by multiple U.S.-based companies including New Orleans-based ReactWell LLC.

Oak Ridge has a cooperative research and development agreement (CRADA) with Wyoming-based Ramaco Carbon through 2025 to explore innovations for the conversion of coal to high-value advanced carbon products and materials. The Innovation Crossroads program supported by DOE and TVA is also supporting innovation in this space. One of the first graduates of the two-year fellowship program is SkyNano Technologies, a company that has developed a process to turn carbon dioxide into carbon-based materials for use in industries from technology to transportation.

Researchers also are utilizing Office of Science User Facilities at Oak Ridge to improve the performance of existing power plants. For instance, researchers from West Virginia University are using neutron scattering at ORNL to study novel materials called high-entropy oxides. Their goal is to collect insights into how the atoms in the HEOs bind together and whether the materials can be used to develop useful applications to improve power plant operations and are testing sensors that monitor efficiency at the Longview Power Plant in Maidsville, W.Va.

Critical materials: The Office of Science and the Office of Energy Efficiency and Renewable Energy support the U.S. manufacturing sector with research that helps to secure supply chains of critical minerals. Research to diversify the supply of rare earth elements examines the complexity of source materials available within the U.S. and is also examining urban waste as a possible source of rare earths. These sources often contain dilute sources of critical material, and researchers are exploring approaches for extracting them. The research includes designing molecules that can control separation selectivity for rare earth elements and then allow the rare earths to be released from the molecules in response to external stimuli on demand.

Researchers are also looking at more scalable methods for making functionally equivalent alternatives to critical materials from plentiful feedstocks, and to move them to market faster and more cheaply. This research relies on state-of-the-art characterization tools and computational resources available from Office of Science User Facilities including Oak Ridge's Center for Nanophase Materials Sciences and Spallation Neutron Source, as well as the Oak Ridge Leadership Computing Facility.

Finally, in research funded by the Office of Energy Efficiency and Renewable Energy, we have designed, built, and tested systems capable of recycling rare earth materials from computer hard drives and Electric Vehicle (EV) batteries, working with industry to commercialize the technology, most recently through a Texas company that licensed our process for recovering cobalt and other metals from spent lithium-ion batteries, fewer than 5 percent of which are recycled today in the U.S.

Isotopes: The Office of Science manages the National Isotope Development Center, serving as an interface with the user community and coordinating isotope production across facilities at Oak Ridge, Argonne, Brookhaven, Idaho, Los Alamos, and Pacific Northwest National Laboratories. At our National Laboratories, we produce many isotopes that are not available from any other source.

Without this important work within the Office of Science, we would not have many of the cancer treatments or medical diagnostics techniques we have today, and NASA would not be able to explore Mars. About a third of all patients admitted to hospitals require diagnosis or treatment using radioisotopes.

Isotopes are used for hundreds of applications beyond healthcare and space exploration, too, including smoke detectors, neutron detectors for homeland security applications, explosives detection, and many others.

Production of these isotopes requires a unique set of facilities and infrastructure, plus a robust research and development program for new or improved production methods. It is worth noting that many of the isotopes we make at Oak Ridge—isotopes that cannot be produced anywhere else—are produced in a reactor built in the 1960s and then processed in nuclear facilities of the same vintage. This is certainly a good example of where Laboratory infrastructure funding could be well spent.

Natural Disaster Protection and Response: National Laboratories offer a suite of capabilities to address the requirements of detection, tracking, forecasting, and assessing wildfire and the recovery of lands impacted by wildfires. A range of predictive models, data resources, remote sensing and tracking applications, measurements, and long-term monitoring, all aided by world-class computational resources can be brought to bear on this critical area, mitigating large-scale interruptions of energy infrastructure that impact the lives and economic prosperity of communities throughout the U.S.

Fusion Energy: Nuclear fusion has the potential to deliver carbon-free, inherently safe, abundant energy to the world for thousands of years, supporting equitable global access to reliable electricity.

ORNL is making crucial contributions to resolving key challenges, including leading the U.S. ITER project for the Office of Science and building the world-leading Material Plasma Exposure Experiment (MPEX), working on fundamental science in burning plasma physics and fusion materials, and leading technology development for the fusion fuel cycle. Fundamental science in burning plasma physics is preparing us for valuable research at the ITER facility, and the ITER project is also providing opportunities for hundreds of U.S. universities and companies to contribute and to gain valuable insight as the project progresses.

For a path to fusion energy—not just fusion science— it is essential to master both the science and the technology. Materials and fuel cycle are less developed and require intensified efforts to accelerate the path to fusion energy. The extreme environment of a fusion device requires materials that can perform reliably to minimize downtime. Facilities such as a Fusion Prototypic Neutron Source are needed to advance fusion materials and prepare the U.S. for a fusion pilot plant.

About $2 billion of private funding has been invested in novel fusion concepts, focused primarily on confinement (physics). Federal investment is vital because a successful fusion industry depends on Oak Ridge and other lab contributions for science and technology expertise. The Office of Science's INFUSE program (Innovation Network for Fusion Energy) managed by Oak Ridge and Princeton Plasma Physics Laboratory, is an excellent example of industry leveraging

DOE science lab fusion expertise. So far, 16 private companies are engaged in 40 projects with DOE science labs.

Place-Based Innovation and Regional Technology Hubs

The growing realization that a vibrant innovation ecosystem is the key to sustained economic vitality is bringing renewed attention to the role of the National Laboratories in catalyzing innovation. National Laboratories can be key players in regional ecosystems made up of "networks of technology firms, capital markets, and research universities" from which, according to a recent report from the Council on Foreign Relations, most innovation emerges. National Laboratories in Northern California and the Chicago area contribute to the strength of those "superstar metro areas" for innovation, as defined by the Brookings Institution.

Most of America's innovation jobs are concentrated in just 41 of the nation's more than 3,000 counties. To overcome what it calls "the entrenched geography of America's innovation industries," Brookings proposes a major package of federal investment for innovation-sector scale-up in metropolitan areas that have been left behind in the agglomeration of the innovation industry. If we overlay the locations of the DOE National Laboratories with *Jump-Starting America*'s 100-city list, promising locations for expanded innovation emerge. Like Brookings, *Jump-Starting America* calls for strategic federal investments in science and both identify the Oak Ridge Corridor—in the Southern Appalachians near Knoxville, Tennessee—as a candidate for transformative growth.

The Oak Ridge Corridor is already an established Center of Excellence, as a world leader in computing, neutrons, materials research, nuclear energy, and advanced manufacturing. It also leverages key partnerships between Oak Ridge National Laboratory and the University of Tennessee, Vanderbilt University, and other regional and national universities including HBCUs. We are proud, in fact, to be recognized recently as one of the Top 20 supporters of HBCU engineering schools, and we are committed to developing the workforce of the future. Oak Ridge provides educational programs for thousands of K-12 students and teachers each year, and hosts 550 undergraduate interns, 300 graduate students, and 400 postdoctoral researchers annually. Each summer, our scientists work with middle and high school students and teachers in the Appalachian Regional Commission's Oak Ridge Summer STEM Program, which offers a residential, hands-on learning experience. Many participants come from economically distressed counties and will be the first generation in their families to attend college. The ARC summer program is often their first exposure to applied science and in-depth STEM education.

Office of Science investments in world-leading User Facilities, programs, people and collaborators from academia and industry provide a foundation for creating a new innovation community for wealth-creating, high-tech jobs in the Oak Ridge Corridor, a region well outside the 41 counties where most of those job are now. In fact, the labor shed for the Oak Ridge Corridor includes a dozen counties designated as distressed or at-risk by the Appalachian Regional Commission. The Corridor also runs through Tennessee's coal mining region and near two of the coal-fired power plants soon to be shut down by the Tennessee Valley

Authority. Those workers will benefit from retraining for innovation jobs, and we are already working with community colleges to develop training and certificate programs.

The Federal Government spends several billion dollars annually in Oak Ridge, when the Laboratory, the Y-12 National Security Complex, and the Department of Energy's cleanup mission are all taken into account. An Innovation Center in East Tennessee can leverage those investments and realize DOE's vision of its Oak Ridge site as a clean, modernized, and reindustrialized city that advances the Department's vital missions in ensuring America's security and prosperity.

Conclusion

In closing, let me again thank you for your support and recognition of the value the Office of Science holds for our nation's innovation and scientific leadership, as well as some of the contributions made through its programs.

As Congress continues to make important decisions about infrastructure investments, I urge the Members of this Committee to prioritize the funding of National Laboratory infrastructure. The needs span the spectrum from deferred maintenance of facilities and basic infrastructure that range from 70 years old to state-of-the-art scientific facilities that will attract the brightest scientists of our time and help win the global race for talent. Facilities like the Electron Ion Collider and the Second Target Station are key examples of infrastructure investments that will keep the United States at the forefront of scientific discovery and innovation for decades—if we choose to make those investments.

As you consider investments in our nation's energy infrastructure more broadly, the National Laboratories also offer key capabilities both to maximize the effects of new technology in mitigating climate change but in redesigning potentially vulnerable critical infrastructure with physical and cyber security in mind.

The Office of Science has given Oak Ridge and its other National Laboratories the significant responsibility of stewarding world-leading research capabilities in the national interest, forming partnerships with the potential to transform industries, and collaborating across the federal government to strengthen national security and keep the United States at the forefront of science and technology.

We are grateful to be entrusted with this mission and look forward to pursuing it together.