



## Leadership in International Standardization

The U.S. Department of Energy (DOE) has a long history of leadership in international standardization efforts to accelerate the adoption of transformative science and technology solutions to energy, environmental, and nuclear challenges. Technical experts at DOE and its 17 National Laboratories provide critical input to new standards in areas ranging from hydrogen and energy storage, to biotechnology, artificial intelligence, and high-performance computing (HPC). DOE's experts work alongside participants from all over the world toward standards that are consistent with U.S. values and informed by the latest scientific and technological advancements.

DOE's continued investments support the U.S. Government National Standards Strategy for Critical and Emerging Technologies:

- *Research, development, and demonstration (RD&D)*: Standards are substantially driven by technical contributions that flow from R&D and are proven by demonstration. DOE invests many billions annually in nondefense and defense RD&D efforts that might inform current or future standards. For example, DOE's FY 2023 budget includes nearly \$8 billion just for clean-energy RD&D; which is proposed to grow to \$9.4 billion in FY 2024.
- *Participation and workforce*: DOE will continue supporting participation in national and international standardization activities, taking a leadership role where appropriate, and growing the standards-knowledgeable workforce from DOE's National Laboratories and its academic and industry partners. DOE recognizes that standardization can accelerate the adoption of transformative science and technology solutions that are key to the success of its mission.

The following case studies exemplify DOE's contributions:

### Case Study: Programming High-Performance Computers

DOE relies on HPC for essential aspects of its mission; in fact, some of the most powerful computers in the world are deployed by DOE offices, including the Office of Science and the National Nuclear Security Administration. Creating applications for these computers is challenging. Standards are required to ensure that applications can be used on multiple computers without significant modifications. For over three decades, DOE technical experts have created standards for this purpose. Examples include the Message Passing Interface (MPI) specification, first released in 1994, and the OpenMP specification, first released in 1997, both of which remain under active development and critical to HPC today. DOE technical experts

have also contributed for decades to the standards for the Fortran and C++ programming languages, which are standardized by the International Organization for Standardization (ISO). For C++, one of the most widely used programming languages in the world and an essential language for modern HPC programming, technical experts from at least six DOE National Laboratories actively contribute to its standards.

#### Case Study: Energy Storage Systems Safety

Energy Storage Systems (ESS) are in increased demand for stationary applications, and since 2013 DOE's Office of Electricity has led support for standards that improve ESS safety and reliability. DOE's *Energy Storage Grand Challenge Roadmap* highlights the need for additional standardization to reduce risk and facilitate technology commercialization. To address this need, technical experts from multiple DOE National Laboratories participate in standardization activities under a variety of standards organizations, including the Institute of Electrical and Electronics Engineers, the International Building Code, the International Electrotechnical Commission, the International Fire Code, the International Residential Code, and the National Fire Protection Association. These energy storage codes and standards include testing criteria to ensure the safety of different chemistries under different uses; design requirements to achieve durable and reliable system assembly, installation, and operation; and interconnection standards to achieve interoperability between power-system components and to minimize of negative impacts of ESS on the larger power system. DOE's Energy Storage Safety Collaborative facilitates the education of and participation in these and many other ESS standards and codes.