ENERGY SCIENCES COALITION

Statement for the Presidential Transition

Strong support of the U.S. Department of Energy Office of Science will enhance energy security, build the economy and restore America's competitive edge in science and technology.

The Energy Sciences Coalition (ESC) is a broad-based coalition of organizations representing scientists, engineers and mathematicians in universities, associations, industry, scientific societies and national laboratories who are committed to supporting and advancing the scientific research programs of the U.S. Department of Energy (DOE) Office of Science.

For more than half a century, the federal government has pursued a strategy of investing in fundamental research on the principle that the United States benefits broadly from this investment over time. The Energy Sciences Coalition urges the new administration to make an early commitment to strongly support the DOE Office of Science to advance the nation's technological leadership and economic competitiveness. Specifically, we recommend:

- **prioritize investment in basic research sponsored by the Office of Science to spur innovation and grow the U.S. economy;**
- **support the next generation of American scientific talent;**
- **continue to build and fully leverage world-class scientific tools and facilities;**
- **support the network of the DOE National Labs to solve important energy, environmental, and national security challenges, and;**
- **expand U.S. international leadership in science.**

The DOE Office of Science is an established leader among federal agencies that enables scientific advancements and pushes forward the frontiers of knowledge to advance our nation's energy, economic and national security interests. It is currently the nation's largest federal sponsor of basic research in the physical sciences, and it has played an especially important role in recent decades. The DOE Office of Science curiosity-driven research has yielded the knowledge necessary to, among other things, develop high-energy storage capacity lithium batteries, energy efficient superconducting wires, DNA sequencing technology, improved medical imaging technology, and detectors to identify concealed nuclear weapons and land mines. The impact the DOE Office of Science has had on U.S. industrial growth is also often unappreciated. For example, its high-performance computers have helped U.S. small- medium- and large-scale businesses bring new products to market faster and at lower cost, such as more fuel-efficient engine designs and jet engines, and basic research investments in chemistry have led to the world's first 3D printed lithium ion batteries. For these reasons, the DOE Office of Science has broad bipartisan support and is recognized as a leader in securing our nation's energy future.

Increase the budget for all DOE Office of Science programs:

The DOE Office of Science plays a critical role in ensuring U.S. leadership in many scientific fields, both in pursuit of fundamental discovery and to advance science for cleaner energy production, storage and transmission. The DOE Office of Science is the primary government sponsor for research in high energy and nuclear physics, heavy-element chemistry, plasma physics, magnetic fusion and catalysis. It is also a leading research sponsor for advanced materials, biological sciences and computing relevant to a broad range of energy applications. Strong and sustained funding is required to advance U.S. leadership in these long-term, research-intensive disciplines that are critical to both our energy security and our national security.

Fundamental research and related scientific facilities are critical to our economic growth, energy security, national security and global competitiveness. The United States' research enterprise is at a critical inflection point. With many nations increasing their research investments to stimulate economic growth and the United States' investments remaining flat, we risk losing our competitive edge. China, India, South Korea, the European Union and others are mirroring our approach to innovation and are expanding their investments in scientific research and facilities. A recent study (Global Innovation Index 2016) ranks the United States fourth among world leaders in innovation, and the U.S. has fallen to 10th place in dollars invested in research as a percentage of GDP.

Additionally, many U.S. companies rely on the advancements created by the fundamental, curiosity-driven research funded by the DOE Office of Science. The American Academy of Arts and Sciences notes in its 2014 report *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream*: "There is a deficit between what America is investing and what it should be investing to remain competitive, not only in research but in innovation and job creation." The report recommends at least 4 percent real annual increases in funding for key federal research agencies, including the DOE Office of Science. This level of funding was endorsed in June 2016 by more than 500 businesses, universities, scientific societies and national organizations in a national call to action – *Innovation: An American Imperative*. CEOs of major corporations such as John Deere, Northrop Grumman, Merck, Lockheed Martin, Boeing, Novartis and Microsoft signed the *Innovation Imperative*.

Recommendation: ESC recommends no less than a four percent real annual increase in the Office of Science over the next five years.

Harvest the fruits of our scientific investment for U.S. economic growth:

In the 20th century, the United States became the world's most outstanding example of a nation that profited from its national investment in science. While the economic impact of this investment is difficult to calculate, some estimates show that science-driven innovation in the U.S. has fueled half of the nation's economic growth since World War II. Today, the growth of our economy and American leadership around the globe depends on technological innovation more than ever before – and the DOE Office of Science is one of the leading federal drivers of the science that helps meet that need.

During the last decade, the DOE Office of Science has made key science investments to advance U.S. leadership in energy technologies. For example, fundamental research in nanostructured cathode materials led to the production and deployment of high-energy, lithium ion batteries used by car companies for electric vehicles; better understanding of the chemistry of sprays of diesel fuel led to the design of a new, more energy-efficient diesel engine for Cummins, which is used in all Dodge Ram pickup trucks; and interest in how organic films harvest light and generate electricity resulted in the commercialization of a thin film that uses solar energy to power tablets, digital signage, wearable devices, and even buildings as a type of window coating.

Recommendation: Take full advantage of the progress achieved through federal investments in fundamental research by continuing DOE Office of Science programs that help American industries become more competitive through the transfer of new ideas and technologies into the marketplace.

Support the next generation of American scientific talent:

The DOE Office of Science supports a diverse portfolio of research at colleges and universities nationwide. It sponsors half of all university physics research and more than 24,000 Ph.D. scientists, engineers, graduate students, undergraduates and technical personnel at more than 300 institutions through competitively awarded grants. DOE-funded research and education programs strengthen our nation's scientific knowledge base and prepare the next generation of scientists and engineers by providing hands-on experience for students. Without adequate support for these programs, our students will not be properly trained for the demands of technology-intensive industries.

Recommendation: Continue to invest in the future of the American technical workforce by supporting programs that train students to be the kind of skilled workers tomorrow's U.S. industries will require.

Continue to build world-class scientific tools and facilities:

The DOE Office of Science supports the operation of the largest collection of major scientific user facilities in the world, which are too large and costly for any one institution or company to build or operate on its own. Located at national laboratories and universities around the country, these open-access facilities include particle accelerators, experimental reactors, high-precision instruments, synchrotrons and light sources, leadership-class supercomputers and high-resolution mass spectrometers. Annually, more than 30,000 researchers from U.S. industry, universities and federal agencies from all 50 states rely on these facilities to support their scientific and engineering needs. Nearly half of the DOE facility users are university and federal investigators working to answer fundamental science questions. More than 50 Fortune 500 companies and 150 small businesses use these facilities to do the underlying research required to develop new technologies and products that drive the economy. U.S. industry has used DOE Office of Science scientific facilities to develop a broad range of new products, including lifesaving drugs, such as KALETRA (for treating HIV); ZELBORAF (for treating melanoma); and Votrient (for treating renal cell carcinoma). Those facilities have also play integral roles in the development of better fuel injector designs for more energy-efficient engines; new instruments to examine the size of pores in gas-producing shales for more economical natural gas extraction; and advanced microprocessors for the computing industry. Industry pays to use these federally funded facilities for proprietary work; but if not for the DOE, U.S. researchers would have no access to these vital scientific tools or would have to look overseas to find the tools needed for their research.

Recommendation: Commit to continued support for the tools and facilities that enable innovation both in fundamental discovery science and in industry, big and small.

Maintain robust support for the DOE National Labs:

The DOE Office of Science is also responsible for stewarding a system of 10 national laboratories. The government-owned, contractor-operated (GOCO) operation model used for U.S. Federally Funded Research and Development Centers (FFRDCs) is based on the success of the Manhattan Project, which was a government-university-industry partnership model that combined the most sophisticated academic research talent with the best industry engineering and management expertise to solve the most compelling national problems. The same cooperative enterprise that was used to build the atomic bomb and win World War II is now employed by the national laboratories to bring together multidisciplinary teams of scientists and engineers and steward one-of-a-kind scientific research facilities to secure American access to abundant, clean, cheap, reliable energy; strengthen its economic competitiveness; and deter the use and

prevent the spread of nuclear weapons and materials. The national laboratories work together to deliver scientific discovery and innovation and serve the national interest, and their impact has been profound. To date, scientists at DOE national laboratories have made contributions to 115 Nobel prizes.

Recommendation: Continue supporting our nation's unique, multidisciplinary national laboratory system, which has a distinguished record of advancing basic science and applied technology to serve America's economic, energy, environmental and national security interests.

Expand U.S. leadership internationally in science and technology:

Strong and sustained funding for the DOE Office of Science programs is vital to the U.S. retaining its competitive edge. Science is becoming increasingly global, with countries in Europe and Asia aggressively investing in the physical sciences and building state-of-the-art facilities to attract the best researchers and scientists from around the world. Because the U.S. cannot afford to build all state-of-the-art scientific facilities on its soil, we can benefit from their investments by participating in international collaborations to advance scientific discovery. For example, the Large Hadron Collider (L.H.C.) – best known for the discovery of the elementary particle, the Higgs boson, in 2012 – is located in Switzerland, cost $10 billion to construct and includes an accelerator ring 17 miles in circumference, straddling two nations. The U.S. joined this international collaboration, is a large contributor to the project, and now sends the largest contingent of scientists to use the facility.

The U.S. must also continue to invest in new facilities to maintain U.S. leadership. Our nation cannot afford to sit on the sidelines while the next generation of large-scale, scientific facilities are constructed and operated by other nations. The U.S. should capitalize on international investments for the Long Baseline Neutrino Facility, for example – the first-ever large scale international investments in science on U.S. soil – to continue U.S. leadership in high energy physics and other areas of fundamental scientific exploration. Knowledge knows no international boundaries, and the U.S. needs to remain a leader so that our scientists and engineers can capitalize and leverage the best ideas wherever they emerge.

Recommendation: Continue the United States' historical commitment to international leadership in science and technology, which is vital to our national security and our economic well-being.

The Energy Science Coalition looks forward to working with the new Administration in support of the DOE Office of Science.

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ESC Membership

Agronomy, Crop and Soil Science Societies
American Association for the Advancement of Science
American Astronomical Society
American Chemical Society
American Geophysical Union
American Geosciences Institute
American Institute of Physics
American Mathematical Society
American Physical Society
American Society for Engineering Education
American Society of Agronomy
American Society of Mechanical Engineers
American Society for Microbiology
American Society of Plant Biologists
Arizona State University
Association of American Universities
Association of Public and Land-grant Universities
Battelle
Binghamton University
Biophysical Society
Boston University
Case Western Reserve University
Clemson University
Coalition for Academic Scientific Computation (CASC)
Columbia University
Computing Research Association
Cornell University
Cray Inc.
Crop Science Society of America
Duke University
Florida State University
Fusion Power Associates
General Atomics
Geological Society of America
George Mason University
Georgia Institute of Technology
Harvard University
IBM
IEEE-USA
Iowa State University
Jefferson Science Associates, LLC
Krell Institute
Massachusetts Institute of Technology
Materials Research Society
Michigan State University
Michigan Technological University
Northern Illinois University
Northwestern University
Oak Ridge Associated Universities (ORAU)
Pace University
Pennsylvania State University
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rutgers, The State University of New Jersey
Society for Industrial and Applied Mathematics
Soil Science Society of America
South Dakota School of Mines
Southeastern Universities Research Association
Stanford University
Tech-X
The Ohio State University
The Optical Society (OSA)
University of California System
University of Chicago
University of Colorado Boulder
University of Delaware
University of Iowa
University of Maryland, College Park
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