

AMERICAN SUPER COMPUTING LEADERSHIP ACT

MAY 19, 2015.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. SMITH of Texas, from the Committee on Science, Space, and Technology, submitted the following

R E P O R T

[To accompany H.R. 874]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 874) to amend the Department of Energy High-End Computing Revitalization Act of 2004 to improve the high-end computing research and development program of the Department of Energy, and for other purposes, having considered the same, report favorably thereon without amendment and recommend that the bill do pass.

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COMMITTEE STATEMENT AND VIEWS

PURPOSE AND SUMMARY

High performance computation keeps the United States competitive in the global market for scientific research and development.

This legislation provides the Department of Energy with statutory authority to build and operate first-of-a-kind exascale computing systems incorporating increased resiliency features and optimized power requirements.

#### BACKGROUND AND NEED FOR LEGISLATION

The next generation of high performance computing facilities, also known as exascale computing systems, will require new developments in hardware and software. The capabilities provided by exascale systems will be unique above current capabilities and serve as a mechanism to greatly enhance scientific research and support the United States nuclear weapons stockpile stewardship responsibility within the Department of Energy.

#### LEGISLATIVE HISTORY

In 2013, Rep. Randy Hultgren and Rep. Eric Swalwell introduced H.R. 2495, American Super Computing Leadership Act. In 2015, Senator Lamar Alexander and Senator Tammy Baldwin introduced S. 454, Exascale Computing for Science, Competitiveness, Advanced Manufacturing, Leadership, and the Economy Act of 2015.

On May 22, 2013, the Subcommittee on Energy of the House Committee on Science, Space, and Technology held a hearing titled “America’s Next Generation Supercomputer: The Exascale Challenge.” On January 28, 2015, the Subcommittee on Energy held a hearing titled “Supercomputing and American Technology Leadership.” These hearings explored the ability of high performance computing facilities to accelerate scientific research and technological advances.

#### COMMITTEE VIEWS

The Committee recognizes that high performance computing modeling supports nearly every area of technological advancement and encourages the Department to continue to develop next generation computing facilities through its Advanced Scientific Computing Research program within the Office of Science.

#### SECTION-BY-SECTION

##### *Section 1. Short title*

The short title of this legislation is “American Super Computing Leadership Act.”

##### *Section 2. Definitions*

Section defines terms associated with high-end computing, including “co-design,” “exascale,” and “high-end computing system.”

##### *Section 3. Department of Energy High-End Computing Research and Development Program*

Section 3 requires the Secretary of Energy to conduct a research program to develop exascale computing systems, including a strategy and program management plan. The program will support research on potential technologies to reduce power requirements for the next generation of high performance computing.

## COMMITTEE CONSIDERATION

On March 4, 2015, the Committee met in open session and ordered reported favorably the bill, H.R. 874, without amendment, by voice vote, a quorum being present.

## APPLICATION OF LAW TO THE LEGISLATIVE BRANCH

Section 102(b)(3) of Public Law 104–1 requires a description of the application of this bill to the legislative branch where the bill relates to the terms and conditions of employment or access to public services and accommodations. This bill provides the Department of Energy with statutory authority to build and operate first-of-a-kind exascale computing systems incorporating increased resiliency features and optimized power requirements. As such this bill does not relate to employment or access to public services and accommodations.

## STATEMENT OF OVERSIGHT FINDINGS AND RECOMMENDATIONS OF THE COMMITTEE

In compliance with clause 3(c)(1) of rule XIII and clause (2)(b)(1) of rule X of the Rules of the House of Representatives, the Committee's oversight findings and recommendations are reflected in the descriptive portions of this report.

## STATEMENT OF GENERAL PERFORMANCE GOALS AND OBJECTIVES

In accordance with clause 3(c)(4) of rule XIII of the Rules of the House of Representatives, the Committee's performance goals and objectives are to recognize that high performance computing modeling supports nearly every area of technological advancement and to encourage the Department of Energy to continue to develop next generation computing facilities through its Advanced Scientific Computing Research program within the Office of Science.

## DUPLICATION OF FEDERAL PROGRAMS

No provision of H.R. 874 establishes or reauthorizes a program of the Federal Government known to be duplicative of another Federal program, a program that was included in any report from the Government Accountability Office to Congress pursuant to section 21 of Public Law 111–139, or a program related to a program identified in the most recent Catalog of Federal Domestic Assistance.

## DISCLOSURE OF DIRECTED RULE MAKINGS

The Committee estimates that enacting H.R. 874 does not direct the completion of any specific rule makings within the meaning of 5 U.S.C. 551.

## FEDERAL ADVISORY COMMITTEE ACT

The Committee finds that the legislation does not establish or authorize the establishment of an advisory committee within the definition of 5 U.S.C. App., Section 5(b).

## UNFUNDED MANDATE STATEMENT

Section 423 of the Congressional Budget and Impoundment Control Act (as amended by Section 101(a)(2) of the Unfunded Mandate Reform Act, P.L. 104-4) requires a statement as to whether the provisions of the reported include unfunded mandates. In compliance with this requirement the Committee has received a letter from the Congressional Budget Office included herein.

## EARMARK IDENTIFICATION

H.R. 874 does not include any congressional earmarks, limited tax benefits, or limited tariff benefits as defined in clause 9 of rule XXI.

## COMMITTEE ESTIMATE

Clause 3(d)(2) of rule XIII of the Rules of the House of Representatives requires an estimate and a comparison by the Committee of the costs that would be incurred in carrying out H.R. 874. However, clause 3(d)(3)(B) of that rule provides that this requirement does not apply when the Committee has included in its report a timely submitted cost estimate of the bill prepared by the Director of the Congressional Budget Office under section 402 of the Congressional Budget Act.

## BUDGET AUTHORITY AND CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

With respect to the requirements of clause 3(c)(2) of rule XIII of the Rules of the House of Representatives and section 308(a) of the Congressional Budget Act of 1974 and with respect to requirements of clause (3)(c)(3) of rule XIII of the Rules of the House of Representatives and section 402 of the Congressional Budget Act of 1974, the Committee has received the following cost estimate for H.R. 874 from the Director of Congressional Budget Office:

U.S. CONGRESS,  
CONGRESSIONAL BUDGET OFFICE,  
*Washington, DC, March 26, 2015.*

Hon. LAMAR SMITH,  
*Chairman, Committee on Science, Space, and Technology,  
House of Representatives, Washington, DC.*

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the enclosed cost estimate for H.R. 874, the American Super Computing Leadership Act.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Marin Burnett.

Sincerely,

DOUGLAS W. ELMENDORF.

Enclosure.

*H.R. 874—American Super Computing Leadership Act*

H.R. 874 would require the Secretary of Energy to advance efforts to develop exascale computing systems. Exascale computing refers to systems capable of at least a billion billion calculations

per second, which is believed to equal the processing power of the human brain.

CBO estimates that implementing H.R. 874 would have no significant effect on the budget because the legislation would largely codify the Department of Energy's current plans to develop advanced computer systems under its existing authorities. Enacting H.R. 874 would not affect direct spending or revenues; therefore, pay-as-you-go procedures do not apply.

The legislation would clarify that the department's efforts to advance high-end computing initiatives should be focused on exascale. H.R. 874 would require that the department conduct research programs, engage in partnerships, submit additional reports, and develop technologies that will advance exascale computing capabilities.

Under the department's mission to research and develop high-end computing systems, the Advanced Scientific Computing Research program, an arm of the Department of Energy's Office of Science, received an appropriation of \$105 million in 2015 for activities to develop exascale computing. According to information from the department, the requirements of the legislation would not result in a significant expansion of their current exascale research and development activities. Once the exascale system has been fully developed, the department plans to place it in an existing facility, which houses high-end computing systems. The department plans to upgrade that facility as necessary to accommodate the exascale system's requirements.

H.R. 874 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act. Public universities would benefit from research partnerships. Any cost incurred by those entities would be incurred voluntarily.

The CBO staff contact for this estimate is Marin Burnett. The estimate was approved by Teresa Gullo, Deputy Assistant Director for Budget Analysis.

#### CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

In compliance with clause 3(e) of rule XIII of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in *italic*, existing law in which no change is proposed is shown in roman):

#### **DEPARTMENT OF ENERGY HIGH-END COMPUTING REVITALIZATION ACT OF 2004**

\* \* \* \* \*

#### **SEC. 2. DEFINITIONS.**

In this Act:

[(1) CENTER.—The term “Center” means a High-End Software Development Center established under section 3(d).

[(2) HIGH-END COMPUTING SYSTEM.—The term “high-end computing system” means a computing system with performance that substantially exceeds that of systems that are commonly available for advanced scientific and engineering applications.

[(3) LEADERSHIP SYSTEM.—The term “Leadership System” means a high-end computing system that is among the most advanced in the world in terms of performance in solving scientific and engineering problems.]

[(4) INSTITUTION OF HIGHER EDUCATION.—The term “institution of higher education” has the meaning given the term in section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).]

[(5) SECRETARY.—The term “Secretary” means the Secretary of Energy, acting through the Director of the Office of Science of the Department of Energy.]

(1) CO-DESIGN.—*The term “co-design” means the joint development of application algorithms, models, and codes with computer technology architectures and operating systems to maximize effective use of high-end computing systems.*

(2) DEPARTMENT.—*The term “Department” means the Department of Energy.*

(3) EXASCALE.—*The term “exascale” means computing system performance at or near 10 to the 18th power floating point operations per second.*

(4) HIGH-END COMPUTING SYSTEM.—*The term “high-end computing system” means a computing system with performance that substantially exceeds that of systems that are commonly available for advanced scientific and engineering applications.*

(5) INSTITUTION OF HIGHER EDUCATION.—*The term “institution of higher education” has the meaning given the term in section 2 of the Energy Policy Act of 2005 (42 U.S.C. 15801).*

(6) LEADERSHIP SYSTEM.—*The term “leadership system” means a high-end computing system that is among the most advanced in the world in terms of performance in solving scientific and engineering problems.*

(7) NATIONAL LABORATORY.—*The term “National Laboratory” means any one of the seventeen laboratories owned by the Department.*

(8) SECRETARY.—*The term “Secretary” means the Secretary of Energy.*

(9) SOFTWARE TECHNOLOGY.—*The term “software technology” includes optimal algorithms, programming environments, tools, languages, and operating systems for high-end computing systems.*

### SEC. 3. DEPARTMENT OF ENERGY HIGH-END COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.

(a) IN GENERAL.—The Secretary shall—

(1) carry out a [program] *coordinated program across the Department of research and development (including development of software and hardware) to advance high-end computing systems; [and]*

(2) develop and deploy high-end computing systems for advanced scientific and engineering applications[.]; *and*

(3) *partner with universities, National Laboratories, and industry to ensure the broadest possible application of the technology developed in this program to other challenges in science, engineering, medicine, and industry.*

(b) PROGRAM.—The program shall—

(1) support both individual investigators and multidisciplinary teams of investigators;

(2) conduct research in multiple architectures, which may include [vector, reconfigurable logic, streaming, processor-in-memory, and multithreading architectures] *computer technologies that show promise of substantial reductions in power requirements and substantial gains in parallelism of multicore processors, concurrency, memory and storage, bandwidth, and reliability;*

(3) conduct research on software for high-end computing systems, including research on algorithms, programming environments, tools, languages, and operating systems for high-end computing systems, in collaboration with architecture development efforts;

(4) provide for sustained access by the research community in the United States to high-end computing systems and to Leadership Systems, including provision of technical support for users of such systems;

(5) support technology transfer to the private sector and others in accordance with applicable law; and

(6) ensure that the high-end computing activities of the Department of Energy are coordinated with relevant activities in industry and with other Federal agencies, including the National Science Foundation, the Defense Advanced Research Projects Agency, the National Nuclear Security Administration, the National Security Agency, the National Institutes of Health, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the National Institutes of Standards and Technology, and the Environmental Protection Agency.

(c) LEADERSHIP SYSTEMS FACILITIES.—

(1) IN GENERAL.—As part of the program carried out under this Act, the Secretary shall establish and operate 1 or more Leadership Systems facilities to—

(A) conduct advanced scientific and engineering research and development using Leadership Systems; and

(B) develop potential advancements in high-end computing system hardware and software.

(2) ADMINISTRATION.—In carrying out this subsection, the Secretary shall provide to Leadership Systems, on a competitive, merit-reviewed basis, access to researchers in United States industry, institutions of higher education, national laboratories, and other Federal agencies.

[(d) HIGH-END SOFTWARE DEVELOPMENT CENTER.—

[(1) IN GENERAL.—As part of the program carried out under this Act, the Secretary shall establish at least 1 High-End Software Development Center.

[(2) DUTIES.—A Center shall concentrate efforts to develop, test, maintain, and support optimal algorithms, programming environments, tools, languages, and operating systems for high-end computing systems.

[(3) PROPOSALS.—In soliciting proposals for the Center, the Secretary shall encourage staffing arrangements that include both permanent staff and a rotating staff of researchers from other institutions and industry to assist in coordination of re-

search efforts and promote technology transfer to the private sector.

【(4) USE OF EXPERTISE.—The Secretary shall use the expertise of a Center to assess research and development in high-end computing system architecture.

【(5) SELECTION.—The selection of a Center shall be determined by a competitive proposal process administered by the Secretary.】

(d) *EXASCALE COMPUTING PROGRAM.*—

(1) *IN GENERAL.*—*The Secretary shall conduct a coordinated research program to develop exascale computing systems to advance the missions of the Department.*

(2) *EXECUTION.*—*The Secretary shall, through competitive merit review, establish two or more National Laboratory-industry-university partnerships to conduct integrated research, development, and engineering of multiple exascale architectures, and—*

(A) *conduct mission-related co-design activities in developing such exascale platforms;*

(B) *develop those advancements in hardware and software technology required to fully realize the potential of an exascale production system in addressing Department target applications and solving scientific problems involving predictive modeling and simulation and large-scale data analytics and management; and*

(C) *explore the use of exascale computing technologies to advance a broad range of science and engineering.*

(3) *ADMINISTRATION.*—*In carrying out this program, the Secretary shall—*

(A) *provide, on a competitive, merit-reviewed basis, access for researchers in United States industry, institutions of higher education, National Laboratories, and other Federal agencies to these exascale systems, as appropriate; and*

(B) *conduct outreach programs to increase the readiness for the use of such platforms by domestic industries, including manufacturers.*

(4) *REPORTS.*—

(A) *INTEGRATED STRATEGY AND PROGRAM MANAGEMENT PLAN.*—*The Secretary shall submit to Congress, not later than 90 days after the date of enactment of the American Super Computing Leadership Act, a report outlining an integrated strategy and program management plan, including target dates for prototypical and production exascale platforms, interim milestones to reaching these targets, functional requirements, roles and responsibilities of National Laboratories and industry, acquisition strategy, and estimated resources required, to achieve this exascale system capability. The report shall include the Secretary's plan for Departmental organization to manage and execute the Exascale Computing Program, including definition of the roles and responsibilities within the Department to ensure an integrated program across the Department. The report shall also include a plan for ensuring balance and prioritizing across ASCR subprograms in a flat or slow-growth budget environment.*



(B) *STATUS REPORTS.*—At the time of the budget submission of the Department for each fiscal year, the Secretary shall submit a report to Congress that describes the status of milestones and costs in achieving the objectives of the exascale computing program.

(C) *EXASCALE MERIT REPORT.*—At least 18 months prior to the initiation of construction or installation of any exascale-class computing facility, the Secretary shall transmit a plan to the Congress detailing—

(i) the proposed facility's cost projections and capabilities to significantly accelerate the development of new energy technologies;

(ii) technical risks and challenges that must be overcome to achieve successful completion and operation of the facility; and

(iii) an independent assessment of the scientific and technological advances expected from such a facility relative to those expected from a comparable investment in expanded research and applications at terascale-class and petascale-class computing facilities, including an evaluation of where investments should be made in the system software and algorithms to enable these advances.

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