

## Calendar No. 358

116TH CONGRESS }  
2d Session }

SENATE

{ REPORT  
116-202

### SOLAR ENERGY RESEARCH AND DEVELOPMENT ACT OF 2019

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JANUARY 9, 2020.—Ordered to be printed

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Ms. MURKOWSKI, from the Committee on Energy and National  
Resources, submitted the following

### R E P O R T

[To accompany S. 2668]

[Including cost estimate of the Congressional Budget Office]

The Committee on Energy and Natural Resources, to which was referred the bill (S. 2668) to establish a program for research, development, and demonstration of solar energy technologies, and for other purposes, having considered the same, reports favorably thereon with an amendment in the nature of a substitute and recommends that the bill, as amended, do pass.

### AMENDMENT

The amendment is as follows:

Strike all after the enacting clause and insert the following:

#### SECTION 1. SHORT TITLE.

This Act may be cited as the “Solar Energy Research and Development Act of 2019”.

#### SEC. 2. DEFINITIONS.

In this Act:

(1) **ECONOMICALLY DISTRESSED AREA.**—The term “economically distressed area” means an area described in section 301(a) of the Public Works and Economic Development Act of 1965 (42 U.S.C. 3161(a)).

(2) **ELIGIBLE ENTITY.**—The term “eligible entity” means—

- (A) an institution of higher education;
- (B) a National Laboratory;
- (C) a Federal research agency;
- (D) a State research agency;
- (E) a research agency associated with a territory or freely associated state;
- (F) a tribal energy development organization;

- (G) an Indian tribe;
  - (H) a tribal organization;
  - (I) a Native Hawaiian community-based organization;
  - (J) a nonprofit research organization;
  - (K) an industrial entity;
  - (L) any other entity, as determined by the Secretary; and
  - (M) a consortium of 2 or more entities described in subparagraphs (A) through (L).
- (3) INDIAN TRIBE.—The term “Indian tribe” has the meaning given the term in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 5304).
- (4) INSTITUTION OF HIGHER EDUCATION.—The term “institution of higher education” has the meaning given the term in section 101 of the Higher Education Act of 1965 (20 U.S.C. 1001).
- (5) NATIONAL LABORATORY.—The term “National Laboratory” has the meaning given the term in section 2 of the Energy Policy Act of 2005 (42 U.S.C. 15801).
- (6) NATIVE HAWAIIAN COMMUNITY BASED ORGANIZATION.—The term “Native Hawaiian community-based organization” has the meaning given the term in section 6207 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 7517).
- (7) PHOTOVOLTAIC DEVICE.—The term “photovoltaic device” means—
- (A) a device that converts light directly into electricity through a solid-state, semiconductor process;
  - (B) the photovoltaic cells of a device described in subparagraph (A); and
  - (C) the electronic and electrical components of a device described in subparagraph (A).
- (8) PROGRAM.—The term “program” means the program established under section 3(a)(1).
- (9) SECRETARY.—The term “Secretary” means the Secretary of Energy.
- (10) SOLAR ENERGY.—The term “solar energy” means—
- (A) thermal or electric energy derived from radiation from the Sun; or
  - (B) energy resulting from a chemical reaction caused by radiation recently originated in the Sun.
- (11) TERRITORY OR FREELY ASSOCIATED STATE.—The term “territory or freely associated state” has the meaning given the term “insular area” in section 1404 of the Food and Agriculture Act of 1977 (7 U.S.C. 3103).
- (12) TRIBAL ENERGY DEVELOPMENT ORGANIZATION.—The term “tribal energy development organization” has the meaning given the term in section 2601 of the Energy Policy Act of 1992 (25 U.S.C. 3501).
- (13) TRIBAL ORGANIZATION.—The term “tribal organization” has the meaning given the term in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 5304).

### SEC. 3. SOLAR ENERGY TECHNOLOGY PROGRAM.

- (a) ESTABLISHMENT.—
- (1) IN GENERAL.—The Secretary shall establish a program to conduct research, development, testing, evaluation, demonstration, and commercialization of solar energy technologies in accordance with this section.
- (2) PURPOSES.—The purposes of the program are the following:
- (A) To improve the energy efficiency, cost effectiveness, reliability, resilience, security, integration, manufacturability, and recyclability of solar energy technologies.
  - (B) To optimize the performance and operation of solar energy components, cells, and systems, and enabling technologies, including through the development of new materials, hardware, and software.
  - (C) To optimize the design and adaptability of solar energy systems to the broadest practical range of geographic and atmospheric conditions.
  - (D) To support the integration of solar energy technologies with the electric grid and complementary energy technologies.
  - (E) To create and improve the conversion of solar energy to other useful forms of energy or other products.
  - (F) To reduce and mitigate any potential negative impacts of solar energy technologies on humans, wildlife, and wildlife habitats.
  - (G) To address barriers to the commercialization and export of solar energy technologies.
  - (H) To support the domestic solar industry, workforce, and supply chain.
- (3) TARGETS.—Not later than 180 days after the date of enactment of this Act, the Secretary shall establish targets for the program to address near-term (up

to 2 years), mid-term (up to 7 years), and long-term (up to 15 years) challenges to the advancement of solar energy systems.

(b) ACTIVITIES.—

(1) TYPES OF ACTIVITIES.—In carrying out the program, the Secretary shall carry out research, development, demonstration, and commercialization activities, including—

- (A) awarding grants and awards, on a competitive, merit-reviewed basis;
- (B) performing precompetitive research and development;
- (C) establishing or maintaining demonstration facilities and projects, including through stewardship of existing facilities;
- (D) providing technical assistance;
- (E) entering into contracts and cooperative agreements;
- (F) providing small business vouchers;
- (G) establishing prize competitions;
- (H) conducting education and outreach activities; and
- (I) conducting analyses, studies, and reports.

(2) SUBJECT AREAS.—The Secretary shall carry out research, development, testing, evaluation, demonstration, and commercialization activities in the following subject areas:

- (A) Advanced solar energy technologies, including—
  - (i) new materials, components, designs, and systems, including perovskites;
  - (ii) advanced photovoltaic and thin-film devices;
  - (iii) concentrated solar power;
  - (iv) solar heating and cooling; and
  - (v) enabling technologies for solar energy systems, including hardware and software.
- (B) Solar energy technology performance, operations, and security.
- (C) Integration of solar energy technologies with—
  - (i) the electric grid, including transmission, distribution, microgrids, and distributed energy systems;
  - (ii) other energy technologies, including—
    - (I) other generation sources;
    - (II) demand response technologies; and
    - (III) energy storage technologies; and
  - (iii) other nonelectric applications, such as in the agriculture, transportation, industrial, and fuels sectors.
- (D) Advanced solar energy manufacturing technologies and practices, including materials, processes, and design.
- (E) Methods to improve the lifetime, maintenance, recycling, and reuse of solar energy components and systems.
- (F) Solar energy forecasting, modeling, and atmospheric measurement systems, including for small-scale, large-scale, and aggregated systems.
- (G) Hybrid solar energy systems that incorporate diverse—
  - (i) generation sources;
  - (ii) loads; and
  - (iii) storage technologies.
- (H) Reducing market barriers to the adoption of solar energy technologies, including impacts on, or challenges relating to—
  - (i) distributed solar technologies, including the development of best practices, models, and voluntary streamlined processes for local permitting of distributed solar energy systems to reduce costs;
  - (ii) local communities;
  - (iii) wildlife and wildlife habitats; and
  - (iv) any other appropriate matter, as determined by the Secretary.
- (I) Transformational technologies for harnessing solar energy.
- (J) Other research areas that advance the purposes of the program, as determined by the Secretary.

(3) PRIORITIZATION.—In carrying out activities under the program, the Secretary shall give priority to projects that—

- (A) are located in a geographically diverse range of eligible entities;
- (B) support the development or demonstration of projects—
  - (i) in collaboration with tribal energy development organizations, Indian tribes, tribal organizations, Native Hawaiian community-based organizations, or territories or freely associated states; or
  - (ii) in economically distressed areas;
- (C) can be replicated in a variety of regions and climates;
- (D) include business commercialization plans that have the potential for—

- (i) domestic manufacturing and production of solar energy technologies; or
  - (ii) exports of solar energy technologies; and
- (E) satisfy any other priority that the Secretary determines to be appropriate.
- (4) COORDINATION.—To the maximum extent practicable, the Secretary shall coordinate activities under the program with other relevant programs and capabilities of the Department of Energy and other Federal research programs.
- (5) USE OF FUNDS.—To the extent that funding is not otherwise available through other Federal programs or power purchase agreements, funding awarded under this subsection may be used for additional nontechnology costs, as determined to be appropriate by the Secretary, such as engineering or feasibility studies.
- (c) ADVANCED SOLAR ENERGY MANUFACTURING INITIATIVE.—
  - (1) GRANTS.—In addition to the program activities described in subsection (b), in carrying out the program, the Secretary shall award multiyear grants to eligible entities for research, development, and demonstration projects to advance new solar energy manufacturing technologies and techniques.
  - (2) PRIORITY.—In awarding grants under paragraph (1), to the extent practicable, the Secretary shall give priority to solar energy manufacturing projects that—
    - (A) increase efficiency and cost effectiveness in—
      - (i) the manufacturing process; and
      - (ii) the use of resources.
    - (B) support domestic supply chains for materials and components;
    - (C) identify and incorporate nonhazardous alternative materials for components and devices;
    - (D) operate in partnership with tribal energy development organizations, Indian tribes, tribal organizations, Native Hawaiian community-based organizations, or territories or freely associated states; or
    - (E) are located in economically distressed areas.
  - (3) EVALUATION.—Not later than 3 years after the date of enactment of this Act, and every 4 years thereafter, the Secretary shall conduct, and make available to the public and the relevant committees of Congress, an independent review of the progress of the grants awarded under paragraph (1).
- (d) SOLAR ENERGY TECHNOLOGY RECYCLING RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAM.—
  - (1) IN GENERAL.—In addition to the program activities described in subsection (b), in carrying out the program, the Secretary shall award multiyear grants to eligible entities for research, development, and demonstration projects to create innovative and practical approaches to increase the reuse and recycling of solar energy technologies, including—
    - (A) by increasing the efficiency and cost effectiveness of the recovery of raw materials from solar energy technology components and systems, including enabling technologies such as inverters;
    - (B) by minimizing environmental impacts from the recovery and disposal processes;
    - (C) by addressing any barriers to the research, development, demonstration, and commercialization of technologies and processes for the disassembly and recycling of solar energy devices;
    - (D) by developing alternative materials, designs, manufacturing processes, and other aspects of solar energy technologies and the disassembly and resource recovery process that enable efficient, cost effective, and environmentally responsible disassembly of, and resource recovery from, solar energy technologies; and
    - (E) strategies to increase consumer acceptance of, and participation in, the recycling of photovoltaic devices.
  - (2) DISSEMINATION OF RESULTS.—The Secretary shall make available to the public and the relevant committees of Congress the results of the projects carried out through grants awarded under paragraph (1), including any educational and outreach materials.
- (e) SOLAR ENERGY TECHNOLOGY MATERIALS PHYSICAL PROPERTY DATABASE.—
  - (1) IN GENERAL.—Not later than September 1, 2021, the Secretary shall establish a comprehensive physical property database of materials for use in solar energy technologies, which shall identify the type, quantity, country of origin, source, significant uses, and physical properties of materials used in solar energy technologies.
  - (2) COORDINATION.—In establishing the database described in paragraph (1), the Secretary shall coordinate with—

- (A) the Director of the National Institute of Standards and Technology;
  - (B) the Administrator of the Environmental Protection Agency;
  - (C) the Secretary of the Interior; and
  - (D) relevant industry stakeholders, as determined by the Secretary.
- (f) SOLAR ENERGY TECHNOLOGY PROGRAM STRATEGIC VISION.—
- (1) IN GENERAL.—Not later than September 1, 2021, and every 6 years thereafter, the Secretary shall submit to Congress a report on the strategic vision, progress, goals, and targets of the program, including assessments of solar energy markets and manufacturing.
  - (2) PREPARATION.—The Secretary shall coordinate the preparation of the report under paragraph (1) with—
    - (A) existing peer review processes;
    - (B) studies conducted by the National Laboratories; and
    - (C) the multiyear program planning required under section 994 of the Energy Policy Act of 2005 (42 U.S.C. 16358).
  - (g) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to the Secretary to carry out the program \$270,000,000 for each of fiscal years 2020 through 2024.

#### SEC. 4. CONFORMING AMENDMENTS.

- (a) The Solar Energy Research, Development, and Demonstration Act of 1974 (42 U.S.C. 5551 et seq.) is repealed.
- (b) Section 6(b)(3) of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5905(b)(3)) is amended—
  - (1) by striking subparagraph (L); and
  - (2) by redesignating subparagraphs (M) through (S) as subparagraphs (L) through (R), respectively.
- (c) The Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978 (42 U.S.C. 5581 et seq.) is repealed.
- (d) Section 4 of the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12003) is amended—
  - (1) in the section heading, by striking “photovoltaics, and solar thermal” and inserting “alcohol from biomass, and other technology”;
  - (2) in subsection (a)—
    - (A) in the matter preceding paragraph (1), by striking “photovoltaics, and solar thermal energy” and inserting “alcohol from biomass, and other energy technology”;
    - (B) by striking paragraphs (2) and (3); and
    - (C) by redesignating paragraphs (4) and (5) as paragraphs (2) and (3), respectively; and
  - (3) in subsection (c)—
    - (A) in the matter preceding paragraph (1), by striking “the Photovoltaic Energy Systems Program, the Solar Thermal Energy Systems Program,”;
    - (B) in paragraph (1)—
      - (i) by striking subparagraph (A); and
      - (ii) by redesignating subparagraphs (B) and (C) as subparagraphs (A) and (B), respectively; and
    - (C) in paragraph (2)—
      - (i) by striking subparagraph (A); and
      - (ii) by redesignating subparagraphs (B) and (C) as subparagraphs (A) and (B), respectively.
- (e) Section 931 of the Energy Policy Act of 2005 (42 U.S.C. 16231) is amended—
  - (1) in subsection (a)(2)—
    - (A) by striking subparagraph (A); and
    - (B) by redesignating subparagraphs (B) through (E) as subparagraphs (A) through (D), respectively;
  - (2) by striking subsection (d); and
  - (3) by redesignating subsections (e) through (g) as subsections (d) through (f), respectively.
- (f) Sections 606 and 607 of the Energy Independence and Security Act of 2007 (42 U.S.C. 17174, 17175) are repealed.

#### SEC. 5. SAVINGS PROVISION.

The repeal of the Solar Energy Research, Development, and Demonstration Act of 1974 (42 U.S.C. 5551 et seq.) under section 4(a) shall not affect the authority of the Secretary to conduct research and development on solar energy.

## PURPOSE

The purpose of S. 2668 is to establish a program for research, development, and demonstration (RD&D) of solar energy technologies.

## BACKGROUND AND NEED

Solar energy is a renewable energy source with zero emissions that captures the radiant light and heat of the sun to create useful energy, including electricity, heat, and chemicals. The most prevalent uses of solar energy are photovoltaic cells (PV), in which solar energy is used to dislodge electrons for use as electricity. Other common forms of solar energy include concentrating solar power (CSP) in which light from the sun is focused on a pipe or tower of liquid until it reaches high temperatures and can be used for electricity or heat, and solar thermal in which direct light and heat from the sun is used for heating.

The United States has significant solar energy resource potential of up to 193,000 gigawatts (GW) of capacity according to resource assessments. As of 2019, solar energy represented over two percent of the U.S. electricity mix but is expected to grow to 15 percent of domestic electricity generation in 2050. The vast majority of current and projected solar electricity is generated by utility-scale PV.

RD&D has been an integral part of solar energy's steep cost decline over the last several decades. As solar has rapidly commercialized, many previous areas of government research within the Department of Energy (DOE), such as silicon-based photovoltaics, have been taken on by the private sector. Much recent research and innovation in solar energy is focused on avoiding the value deflation inherent in variable renewable energy technologies. These areas include continued cost reduction, increasing the availability factor of solar, and financial innovation.

The DOE has historically made significant investments into solar energy R&D, beginning in 1975 with the Flat-Plate Solar array project and culminating in the SunShot Initiative that aimed to reduce solar module costs to \$1 per watt of capacity, a goal that was reached in 2017. DOE's Solar Energy Technologies Office (SETO) continues to conduct R&D programs and has announced a new 2030 goal of achieving average PV costs of 3 cents per kilowatt-hour (kWh) for utility scale and 5 cents for residential scale. SETO also set a goal of 5 cents per kWh by 2030 for CSP plants operating as baseload power facilities, which would be a 75 percent price decline from 2010 costs.

S. 2668 would modernize the solar energy R&D programs of DOE to better reflect current needs, such as extremely low cost alternatives to silicon PV, methods to restore solar manufacturing in the United States, and technologies to improve the recycling of materials and systems used in solar energy, including PV cells and modules. It would also replace previous solar energy R&D authorizations. The Secretary of Energy (Secretary) is also directed to support wildlife impact mitigation to the maximum extent practicable.

## LEGISLATIVE HISTORY

S. 2668 was introduced by Senator Sinema on October 22, 2019. Senator McSally was later added as a cosponsor. The Subcommittee on Energy held a hearing on the measure on November 6, 2019.

Similar legislation, H.R. 3597, was introduced in the House of Representatives by Representative McAdams on June 28, 2019, and was referred to the Committee on Science, Space, and Technology. The House Committee on Space, Science, and Technology favorably reported the bill with an amendment on July 24, 2019, by a vote of 21–13.

The Senate Committee on Energy and Natural Resources met in open business session on November 19, 2019, and ordered S. 2668 favorably reported, as amended.

## COMMITTEE RECOMMENDATION

The Senate Committee on Energy and Natural Resources, in open business session on November 19, 2019, by a majority voice vote of a quorum present, recommends that the Senate pass S. 2668, if amended as described herein. Senator Lee asked to be recorded as voting no.

## COMMITTEE AMENDMENT

During its consideration of S. 2668, the Committee adopted an amendment in the nature of a substitute.

In section 2 the substitute amendment modifies the definition of the term “Indian tribe” and adds definitions for the terms “solar energy,” “territory or freely associated state,” “tribal energy development organization,” and “tribal organization.” It also adds research agencies associated with a territory or freely associated state, tribal energy development organizations, and tribal organizations to the list of eligible entities.

In section 3(a) the substitute amendment adds additional program purposes and specifies that program targets must be developed within 180 days of enactment. The substitute also deletes paragraphs (4) and (7) and incorporates paragraphs (5) and (6) as types of activities and subject areas of the program under subsection (c).

The substitute renames subsection (b) as “Activities,” and moves the grant subject areas to paragraph (2) in that subsection. It further specifies activities under the program as the new paragraph (1) and consolidates the subject areas within the new paragraph (2) from 20 areas to 10. It adds prioritization criteria for grants under this subsection, as well as clarifications regarding coordination and use of funds.

The substitute amendment incorporates demonstration grants as a subject area in subsection (b) and accordingly deletes subsection (c) as introduced.

The substitute moves subsection (d) to be subsection (c), and changes “Next Generation” to “Advanced.” It also reduces the list of priorities in subsection (c) and moves the strategic vision study in paragraph (3) to be a new subsection (f).

The substitute moves subsection (e) to be subsection (d), and reduces the number of program purposes. It also eliminates specific

application requirements for the grant program, and reduces the specifications under dissemination of results.

The substitute moves subsection (f) to be subsection (e), and requires that priorities for the physical property database established under that subsection be developed with private industry by September 1, 2020.

The substitute amendment authorizes \$270 million annually for five years instead of such sums.

#### SECTION-BY-SECTION ANALYSIS

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

Section 1 sets forth the short title of the bill.

##### *Sec. 2. Definitions*

Section 2 sets forth the definitions of the bill.

##### *Sec. 3. Solar energy technology program*

Section 3(a) directs the Secretary to establish a solar energy technology program and outlines the purposes of the program. The Secretary is required to address near-term, mid-term and long-term challenges in advancing solar energy development.

Subsection (b) outlines the types of activities and subject areas the Secretary may undertake and focus on in meeting the purposes of the program. The types of activities include: awarding competitive grants; precompetitive R&D; establishing demonstration facilities; providing technical assistance; entering into contracts and agreements; providing small business vouchers; establishing prize competitions; conducting education and outreach; and conducting analyses, studies, and reports.

The subject areas include: advanced solar energy technologies; solar energy technology performance; operations and security; integration of solar energy with other energy technologies and other nonelectric applications; advanced solar manufacturing technologies; methods to improve the lifetime and recycling of solar energy technologies; solar energy forecasting and modeling; hybrid energy systems; reducing market barriers; and transformational technologies for harnessing solar energy.

Subsection (b) further specifies the prioritization of solar energy grants and directs the Secretary to coordinate activities with other Federal R&D programs.

Subsection (c) requires the Secretary to award multiyear grants to eligible entities for RD&D projects to advance new solar manufacturing technologies and techniques. The Secretary is required to evaluate the progress of grants given for next generation manufacturing three years after enactment, and every four years thereafter.

Subsection (d) requires the Secretary to award multiyear grants to eligible entities for RD&D projects to create innovative and practical approaches to increase the reuse and recycling of solar energy technologies. The subsection includes instructions for the content of an application to the grant program and on the dissemination of results.

Subsection (e) directs the Secretary to, not later than September 1, 2021, establish a comprehensive physical property database of materials for use in solar energy technologies. The Secretary is di-



rected to develop a plan to establish priorities and requirements for the database in collaboration with the private sector. The Secretary is further directed to coordinate with the Director of the National Institute of Standards and Technology, the Administrator of the Environmental Protection Agency, and the Secretary of the Interior to incorporate the database with any existing database relevant for electronic materials manufacturing and recycling.

Subsection (f) directs the Secretary to develop a strategic vision of SETO's activities for Congress not later than September 1, 2021, and every six years thereafter.

Subsection (g) authorizes \$270 million annually for fiscal years 2020 through 2024.

#### *Sec. 4. Conforming amendments*

Section 4 makes conforming changes to existing law.

#### *Sec. 5. Savings provision*

Section 5 contains a savings provision stipulating that nothing in the bill shall affect the authority of the Secretary to conduct R&D on solar energy.

### COST AND BUDGETARY CONSIDERATIONS

The following estimate of the costs of this measure has been provided by the Congressional Budget Office:

<b>S. 2668, Solar Energy Research and Development Act of 2019</b>			
As ordered reported by the Senate Committee on Energy and Natural Resources on November 19, 2019			
By Fiscal Year, Millions of Dollars	2020	2020-2024	2020-2029
Direct Spending (Outlays)	0	0	0
Revenues	0	0	0
Increase or Decrease (-) in the Deficit	0	0	0
Spending Subject to Appropriation (Outlays)	5	658	1,104
Statutory pay-as-you-go procedures apply?	No	<b>Mandate Effects</b>	
Increases on-budget deficits in any of the four consecutive 10-year periods beginning in 2030?	No	Contains intergovernmental mandate?	No
		Contains private-sector mandate?	No

S. 2668 would authorize the appropriation of \$270 million annually through 2024 for the Department of Energy (DOE) to research, develop, test, evaluate, and demonstrate solar energy technologies. The bill would recodify existing DOE activities related to those technologies and would direct the department to establish new programs. Under S. 2668, DOE would:

- Award grants and provide technical assistance for entities to research, develop, and demonstrate various solar energy technologies;
- Perform precompetitive research and development activities;
- Maintain or establish demonstration facilities;
- Establish prize competitions;

- Conduct education and outreach activities;
- Create a solar energy technologies database in coordination with other federal agencies; and
- Submit reports and analyses.

In 2019, the Congress appropriated \$246 million for DOE to conduct activities related to solar energy. Because CBO scores continuing resolutions on an annualized basis, in 2020 CBO assumes that the same amount of funds will be available under the current continuing resolution (Public Law 116 69). As a result, CBO estimates that S. 2668 would authorize an increase in spending subject to appropriation in 2020 of \$24 million, the difference between the authorized amount and the annualized amount under the continuing resolution.

CBO estimates that implementing S. 2668 would cost \$658 million over the 2020–2024 period and \$446 million after 2024, assuming appropriation of the specified amounts and that the bill is enacted near the end of 2019. Estimated outlays are based on historical spending patterns for similar programs. The costs of the legislation, detailed in Table 1, would fall within budget function 270 (energy).

TABLE 1.—ESTIMATED INCREASES IN SPENDING SUBJECT TO APPROPRIATION UNDER S. 2668

	By fiscal year, millions of dollars—											2020– 2024	2020– 2029
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029			
Authorization <sup>a</sup> .....	24	270	270	270	270	0	0	0	0	0	1,104	1,104	
Estimated Outlays .....	5	61	141	206	245	209	135	67	27	8	658	1,104	

<sup>a</sup> S. 2668 would authorize the appropriation of \$270 million in 2020 for DOE to conduct activities related to solar energy research, development, and demonstration. However, CBO estimates that \$246 million has been allocated on an annualized basis from funds made available under the current continuing resolution (Public Law 116 69), which provided appropriations through December 20, 2019. Thus, the estimated authorization for 2020 (\$24 million) is equal to the specified amount (\$270 million) minus the annualized amount from the continuing resolution (\$246 million).

On August 28, 2019, CBO transmitted a cost estimate for H.R. 3597, the Solar Energy Research and Development Act of 2019, as ordered reported by the House Committee on Science, Space, and Technology on July 24, 2019. The two pieces of legislation are similar, but CBO's cost estimates are different because of differences in the authorized amounts. The cost estimate for S. 2668 also reflects enactment of the continuing resolution for 2020.

The CBO staff contact for this estimate is Aaron Krupkin. The estimate was reviewed by H. Samuel Papenfuss, Deputy Assistant Director for Budget Analysis.

#### REGULATORY IMPACT EVALUATION

In compliance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the Committee makes the following evaluation of the regulatory impact which would be incurred in carrying out S. 2668. The bill is not a regulatory measure in the sense of imposing Government-established standards or significant economic responsibilities on private individuals and businesses.

No personal information would be collected in administering the program. Therefore, there would be no impact on personal privacy.

Little, if any, additional paperwork would result from the enactment of S. 2668, as ordered reported.

## CONGRESSIONALLY DIRECTED SPENDING

S. 2668, as ordered reported, does not contain any congressionally directed spending items, limited tax benefits, or limited tariff benefits as defined in rule XLIV of the Standing Rules of the Senate.

## EXECUTIVE COMMUNICATIONS

The testimony provided by the Department of Energy at the November 6, 2019, hearing on S. 2668 follows:

TESTIMONY OF ASSISTANT SECRETARY DANIEL SIMMONS,  
OFFICE OF ENERGY EFFICIENCY AND RENEWABLE EN-  
ERGY, U.S. DEPARTMENT OF ENERGY

## INTRODUCTION

Chairman Cassidy, Ranking Member Heinrich, and Members of the Energy Subcommittee of the Committee on Energy and Natural Resources, thank you for the opportunity to testify today on legislation pertinent to the Department of Energy now pending in the Senate. My name is Daniel Simmons, and I am the Assistant Secretary for the Office of Energy Efficiency and Renewable Energy (EERE).

As the Assistant Secretary, I am responsible for overseeing a broad portfolio of energy efficiency and renewable energy programs. The technologies in my portfolio advance America's economic growth and energy security while enhancing the reliability and resilience of the U.S. energy system. The Department of Energy supports improving the energy efficiency and reducing energy costs, while at the same time ensuring important performance standards are met or exceeded. For instance, we want to ensure schools and other buildings are sufficiently bright to ensure safety, and that water flow from faucets is strong enough to clean dirty hands. Today, I would like to share what relevant work my office has done and is doing in the areas that these bills address.

I have been asked to testify on eleven (11) bills today, addressing a range of important energy issues. The Administration continues to review all of these bills. I appreciate the ongoing bipartisan efforts to address our Nation's energy challenges and I look forward to working with the Committee.

## BILLS

*S. 2668—Solar Energy Research, Development, and Demonstration Program Act of 2019*

S. 2668, the Solar Energy Research, Development, and Demonstration Program Act of 2019 reauthorizes the activities of EERE's Solar Energy Technology Office (SETO). The bill outlines several research priority areas, such as improving the energy efficiency, reliability, and security of solar energy technologies, while also focusing on reducing

the overall costs of solar energy systems. The bill authorizes additional work to be carried out by SETO, such as providing technical assistance, supporting workforce development and training activities, and the awarding of grants to carry out both research and development and demonstration projects to advance the development of solar technologies.

Work currently underway in SETO to address near-term, mid-term, and long-term challenges to the advancement of solar energy technologies includes: the American-Made Solar Prize, a prize competition designed to revitalize U.S. solar manufacturing; photovoltaics and concentrating solar power research; and systems integration research, which works to improve situational awareness of solar energy systems on the grid.

The Department will continue to review the legislation and looks forward to working with Congress as the legislative process moves forward.

#### CONCLUSION

Thank you again for the opportunity to testify before the Subcommittee today. The Department appreciates the ongoing bipartisan efforts to address our Nation's energy challenges, and looks forward to working with the Committee on the legislation on today's agenda and any future legislation. I would be happy to answer your questions.

#### CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, the changes in existing law made by S. 2668, 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):

#### CONTENTS

	Page
1. Solar Energy Research, Development, and Demonstration Act of 1974, Public Law 93–473 .....	12
2. Federal Nonnuclear Energy Research and Development Act of 1974, Public Law 93–577 .....	21
3. Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978, Public Law 95–90 .....	23
4. Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989, Public Law 101–218 .....	33
5. Energy Policy Act of 2005, Public Law 109–58, as Amended .....	35
6. Energy Independence and Security Act of 2007, Public Law 110–140, as Amended .....	38

### **SOLAR ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1974**

Public Law 93–473, as Amended

\* \* \* \* \*

【DECLARATION OF FINDINGS AND POLICY

【SEC. 2. (a) The Congress hereby finds that—

【(1) the needs of a viable society depend on an ample supply of energy;

【(2) the current imbalance between domestic supply and demand for fuels and energy is likely to persist for some time;

【(3) dependence on nonrenewable energy resources cannot be continued indefinitely, particularly at current rates of consumption;

【(4) it is in the Nation's interest to expedite the long-term development of renewable and nonpolluting energy resources, such as solar energy;

【(5) the various solar energy technologies are today at widely differing stages of development, with some already near the stage of commercial application and others still requiring basic research;

【(6) the early development and export of viable equipment utilizing solar energy, consistent with the established pre-eminence of the United States in the field of high technology products, can make a valuable contribution to our balance of trade;

【(7) the mass production and use of equipment utilizing solar energy will help to eliminate the dependence of the United States upon foreign energy sources and promote the national defense;

【(8) to date, the national effort in research, development, and demonstration activities relating to the utilization of solar energy has been extremely limited; therefore

【(9) the urgency of the Nation's critical energy shortages and the need to make clean and renewable energy alternatives commercially viable require that the Nation undertake an intensive research, development, and demonstration program with an estimated Federal investment which may reach or exceed \$1,000,000,000.

【(b) The Congress declares that it is the policy of the Federal Government to—

【(1) pursue a vigorous and viable program of research and resource assessment of solar energy as a major source of energy for our national needs; and

【(2) provide for the development and demonstration of practicable means to employ solar energy on a commercial scale.

【DEFINITIONS

【SEC. 3. For the purposes of this Act—

【(1) the term “solar energy” means energy which has recently originated in the Sun, including direct and indirect solar radiation and intermediate solar energy forms such as wind, sea thermal gradients, products of photosynthetic processes, organic wastes, and others;

【(2) the term “byproducts” includes, with respect to any solar energy technology or process, any solar energy products (including energy forms) other than those associated with or constituting the primary product of such technology or process;

[(3) the term “insolation” means the rate at which solar energy is received at the surface of the Earth;

[(4) the term “Project” means the Solar Energy Coordination and Management Project; and

[(5) the term “Chairman” means the Chairman of the Project.

[SOLAR ENERGY COORDINATION AND MANAGEMENT PROJECT

[SEC. 4. (a) There is hereby established the Solar Energy Coordination and Management Project.

[(b)(1) The Project shall be composed of six members as follows:

[(A) an Assistant Director of the National Science Foundation;

[(B) an Assistant Secretary of Housing and Urban Development;

[(C) a member of the Federal Power Commission;

[(D) an Associate Administrator of the National Aeronautics and Space Administration;

[(E) the General Manager of the Atomic Energy Commission; and

[(F) a member to be designated by the President.

[(2) The President shall designate one member of the Project to serve as Chairman of the Project.

[(3) If the individual designated under paragraph (1)(F) is an officer or employee of the Federal Government, he shall receive no additional pay on account of his service as a member of the Project. If such individual is not an officer or employee of the Federal Government, he shall be entitled to receive the daily equivalent of the annual rate of basic pay in effect for level IV of the Executive Schedule (5 U.S.C. 5315) for each day (including traveltime) during which he is engaged in the actual performance of duties vested in the Project.

[(c) The Project shall have overall responsibility for the provision of effective management and coordination with respect to a national solar energy research, development, and demonstration program, including—

[(1) the determination and evaluation of the resource base, including its temporal and geographic characteristics;

[(2) research and development on solar energy technologies; and

[(3) the demonstration of appropriate solar energy technologies.

[(d)(1) The Project shall carry out its responsibilities under this section in cooperation with the following Federal agencies:

[(A) the National Science Foundation, the responsibilities of which shall include research;

[(B) the National Aeronautics and Space Administration, the responsibilities of which shall include the provision of management capability and the development of technologies;

[(C) the Atomic Energy Commission, the responsibilities of which shall include the development of technologies;

[(D) the Department of Housing and Urban Development, the responsibilities of which shall include fostering the utilization of solar energy for the heating and cooling of buildings,

pursuant to the Solar Heating and Cooling Demonstration Act of 1974; and

[(E) the Federal Power Commission, the responsibilities of which shall include fostering the utilization of solar energy for the generation of electricity and for the production of synthetic fuels.

[(2) Upon request of the Chairman, the head of any such agency is authorized to detail or assign, on a reimbursable basis or otherwise, any of the personnel of such agency to the Project to assist it in carrying out its responsibilities under this Act.

[(e) The Project shall have exclusive authority with respect to the establishment or approval of programs or projects initiated under this Act, but the agency involved in any particular program or project shall be responsible for the operation and administration of such program or project.

[(f) The National Aeronautics and Space Administration is authorized to undertake and carry out those programs assigned to it by the Project.

#### [(RESOURCE DETERMINATION AND ASSESSMENT

[SEC. 5. (a) The Chairman shall initiate a solar energy resource determination and assessment program with the objective of making a regional and national appraisal of all solar energy resources, including data on insolation, wind, sea thermal gradients, and potentials for photosynthetic conversion. The program shall emphasize identification of promising areas for commercial exploitation and development. The specific goals shall include—

[(1) the development of better methods for predicting the availability of all solar energy resources, over long time periods and by geographic location;

[(2) the development of advanced meteorological, oceanographic, and other instruments, methodology, and procedures necessary to measure the quality and quantity of all solar resources on periodic bases;

[(3) the development of activities, arrangements, and procedures for the collection, evaluation, and dissemination of information and data relating to solar energy resource assessment.

[(b) The Chairman, acting through the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, and other appropriate agencies, shall—

[(1) develop and carry out a general plan for inventorying all forms of solar energy resources associated with Federal lands and (where consistent with property rights) non-Federal lands;

[(2) conduct regional surveys based upon such general plan, using innovative meteorological, oceanographic, and space-related techniques, in sufficient numbers to lead to a national inventory of solar energy resources in the United States;

[(3) publish and make available maps, reports, and other documents developed from such surveys to encourage and facilitate the commercial development of solar energy resources; and

[(4) make such recommendations for legislation as may appear to be necessary to establish policies for solar resources involving Federal lands and waters, consistent with known inventories of various resource types, with the state of tech-

nologies for solar energy development, and with evaluation of the environmental impacts of such development.

#### 【RESEARCH AND DEVELOPMENT PROGRAM

【SEC. 6. (a) The Chairman shall initiate a research and development program for the purpose of resolving the major technical problems inhibiting commercial utilization of solar energy in the United States.

【(b) In connection with or as a part of such program, the Chairman shall—

【(1) conduct, encourage, and promote scientific research and studies to develop effective and economical processes and equipment for the purpose of utilizing solar energy in an acceptable manner for beneficial uses;

【(2) carry out systems, economic, social, and environmental studies to provide a basis for research, development and demonstration planning and phasing; and

【(3) perform or cause to be performed technology assessments relevant to the utilization of solar energy.

【(c) The specific solar energy technologies to be addressed or dealt with in the program shall include—

【(1) direct solar heat as a source for industrial processes, including the utilization of low-level heat for process and other industrial purposes;

【(2) thermal energy conversion, and other methods, for the generation of electricity and the production of chemical fuels;

【(3) the conversion of cellulose and other organic materials (including wastes) to useful energy or fuels;

【(4) photovoltaic and other direct conversion processes;

【(5) sea thermal gradient conversion;

【(6) windpower conversion;

【(7) solar heating and cooling of housing and of commercial and public buildings; and

【(8) energy storage.

#### 【DEMONSTRATION

【SEC. 7. (a) The Chairman is authorized to initiate a program to design and construct, in specific solar energy technologies (including, but not limited to, those listed in section 6(c), facilities or powerplants of sufficient size to demonstrate the technical and economic feasibility of utilizing the various forms of solar energy. The specific goals of such programs shall include—

【(1) production of electricity from a number of power plants, on the order of one to ten megawatts each;

【(2) production of synthetic fuels in commercial quantities;

【(3) large-scale utilization of solar energy in the form of direct heat;

【(4) utilization of thermal and all other byproducts of the solar facilities;

【(5) design and development of hybrid systems involving the concomitant utilization of solar and other energy sources; and

【(6) the continuous operation of such plants and facilities for a period of time.

【(b) For each of the technologies for which a successful and appropriate development program is completed, the Chairman shall



make a determination to proceed to demonstration based on criteria including, but not necessarily limited to, the following:

- [(1) the technological feasibility of the project;
- [(2) the costs and benefits of the project, as determined by an economic assessment;
- [(3) the immediate and the potential uses of the solar energy utilized in the project;
- [(4) long-term national need for the technology;
- [(5) environmental impact;
- [(6) potential for technology transfer to other applications;
- and
- [(7) the nature and extent of Federal participation, if any, in the project.

[(c) In carrying out his responsibilities under this section, the Chairman, acting through the appropriate Federal agencies, may provide for the establishment of one or more demonstration projects utilizing each form of solar energy, which shall include, as appropriate, the specific research, development, pilot plant construction and operation, demonstration plant construction and operation, and other facilities and activities which may be necessary to show commercial viability of the specific solar technology.

[(d) The Chairman, acting through the appropriate Federal agencies, is authorized to investigate and enter into agreements for the cooperative development of facilities to demonstrate solar technologies. The responsible Federal agency may consider—

- [(1) cooperative agreements with non-Federal entities for construction of facilities and equipment to demonstrate solar energy technologies; and
- [(2) cooperative agreements with other Federal agencies for the construction of facilities and equipment and operation of facilities to produce energy for direct Federal utilization.

[(e) The Chairman, acting through appropriate Federal agencies is authorized to construct and operate demonstration projects without entering into cooperative agreements with respect to such projects, if the Chairman finds that—

- [(1) the nature of the resource, the geographical location, the scale and engineering design of the facilities, the techniques of production, or any other significant factor of the specific demonstration project offers opportunities to make important contributions to the general knowledge of solar resources, the techniques of its development, or public confidence in the technology; and
- [(2) there is no opportunity for cooperative agreements with any non-Federal entity willing and able to cooperate in the demonstration project under subsection (d)(1), and there is no opportunity for cooperative agreements with other Federal agencies under subsection (d)(2).

[(f) If the estimate of the Federal investment with respect to construction and operation costs of any demonstration project proposed to be established under this section exceeds \$20,000,000, no amount may be appropriated for such project except as specifically authorized by legislation hereafter enacted by the Congress.

[(g) (1) At the conclusion of any demonstration project established under this section, or as soon thereafter as may be practicable, the responsible Federal agencies shall, by sale, lease, or

otherwise, dispose of all Federal property interests which they have acquired pursuant to this section in accordance with existing law and the terms of the cooperative agreements involved.

[(2) The agency involved shall, under appropriate agreements or other arrangements, provide for the disposition of electricity, synthetic fuels, and other byproducts of the project administered by such agency.

#### [SOLAR ENERGY INFORMATION DATA BANK

[SEC. 8. (a)(1) In carrying out his functions under this Act the Chairman, utilizing the capabilities of the National Science Foundation, the National Aeronautics and Space Administration, the Department of Commerce, the Atomic Energy Commission, and other appropriate Federal agencies to the maximum extent possible, shall establish and operate a Solar Energy Information Data Bank (hereinafter in this subsection referred to as the "bank") for the purpose of collecting, reviewing, processing, and disseminating information and data in all of the solar energy technologies referred to in section 7(c) title in a timely and accurate manner in support of the objectives of this Act.

[(2) Information and data compiled in the bank shall include—

[(A) technical information (including reports, journal articles, dissertations, monographs, and project descriptions) on solar energy research, development, and applications;

[(B) similar technical information on the design, construction, and maintenance of equipment utilizing solar energy;

[(C) general information on solar energy applications to be disseminated for popular consumption;

[(D) physical and chemical properties of materials required for solar energy activities and equipment; and

[(E) engineering performance data on equipment and devices utilizing solar energy.

[(3) In accordance with regulations prescribed under section 5561 of this title, the Chairman shall provide retrieval and dissemination services with respect to the information described under paragraph (2) for—

[(A) Federal, State, and local government organizations that are active in the area of energy resources (and their contractors);

[(B) universities and colleges in their related research and consulting activities; and

[(C) the private sector upon request in appropriate cases.

[(4) In carrying out his functions under this subsection, the Chairman shall utilize, when feasible, the existing data base of scientific and technical information in Federal agencies, adding to such data base any information described in paragraph (2) which does not already reside in such base. He shall coordinate or merge this data bank with other Federal energy information data banks as necessary to assure efficient and effective operation.

[(b) In carrying out his functions under this Act the Chairman shall perform or cause to be performed studies and research on incentives to promote broader utilization and consumer acceptance of solar energy technologies.

[(c) The Chairman shall enter into such arrangements and take such other steps as may be necessary or appropriate to provide for

the effective coordination of solar energy technology utilization with all other technology utilization programs within the Federal Government.

#### 【SCIENTIFIC AND TECHNICAL EDUCATION PROGRAMS

【SEC. 9. The Chairman, acting through the National Science Foundation, is authorized and directed to support programs of education in the sciences and engineering to provide the necessary trained personnel to perform the solar energy research, development, and demonstration activities required under this Act. Such support may include fellowships, traineeships, technical training programs, technologist training programs, and summer institute programs.

#### 【SOLAR ENERGY RESEARCH INSTITUTE

【SEC. 10. (a) There is established a Solar Energy Research Institute, which shall perform such research, development, and related functions as the Chairman may determine to be necessary or appropriate in connection with the Project's activities under this Act or to be otherwise in furtherance of the purpose and objectives of this Act.

【(b) The Institute may be located (as designated by the Chairman) at a new or existing Federal laboratory (including a non-Federal laboratory performing functions under a contract entered into with the Project or with any of the agencies represented in the Project as well as a laboratory whose personnel are Federal employees).

#### 【INTERNATIONAL COOPERATION

【SEC. 11. (a) The Chairman, in furtherance of the objectives of this Act, is authorized to cooperate and participate jointly with other nations, especially those with agreements for scientific cooperation with the United States, in the following activities:

【(1) interinstitutional, bilateral, or multilateral research projects in the field of solar energy; and

【(2) agreements and programs which will facilitate the exchange of information and data relating to solar energy resource assessment and solar energy technologies.

【(b) The National Science Foundation is authorized to encourage, to the maximum extent practicable and consistent with the other objectives of this Act, international participation and cooperation in the development and maintenance of programs of education to carry out the policy set forth in section 9.

#### 【REGULATIONS

【SEC. 12. The Chairman, in consultation with heads of the Federal agencies having functions under this Act and with other appropriate officers and agencies, shall prescribe such regulations as may be necessary or appropriate to carry out this Act promptly and efficiently. Each such officer or agency, in consultation with the Chairman, may prescribe such regulations as may be necessary or appropriate to carry out his or its particular functions under this Act promptly and efficiently.

**【ANNUAL REPORTS**

**【SEC. 13.** A summary of all actions taken under the provisions of this Act and action planned for the ensuing year shall be included in the annual report required by section 657 of the Department of Energy Organization Act (42 U.S.C. 7267).

**【INFORMATION TO CONGRESS**

**【SEC. 14.** Notwithstanding any other provision of law, the Chairman (or the head of any agency which assumes the functions of the Project pursuant to section 16) shall keep the appropriate committees of the House of Representatives and the Senate fully and currently informed with respect to all activities under this Act.

**【COMPREHENSIVE PROGRAM DEFINITION**

**【SEC. 15. (a)** The Chairman is authorized and directed to prepare a comprehensive program definition of an integrated effort and commitment for effectively developing solar energy resources. The Chairman, in preparing such program definition, shall utilize and consult with the appropriate Federal agencies, State and local government agencies, and private organizations.

**【(b)** The Chairman shall transmit such comprehensive program definition to the President and to each House of the Congress. An interim report shall be transmitted not later than March 1, 1975. The comprehensive program definition shall be transmitted as soon as possible thereafter, but in any case not later than June 30, 1975.

**【TRANSFER OF FUNCTIONS**

**【SEC. 16.** Within sixty days after the effective date of the law creating a permanent Federal organization or agency having jurisdiction over the energy research and development functions of the United States (or within sixty days after October 26, 1974, if the effective date of such law occurs prior to the date of the enactment of this Act), all of the authorities of the Project and all of the research and development functions (and other functions except those related to scientific and technical education) vested in Federal agencies under this Act along with related records, documents, personnel, obligations, and other items, to the extent necessary or appropriate, shall, in accordance with regulations prescribed by the Office of Management and Budget, be transferred to and vested in such organization or agency.

**【AUTHORIZATION OF APPROPRIATIONS**

**【SEC. 17.** To carry out the provisions of this Act, there are authorized to be appropriated—

**【(1)** for the fiscal year ending June 30, 1976, \$75,000,000;

**【(2)** for subsequent fiscal years, only such sums as the Congress hereafter may authorize by law;

**【(3)** such amounts as may be authorized for the construction of demonstrations pursuant to section 7(f) of this Act; and

**【(4)** to the National Science Foundation for the fiscal year ending June 30, 1975, not to exceed \$2,000,000 to be made available for use in the preparation of the comprehensive program definition under section 15.】

## FEDERAL NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT ACT OF 1974

Public Law 93-577, as Amended

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### COMPREHENSIVE PLANNING AND PROGRAMMING

SEC. 6. (a) Pursuant to the authority and directions of this Act and the Energy Reorganization Act of 1974 (Public Law 93-438), the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), and titles XX through XXIII of the Energy Policy Act of 1992, the Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992, shall transmit to the Congress, on or before June 30, 1975, a comprehensive plan for energy research, development, and demonstration. This plan shall be appropriately revised annually as provided in section 15(a). Such plan shall be designed to achieve—

(1) solutions to immediate and short-term (the period up to 5 years after submission of the plan or its annual revision) energy supply system and associated environmental problems;

(2) solutions to middle-term (the period from 5 years to 10 years after submission of the plan or its annual revision) energy supply system and associated environmental problems; and

(3) solutions to long-term (the period beyond 10 years after submission of the plan or its annual revision) energy supply system and associated environmental problems.

(b)(1) Based on the comprehensive energy research, development, and demonstration plan developed under subsection (a), the Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992, shall develop and transmit to the Congress, on or before June 30, 1975, a comprehensive nonnuclear energy research, development, and demonstration program to implement the nonnuclear research, development, and demonstration aspects of the comprehensive plan. Such program shall be updated and transmitted to the Congress annually as part of the report required under section 15.

(2) This program shall be designed to achieve solutions to the energy supply and associated environmental problems in the immediate and short-term, middle-term, and long-term time intervals described in subsection (a)(1) through (3). In formulating the non-nuclear aspects of this program, the Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992, shall evaluate the economic, environmental, and technological merits of each aspect of the program.

(3) The Secretary shall assign program elements and activities in specific nonnuclear energy technologies, to the short-term, middle-term, and long-term time intervals, and shall present full and complete justification for these assignments and the degree of emphasis for each. These program elements and activities shall include, but not be limited to, research, development, and demonstrations designed—

(A) to advance energy conservation technologies, including but not limited to—

- (i) productive use of waste, including garbage, sewage, agricultural wastes, and industrial waste heat;
  - (ii) reuse and recycling of materials and consumer products;
  - (iii) improvements in automobile design for increased efficiency and lowered emissions, including investigation of the full range of alternatives to the internal combustion engine and systems of efficient public transportation; and
  - (iv) advanced urban and architectural design to promote efficient energy use in the residential and commercial sectors, improvements in home design and insulation technologies, small thermal storage units and increased efficiency in electrical appliances and lighting fixtures;
- (B) to accelerate the commercial demonstration of technologies for producing low-sulfur fuels suitable for boiler use;
- (C) to demonstrate improved methods for the generation, storage, and transmission of electrical energy through (i) advances in gas turbine technologies, combined power cycles, the use of low British thermal unit gas and, if practicable, magnetohydrodynamics; (ii) storage systems to allow more efficient load following, including the use of inertial energy storage systems; and (iii) improvement in cryogenic transmission methods;
- (D) to accelerate the commercial demonstration of technologies for producing substitutes for natural gas, including coal gasification: *Provided*, That the Secretary shall invite and consider proposals from potential participants based upon Federal assistance and participation in the form of a joint Federal-industry corporation, and recommendations pursuant to this clause shall be accompanied by a report on the viability of using this form of Federal assistance or participation;
- (E) to accelerate the commercial demonstration of technologies for producing syncrude and liquid petroleum products from coal: *Provided*, That the Secretary shall invite and consider proposals from potential participants based upon Federal assistance and participation through guaranteed prices or purchase of the products, and recommendations pursuant to this clause shall be accompanied by a report on the viability of using this form of Federal assistance or participation;
- (F) in accordance with the program authorized by the Geothermal Energy Research, Development, and Demonstration Act of 1974 (Public Law 93-410), to accelerate the commercial demonstration of geothermal energy technologies;
- (G) to demonstrate the production of syncrude from oil shale by all promising technologies including in situ technologies;
- (H) to demonstrate new and improved methods for the extraction of petroleum resources, including secondary and tertiary recovery of crude oil;
- (I) to demonstrate the economics and commercial viability of solar energy for residential and commercial energy supply applications in accordance with the program authorized by the Solar Heating and Cooling Demonstration Act of 1974 (Public Law 93-409);

(J) to accelerate the commercial demonstration of environmental control systems for energy technologies developed pursuant to this chapter;

(K) to investigate the technical and economic feasibility of tidal power for supplying electrical energy;

[(L)] to commercially demonstrate advanced solar energy technologies in accordance with the Solar Energy Research, Development, and Demonstration Act of 1974 (Public Law 93-473) ;]

[(M)] (L) to determine the economics and commercial viability of the production of synthetic fuels such as hydrogen and methanol;

[(N)] (M) to commercially demonstrate the use of fuel cells for central station electric power generation;

[(O)] (N) to determine the economics and commercial viability of in situ coal gasification;

[(P)] (O) to improve techniques for the management of existing energy systems by means of quality control; application of systems analysis, communications, and computer techniques; and public information with the objective of improving the reliability and efficiency of energy supplies and encourage the conservation of energy resources;

[(Q)] (P) to improve methods for the prevention and cleanup of marine oil spills;

[(R)] (Q) to implement the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 (42 U.S.C. 12001 et seq.); and

[(S)] (R) to implement titles XX through XXIII of the Energy Policy Act of 1992. (c) Based upon the comprehensive plan developed under subsection (a), the Secretary, in consultation with the Advisory Board established under section 2302 of the Energy Policy Act of 1992, shall develop and transmit to the Congress, on or before September 1, 1978, a comprehensive environment and safety program to insure the full consideration and evaluation of all environmental, health, and safety impacts of each element, program, or initiative contained in the nuclear and nonnuclear energy research, development, and demonstration plans. Such program shall be updated and transmitted to the Congress annually as part of the report required under section 15.

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## **SOLAR PHOTOVOLTAIC ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1978**

Public Law 95-590

\* \* \* \* \*

### **FINDINGS AND POLICY**

SEC. 2. (a) The Congress hereby finds that—

(1) the United States of America is faced with a finite and diminishing resource base of native fossil fuels, and as a con-

sequence must develop as quickly as possible a diversified, pluralistic national energy capability and posture;

(2) the current imbalance between supply and demand for fuels and energy in the United States is likely to grow for many years;

(3) the early demonstration of the feasibility of using solar photovoltaic energy systems for the generation of electricity could help to relieve the demand on existing fuel and energy supplies;

(4) the national security and economic well-being of the United States is endangered by its dependence on imported energy supplies which are subject to resource limitations, artificial pricing mechanisms which do not accurately reflect supply and demand relationships, and supply interruptions;

(5) the early development and widespread utilization of photovoltaic energy systems could significantly expand the domestic energy resource base of the United States, thereby lessening its dependence on foreign supplies;

(6) the establishment of sizable markets for photovoltaic energy systems will justify private investment in plant and equipment necessary to realize the economies of scale, and will result in significant reductions in the unit costs of these systems;

(7) the use of solar photovoltaic energy systems for certain limited applications has already proved feasible;

(8) there appear to be no insoluble technical obstacles to the widespread commercial use of solar photovoltaic energy technologies;

(9) an aggressive research and development program should solve existing technical problems of solar photovoltaic systems; and, supported by an assured and growing market for photovoltaic systems during the next decade, should maximize the future contribution of solar photovoltaic energy to this Nation's future energy production;

(10) it is the proper and appropriate role of the Federal Government to undertake research, development, and demonstration programs in solar photovoltaic energy technologies and to supplement and assist private industry and other entities and thereby the general public, so as to hasten the general commercial use of such technologies;

(11) the high cost of imported energy sources impairs the economic growth of many nations which lack sizable domestic energy supplies or are unable to develop these resources;

(12) photovoltaic energy systems are economically competitive with conventional energy resources for a wide variety of applications in many foreign nations at the present time, and will find additional applications with continued cost reductions;

(13) the early development and export of solar photovoltaic energy systems, consistent with the established preeminence of the United States in the field of high technology products, can make a valuable contribution to the well-being of the people of other nations and to this Nation's balance of trade;

(14) the widespread use of solar photovoltaic energy systems to supplement and replace conventional methods for the gen-



eration of electricity would have a beneficial effect upon the environment;

(15) to increase the potential application of solar photovoltaic energy systems in remote locations, and to minimize the need for backup systems depending on fossil fuel, programs leading to the development of inexpensive and reliable systems for the storage of electricity should be pursued as part of any solar photovoltaic energy research, development, and demonstration program;

(16) evaluation of the performance and reliability of solar photovoltaic energy technologies can be expedited by testing of prototypes under carefully controlled conditions;

(17) commercial application of solar photovoltaic energy technologies can be expedited by early commercial demonstration under practical conditions;

(18) photovoltaic energy systems are currently adaptable on a life cycle, cost-justified basis for certain of the energy needs of the Federal Government, and will find additional applications as continued refinements improve performance and reduce unit costs;

(19) the Federal Government can stimulate innovation and economic efficiency in the production of photovoltaic energy systems through the development and implementation of policies to promote diversity and maximum competition between firms engaged in the research, manufacture, installation, and/or maintenance of these systems;

(20) innovation and creativity in the development of solar photovoltaic energy components and systems can be fostered through encouraging direct contact between the manufacturers of such systems and the architects, engineers, developers, contractors, and other persons interested in utilizing such systems; and

(21) it is contemplated that the ten-year program established by this Act will require the expenditure of \$1,500,000,000 by the Federal Government.

(b) It is therefore declared to be the policy of the United States and the purpose of this Act to establish during the next decade an aggressive research, development, and demonstration program involving solar photovoltaic energy systems and in the long term, to have as an objective the production of electricity from photovoltaic systems cost competitive with utility-generated electricity from conventional sources. Further, it is declared to be the policy of the United States and the purpose of this Act that the objectives of this research, development, and demonstration program are—

(1) to double the production of solar photovoltaic energy systems each year during the decade starting with fiscal year 1979, measured by the peak generating capacity of the systems produced, so as to reach a total annual United States production of solar photovoltaic energy systems of approximately two million peak kilowatts, and a total cumulative production of such systems of approximately four million peak kilowatts by fiscal year 1988;

(2) to reduce the average cost of installed solar photovoltaic energy systems to \$1 per peak watt by fiscal year 1988; and

(3) to stimulate the purchase by private buyers of at least 90 per centum of all solar photovoltaic energy systems produced in the United States during fiscal year 1988.

#### DEFINITIONS

SEC. 3. For purposes of this Act—

(1) a “solar photovoltaic energy system” is a system of components which generates electricity from incident sunlight by means of the photovoltaic effect, and which shall include all components, including energy storage devices where appropriate, necessary to provide electricity for individual, industrial, agricultural, or governmental use;

(2) the term “solar photovoltaic energy system” may be used interchangeably with the term “photovoltaic system”;

(3) a “hybrid solar photovoltaic energy system” is a system of components that generates electricity from incident sunlight by means of the photovoltaic effect and, in conjunction with electronic and, if appropriate, optical, thermal and storage devices, provides electricity, as well as heat and/or light for individual, commercial, industrial, agricultural, or governmental use;

(4) “photovoltaic effect” refers to the physical phenomenon exhibited under certain circumstances by some materials in which a portion of the light energy striking the material is directly converted to electrical energy;

(5) “facility” means any building, agricultural, commercial or industrial complex or other device constructively employing photovoltaic systems; and

(6) “Secretary” means the Secretary of Energy.

#### RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF SOLAR PHOTOVOLTAIC ENERGY SYSTEMS

SEC. 4. The Secretary is directed to establish immediately and carry forth such research, development, and demonstration programs as may be necessary to meet the objectives of this Act as set forth in section 2(b), and as a part of any such program shall—

(a) conduct, and promote the coordination and acceleration of, research, development, and demonstrations relating to solar photovoltaic energy systems and components thereof, and

(b) conduct, and promote the coordination and acceleration of, research, development, and demonstrations for systems and components to be used in applications that are dependent for their energy on solar photovoltaic energy systems.

SEC. 5. (a) In carrying out the provisions of section 4, the Secretary is authorized—

(1) to establish procedures whereby any public or private entity wishing to install solar photovoltaic components and systems in any new or existing facility may apply for Federal assistance in purchasing and installing, in such facility, photovoltaic components or systems;

(2) to select, as soon as he deems it feasible, a number of the applicants under paragraph (1) and enter into agreements with them for the design, purchase, fabrication, testing, installation, and demonstration of photovoltaic components and systems. Such selection shall be based on the need to obtain scientific,

technological, and economic information from a variety of such systems under a variety of circumstances and conditions; and

(3) to arrange, as part of any agreement entered into under paragraph (2), to provide up to 75 per centum of the purchase and installation costs of photovoltaic components or systems, taking into account relevant considerations involving the relative stage of consumer and industry interest and development at the time of the financial assistance action. Such arrangements shall be contingent upon terms and conditions prescribed by the Secretary, including an express agreement that the entity with whom the agreement is entered into shall, in such manner and form and on such terms and conditions as the Secretary may prescribe, observe and monitor (or permit the Secretary or his agents to observe and monitor) the performance and operation of such system for a period of five years, and that such entity (including any subsequent owner of the property) shall regularly furnish the Secretary with such reports thereon as the agreement may require.

(b) The Secretary shall, as he deems appropriate, undertake any projects or activities (including demonstration projects) to further the attainment of the objectives of this section.

SEC. 6. (a) The Secretary is authorized to select on the basis of open competitions—

(1) a number of readily available photovoltaic components and systems;

(2) a number of design concepts for various types of applications which demonstrate adaptability to the utilization of photovoltaic components and systems; and

(3) a number of designs for applications selected under paragraph (2), so that each design includes specific provisions for the utilization of solar photovoltaic components and systems selected under paragraph (1).

(b) The Secretary, in accordance with the applicable provisions of sections 7, 8, and 9 of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5901 et seq.) and with such program guidelines as the Secretary may establish, shall—

(1) enter into such contracts and grants as may be necessary or appropriate for the development for commercial production and utilization of photovoltaic components and systems, including any further planning and design which may be required to conform with the specifications set forth in any applicable criteria;

(2) select, as being compatible with the design concepts chosen under subsection (a)(2) of this section, a reasonable number of photovoltaic components and systems; and

(3) enter into contracts with a number of persons or firms for the procurement of photovoltaic components and systems, including adequate numbers of spare and replacement parts for such systems.

(c) The Secretary is authorized to award contracts for the design integration between the application concepts and the photovoltaic systems procured by the Secretary under subsection (b)(3), and for the demonstration of prototype solar photovoltaic systems, and, when appropriate, for the utilization of such systems in existing facilities. Title to and ownership of the facilities so constructed and

of photovoltaic systems installed hereunder may be conveyed to purchasers of such facilities under terms and conditions prescribed by the Secretary, including an express agreement that any such purchaser shall, in such manner and form and on such terms and conditions as the Secretary may prescribe, observe and monitor (or permit the Secretary to observe and monitor) the performance and operation of such systems for a period of five years, and that such purchaser (including any subsequent owner) shall regularly furnish the Secretary with such reports thereon as the agreement may require.

(d) The Secretary, in consultation with the Administrator of General Services or the Secretary of Defense or both (as may be appropriate) shall enter into arrangements with appropriate Federal agencies concurrently with the conduct of the programs under this section and section 5586 of this title, to carry out such projects and activities (including demonstration projects), with respect to Federal buildings and facilities, as may be appropriate for the demonstration of photovoltaic systems suitable and effective for use in such applications.

(e) The Secretary shall, as he deems appropriate, undertake any projects or activities (including demonstration projects) to further the attainment of the objectives of this section.

#### TEST PROCEDURES AND PERFORMANCE CRITERIA

SEC. 7. (a) The Secretary shall conduct a testing program for photovoltaic systems to assist in the development and demonstration of prototype photovoltaic systems, including collectors, controls, power conditioning, and energy storage systems.

(b) Data obtained from the testing program under subsection (a) shall be evaluated and used in establishing performance criteria. These performance criteria shall be used in the demonstration program described in sections 4, 5, and 6 of this Act.

(c) The Secretary shall determine, prescribe, and publish in the Federal Register, at a time which he determines to be feasible and justified—

(1) performance criteria for photovoltaic components and systems to be used in appropriate applications, and procedures whereby manufacturers of photovoltaic components and systems shall have their products tested in order to provide certification that such products conform to the performance criteria established under this paragraph; and

(2) revised performance criteria for photovoltaic components and systems to be used in appropriate applications, and procedures whereby manufacturers of photovoltaic components and systems shall have their products tested in order to provide certification that such products conform to the performance criteria established under this paragraph. Such criteria may be annually revised by the Secretary, as he deems appropriate.

(d) Any photovoltaic component or system procured or installed by the Federal Government or procured or installed with Federal assistance under section 5 or section 6 of this Act shall meet appropriate performance criteria prescribed under this section, if such performance criteria have been prescribed.

## COORDINATION MONITORING, AND LIAISON

SEC. 8. (a) The Secretary, in coordination with such Government agencies as may be appropriate, shall—

(1) monitor the performance and operation of photovoltaic systems installed under this Act;

(2) collect and evaluate data and information on the performance and operation of photovoltaic systems installed under this Act; and

(3) from time to time carry out such studies and investigations and take such other actions, including the submission of special reports to the Congress when appropriate, as may be necessary to assure that the programs for which the Secretary is responsible under this Act effectively carry out the policy of this Act.

(b) In the development of the performance criteria and test procedures required under section 7 of this Act, the Secretary shall work closely with the appropriate scientific, technical, and professional societies and industry representatives in order to assure the best possible use of available expertise in this area.

(c) The Secretary shall also maintain continuing liaison with related industries and interests, and with the scientific and technical community, during and after the period of the programs carried out under this Act, in order to assure that the projected benefits of such programs are and will continue to be realized.

## SOLAR PHOTOVOLTAIC ENERGY ADVISORY COMMITTEE

SEC. 9. (a) There is hereby established a Solar Photovoltaic Energy Advisory Committee, which shall study and advise the Secretary on—

(1) the scope and pace of research and development with respect to solar photovoltaic energy systems;

(2) the need for and timing of solar photovoltaic energy systems demonstration projects;

(3) the need for change in any research, development, or demonstration program established under this Act; and

(4) the economic, technological, and environmental consequences of the use of solar photovoltaic energy systems.

(b) The Committee shall be composed of thirteen members, including eleven members appointed by the Secretary from industrial organizations, academic institutions, professional societies or institutions, and other sources as he sees fit, and two members of the public appointed by the President. The Chairman of the Committee shall be elected from among the members thereof.

(c) The heads of the departments, agencies, and instrumentalities of the executive branch of the Federal Government shall cooperate with the Committee in carrying out the requirements of this section, and shall furnish to the Committee such information as the Committee deems necessary to carry out this section.

(d) Section 624 of the Department of Energy Organization Act shall be applicable to the Committee, except as inconsistent with this section.

DISSEMINATION OF INFORMATION AND OTHER ACTIVITIES TO PROMOTE  
PRACTICAL USE OF SOLAR PHOTOVOLTAIC TECHNOLOGIES

SEC. 10. (a) The Secretary shall take all possible steps to assure that full and complete information with respect to the demonstrations and other activities conducted under this Act is made available to Federal, State, and local authorities, relevant segments of the economy, the scientific and technical community, and the public at large, both during and after the close of the programs under this Act, with the objective of promoting and facilitating to the maximum extent feasible the early and widespread practical use of photovoltaic energy throughout the United States. Any trade secret or other proprietary information shall be exempted from such mandatory disclosure, as otherwise specified in law applicable to research, development and demonstration programs of the Department of Energy, including, but not limited to, section 17 of the Federal Non-Nuclear Energy Research and Development Act of 1974, Public Law 93-577, as amended.

(b) The Secretary shall—

(1) study the effect of the widespread utilization of photovoltaic systems on the existing electric utility system at varying levels of photovoltaic contribution to the system;

(2) study and investigate the effect of utility rate structures, building codes, zoning ordinances, and other laws, codes, ordinances, and practices upon the practical use of photovoltaic systems;

(3) determine the extent to which such laws, codes, ordinances, and practices should be changed to permit or facilitate such use and the methods by which any such changes may best be accomplished; and

(4) determine the necessity of a program of incentives to accelerate the commercial application of photovoltaic technologies.

(c) The Secretary is authorized and directed, within one year of the date of enactment of this Act, to make recommendations to the President and to the Congress for Federal policies relating to barriers to the early and widespread utilization of photovoltaic systems in order to realize the goals set forth in section 2. These recommendations shall include but not be limited to—

(1) the potential for integration of electricity derived from photovoltaic energy systems into the existing national grid system, including the potential of photovoltaic-generated electricity to meet the peak-load energy needs of electric utilities, load management and reliability implications of the utilization of photovoltaic electricity by utilities, the implications of utility ownership of photovoltaic components leased to others primarily for decentralized applications, the impacts of utility use of electricity derived from photovoltaic energy systems on utility rate structures, and the potential for reducing or obviating the need for energy storage components for photovoltaic energy systems through utility interface;

(2) the extent of competition between firms currently engaged in the fabrication and installation of photovoltaic components and systems as it affects the character and growth potential of the American photovoltaics industry, and the likeli-

hood that small photovoltaic firms will have reasonable opportunities to compete and participate in the various programs authorized by this Act;

(3) the need to identify legal alternatives to ensure access to direct sunlight for photovoltaic energy systems, the appropriate methods of encouraging the adoption of such alternatives, and the implications of widespread utilization of photovoltaic energy systems for land use and urban development;

(4) the availability of private capital at reasonable interest rates for individuals, businesses and others desiring to establish commercial enterprises to manufacture, market, install, and/or, maintain photovoltaic components and systems, or purchase and install such systems for private, industrial, agricultural, commercial or other uses;

(5) the need for industry-wide warranty and reliability standards for photovoltaic energy components and systems for private sector applications, and, if appropriate, the mechanisms for establishing such standards; and

(6) the attainability of the goals specified in subsection 2(b), and any modification of such goals which the Secretary proposes for consideration by Congress, with supporting analyses.

(d) In carrying out his functions under this section, the Secretary shall consult with the appropriate government agencies, industry representatives, and members of the scientific and technical community having expertise and interest in this area. The Secretary also shall ensure that any study or report prepared pursuant to this section is fully coordinated with and reflective of any analyses or reports prepared pursuant to the requirements in section 5556a of this title, and in the President's Solar Energy Domestic Policy Review. The Secretary, as appropriate, may merge any continuing or on-going studies under section 5556a of this title or the Domestic Policy Review with those required by this section or avoid any unnecessary duplication of effort or funding. The separate report requirements of section 5556a of this title and this section, however, shall remain in force.

#### INTERNATIONAL PARTICIPATION AND COOPERATION

SEC. 11. (a) Within one year after the date of enactment of this Act, the Secretary, in consultation with the Secretary of State, the Administrator of the Agency for International Development, the Director of the Export/Import Bank and other appropriate Federal officials, shall submit to the House Committee on Science and Technology and the Senate Committee on Energy and Natural Resources a plan for demonstrating applications of solar photovoltaic energy systems and facilitating their widespread use in other nations, especially those with agreements for scientific cooperation with the United States.

(b) The Secretary is authorized to encourage, to the maximum extent practicable, international participation and cooperation in the development and maintenance of programs established under this plan. The Secretary, in consultation and cooperation with the Federal officials specified in subsection (a), shall insure to the maximum extent possible that the plan submitted under subsection (a) and any other international activities under this section are consistent with and reflective of any similar activities or requirements

under any other Federal statute, specifically including any of the several programs under other agencies and Departments involving United States international cooperation and assistance in non-nuclear energy technology, and will not duplicate activities under such programs. The plan required in subsection (a) shall specifically identify all such programs and statutes and describe how the activities under this section will be consistent with such programs, will be coordinated with them, and will avoid duplication of activities under such programs.

#### ENCOURAGEMENT AND PROTECTION OF SMALL BUSINESS

SEC. 12. In carrying out his functions under this Act, the Secretary shall take steps to assure that small-business concerns will have realistic and adequate opportunities to participate in the programs under this Act to the maximum extent practicable, and the Secretary is directed to set aside at least 10 per centum of the funds authorized and appropriated for the participation of small business concerns.

#### PRIORITIES

SEC. 13. The Secretary shall set priorities, as far as possible consistent with the intent and operation of this Act, in accordance with the following criteria:

(1) The applications utilizing photovoltaic systems which will be part of the research, development, and demonstration program and testing and demonstration programs referred to in sections 4, 5, 6, and 7 shall be located in a sufficient number of different geographic areas in the United States to assure a realistic and effective demonstration of the use of photovoltaic systems and of the applications themselves, in both rural and urban locations and under climatic conditions which vary as much as possible.

(2) The projected costs of commercial production and maintenance of the photovoltaic systems utilized in the testing and demonstration programs established under this Act should be taken into account.

(3) Encouragement should be given in the conduct of programs under this Act to those projects in which funds are appropriated by any State or political subdivision thereof for the purpose of sharing costs with the Federal Government for the purchase and installation of photovoltaic components and systems.

SEC. 14. Nothing in this Act shall be construed to negate, duplicate, or otherwise affect the provisions of title V (Federal Initiatives), part 4 (Federal Photovoltaic Utilization), National Energy Conservation Policy Act, H.R. 5037, 95th Congress, if and when that Act becomes enacted by the Ninety-fifth Congress, and such part 4 shall be exempted fully from the provisions of this Act and any regulations, guidelines, or criteria pursuant thereto.

#### AUTHORIZATION OF APPROPRIATIONS

SEC. 15. There is hereby authorized to be appropriated to the Secretary, for the fiscal year ending September 30, 1979, \$125,000,000, inclusive of any funds otherwise authorized for pho-



photovoltaic programs, (1) to carry out the functions vested in the Secretary by this Act, (2) to carry out the functions in fiscal year 1979, vested in the Secretary by part 4 of title V of H.R. 5037, 95th Congress, if enacted by the 95th Congress, and (3) for transfer to such other agencies of the Federal Government as may be required to enable them to carry out their respective functions under this Act. Funds appropriated pursuant to this section shall remain available until expended: Provided, That any contract or agreement entered into pursuant to this Act shall be effective only to such extent or in such amounts as are provided in advance in appropriation Acts. Authorizations of appropriations for fiscal years after fiscal year 1979 shall be contained in the annual authorization for the Department of Energy, except for those funds authorized for fiscal years 1980 and 1981 contained in part 4 of title V of H.R. 5037, Ninety-fifth Congress, if by the Ninety-fifth Congress,.]

## **RENEWABLE ENERGY AND ENERGY EFFICIENCY TECHNOLOGY COMPETITIVENESS ACT OF 1989**

Public Law 101-218, as Amended

\* \* \* \* \*

### **SEC. 4. NATIONAL GOALS AND MULTI YEAR FUNDING FOR FEDERAL WIND, [PHOTOVOLTAICS, AND SOLAR THERMAL] ALCOHOL FROM BIOMASS, AND OTHER TECHNOLOGY PROGRAMS**

(a) NATIONAL GOALS.—The following are declared to be the national goals for the wind, [photovoltaics, and solar thermal energy] *alcohol from biomass, and other energy technology* programs being carried out by the Secretary:

(1) WIND.—(A) In general, the goals for the Wind Energy Research Program include improving design methodologies and developing more reliable and efficient wind turbines to increase the cost competitiveness of wind energy. Research efforts shall emphasize—

(i) activities that address near-term technical problems and assist private sector exploitation of market opportunities of the wind energy industry;

(ii) developing technologies such as advanced airfoils and variable speed generators to increase wind turbine output and reduce maintenance costs by decreasing structural stress and fatigue;

(iii) increasing the basic knowledge of aerodynamics, structural dynamics, fatigue, and electrical systems interactions as applied to wind energy technology; and

(iv) improving the compatibility of electricity produced from wind farms with conventional utility needs.

(B) Specific goals for the Wind Energy Research Program shall be to—

(i) reduce average wind energy costs to 3 to 5 cents per kilowatt hour by 1995;

(ii) reduce capital costs of new wind energy systems to \$500 to \$750 per kilowatt of installed capacity by 1995;

(iii) reduce operation and maintenance costs for wind energy systems to less than one cent per kilowatt hour by 1995; and

(iv) increase capacity factors for new wind energy systems to 25 to 35 percent by 1995.

[(2) PHOTOVOLTAICS.—(A) In general, the goals of the Photovoltaic Energy Systems Program shall include improving the reliability and conversion efficiencies of and lowering the costs of photovoltaic conversion. Research efforts shall emphasize advancements in the performance, stability, and durability of photovoltaic materials.

(B) Specific goals of the Photovoltaic Energy Systems Program shall be to—

(i) improve operational reliability of photovoltaic modules to 30 years by 1995;

(ii) increase photovoltaic conversion efficiencies by 20 percent by 1995;

(iii) decrease new photovoltaic module direct manufacturing costs to \$800 per kilowatt by 1995; and

(iv) increase cost efficiency of photovoltaic power production to 10 cents per kilowatt hour by 1995.

[(3) SOLAR THERMAL.—(A) In general, the goal of the Solar Thermal Energy Systems Program shall be to advance research and development to a point where solar thermal technology is cost-competitive with conventional energy sources, and to promote the integration of this technology into the production of industrial process heat and the conventional utility network. Research and development shall emphasize development of a thermal storage technology to provide capacity for shifting power to periods of demand when full insolation is not available; improvement in receivers, energy conversion devices, and innovative concentrators using stretch membranes, lenses, and other materials; and exploration of advanced manufacturing techniques.

(B) Specific goals of the Solar Thermal Energy Systems Program shall be to—

(i) reduce solar thermal costs for industrial process heat to \$9.00 per million Btu by 1995; and

(ii) reduce average solar thermal costs for electricity to 4 to 5 cents per kilowatt hour by 1995.]

[(4)] (2) ALCOHOL FROM BIOMASS.—(A) In general, the goal of the Alcohol From Biomass Program shall be to advance research and development to a point where alcohol from biomass technology is cost-competitive with conventional hydrocarbon transportation fuels, and to promote the integration of this technology into the transportation fuel sector of the economy.

(B)(i) Specific goals for producing ethanol from biomass shall be to—

(I) reduce the cost of alcohol to 70 cents per gallon;

(II) improve the overall biomass carbohydrate conversion efficiency to 91 percent;

(III) reduce the capital cost component of the cost of alcohol to 23 cents per gallon; and

(IV) reduce the operating and maintenance component of the cost of alcohol to 47 cents per gallon.

(ii) Specific goals for producing methanol from biomass shall be to

(I) reduce the cost of alcohol to 47 cents per gallon; and

(II) reduce the capital component of the cost of alcohol to 16 cents per gallon.

[(5)] (3) OTHER TECHNOLOGIES.—The Secretary shall submit to the Congress, as part of the first report submitted under section 9, recommendations for specific cost goals and other pertinent goals for 1995 for Department of Energy research, development, and demonstration programs in Biofuels Energy Systems, Biodiesel Energy Systems, Hydrogen Energy Systems, Solar Buildings Energy Systems, Ocean Energy Systems, Geothermal Energy Systems, Low-Head Hydro, and Energy Storage Systems.

(b) AMENDED GOALS.—Whenever the Secretary determines that any of the goals established under this section is no longer appropriate, the Secretary shall notify Congress, as part of a report submitted under section 9, of the reason for the determination and provide an amended goal that is consistent with the purpose stated in section 2(b).

(c) AUTHORIZATIONS.— There are authorized to be appropriated to the Secretary for the following renewable energy research, development, and demonstration programs: the Wind Energy Research Program, [the Photovoltaic Energy Systems Program, the Solar Thermal Energy Systems Program,] the Biofuels Energy Systems Program, the Hydrogen Energy Systems Program, the Solar Buildings Energy Systems Program, the Ocean Energy Systems Program, and the Geothermal Energy Systems Program—

(1) not to exceed \$113,000,000 for fiscal year 1991, of which—

[(A) not to exceed \$39,000,000 shall be available for the Photovoltaic Energy Systems Program;]

[(B)] (A) not to exceed \$19,000,000 shall be available for the Geothermal Energy Systems Program; and

[(C)] (B) not to exceed \$4,000,000 shall be available for the Hydrogen Energy Systems Program; and

(2) not to exceed \$121,000,000 for fiscal year 1992, of which—

[(A) not to exceed \$40,000,000 shall be available for the Photovoltaic Energy Systems Program;]

[(B)] (A) not to exceed \$20,500,000 shall be available for the Geothermal Energy Systems Program; and

[(C)] (B) not to exceed \$5,000,000 shall be available for the Hydrogen Energy Systems Program.

Each of the President's annual budget requests submitted to Congress after the date of enactment of this Act shall include as separate line items each of the categories of renewable energy programs described in this subsection.

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## ENERGY POLICY ACT OF 2005

Public Law 109–58, as Amended

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## TITLE IX—RESEARCH AND DEVELOPMENT

### Subtitle C—Renewable Energy

#### SEC. 931. RENEWABLE ENERGY.

##### (a) IN GENERAL.—

(1) OBJECTIVES.—The Secretary shall conduct programs of renewable energy research, development, demonstration, and commercial application, including activities described in this part. Such programs shall take into consideration the following objectives:

- (A) Increasing the conversion efficiency of all forms of renewable energy through improved technologies.
- (B) Decreasing the cost of renewable energy generation and delivery.
- (C) Promoting the diversity of the energy supply.
- (D) Decreasing the dependence of the United States on foreign energy supplies.
- (E) Improving United States energy security.
- (F) Decreasing the environmental impact of energy-related activities.
- (G) Increasing the export of renewable generation equipment from the United States.

##### (2) PROGRAMS.—

[(A) SOLAR ENERGY.—The Secretary shall conduct a program of research, development, demonstration, and commercial application for solar energy, including—

- (i) photovoltaics;
- (ii) solar hot water and solar space heating;
- (iii) concentrating solar power;
- (iv) lighting systems that integrate sunlight and electrical lighting in complement to each other in common lighting fixtures for the purpose of improving energy efficiency;
- (v) manufacturability of low cost, high quality solar systems; and
- (vi) development of products that can be easily integrated into new and existing buildings.]

[(B)] (A) WIND ENERGY.— The Secretary shall conduct a program of research, development, demonstration, and commercial application for wind energy, including—

- (i) low speed wind energy;
- (ii) offshore wind energy;
- (iii) testing and verification (including construction and operation of a research and testing facility capable of testing wind turbines); and
- (iv) distributed wind energy generation.

[(C)] (B) GEOTHERMAL.—The Secretary shall conduct a program of research, development, demonstration, and commercial application for geothermal energy. The program shall focus on developing improved technologies for reducing the costs of geothermal energy installations, including technologies for—

- (i) improving detection of geothermal resources;
- (ii) decreasing drilling costs;

- (iii) decreasing maintenance costs through improved materials;
- (iv) increasing the potential for other revenue sources, such as mineral production; and
- (v) increasing the understanding of reservoir life cycle and management.

【(D)】 *(C) HYDROPOWER.*—The Secretary shall conduct a program of research, development, demonstration, and commercial application for cost competitive technologies that enable the development of new and incremental hydropower capacity, adding to the diversity of the energy supply of the United States, including:

- (i) Fish-friendly large turbines.
- (ii) Advanced technologies to enhance environmental performance and yield greater energy efficiencies.

【(E)】 *(D) MISCELLANEOUS PROJECTS.*—The Secretary shall conduct research, development, demonstration, and commercial application programs for—

- (i) ocean energy, including wave energy;
- (ii) the combined use of renewable energy technologies with one another and with other energy technologies, including the combined use of wind power and coal gasification technologies;
- (iii) renewable energy technologies for cogeneration of hydrogen and electricity; and
- (iv) kinetic hydro turbines.

(b) *AUTHORIZATION OF APPROPRIATIONS.*—There are authorized to be appropriated to the Secretary to carry out renewable energy research, development, demonstration, and commercial application activities, including activities authorized under this subtitle—

- (1) \$632,000,000 for fiscal year 2007;
- (2) \$743,000,000 for fiscal year 2008;
- (3) \$852,000,000 for fiscal year 2009; and
- (4) \$963,000,000 for fiscal year 2010.

(c) *BIOENERGY.*—From the amounts authorized under subsection (b), there are authorized to be appropriated to carry out section 932—

- (1) \$213,000,000 for fiscal year 2007, of which \$100,000,000 shall be for section 932(d);
- (2) \$377,000,000 for fiscal year 2008, of which \$125,000,000 shall be for section 932(d);
- (3) \$398,000,000 for fiscal year 2009, of which \$150,000,000 shall be for section 932(d); and
- (4) \$419,000,000 for fiscal year 2010, of which \$150,000,000 shall be for section 932(d).

【(d) *SOLAR POWER.*—From amounts authorized under subsection (b), there is authorized to be appropriated to carry out activities under subsection (a)(2)(A)—

- (1) \$140,000,000 for fiscal year 2007, of which \$40,000,000 shall be for activities under section 935;
- (2) \$200,000,000 for fiscal year 2008, of which \$50,000,000 shall be for activities under section 935; and
- (3) \$250,000,000 for fiscal year 2009, of which \$50,000,000 shall be for activities under section 935.】

[(e)] (d) ADMINISTRATION.—Of the funds authorized under subsection (c), not less than \$5,000,000 for each fiscal year shall be made available for grants to—

- (1) part B institutions;
- (2) Tribal Colleges or Universities (as defined in section 316(b) of the Higher Education Act of 1965); and
- (3) Hispanic-serving institutions.

[(f)] (e) RURAL DEMONSTRATION PROJECTS.—In carrying out this section, the Secretary, in consultation with the Secretary of Agriculture, shall demonstrate the use of renewable energy technologies to assist in delivering electricity to rural and remote locations including—

- (1) advanced wind power technology, including combined use with coal gasification;
- (2) biomass; and
- (3) geothermal energy systems.

[(g)] (f) ANALYSIS AND EVALUATION.—

(1) IN GENERAL.—The Secretary shall conduct analysis and evaluation in support of the renewable energy programs under this part. These activities shall be used to guide budget and program decisions, and shall include—

- (A) economic and technical analysis of renewable energy potential, including resource assessment;
- (B) analysis of past program performance, both in terms of technical advances and in market introduction of renewable energy; and
- (C) any other analysis or evaluation that the Secretary considers appropriate.

(2) FUNDING.—The Secretary may designate up to 1 percent of the funds appropriated for carrying out this part for analysis and evaluation activities under this subsection.

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## ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

Public Law 110–140, as Amended

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### TITLE VI—ACCELERATED RESEARCH AND DEVELOPMENT

#### Subtitle A—Solar Energy

##### SEC. 601. SHORT TITLE.

This subtitle may be cited as the “Solar Energy Research and Advancement Act of 2007.”

##### SEC. 602. THERMAL ENERGY STORAGE RESEARCH AND DEVELOPMENT PROGRAM.

(a) ESTABLISHMENT.—The Secretary shall establish a program of research and development to provide lower cost and more viable thermal energy storage technologies to enable the shifting of electric power loads on demand and extend the operating time of concentrating solar power electric generating plants.

(b) **AUTHORIZATION OF APPROPRIATIONS.**—There are authorized to be appropriated to the Secretary for carrying out this section \$5,000,000 for fiscal year 2008, \$7,000,000 for fiscal year 2009, \$9,000,000 for fiscal year 2010, \$10,000,000 for fiscal year 2011, and \$12,000,000 for fiscal year 2012.

**SEC. 604. SOLAR ENERGY CURRICULUM DEVELOPMENT AND CERTIFICATION GRANTS.**

(a) **ESTABLISHMENT.**—The Secretary shall establish in the Office of Solar Energy Technologies a competitive grant program to create and strengthen solar industry workforce training and internship programs in installation, operation, and maintenance of solar energy products. The goal of this program is to ensure a supply of well-trained individuals to support the expansion of the solar energy industry.

(b) **AUTHORIZED ACTIVITIES.**—Grant funds may be used to support the following activities:

(1) Creation and development of a solar energy curriculum appropriate for the local educational, entrepreneurial, and environmental conditions, including curriculum for community colleges.

(2) Support of certification programs for individual solar energy system installers, instructors, and training programs.

(3) Internship programs that provide hands-on participation by students in commercial applications.

(4) Activities required to obtain certification of training programs and facilities by an industry-accepted quality-control certification program.

(5) Incorporation of solar-specific learning modules into traditional occupational training and internship programs for construction-related trades.

(6) The purchase of equipment necessary to carry out activities under this section.

(7) Support of programs that provide guidance and updates to solar energy curriculum instructors.

(c) **ADMINISTRATION OF GRANTS.**—Grants may be awarded under this section for up to 3 years. The Secretary shall award grants to ensure sufficient geographic distribution of training programs nationally. Grants shall only be awarded for programs certified by an industry-accepted quality-control certification institution, or for new and growing programs with a credible path to certification. Due consideration shall be given to women, underrepresented minorities, and persons with disabilities.

(d) **REPORT.**—The Secretary shall make public, on the website of the Department or upon request, information on the name and institution for all grants awarded under this section, including a brief description of the project as well as the grant award amount.

(e) **AUTHORIZATION OF APPROPRIATIONS.**—There are authorized to be appropriated to the Secretary for carrying out this section \$10,000,000 for each of the fiscal years 2008 through 2012.

**SEC. 605. DAYLIGHTING SYSTEMS AND DIRECT SOLAR LIGHT PIPE TECHNOLOGY.**

(a) **ESTABLISHMENT.**—The Secretary shall establish a program of research and development to provide assistance in the demonstration and commercial application of direct solar renewable energy sources to provide alternatives to traditional power generation for

lighting and illumination, including light pipe technology, and to promote greater energy conservation and improved efficiency. All direct solar renewable energy devices supported under this program shall have the capability to provide measurable data on the amount of kilowatt-hours saved over the traditionally powered light sources they have replaced.

(b) **REPORTING.**—The Secretary shall transmit to Congress an annual report assessing the measurable data derived from each project in the direct solar renewable energy sources program and the energy savings resulting from its use.

(c) **DEFINITIONS.**—For purposes of this section—

(1) the term “direct solar renewable energy” means energy from a device that converts sunlight into useable light within a building, tunnel, or other enclosed structure, replacing artificial light generated by a light fixture and doing so without the conversion of the sunlight into another form of energy; and (2) the term “light pipe” means a device designed to transport visible solar radiation from its collection point to the interior of a building while excluding interior heat gain in the nonheating season.

(d) **AUTHORIZATION OF APPROPRIATIONS.**—There are authorized to be appropriated to the Secretary for carrying out this section \$3,500,000 for each of the fiscal years 2008 through 2012.

**[SEC. 606. SOLAR AIR CONDITIONING RESEARCH AND DEVELOPMENT PROGRAM.]**

(a) **ESTABLISHMENT.**—The Secretary shall establish a research, development, and demonstration program to promote less costly and more reliable decentralized distributed solar-powered air conditioning for individuals and businesses.

(b) **AUTHORIZED ACTIVITIES.**—Grants made available under this section may be used to support the following activities:

(1) Advancing solar thermal collectors, including concentrating solar thermal and electric systems, flat plate and evacuated tube collector performance.

(2) Achieving technical and economic integration of solar-powered distributed air-conditioning systems with existing hot water and storage systems for residential applications.

(3) Designing and demonstrating mass manufacturing capability to reduce costs of modular standardized solar-powered distributed air conditioning systems and components.

(4) Improving the efficiency of solar-powered distributed air-conditioning to increase the effectiveness of solar-powered absorption chillers, solar-driven compressors and condensers,<sup>1</sup> and cost-effective precooling approaches.

(5) Researching and comparing performance of solar-powered distributed air conditioning systems in different regions of the country, including potential integration with other onsite systems, such as solar, biogas, geothermal heat pumps, and propane assist or combined propane fuel cells, with a goal to develop site-specific energy production and management systems that ease fuel and peak utility loading.

(c) **COST SHARING.**—Section 988 of the Energy Policy Act of 2005 (42 U.S.C. 16352) shall apply to a project carried out under this section.



(d) **AUTHORIZATION OF APPROPRIATIONS.**—There are authorized to be appropriated to the Secretary for carrying out this section \$2,500,000 for each of the fiscal years 2008 through 2012.

**[SEC. 607. PHOTOVOLTAIC DEMONSTRATION PROGRAM.]**

(a) **IN GENERAL.**—The Secretary shall establish a program of grants to States to demonstrate advanced photovoltaic technology.

(b) **REQUIREMENTS.**—

(1) **ABILITY TO MEET REQUIREMENTS.**—To receive funding under the program under this section, a State must submit a proposal that demonstrates, to the satisfaction of the Secretary, that the State will meet the requirements of subsection (f).

(2) **COMPLIANCE WITH REQUIREMENTS.**—If a State has received funding under this section for the preceding year, the State must demonstrate, to the satisfaction of the Secretary, that it complied with the requirements of subsection (f) in carrying out the program during that preceding year, and that it will do so in the future, before it can receive further funding under this section.

(c) **COMPETITION.**—The Secretary shall award grants on a competitive basis to the States with the proposals the Secretary considers most likely to encourage the widespread adoption of photovoltaic technologies. The Secretary shall take into consideration the geographic distribution of awards.

(d) **PROPOSALS.**—Not later than 6 months after the date of enactment of this Act, and in each subsequent fiscal year for the life of the program, the Secretary shall solicit proposals from the States to participate in the program under this section.

(e) **COMPETITIVE CRITERIA.**—In awarding funds in a competitive allocation under subsection (c), the Secretary shall consider—

(1) the likelihood of a proposal to encourage the demonstration of, or lower the costs of, advanced photovoltaic technologies; and

(2) the extent to which a proposal is likely to—

(A) maximize the amount of photovoltaics demonstrated;

(B) maximize the proportion of non-Federal cost share;

and

(C) limit State administrative costs.

(f) **STATE PROGRAM.**—A program operated by a State with funding under this section shall provide competitive awards for the demonstration of advanced photovoltaic technologies. Each State program shall—

(1) require a contribution of at least 60 percent per award from non-Federal sources, which may include any combination of State, local, and private funds, except that at least 10 percent of the funding must be supplied by the State;

(2) endeavor to fund recipients in the commercial, industrial, institutional, governmental, and residential sectors;

(3) limit State administrative costs to no more than 10 percent of the grant;

(4) report annually to the Secretary on—

(A) the amount of funds disbursed;

(B) the amount of photovoltaics purchased; and

(C) the results of the monitoring under paragraph (5);

(5) provide for measurement and verification of the output of a representative sample of the photovoltaics systems demonstrated throughout the average working life of the systems, or at least 20 years; and

(6) require that applicant buildings must have received an independent energy efficiency audit during the 6-month period preceding the filing of the application.

(g) UNEXPENDED FUNDS.—If a State fails to expend any funds received under this section within 3 years of receipt, such remaining funds shall be returned to the Treasury.

(h) REPORTS.—The Secretary shall report to Congress 5 years after funds are first distributed to the States under this section—

(1) the amount of photovoltaics demonstrated;

(2) the number of projects undertaken;

(3) the administrative costs of the program;

(4) the results of the monitoring under subsection (f)(5); and

(5) the total amount of funds distributed, including a breakdown by State.

(i) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Secretary for the purposes of carrying out this section—

(1) \$15,000,000 for fiscal year 2008;

(2) \$30,000,000 for fiscal year 2009;

(3) \$45,000,000 for fiscal year 2010;

(4) \$60,000,000 for fiscal year 2011; and

(5) \$70,000,000 for fiscal year 2012.】

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