

GRID MODERNIZATION RESEARCH AND DEVELOPMENT ACT OF 2019

AUGUST 11, 2020.—Committed to the Committee of the Whole House on the State
of the Union and ordered to be printed

Ms. JOHNSON of Texas, from the Committee on Science, Space, and
Technology, submitted the following

R E P O R T

[To accompany H.R. 5428]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 5428) to amend the Energy Independence and Security Act of 2007 and the Energy Policy Act of 2005 to direct Federal research on grid modernization and security, and for other purposes, having considered the same, reports favorably thereon with an amendment and recommends that the bill as amended do pass.

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I. AMENDMENT

The amendment is as follows:

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the “Grid Modernization Research and Development Act of 2020”.

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

- Sec. 1. Short title; table of contents.
- Sec. 2. Smart grid regional demonstration initiative.
- Sec. 3. Smart grid modeling, visualization, architecture, and controls.
- Sec. 4. Enhancing grid resilience and emergency response.
- Sec. 5. Hybrid energy systems.
- Sec. 6. Grid integration research and development.
- Sec. 7. Industry alliance.
- Sec. 8. Coordination of efforts.
- Sec. 9. Definitions.
- Sec. 10. Technical amendments; authorization of appropriations.

SEC. 2. SMART GRID REGIONAL DEMONSTRATION INITIATIVE.

Section 1304 of the Energy Independence and Security Act of 2007 (42 U.S.C. 17384) is amended—

(1) in subsection (a), by inserting “research, development, and demonstration” before “program”;

(2) in subsection (b)—

(A) by amending paragraph (1) to read as follows:

“(1) IN GENERAL.—The Secretary shall establish a smart grid regional demonstration initiative (referred to in this subsection as the ‘Initiative’) composed of demonstration projects focused on cost-effective, advanced technologies for use in power grid sensing, communications, analysis, power flow control, visualization, distribution automation, industrial control systems, dynamic line rating systems, grid redesign, and the integration of distributed energy resources.”;

and

(B) in paragraph (2)—

(i) in subparagraph (D), by striking “and” at the end;

(ii) in subparagraph (E), by striking the period and inserting “; and”;

and

(iii) by inserting at the end the following:

“(F) to encourage the commercial application of advanced distribution automation technologies that improve system resilience.”.

SEC. 3. SMART GRID MODELING, VISUALIZATION, ARCHITECTURE, AND CONTROLS.

Title XIII of the Energy Independence and Security Act of 2007 (42 U.S.C. 17381 et seq.) is amended by inserting after section 1304 the following:

“SEC. 1304a. SMART GRID MODELING, VISUALIZATION, ARCHITECTURE, AND CONTROLS.

“(a) IN GENERAL.—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2020, the Secretary shall establish a program of research, development, demonstration, and commercial application on electric grid modeling, sensing, visualization, architecture development, and advanced operation and controls.

“(b) MODELING RESEARCH AND DEVELOPMENT.—The Secretary shall support development of models of emerging technologies and systems to facilitate the secure and reliable design, planning, and operation of the electric grid for use by industry stakeholders. In particular, the Secretary shall support development of—

“(1) models to analyze and predict the effects of adverse physical and cyber events on the electric grid;

“(2) coupled models of electrical, physical, and cyber systems;

“(3) models of existing and emerging technologies being deployed on the electric grid due to projected changes in the electric generation mix and loads, for a variety of regional characteristics; and

“(4) integrated models of the communications, transmission, distribution, and other interdependent systems for existing, new, and emerging technologies.

“(c) SITUATIONAL AWARENESS RESEARCH AND DEVELOPMENT.—

“(1) IN GENERAL.—The Secretary shall support development of computational tools and technologies to improve sensing, monitoring, and visualization of the electric grid for real-time situational awareness and decision support tools that

enable improved operation of the power system, including utility, non-utility, and customer grid-connected assets, for use by industry partners.

“(2) DATA USE.—In developing visualization capabilities under this section, the Secretary shall develop tools for industry stakeholders to use to analyze data collected from advanced measurement and monitoring technologies, including data from phasor measurement units and advanced metering units.

“(3) SEVERE EVENTS.—The Secretary shall prioritize enhancing cyber and physical situational awareness of the electric grid during adverse manmade and naturally-occurring events.

“(d) ARCHITECTURE.—The Secretary shall conduct research in collaboration with industry stakeholders to develop model grid architectures to assist with wide-area transmission and distribution planning that incorporate expected changes to the modern electric grid. In supporting the development of model grid architectures, the Secretary shall—

“(1) analyze a variety of grid architecture scenarios that range from minor upgrades to existing transmission grid infrastructure to scenarios that involve the replacement of significant portions of existing transmission grid infrastructure;

“(2) analyze the effects of the increasing proliferation of renewable and other zero emissions energy generation sources, increasing use of distributed resources owned by non-utility entities, and the use of digital and automated controls not managed by grid operators;

“(3) include a variety of new and emerging distribution grid technologies, including distributed energy resources, electric vehicle charging stations, distribution automation technologies, energy storage, and renewable energy sources;

“(4) analyze the effects of local load balancing and other forms of decentralized control;

“(5) analyze the effects of changes to grid architectures resulting from modernizing electric grid systems, including communications, controls, markets, consumer choice, emergency response, electrification, and cybersecurity concerns; and

“(6) develop integrated grid architectures that incorporate system resilience for cyber, physical, and communications systems.

“(e) OPERATION AND CONTROLS RESEARCH AND DEVELOPMENT.—The Secretary shall conduct research to develop improvements to the operation and controls of the electric grid, in coordination with industry partners. Such activities shall include—

“(1) a training facility or facilities to allow grid operators to gain operational experience with advanced grid control concepts and technologies;

“(2) development of cost-effective advanced operation and control concepts and technologies, such as adaptive islanding, dynamic line rating systems, power flow controllers, network topology optimization, smart circuit breakers, intelligent load shedding, and fault-tolerant control system architectures;

“(3) development of real-time control concepts using artificial intelligence and machine learning for improved electric grid resilience; and

“(4) utilization of advanced data analytics including load forecasting, power flow modeling, equipment failure prediction, resource optimization, risk analysis, and decision analysis.

“(f) INTEROPERABILITY RESEARCH AND DEVELOPMENT.—The Secretary shall conduct research and development on tools and technologies that improve the interoperability and compatibility of new and emerging components, technologies, and systems with existing electric grid infrastructure.

“(g) COMPUTING RESOURCES AND DATA COORDINATION RESEARCH AND DEVELOPMENT.—In carrying out this section, the Secretary shall—

“(1) leverage existing computing resources at the National Laboratories;

“(2) develop voluntary standards for data taxonomies and communication protocols in coordination with public and private sector stakeholders; and

“(3) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

“(h) INFORMATION SHARING.—None of the activities authorized in this section shall require private entities to share information or data with the Secretary.”.

SEC. 4. ENHANCING GRID RESILIENCE AND EMERGENCY RESPONSE.

Title XIII of the Energy Independence and Security Act of 2007 (42 U.S.C. 17381 et. seq.) is amended by adding at the end the following:

“SEC. 1310. GRID RESILIENCE AND EMERGENCY RESPONSE.

“(a) IN GENERAL.—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a research, development, and demonstration program to enhance resilience and strengthen emergency response and management pertaining to the electric grid.

“(b) GRANTS.—The Secretary shall award grants to eligible entities under subsection (c) on a competitive basis to conduct research and development with the purpose of improving the resilience and reliability of electric grid by—

“(1) developing methods to improve community and governmental preparation for and emergency response to large-area, long-duration electricity interruptions, including through the use of energy efficiency, storage, and distributed generation technologies;

“(2) developing tools to help utilities and communities ensure the continuous delivery of electricity to critical facilities;

“(3) developing tools to improve coordination between utilities and relevant Federal agencies to enable communication, information-sharing, and situational awareness in the event of a physical or cyber attack on the electric grid;

“(4) developing technologies and capabilities to withstand and address the current and projected impact of the changing climate on electric grid infrastructure, including extreme weather events and other natural disasters;

“(5) developing technologies capable of early detection of deteriorating electrical equipment on the transmission and distribution grid, including detection of spark ignition from wildfires and risks of vegetation contact; and

“(6) assessing upgrades and additions needed to electric grid infrastructure due to projected changes in the electricity generation mix and electricity demand.

“(c) ELIGIBLE ENTITIES.—The entities eligible to receive grants under this section include—

“(1) an institution of higher education;

“(2) a nonprofit organization;

“(3) a National Laboratory;

“(4) a unit of State, local, or tribal government;

“(5) an electric utility or electric cooperative;

“(6) a retail service provider of electricity;

“(7) a private commercial entity; and

“(8) a partnership or consortium of 2 or more entities described in subparagraphs (1) through (7).

“(d) RELEVANT ACTIVITIES.—Grants awarded under subsection (b) shall include funding for research and development activities related to the purpose described in subsection (b), such as—

“(1) development of technologies to use distributed energy resources, such as solar photovoltaics, energy storage systems, electric vehicles, and microgrids to improve grid and critical end-user resilience;

“(2) analysis of non-technical barriers to greater integration and use of technologies on the distribution grid;

“(3) analysis of past large-area, long-duration electricity interruptions to identify common elements and best practices for electricity restoration, mitigation, and prevention of future disruptions;

“(4) development of advanced monitoring, analytics, operation, and controls of electricity grid systems to improve electric grid resilience;

“(5) analysis of technologies, methods, and concepts that can improve community resilience and survivability of frequent or long-duration power outages;

“(6) development of methodologies to maintain cybersecurity during restoration of electric grid infrastructure and operation;

“(7) development of advanced power flow control systems and components to improve electric grid resilience; and

“(8) any other relevant activities determined by the Secretary.

“(e) TECHNICAL ASSISTANCE.—

“(1) IN GENERAL.—The Secretary shall provide technical assistance to eligible entities for the commercial application of technologies to improve the resilience of the electric grid and commercial application of technologies to help entities develop plans for preventing and recovering from various power outage scenarios at the local, regional, and State level.

“(2) TECHNICAL ASSISTANCE PROGRAM.—The technical assistance program established in paragraph (1) shall include assistance to eligible entities for—

“(A) the commercial application of technologies developed from the grant program established in subsection (b), including municipal and cooperative utilities;

“(B) the development of methods to strengthen or otherwise mitigate adverse impacts on electric grid infrastructure against natural hazards;

“(C) the use of Department data and modeling tools for various purposes; and

“(D) a resource assessment and analysis of future demand and distribution requirements, including development of advanced grid architectures and risk analysis.

“(3) ELIGIBLE ENTITIES.—The entities eligible to receive technical assistance for commercial application of technologies under this section include—

“(A) representatives of all sectors of the electric power industry, including electric utilities, trade organizations, and transmission and distribution system organizations, owners, and operators;

“(B) State and local governments and regulatory authorities, including public utility commissions;

“(C) tribal and Alaska Native governmental entities;

“(D) partnerships among entities under subparagraphs (A) through (C);

“(E) regional partnerships; and

“(F) any other entities the Secretary deems appropriate.

“(4) AUTHORITY.—Nothing in this section shall authorize the Secretary to require any entity to adopt any model, tool, technology, plan, analysis, or assessment.

“(f) COORDINATION.—In carrying out this section, the Secretary shall comply with section 8 of the Grid Modernization Research and Development Act of 2019.”.

SEC. 5. HYBRID ENERGY SYSTEMS.

Title XIII of the Energy Independence and Security Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is amended by adding at the end the following:

“SEC. 1311. HYBRID ENERGY SYSTEMS.

“(a) IN GENERAL.—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a research, development, and demonstration program to develop cost-effective hybrid energy systems, including—

“(1) development of computer modeling to design different configurations of hybrid energy systems and to optimize system operation;

“(2) research on system integration needed to plan, design, build, and operate hybrid energy systems, including interconnection requirements with the electric grid;

“(3) development of hybrid energy systems for various applications, including—

“(A) thermal energy generation and storage for buildings and manufacturing;

“(B) electricity storage coupled with energy generation;

“(C) desalination;

“(D) production of liquid and gaseous fuels; and

“(E) production of chemicals such as ammonia and ethylene;

“(4) development of testing facilities for hybrid energy systems; and

“(5) research on incorporation of various technologies for hybrid energy systems, including nuclear energy, renewable energy, storage, and carbon capture, utilization, and sequestration technologies.

“(b) STRATEGIC PLAN.—

“(1) IN GENERAL.—Not later than 1 year after the date of the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a strategic plan that identifies opportunities, challenges, and standards needed for the development and commercial application of hybrid energy systems. The strategic plan shall include—

“(A) analysis of the potential benefits of development of hybrid electric systems on the electric grid;

“(B) analysis of the potential contributions of hybrid energy systems to different grid architecture scenarios;

“(C) research and development goals for various hybrid energy systems, including those identified in subsection (b);

“(D) assessment of policy and market barriers to the adoption of hybrid energy systems;

“(E) analysis of the technical and economic feasibility of adoption of different hybrid energy systems; and

“(F) a 10-year roadmap to guide the program established under subsection (a).

“(2) UPDATES.—Not less than once every 3 years for the duration of this research program, the Secretary shall submit an updated version of the strategic plan to the Committee on Science, Space, and Technology of the House of Rep-

representatives and the Committee on Energy and Natural Resources of the Senate.

“(c) PROGRAM IMPLEMENTATION.—In carrying out the research, development, demonstration, and commercial application aims of section, the Secretary shall—

“(1) implement the recommendations set forth in the strategic plan in subsection (b);

“(2) coordinate across all relevant program offices at the Department, including—

“(A) the Office of Energy Efficiency and Renewable Energy;

“(B) the Office of Nuclear Energy; and

“(C) the Office of Fossil Energy;

“(3) leverage existing programs and resources of the Department;

“(4) prioritize activities that accelerate the development of integrated electricity generation, storage, and distribution systems with net zero greenhouse gas emissions; and

“(5) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

“(d) HYBRID ENERGY SYSTEM DEFINED.—The term ‘hybrid energy system’ means a system composed of 2 or more co-located or jointly operated sub-systems of energy generation, energy storage, or other energy technologies.”.

SEC. 6. GRID INTEGRATION RESEARCH AND DEVELOPMENT.

(a) INTEGRATING DISTRIBUTED ENERGY RESOURCES ONTO THE ELECTRIC GRID.—Section 925(a) of the Energy Policy Act of 2005 (42 U.S.C. 16215) is amended—

(1) by redesignating paragraphs (10) and (11) as paragraphs (12) and (13), respectively; and

(2) by inserting after paragraph (9) the following:

“(10) the development of cost-effective technologies that enable two-way information and power flow between distributed energy resources and the electric grid;

“(11) the development of technologies and concepts that enable interoperability between distributed energy resources and other behind-the-meter devices and the electric grid;”.

(b) INTEGRATING RENEWABLE ENERGY ONTO THE ELECTRIC GRID.—Subtitle C of title IX of the Energy Policy Act of 2005 (42 U.S.C. 16231 et seq.) is amended by adding at the end the following:

“SEC. 936. RESEARCH AND DEVELOPMENT INTO INTEGRATING RENEWABLE ENERGY ONTO THE ELECTRIC GRID.

“(a) IN GENERAL.—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a research, development, and demonstration program on technologies that enable integration of renewable energy generation sources onto the electric grid across multiple program offices of the Department. The program shall include—

“(1) forecasting for predicting generation from variable renewable energy sources;

“(2) development of cost-effective low-loss, long-distance transmission lines; and

“(3) development of cost-effective advanced technologies for variable renewable generation sources to provide grid services.

“(b) COORDINATION.—In carrying out this program, the Secretary shall—

“(1) coordinate across all relevant program offices at the Department to achieve the goals established in this section, including the Office of Electricity; and

“(2) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

“(c) ADOPTION OF TECHNOLOGIES.—In carrying out this section, the Secretary shall consider barriers to adoption and commercial application of technologies that enable integration of renewable energy sources onto the electric grid, including cost and other economic barriers, and shall coordinate with relevant entities to reduce these barriers.”.

(c) INTEGRATING ELECTRIC VEHICLES ONTO THE ELECTRIC GRID.—Subtitle B of title I of the Energy Independence and Security Act of 2007 (42 U.S.C. 17011 et seq.) is amended by adding at the end the following:

“SEC. 137. RESEARCH AND DEVELOPMENT INTO INTEGRATING ELECTRIC VEHICLES ONTO THE ELECTRIC GRID.

“(a) IN GENERAL.—The Secretary shall establish a research, development, and demonstration program to advance the integration of electric vehicles, including plug-in hybrid electric vehicles, onto the electric grid.

“(b) VEHICLES-TO-GRID INTEGRATION ASSESSMENT REPORT.—Not later than 1 year after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on the results of a study that examines the research, development, and demonstration opportunities, challenges, and standards needed for integrating electric vehicles onto the electric grid.

“(1) REPORT REQUIREMENTS.—The report shall include—

“(A) an evaluation of the use of electric vehicles to maintain the reliability of the electric grid, including—

“(i) the use of electric vehicles for demand response, load shaping, emergency power, and frequency regulation; and

“(ii) the potential for the reuse of spent electric vehicle batteries for stationary grid storage;

“(B) the impact of grid integration on electric vehicles, including—

“(i) the impact of bi-directional electricity flow on battery degradation; and

“(ii) the implications of the use of electric vehicles for grid services on original equipment manufacturer warranties;

“(C) the impacts to the electric grid of increased penetration of electric vehicles, including—

“(i) the distribution grid infrastructure needed to support an increase in charging capacity;

“(ii) strategies for integrating electric vehicles onto the distribution grid while limiting infrastructure upgrades;

“(iii) the changes in electricity demand over a 24-hour cycle due to electric vehicle charging behavior;

“(iv) the load increases expected from electrifying the transportation sector;

“(v) the potential for customer incentives and other managed charging stations strategies to shift charging off-peak;

“(vi) the technology needed to achieve bi-directional power flow on the distribution grid; and

“(vii) the implementation of smart charging techniques;

“(D) research on the standards needed to integrate electric vehicles with the grid, including communications systems, protocols, and charging stations, in collaboration with the National Institute for Standards and Technology;

“(E) the cybersecurity challenges and needs associated with electrifying the transportation sector; and

“(F) an assessment of the feasibility of adopting technologies developed under the program established under subsection (a) at Department facilities.

“(2) RECOMMENDATIONS.—As part of the Vehicles-to-Grid Integration Assessment Report, the Secretary shall develop a 10-year roadmap to guide the research, development, and demonstration program to integrate electric vehicles onto the electric grid.

“(3) CONSULTATION.—In developing this report, the Secretary shall consult with relevant stakeholders, including—

“(A) electric vehicle manufacturers;

“(B) electric utilities;

“(C) public utility commissions;

“(D) vehicle battery manufacturers;

“(E) electric vehicle supply equipment manufacturers;

“(F) charging infrastructure manufacturers;

“(G) the National Laboratories; and

“(H) other Federal agencies, as the Secretary determines appropriate.

“(4) UPDATES.—The Secretary shall update the report required under this section every 3 years for the duration of the program under section (a) and shall submit the updated report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

“(c) PROGRAM IMPLEMENTATION.—In carrying out the research, development, demonstration, and commercial application aims of section, the Secretary shall—

“(1) implement the recommendations set forth in the report in subsection (b);

“(2) coordinate across all relevant program offices at the Department to achieve the goals established in this section, including the Office of Electricity; and

“(3) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

“(d) TESTING CAPABILITIES.—The Secretary shall coordinate with the National Laboratories to develop testing capabilities for the evaluation, rapid prototyping, and optimization of technologies enabling integration of electric vehicles onto the electric grid.”.

(d) RESEARCH AND DEVELOPMENT ON INTEGRATING BUILDINGS ONTO THE ELECTRIC GRID.—Subtitle B of title IV of the Energy Independence and Security Act of 2007 (42 U.S.C. 17081 et seq.) is amended by adding at the end the following:

“SEC. 426. ADVANCED INTEGRATION OF BUILDINGS ONTO THE ELECTRIC GRID.

“(a) IN GENERAL.—The Secretary shall establish a program of research, development, and demonstration to enable components of commercial and residential buildings to serve as dynamic energy loads on and resources for the electric grid. The program shall focus on—

“(1) developing low-cost, low power, wireless sensors to—

“(A) monitor building energy load;

“(B) forecast building energy need; and

“(C) enable building-level energy control;

“(2) developing data management capabilities and standard communication protocols to further interoperability at the building and grid-level;

“(3) developing advanced building-level energy management of components through integration of smart technologies, control systems, and data processing, to enable energy efficiency and savings;

“(4) optimizing energy consumption at the building level to enable grid stability and resilience;

“(5) improving visualization of behind the meter equipment and technologies to provide better insight into the energy needs and energy forecasts of individual buildings;

“(6) reducing the cost of key components to accelerate the adoption of smart building technologies;

“(7) protecting against cybersecurity threats and addressing security vulnerabilities of building systems or equipment; and

“(8) other areas determined appropriate by the Secretary.

“(b) CONSIDERATIONS.—In carrying out the program under subsection (a), the Secretary shall—

“(1) work with utility partners, building owners, technology vendors, and building developers to test and validate technologies and encourage the commercial application of these technologies by building owners; and

“(2) consider the specific challenges of enabling greater interaction between components of—

“(A) small- and medium-sized buildings and the electric grid; and

“(B) residential and commercial buildings and the electric grid.

“(c) BUILDINGS-TO-GRID INTEGRATION REPORT.—Not later than one year after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on the results of a study that examines the research, development, and demonstration opportunities, challenges, and standards needed to enable components of commercial and residential buildings to serve as dynamic energy loads on and resources for the electric grid.

“(1) REPORT REQUIREMENTS.—The report shall include—

“(A) an assessment of the technologies needed to enable building components as dynamic loads on and resources for the electric grid, including how such technologies can be—

“(i) incorporated into new commercial and residential buildings; and

“(ii) retrofitted in older buildings;

“(B) guidelines for the design of new buildings and building components to enable modern grid interactivity and improve energy efficiency;

“(C) an assessment of barriers to the adoption by building owners of advanced technologies enabling greater integration of building components onto the electric grid; and

“(D) an assessment of the feasibility of adopting technologies developed under the program established under subsection (a) at Department facilities.

“(2) RECOMMENDATIONS.—As part of the report, the Secretary shall develop a 10-year roadmap to guide the research, development, and demonstration program to enable components of commercial and residential buildings to serve as dynamic energy loads on and resources for the electric grid.

“(3) UPDATES.—The Secretary shall update the report required under this section every 3 years for the duration of the program under subsection (a) and shall submit the updated report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

“(d) PROGRAM IMPLEMENTATION.—In carrying out this section, the Secretary shall—

- “(1) implement the recommendations from the report in subsection (c);
- “(2) coordinate across all relevant program offices at the Department to achieve the goals established in this section, including the Office of Electricity; and
- “(3) comply with section 8 of the Grid Modernization Research and Development Act of 2019.”.

SEC. 7. INDUSTRY ALLIANCE.

Title XIII of the Energy Independence and Security Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is amended by adding at the end the following:

“SEC. 1312. INDUSTRY ALLIANCE.

“(a) IN GENERAL.—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish an advisory committee (to be known as the ‘Industry Alliance’) to advise the Secretary on the authorization of research, development, and demonstration projects under sections 1304 and 1304a.

“(b) MEMBERSHIP.—The Industry Alliance shall be composed of members selected by the Secretary that, as a group, are broadly representative of United States electric grid research, development, infrastructure, operations, and manufacturing expertise.

“(c) RESPONSIBILITY.—The Secretary shall annually solicit from the Industry Alliance—

- “(1) comments to identify grid modernization technology needs;
- “(2) an assessment of the progress of the research activities on grid modernization; and
- “(3) assistance in annually updating grid modernization technology roadmaps.”.

SEC. 8. COORDINATION OF EFFORTS.

In carrying out the amendments made by this Act, the Secretary shall coordinate with relevant entities to the maximum extent practicable, including—

- (1) electric utilities;
- (2) private sector entities;
- (3) representatives of all sectors of the electric power industry;
- (4) transmission organizations;
- (5) transmission owners and operators;
- (6) distribution organizations;
- (7) distribution asset owners and operators;
- (8) State and local governments and regulatory authorities;
- (9) academic institutions;
- (10) the National Laboratories;
- (11) other Federal agencies;
- (12) nonprofit organizations;
- (13) the Federal Energy Regulatory Commission;
- (14) the North American Reliability Corporation;
- (15) independent system operators; and
- (16) programs and program offices at the Department.

SEC. 9. DEFINITIONS.

Title XIII of the Energy Independence and Security Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is amended by adding at the end the following:

“SEC. 1313. DEFINITIONS.

“In this title, the following definitions apply:

“(1) CRITICAL FACILITY.—The term ‘critical facility’ means a manmade structure that the Secretary determines vital to socioeconomic activities such that, if destroyed or damaged, such destruction or damage could cause substantial disruption to such socioeconomic activities.

“(2) DISTRIBUTION AUTOMATION.—The term ‘distribution automation’ means systems and technologies that exert intelligent control over electrical grid functions at the distribution level.

“(3) RESILIENCE.—The term ‘resilience’ means the ability to withstand and reduce the magnitude or duration of disruptive events, which includes the capa-

bility to anticipate, absorb, adapt to, or rapidly recover from such an event, including from deliberate attacks, accidents, and naturally occurring threats or incidents.”.

SEC. 10. TECHNICAL AMENDMENTS; AUTHORIZATION OF APPROPRIATIONS.

(a) **TECHNICAL AMENDMENTS.**—

(1) **ENERGY INDEPENDENCE AND SECURITY ACT OF 2007.**—Section 1(b) of the Energy Independence and Security Act of 2007 is amended in the table of contents—

(A) by inserting the following after the item related to section 136:

“Sec. 137. Research and development into integrating electric vehicles onto the electric grid.”;

(B) by inserting the following after the item related to section 425:

“Sec. 426. Advanced integration of buildings onto the electric grid.”;

(C) by inserting the following after the item related to section 1304:

“Sec. 1304a. Smart grid modeling, visualization, architecture, and controls.”; and

(D) by inserting the following after the item related to section 1309:

“Sec. 1310. Grid resilience and emergency response.

“Sec. 1311. Hybrid energy systems.

“Sec. 1312. Industry Alliance.

“Sec. 1313. Definitions.”.

(2) **ENERGY POLICY ACT OF 2005.**—Section 1(b) of the Energy Policy Act of 2005 is amended in the table of contents by inserting the following after the item related to section 935:

“Sec. 936. Research and development into integrating renewable energy onto the electric grid.”.

(b) **AUTHORIZATION OF APPROPRIATIONS.**—There are authorized to be appropriated—

(1) to carry out sections 7 and 8 and the amendments made by sections 2 and 3 of this Act—

- (A) \$170,000,000 for fiscal year 2020;
- (B) \$175,000,000 for fiscal year 2021;
- (C) \$180,000,000 for fiscal year 2022;
- (D) \$185,000,000 for fiscal year 2023; and
- (E) \$190,000,000 for fiscal year 2024;

(2) to carry out section 5 of this Act—

- (A) \$20,000,000 for fiscal year 2020;
- (B) \$21,000,000 for fiscal year 2021;
- (C) \$22,050,000 for fiscal year 2022;
- (D) \$23,153,000 for fiscal year 2023; and
- (E) \$24,310,000 for fiscal year 2024; and

(3) to carry out section 6 of this Act—

- (A) \$50,000,000 for fiscal year 2020;
- (B) \$52,500,000 for fiscal year 2021;
- (C) \$55,152,000 for fiscal year 2022;
- (D) \$57,882,000 for fiscal year 2023; and
- (E) \$60,775,000 for fiscal year 2024.

II. PURPOSE OF THE BILL

The purpose of the bill is to amend the Energy Independence and Security Act of 2007 and the Energy Policy Act of 2005 to direct Federal research on grid modernization and resilience. H.R. 5428 is sponsored by Mr. Lamb and co-sponsored by Ms. Herrera-Beutler, Ms. Johnson, Mr. Fitzpatrick, and Mr. McAdams.

III. BACKGROUND AND NEED FOR THE LEGISLATION

Our nation’s electricity grid is undergoing a series of transformations, which includes adapting to a changing electricity generation mix; an increase in “smart grid” technologies to help develop an intelligent electric power system; and a growing need to improve the resilience of the grid. Given this rapidly evolving landscape, the National Academies published a report in 2017 with a series of recommendations for improving the resilience of our na-

tion’s electric transmission and distribution grid infrastructure.¹ The Department of Energy (DOE) has an important role to play in the development of relevant technologies and other supporting programs to achieve these goals.

DOE’s Office of Electricity (OE) stewards our nation’s primary research programs related to grid modernization. The main mission of OE is to support grid modernization and resilience through programs that improve the planning and operational capabilities of the energy sector at both the transmission and distribution level. This includes research on a variety of technologies related to: the smart grid, demand response, microgrids, energy storage, renewable energy integration, transformer resilience, grid planning, sensor development, and power flow controllers. OE also provides technical assistance to States, regional entities, and tribes on a variety of topics to assist with the development and implementation of their electricity-related policies and handles permitting of cross-border transmission lines and coordinating Federal transmission permitting on Federal lands.

IV. COMMITTEE HEARINGS

Pursuant to Section 103 (i) of H. Res. 6, the Committee designates the following hearings as having been used to develop or consider the legislation:

On July 17, 2019 the Honorable Conor Lamb presiding, the Energy Subcommittee of the Committee on Science, Space, and Technology held a hearing to examine research needs to modernize and secure our nation’s electricity grid. Witnesses and Members discussed the extensive work done at the Department of Energy to develop technologies that improve the flexibility, resilience, and security of the electric grid, including energy storage, and the need for continued and additional investments in grid operation technology to keep up with a rapidly evolving grid system.

WITNESSES

The Honorable Karen Evans, Assistant Secretary, Office of Cybersecurity, Energy Security, and Emergency Response, U.S. Department of Energy

Mr. Juan J. Torres, Associate Laboratory Director, Energy Systems Integration, National Renewable Energy Laboratory and Co-Chair, Grid Modernization Lab Consortium

Ms. Kelly Speakes-Backman, CEO, Energy Storage Association

Ms. Katherine Hamilton, Chair, 38 North Solutions and Executive Director, Advanced Energy Management Alliance

V. COMMITTEE CONSIDERATION AND VOTES

The Energy Subcommittee of the Committee on Science, Space, and Technology met to consider H.R. 5428 on December 19, 2019.

Mr. McNerney offered an amendment that would direct the Department of Energy to analyze non-technical barriers to the greater integration and use of technologies on the distribution grid. *The amendment was agreed to by a voice vote.*

¹National Academies of Science, Engineering, and Medicine, *Enhancing the Resilience of the Nation’s Electricity System*, <https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system>.

Mr. Lamb moved that the Committee favorably report the bill, H.R. 5428, as amended, to the Full Committee with the recommendation that the bill be approved. *The motion was agreed to by a voice vote.*

The Committee on Science, Space, and Technology met to consider H.R. 5428 on February 12, 2020.

Ms. Fletcher offered an amendment that would include in the bill research and development on improving the interoperability and compatibility of new and emerging components, technologies, and systems with existing electric grid infrastructure. *The amendment was agreed to by a voice vote.*

Chairwoman Johnson moved that the Committee favorably report the bill, H.R. 5428, as amended, to the House of Representatives with the recommendation that the bill be approved. *The motion was agreed to by a voice vote.*

VI. SUMMARY OF MAJOR PROVISIONS OF THE BILL

The Grid Modernization Research and Development Act of 2019 (H.R. 5428) would authorize a research, development, demonstration, and commercial application program at the Department of Energy to improve the resilience, flexibility, and security of the electric grid. The bill also authorizes an industry alliance to assist the Secretary with identifying research needs, assessing progress on research activities, and updating relevant technology roadmaps.

VII. SECTION-BY-SECTION ANALYSIS (BY TITLE AND SECTION)

Sec. 1. Short title; Table of contents

“Grid Modernization Research and Development Act of 2019”

Sec. 2. Smart grid regional demonstration initiative

Reauthorizes the smart grid demonstration program in the Energy Independence and Security Act of 2007 and adds the commercial application of distribution automation technologies to the goals of the program.

Sec. 3. Smart grid modeling, visualization, architecture, and controls

Authorizes a research, development, demonstration, and commercial application program on modeling emerging technologies and systems for secure and reliable design and planning of the grid; technologies to improve sensing, monitoring, and visualization of the grid; development of grid architectures for a modern grid; and operation and controls of the grid.

Sec. 4. Enhancing grid resilience and emergency response

This section authorizes a research, development, and demonstration program on methods, tools, and technologies to improve grid resilience, grid reliability, and emergency response, including technologies to detect sparks causing wildfires and assessments to determine necessary grid infrastructure upgrades. This section also authorizes a technical assistance program for eligible entities to develop plans for preventing and recovering from various power outage scenarios.

Sec. 5. Hybrid energy systems

Authorizes a research, development, and demonstration program to develop cost-effective hybrid energy systems incorporating a variety of technologies, including nuclear energy, renewable energy, storage, and carbon capture and directs the Secretary to submit a 10-year strategic plan on hybrid energy systems.

Sec. 6. Grid integration research and development

Authorizes research, development, and demonstration activities relating to integrating renewable energy, electric vehicles, and buildings onto the electric grid.

Sec. 7. Industry alliance

Directs the Secretary to establish an industry alliance that is broadly representative of the U.S. electric grid research and development, infrastructure, operations, and manufacturing expertise to assist the Secretary with identifying research and development needs, assessing progress on research and development activities, and updating technology roadmaps.

Sec. 8. Coordination of efforts

Directs the Secretary to coordinate with relevant entities on the activities authorized in this Act, including electric utilities, transmission organizations, distributions owners and operators, the national labs, among other entities.

Sec. 9. Definitions

Defines terms used in the bill.

Sec. 10. Technical amendments; authorization of appropriations

Makes technical amendments to existing statute and authorizes the following amounts for appropriations: for sections 2, 3, 7, and 8, \$170 million in fiscal year 2020, with \$5 million annual funding increases through fiscal year 2024; for section 5, \$20 million in fiscal year 2020, with 5% annual funding increases through fiscal year 2024; and for section 6, \$50 million in fiscal year 2020 with 5% annual funding increases through fiscal year 2024.

VIII. COMMITTEE VIEWS

The Committee intends that the research, development, demonstration, and commercial application program authorized in this legislation be carried out with significant coordination with the public and private sector to ensure that the tools and technologies developed under this program are of use to relevant stakeholders, and that the industry alliance authorized in this legislation aid in achieving this goal. Furthermore, the Committee intends that the Department of Energy coordinate across all relevant program offices in carrying out research on grid integration and hybrid energy systems, given the cross-cutting nature of these research programs, and utilize the work of the national laboratories through the Grid Modernization Laboratory Consortium. Lastly, when analyzing non-technical barriers to greater integration and use of technologies developed under the authorities granted in this bill, the

Committee intends that this includes the analysis of contractual and regulatory barriers.

IX. COST ESTIMATE

Pursuant to clause 3(c)(2) of rule XIII of the Rules of the House of Representatives, the Committee adopts as its own the estimate of new budget authority, entitlement authority, or tax expenditures or revenues contained in the cost estimate prepared by the Director of the Congressional Budget Office pursuant to section 402 of the Congressional Budget Act of 1974.

X. CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, DC, June 1, 2020.

Hon. EDDIE BERNICE JOHNSON,
*Chairwoman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.*

Dear MADAM CHAIRWOMAN: The Congressional Budget Office has prepared the enclosed cost estimate for H.R. 5428, the Grid Modernization Research and Development Act of 2019.

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

Sincerely,

PHILLIP L. SWAGEL,
Director.

Enclosure.

H.R. 5428, Grid Modernization Research and Development Act of 2019			
As ordered reported by the House Committee on Science, Space, and Technology on February 12, 2020			
By Fiscal Year, Millions of Dollars	2020	2020-2025	2020-2030
Direct Spending (Outlays)	0	0	0
Revenues	0	0	0
Increase or Decrease (-) in the Deficit	0	0	0
Spending Subject to Appropriation (Outlays)	37	1,223	not estimated
Statutory pay-as-you-go procedures apply?	No	Mandate Effects	
Increases on-budget deficits in any of the four consecutive 10-year periods beginning in 2031?	No	Contains intergovernmental mandate?	No
		Contains private-sector mandate?	No

H.R. 5428 would require the Department of Energy (DOE) to administer several research, development, and demonstration grant programs aimed at modernizing the electric grid, including smart grid modeling, developing hybrid energy systems, and technologies to integrate electric vehicles onto the electric grid. The bill also would require DOE to provide technical assistance to grant recipients, establish an advisory committee, and report to the Congress.

CBO estimates that implementing H.R. 5428 would cost about \$1.2 billion over the 2020–2025 period.

For this estimate, CBO assumes that the bill will be enacted in fiscal year 2020 and that the authorized and estimated amounts will be appropriated each year. Estimated outlays are based on historical spending patterns for similar activities. The bill would authorize the appropriation of specific amounts each year over the 2020–2024 period for most of the activities in the bill, but does not specify an amount for section 4 for activities related to grid resilience. Using information from DOE, CBO estimates that the department allocated \$57 million in 2020 for research and development activities on grid resilience that are similar to the activities authorized under section 4. CBO estimates that the department would need about the same amount each year, adjusted for inflation, to continue grid resilience activities, over the 2021–2025 period.

The costs of the legislation (detailed in Table 1) fall under budget function 270 (energy).

TABLE 1.—ESTIMATED INCREASES IN SPENDING SUBJECT TO APPROPRIATION UNDER H.R. 5428

	By fiscal year, millions of dollars—						2020– 2025
	2020	2021	2022	2023	2024	2025	
Grid Initiatives and R&D:							
Authorization	170	175	180	185	190	0	900
Estimated Outlays	37	95	136	164	178	145	755
Hybrid Energy Systems:							
Authorization ^a	0	21	22	23	24	0	90
Estimated Outlays	0	5	12	17	21	18	73
Grid Integration R&D:							
Authorization ^a	0	53	55	58	61	0	227
Estimated Outlays	0	11	29	43	52	44	179
Grid Resilience R&D:							
Estimated Authorization	0	59	62	64	66	69	320
Estimated Outlays	0	13	33	48	58	64	216
Total Changes:							
Estimated Authorization	170	308	319	330	341	69	1,537
Estimated Outlays	37	124	210	272	309	271	1,223

^a Components may not sum totals because of rounding; R&D = Research and Development.

^a In 2020, H.R. 5428 would authorize the appropriation of \$20 million for hybrid energy systems programs and \$50 million for grid integration R&D programs. Using information from budget justification documents for the Department of Energy, CBO estimates that \$41 million and \$84 million, respectively, have already been allocated to similar activities under the 2020 annual appropriation. Because those amounts are greater than the amounts authorized in the bill, CBO does not show any authorization for those programs in 2020.

The CBO staff contact for this estimate is Sofia Guo. The estimate was reviewed by H. Samuel Papenfuss, Deputy Director of Budget Analysis.

XI. FEDERAL MANDATES STATEMENT

H.R. 5428 contains no unfunded mandates.

XII. COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

The Committee’s oversight findings and recommendations are reflected in the body of this report.

XIII. STATEMENT ON GENERAL PERFORMANCE GOALS AND OBJECTIVES

Pursuant to clause (3)(c) of House rule XIII, the goals of H.R. 5428 are to direct Federal research on grid modernization, including smart grid demonstration regional projects; modeling, visualization, architecture, and controls; grid resilience and emergency response; hybrid energy systems; and grid integration.

XIV. FEDERAL ADVISORY COMMITTEE STATEMENT

The functions of the advisory committee authorized in H.R. 5428 are not currently being nor could they be performed by one or more agencies or by enlarging the mandate of another existing advisory committee.

XV. DUPLICATION OF FEDERAL PROGRAMS

Pursuant to clause 3(c)(5) of rule XIII of the Rules of the House of Representatives, the Committee finds that no provision of H.R. 5428 establishes or reauthorizes a program of the federal government known to be duplicative of another federal program, including any program that was included in a report to Congress pursuant to section 21 of Public Law 111–139 or the most recent Catalog of Federal Domestic Assistance.

XVI. EARMARK IDENTIFICATION

Pursuant to clause 9(e), 9(f), and 9(g) of rule XXI, the Committee finds that H.R. 5428 contains no earmarks, limited tax benefits, or limited tariff benefits.

XVII. APPLICABILITY TO THE LEGISLATIVE BRANCH

The Committee finds that H.R. 5428 does not relate to the terms and conditions of employment or access to public services or accommodations within the meaning of section 102(b)(3) of the Congressional Accountability Act (Public Law 104–1).

XVIII. STATEMENT ON PREEMPTION OF STATE, LOCAL, OR TRIBAL LAW

This bill is not intended to preempt any state, local, or tribal law.

XIX. CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

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

ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the “Energy Independence and Security Act of 2007”.

(b) TABLE OF CONTENTS.—The table of contents of this Act is as follows:

Sec. 1. Short title; table of contents.

* * * * *

TITLE I—ENERGY SECURITY THROUGH IMPROVED VEHICLE FUEL ECONOMY

* * * * *

Subtitle B—Improved Vehicle Technology

* * * * *

Sec. 137. Research and development into integrating electric vehicles onto the electric grid.

* * * * *

TITLE IV—ENERGY SAVINGS IN BUILDINGS AND INDUSTRY

* * * * *

Subtitle B—High-Performance Commercial Buildings

* * * * *

Sec. 426. Advanced integration of buildings onto the electric grid.

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TITLE XIII—SMART GRID

* * * * *

Sec. 1304a. Smart grid modeling, visualization, architecture, and controls.

* * * * *

Sec. 1310. Grid resilience and emergency response.

Sec. 1311. Hybrid energy systems.

Sec. 1312. Industry Alliance.

Sec. 1313. Definitions.

* * * * *

TITLE I—ENERGY SECURITY THROUGH IMPROVED VEHICLE FUEL ECONOMY

* * * * *

Subtitle B—Improved Vehicle Technology

* * * * *

SEC. 137. RESEARCH AND DEVELOPMENT INTO INTEGRATING ELECTRIC VEHICLES ONTO THE ELECTRIC GRID.

(a) *IN GENERAL.*—The Secretary shall establish a research, development, and demonstration program to advance the integration of electric vehicles, including plug-in hybrid electric vehicles, onto the electric grid.

(b) *VEHICLES-TO-GRID INTEGRATION ASSESSMENT REPORT.*—Not later than 1 year after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall submit to

the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on the results of a study that examines the research, development, and demonstration opportunities, challenges, and standards needed for integrating electric vehicles onto the electric grid.

(1) REPORT REQUIREMENTS.—The report shall include—

(A) an evaluation of the use of electric vehicles to maintain the reliability of the electric grid, including—

(i) the use of electric vehicles for demand response, load shaping, emergency power, and frequency regulation; and

(ii) the potential for the reuse of spent electric vehicle batteries for stationary grid storage;

(B) the impact of grid integration on electric vehicles, including—

(i) the impact of bi-directional electricity flow on battery degradation; and

(ii) the implications of the use of electric vehicles for grid services on original equipment manufacturer warranties;

(C) the impacts to the electric grid of increased penetration of electric vehicles, including—

(i) the distribution grid infrastructure needed to support an increase in charging capacity;

(ii) strategies for integrating electric vehicles onto the distribution grid while limiting infrastructure upgrades;

(iii) the changes in electricity demand over a 24-hour cycle due to electric vehicle charging behavior;

(iv) the load increases expected from electrifying the transportation sector;

(v) the potential for customer incentives and other managed charging stations strategies to shift charging off-peak;

(vi) the technology needed to achieve bi-directional power flow on the distribution grid; and

(vii) the implementation of smart charging techniques;

(D) research on the standards needed to integrate electric vehicles with the grid, including communications systems, protocols, and charging stations, in collaboration with the National Institute for Standards and Technology;

(E) the cybersecurity challenges and needs associated with electrifying the transportation sector; and

(F) an assessment of the feasibility of adopting technologies developed under the program established under subsection (a) at Department facilities.

(2) RECOMMENDATIONS.—As part of the Vehicles-to-Grid Integration Assessment Report, the Secretary shall develop a 10-year roadmap to guide the research, development, and demonstration program to integrate electric vehicles onto the electric grid.

(3) CONSULTATION.—In developing this report, the Secretary shall consult with relevant stakeholders, including—

- (A) electric vehicle manufacturers;
- (B) electric utilities;
- (C) public utility commissions;
- (D) vehicle battery manufacturers;
- (E) electric vehicle supply equipment manufacturers;
- (F) charging infrastructure manufacturers;
- (G) the National Laboratories; and
- (H) other Federal agencies, as the Secretary determines appropriate.

(4) **UPDATES.**—The Secretary shall update the report required under this section every 3 years for the duration of the program under section (a) and shall submit the updated report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

(c) **PROGRAM IMPLEMENTATION.**—In carrying out the research, development, demonstration, and commercial application aims of section, the Secretary shall—

(1) implement the recommendations set forth in the report in subsection (b);

(2) coordinate across all relevant program offices at the Department to achieve the goals established in this section, including the Office of Electricity; and

(3) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

(d) **TESTING CAPABILITIES.**—The Secretary shall coordinate with the National Laboratories to develop testing capabilities for the evaluation, rapid prototyping, and optimization of technologies enabling integration of electric vehicles onto the electric grid.

* * * * *

TITLE IV—ENERGY SAVINGS IN BUILDINGS AND INDUSTRY

* * * * *

Subtitle B—High-Performance Commercial Buildings

* * * * *

SEC. 426. ADVANCED INTEGRATION OF BUILDINGS ONTO THE ELECTRIC GRID.

(a) **IN GENERAL.**—The Secretary shall establish a program of research, development, and demonstration to enable components of commercial and residential buildings to serve as dynamic energy loads on and resources for the electric grid. The program shall focus on—

- (1) developing low-cost, low power, wireless sensors to—
 - (A) monitor building energy load;
 - (B) forecast building energy need; and
 - (C) enable building-level energy control;

(2) *developing data management capabilities and standard communication protocols to further interoperability at the building and grid-level;*

(3) *developing advanced building-level energy management of components through integration of smart technologies, control systems, and data processing, to enable energy efficiency and savings;*

(4) *optimizing energy consumption at the building level to enable grid stability and resilience;*

(5) *improving visualization of behind the meter equipment and technologies to provide better insight into the energy needs and energy forecasts of individual buildings;*

(6) *reducing the cost of key components to accelerate the adoption of smart building technologies;*

(7) *protecting against cybersecurity threats and addressing security vulnerabilities of building systems or equipment; and*

(8) *other areas determined appropriate by the Secretary.*

(b) *CONSIDERATIONS.—In carrying out the program under subsection (a), the Secretary shall—*

(1) *work with utility partners, building owners, technology vendors, and building developers to test and validate technologies and encourage the commercial application of these technologies by building owners; and*

(2) *consider the specific challenges of enabling greater interaction between components of—*

(A) *small- and medium-sized buildings and the electric grid; and*

(B) *residential and commercial buildings and the electric grid.*

(c) *BUILDINGS-TO-GRID INTEGRATION REPORT.—Not later than one year after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on the results of a study that examines the research, development, and demonstration opportunities, challenges, and standards needed to enable components of commercial and residential buildings to serve as dynamic energy loads on and resources for the electric grid.*

(1) *REPORT REQUIREMENTS.—The report shall include—*

(A) *an assessment of the technologies needed to enable building components as dynamic loads on and resources for the electric grid, including how such technologies can be—*

(i) *incorporated into new commercial and residential buildings; and*

(ii) *retrofitted in older buildings;*

(B) *guidelines for the design of new buildings and building components to enable modern grid interactivity and improve energy efficiency;*

(C) *an assessment of barriers to the adoption by building owners of advanced technologies enabling greater integration of building components onto the electric grid; and*

(D) *an assessment of the feasibility of adopting technologies developed under the program established under subsection (a) at Department facilities.*

(2) *RECOMMENDATIONS.*—As part of the report, the Secretary shall develop a 10-year roadmap to guide the research, development, and demonstration program to enable components of commercial and residential buildings to serve as dynamic energy loads on and resources for the electric grid.

(3) *UPDATES.*—The Secretary shall update the report required under this section every 3 years for the duration of the program under subsection (a) and shall submit the updated report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

(d) *PROGRAM IMPLEMENTATION.*—In carrying out this section, the Secretary shall—

(1) implement the recommendations from the report in subsection (c);

(2) coordinate across all relevant program offices at the Department to achieve the goals established in this section, including the Office of Electricity; and

(3) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

* * * * *

TITLE XIII—SMART GRID

* * * * *

SEC. 1304. SMART GRID TECHNOLOGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION.

(a) *POWER GRID DIGITAL INFORMATION TECHNOLOGY.*—The Secretary, in consultation with the Federal Energy Regulatory Commission and other appropriate agencies, electric utilities, the States, and other stakeholders, shall carry out a *research, development, and demonstration* program—

(1) to develop advanced techniques for measuring peak load reductions and energy-efficiency savings from smart metering, demand response, distributed generation, and electricity storage systems;

(2) to investigate means for demand response, distributed generation, and storage to provide ancillary services;

(3) to conduct research to advance the use of wide-area measurement and control networks, including data mining, visualization, advanced computing, and secure and dependable communications in a highly-distributed environment;

(4) to test new reliability technologies, including those concerning communications network capabilities, in a grid control room environment against a representative set of local outage and wide area blackout scenarios;

(5) to identify communications network capacity needed to implement advanced technologies.

(6) to investigate the feasibility of a transition to time-of-use and real-time electricity pricing;

(7) to develop algorithms for use in electric transmission system software applications;

(8) to promote the use of underutilized electricity generation capacity in any substitution of electricity for liquid fuels in the transportation system of the United States; and

(9) in consultation with the Federal Energy Regulatory Commission, to propose interconnection protocols to enable electric utilities to access electricity stored in vehicles to help meet peak demand loads.

(b) SMART GRID REGIONAL DEMONSTRATION INITIATIVE.—

【(1) IN GENERAL.—The Secretary shall establish a smart grid regional demonstration initiative (referred to in this subsection as the “Initiative”) composed of demonstration projects specifically focused on advanced technologies for use in power grid sensing, communications, analysis, and power flow control. The Secretary shall seek to leverage existing smart grid deployments.】

(1) IN GENERAL.—The Secretary shall establish a smart grid regional demonstration initiative (referred to in this subsection as the “Initiative”) composed of demonstration projects focused on cost-effective, advanced technologies for use in power grid sensing, communications, analysis, power flow control, visualization, distribution automation, industrial control systems, dynamic line rating systems, grid redesign, and the integration of distributed energy resources.

(2) GOALS.—The goals of the Initiative shall be—

(A) to demonstrate the potential benefits of concentrated investments in advanced grid technologies on a regional grid;

(B) to facilitate the commercial transition from the current power transmission and distribution system technologies to advanced technologies;

(C) to facilitate the integration of advanced technologies in existing electric networks to improve system performance, power flow control, and reliability;

(D) to demonstrate protocols and standards that allow for the measurement and validation of the energy savings and fossil fuel emission reductions associated with the installation and use of energy efficiency and demand response technologies and practices; **【and】**

(E) to investigate differences in each region and regulatory environment regarding best practices in implementing smart grid technologies**【.】**; *and*

(F) to encourage the commercial application of advanced distribution automation technologies that improve system resilience.

(3) DEMONSTRATION PROJECTS.—

(A) IN GENERAL.—In carrying out the initiative, the Secretary shall provide financial support to smart grid demonstration projects in urban, suburban, tribal, and rural areas, including areas where electric system assets are controlled by nonprofit entities and areas where electric system assets are controlled by investor-owned utilities.

(B) COOPERATION.—A demonstration project under subparagraph (A) shall be carried out in cooperation with the electric utility that owns the grid facilities in the elec-

tricity control area in which the demonstration project is carried out.

(C) **FEDERAL SHARE OF COST OF TECHNOLOGY INVESTMENTS.**—The Secretary shall provide to an electric utility described in subparagraph (B) or to other parties financial assistance for use in paying an amount equal to not more than 50 percent of the cost of qualifying advanced grid technology investments made by the electric utility or other party to carry out a demonstration project.

(D) **INELIGIBILITY FOR GRANTS.**—No person or entity participating in any demonstration project conducted under this subsection shall be eligible for grants under section 1306 for otherwise qualifying investments made as part of that demonstration project.

(E) **AVAILABILITY OF DATA.**—The Secretary shall establish and maintain a smart grid information clearinghouse in a timely manner which will make data from smart grid demonstration projects and other sources available to the public. As a condition of receiving financial assistance under this subsection, a utility or other participant in a smart grid demonstration project shall provide such information as the Secretary may require to become available through the smart grid information clearinghouse in the form and within the timeframes as directed by the Secretary. The Secretary shall assure that business proprietary information and individual customer information is not included in the information made available through the clearinghouse.

(F) **OPEN PROTOCOLS AND STANDARDS.**—The Secretary shall require as a condition of receiving funding under this subsection that demonstration projects utilize open protocols and standards (including Internet-based protocols and standards) if available and appropriate.

(c) **AUTHORIZATION OF APPROPRIATIONS.**—There are authorized to be appropriated—

(1) to carry out subsection (a), such sums as are necessary for each of fiscal years 2008 through 2012; and

(2) to carry out subsection (b), such sums as may be necessary.

* * * * *

SEC. 1304a. SMART GRID MODELING, VISUALIZATION, ARCHITECTURE, AND CONTROLS.

(a) *IN GENERAL.*—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a program of research, development, demonstration, and commercial application on electric grid modeling, sensing, visualization, architecture development, and advanced operation and controls.

(b) *MODELING RESEARCH AND DEVELOPMENT.*—The Secretary shall support development of models of emerging technologies and systems to facilitate the secure and reliable design, planning, and operation of the electric grid for use by industry stakeholders. In particular, the Secretary shall support development of—

(1) *models to analyze and predict the effects of adverse physical and cyber events on the electric grid;*

(2) *coupled models of electrical, physical, and cyber systems;*

(3) *models of existing and emerging technologies being deployed on the electric grid due to projected changes in the electric generation mix and loads, for a variety of regional characteristics; and*

(4) *integrated models of the communications, transmission, distribution, and other interdependent systems for existing, new, and emerging technologies.*

(c) **SITUATIONAL AWARENESS RESEARCH AND DEVELOPMENT.**—

(1) **IN GENERAL.**—*The Secretary shall support development of computational tools and technologies to improve sensing, monitoring, and visualization of the electric grid for real-time situational awareness and decision support tools that enable improved operation of the power system, including utility, non-utility, and customer grid-connected assets, for use by industry partners.*

(2) **DATA USE.**—*In developing visualization capabilities under this section, the Secretary shall develop tools for industry stakeholders to use to analyze data collected from advanced measurement and monitoring technologies, including data from phasor measurement units and advanced metering units.*

(3) **SEVERE EVENTS.**—*The Secretary shall prioritize enhancing cyber and physical situational awareness of the electric grid during adverse manmade and naturally-occurring events.*

(d) **ARCHITECTURE.**—*The Secretary shall conduct research in collaboration with industry stakeholders to develop model grid architectures to assist with wide-area transmission and distribution planning that incorporate expected changes to the modern electric grid. In supporting the development of model grid architectures, the Secretary shall—*

(1) *analyze a variety of grid architecture scenarios that range from minor upgrades to existing transmission grid infrastructure to scenarios that involve the replacement of significant portions of existing transmission grid infrastructure;*

(2) *analyze the effects of the increasing proliferation of renewable and other zero emissions energy generation sources, increasing use of distributed resources owned by non-utility entities, and the use of digital and automated controls not managed by grid operators;*

(3) *include a variety of new and emerging distribution grid technologies, including distributed energy resources, electric vehicle charging stations, distribution automation technologies, energy storage, and renewable energy sources;*

(4) *analyze the effects of local load balancing and other forms of decentralized control;*

(5) *analyze the effects of changes to grid architectures resulting from modernizing electric grid systems, including communications, controls, markets, consumer choice, emergency response, electrification, and cybersecurity concerns; and*

(6) *develop integrated grid architectures that incorporate system resilience for cyber, physical, and communications systems.*

(e) **OPERATION AND CONTROLS RESEARCH AND DEVELOPMENT.**—*The Secretary shall conduct research to develop improvements to the*

operation and controls of the electric grid, in coordination with industry partners. Such activities shall include—

(1) a training facility or facilities to allow grid operators to gain operational experience with advanced grid control concepts and technologies;

(2) development of cost-effective advanced operation and control concepts and technologies, such as adaptive islanding, dynamic line rating systems, power flow controllers, network topology optimization, smart circuit breakers, intelligent load shedding, and fault-tolerant control system architectures;

(3) development of real-time control concepts using artificial intelligence and machine learning for improved electric grid resilience; and

(4) utilization of advanced data analytics including load forecasting, power flow modeling, equipment failure prediction, resource optimization, risk analysis, and decision analysis.

(f) **INTEROPERABILITY RESEARCH AND DEVELOPMENT.**—The Secretary shall conduct research and development on tools and technologies that improve the interoperability and compatibility of new and emerging components, technologies, and systems with existing electric grid infrastructure.

(g) **COMPUTING RESOURCES AND DATA COORDINATION RESEARCH AND DEVELOPMENT.**—In carrying out this section, the Secretary shall—

(1) leverage existing computing resources at the National Laboratories;

(2) develop voluntary standards for data taxonomies and communication protocols in coordination with public and private sector stakeholders; and

(3) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

(h) **INFORMATION SHARING.**—None of the activities authorized in this section shall require private entities to share information or data with the Secretary.

* * * * *

SEC. 1310. GRID RESILIENCE AND EMERGENCY RESPONSE.

(a) **IN GENERAL.**—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a research, development, and demonstration program to enhance resilience and strengthen emergency response and management pertaining to the electric grid.

(b) **GRANTS.**—The Secretary shall award grants to eligible entities under subsection (c) on a competitive basis to conduct research and development with the purpose of improving the resilience and reliability of electric grid by—

(1) developing methods to improve community and governmental preparation for and emergency response to large-area, long-duration electricity interruptions, including through the use of energy efficiency, storage, and distributed generation technologies;

(2) developing tools to help utilities and communities ensure the continuous delivery of electricity to critical facilities;

(3) developing tools to improve coordination between utilities and relevant Federal agencies to enable communication, infor-

mation-sharing, and situational awareness in the event of a physical or cyber attack on the electric grid;

(4) developing technologies and capabilities to withstand and address the current and projected impact of the changing climate on electric grid infrastructure, including extreme weather events and other natural disasters;

(5) developing technologies capable of early detection of deteriorating electrical equipment on the transmission and distribution grid, including detection of spark ignition from wildfires and risks of vegetation contact; and

(6) assessing upgrades and additions needed to electric grid infrastructure due to projected changes in the electricity generation mix and electricity demand.

(c) **ELIGIBLE ENTITIES.**—The entities eligible to receive grants under this section include—

(1) an institution of higher education;

(2) a nonprofit organization;

(3) a National Laboratory;

(4) a unit of State, local, or tribal government;

(5) an electric utility or electric cooperative;

(6) a retail service provider of electricity;

(7) a private commercial entity;

(8) a partnership or consortium of 2 or more entities described in subparagraphs (1) through (7).

(d) **RELEVANT ACTIVITIES.**—Grants awarded under subsection (b) shall include funding for research and development activities related to the purpose described in subsection (b), such as—

(1) development of technologies to use distributed energy resources, such as solar photovoltaics, energy storage systems, electric vehicles, and microgrids to improve grid and critical end-user resilience;

(2) analysis of non-technical barriers to greater integration and use of technologies on the distribution grid;

(3) analysis of past large-area, long-duration electricity interruptions to identify common elements and best practices for electricity restoration, mitigation, and prevention of future disruptions;

(4) development of advanced monitoring, analytics, operation, and controls of electricity grid systems to improve electric grid resilience;

(5) analysis of technologies, methods, and concepts that can improve community resilience and survivability of frequent or long-duration power outages;

(6) development of methodologies to maintain cybersecurity during restoration of electric grid infrastructure and operation;

(7) development of advanced power flow control systems and components to improve electric grid resilience; and

(8) any other relevant activities determined by the Secretary.

(e) **TECHNICAL ASSISTANCE.**—

(1) **IN GENERAL.**—The Secretary shall provide technical assistance to eligible entities for the commercial application of technologies to improve the resilience of the electric grid and commercial application of technologies to help entities develop plans for preventing and recovering from various power outage scenarios at the local, regional, and State level.

(2) *TECHNICAL ASSISTANCE PROGRAM.*—The technical assistance program established in paragraph (1) shall include assistance to eligible entities for—

(A) the commercial application of technologies developed from the grant program established in subsection (b), including municipal and cooperative utilities;

(B) the development of methods to strengthen or otherwise mitigate adverse impacts on electric grid infrastructure against natural hazards;

(C) the use of Department data and modeling tools for various purposes; and

(D) a resource assessment and analysis of future demand and distribution requirements, including development of advanced grid architectures and risk analysis.

(3) *ELIGIBLE ENTITIES.*—The entities eligible to receive technical assistance for commercial application of technologies under this section include—

(A) representatives of all sectors of the electric power industry, including electric utilities, trade organizations, and transmission and distribution system organizations, owners, and operators;

(B) State and local governments and regulatory authorities, including public utility commissions;

(C) tribal and Alaska Native governmental entities;

(D) partnerships among entities under subparagraphs (A) through (C);

(E) regional partnerships; and

(F) any other entities the Secretary deems appropriate.

(4) *AUTHORITY.*—Nothing in this section shall authorize the Secretary to require any entity to adopt any model, tool, technology, plan, analysis, or assessment.

(f) *COORDINATION.*—In carrying out this section, the Secretary shall comply with section 8 of the Grid Modernization Research and Development Act of 2019.

SEC. 1311. HYBRID ENERGY SYSTEMS.

(a) *IN GENERAL.*—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a research, development, and demonstration program to develop cost-effective hybrid energy systems, including—

(1) development of computer modeling to design different configurations of hybrid energy systems and to optimize system operation;

(2) research on system integration needed to plan, design, build, and operate hybrid energy systems, including interconnection requirements with the electric grid;

(3) development of hybrid energy systems for various applications, including—

(A) thermal energy generation and storage for buildings and manufacturing;

(B) electricity storage coupled with energy generation;

(C) desalination;

(D) production of liquid and gaseous fuels; and

(E) production of chemicals such as ammonia and ethylene;

(4) development of testing facilities for hybrid energy systems; and

(5) research on incorporation of various technologies for hybrid energy systems, including nuclear energy, renewable energy, storage, and carbon capture, utilization, and sequestration technologies.

(b) **STRATEGIC PLAN.**—

(1) **IN GENERAL.**—Not later than 1 year after the date of the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a strategic plan that identifies opportunities, challenges, and standards needed for the development and commercial application of hybrid energy systems. The strategic plan shall include—

(A) analysis of the potential benefits of development of hybrid electric systems on the electric grid;

(B) analysis of the potential contributions of hybrid energy systems to different grid architecture scenarios;

(C) research and development goals for various hybrid energy systems, including those identified in subsection (b);

(D) assessment of policy and market barriers to the adoption of hybrid energy systems;

(E) analysis of the technical and economic feasibility of adoption of different hybrid energy systems; and

(F) a 10-year roadmap to guide the program established under subsection (a).

(2) **UPDATES.**—Not less than once every 3 years for the duration of this research program, the Secretary shall submit an updated version of the strategic plan to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

(c) **PROGRAM IMPLEMENTATION.**—In carrying out the research, development, demonstration, and commercial application aims of section, the Secretary shall—

(1) implement the recommendations set forth in the strategic plan in subsection (b);

(2) coordinate across all relevant program offices at the Department, including—

(A) the Office of Energy Efficiency and Renewable Energy;

(B) the Office of Nuclear Energy; and

(C) the Office of Fossil Energy;

(3) leverage existing programs and resources of the Department;

(4) prioritize activities that accelerate the development of integrated electricity generation, storage, and distribution systems with net zero greenhouse gas emissions; and

(5) comply with section 8 of the Grid Modernization Research and Development Act of 2019.

(d) **HYBRID ENERGY SYSTEM DEFINED.**—The term “hybrid energy system” means a system composed of 2 or more co-located or jointly operated sub-systems of energy generation, energy storage, or other energy technologies.

SEC. 1312. INDUSTRY ALLIANCE.

(a) *IN GENERAL.*—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish an advisory committee (to be known as the “Industry Alliance”) to advise the Secretary on the authorization of research, development, and demonstration projects under sections 1304 and 1304a.

(b) *MEMBERSHIP.*—The Industry Alliance shall be composed of members selected by the Secretary that, as a group, are broadly representative of United States electric grid research, development, infrastructure, operations, and manufacturing expertise.

(c) *RESPONSIBILITY.*—The Secretary shall annually solicit from the Industry Alliance—

- (1) comments to identify grid modernization technology needs;
- (2) an assessment of the progress of the research activities on grid modernization; and
- (3) assistance in annually updating grid modernization technology roadmaps.

SEC. 1313. DEFINITIONS.

In this title, the following definitions apply:

(1) *CRITICAL FACILITY.*—The term “critical facility” means a manmade structure that the Secretary determines vital to socioeconomic activities such that, if destroyed or damaged, such destruction or damage could cause substantial disruption to such socioeconomic activities.

(2) *DISTRIBUTION AUTOMATION.*—The term “distribution automation” means systems and technologies that exert intelligent control over electrical grid functions at the distribution level.

(3) *RESILIENCE.*—The term “resilience” means the ability to withstand and reduce the magnitude or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, or rapidly recover from such an event, including from deliberate attacks, accidents, and naturally occurring threats or incidents.

* * * * *

ENERGY POLICY ACT OF 2005

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) *SHORT TITLE.*—This Act may be cited as the “Energy Policy Act of 2005”.

(b) *TABLE OF CONTENTS.*—The table of contents for this Act is as follows:

Sec. 1. Short title; table of contents.

* * * * *

TITLE IX—RESEARCH AND DEVELOPMENT

* * * * *

Subtitle C—Renewable Energy

* * * * *

Sec. 936. Research and development into integrating renewable energy onto the electric grid.

* * * * *

TITLE IX—RESEARCH AND DEVELOPMENT

* * * * *

Subtitle B—Distributed Energy and Electric Energy Systems

* * * * *

SEC. 925. ELECTRIC TRANSMISSION AND DISTRIBUTION PROGRAMS.

(a) PROGRAM.—The Secretary shall establish a comprehensive research, development, and demonstration program to ensure the reliability, efficiency, and environmental integrity of electrical transmission and distribution systems, which shall include—

(1) advanced energy delivery technologies, energy storage technologies, materials, and systems, giving priority to new transmission technologies, including composite conductor materials and other technologies that enhance reliability, operational flexibility, or power-carrying capability;

(2) advanced grid reliability and efficiency technology development;

(3) technologies contributing to significant load reductions;

(4) advanced metering, load management, and control technologies;

(5) technologies to enhance existing grid components;

(6) the development and use of high-temperature superconductors to—

(A) enhance the reliability, operational flexibility, or power-carrying capability of electric transmission or distribution systems; or

(B) increase the efficiency of electric energy generation, transmission, distribution, or storage systems;

(7) integration of power systems, including systems to deliver high-quality electric power, electric power reliability, and combined heat and power;

(8) supply of electricity to the power grid by small scale, distributed and residential-based power generators;

(9) the development and use of advanced grid design, operation, and planning tools;

(10) *the development of cost-effective technologies that enable two-way information and power flow between distributed energy resources and the electric grid;*

(11) *the development of technologies and concepts that enable interoperability between distributed energy resources and other behind-the-meter devices and the electric grid;*

[(10)] (12) any other infrastructure technologies, as appropriate; and

[(11)] (13) technology transfer and education.

(b) PROGRAM PLAN.—

(1) IN GENERAL.—Not later than 1 year after the date of enactment of this Act, the Secretary, in consultation with other appropriate Federal agencies, shall prepare and submit to Con-

gress a 5-year program plan to guide activities under this section.

(2) CONSULTATION.—In preparing the program plan, the Secretary shall consult with—

- (A) utilities;
- (B) energy service providers;
- (C) manufacturers;
- (D) institutions of higher education;
- (E) other appropriate State and local agencies;
- (F) environmental organizations;
- (G) professional and technical societies; and
- (H) any other persons the Secretary considers appropriate.

(c) IMPLEMENTATION.—The Secretary shall consider implementing the program under this section using a consortium of participants from industry, institutions of higher education, and National Laboratories.

(d) REPORT.—Not later than 2 years after the submission of the plan under subsection (b), the Secretary shall submit to Congress a report—

- (1) describing the progress made under this section; and
- (2) identifying any additional resources needed to continue the development and commercial application of transmission and distribution of infrastructure technologies.

(e) POWER DELIVERY RESEARCH INITIATIVE.—

(1) IN GENERAL.—The Secretary shall establish a research, development, and demonstration initiative specifically focused on power delivery using components incorporating high temperature superconductivity.

(2) GOALS.—The goals of the Initiative shall be—

(A) to establish world-class facilities to develop high temperature superconductivity power applications in partnership with manufacturers and utilities;

(B) to provide technical leadership for establishing reliability for high temperature superconductivity power applications, including suitable modeling and analysis;

(C) to facilitate the commercial transition toward direct current power transmission, storage, and use for high power systems using high temperature superconductivity; and

(D) to facilitate the integration of very low impedance high temperature superconducting wires and cables in existing electric networks to improve system performance, power flow control, and reliability.

(3) INCLUSIONS.—The Initiative shall include—

(A) feasibility analysis, planning, research, and design to construct demonstrations of superconducting links in high power, direct current, and controllable alternating current transmission systems;

(B) public-private partnerships to demonstrate deployment of high temperature superconducting cable into testbeds simulating a realistic transmission grid and under varying transmission conditions, including actual grid insertions; and

(C) testbeds developed in cooperation with National Laboratories, industries, and institutions of higher education to—

- (i) demonstrate those technologies;
- (ii) prepare the technologies for commercial introduction; and
- (iii) address cost or performance roadblocks to successful commercial use.

(f) TRANSMISSION AND DISTRIBUTION GRID PLANNING AND OPERATIONS INITIATIVE.—

(1) IN GENERAL.—The Secretary shall establish a research, development, and demonstration initiative specifically focused on tools needed to plan, operate, and expand the transmission and distribution grids in the presence of competitive market mechanisms for energy, load demand, customer response, and ancillary services.

(2) GOALS.—The goals of the Initiative shall be—

(A)(i) to develop and use a geographically distributed center, consisting of institutions of higher education, and National Laboratories, with expertise and facilities to develop the underlying theory and software for power system application; and

(ii) to ensure commercial development in partnership with software vendors and utilities;

(B) to provide technical leadership in engineering and economic analysis for the reliability and efficiency of power systems planning and operations in the presence of competitive markets for electricity;

(C) to model, simulate, and experiment with new market mechanisms and operating practices to understand and optimize those new methods before actual use; and

(D) to provide technical support and technology transfer to electric utilities and other participants in the domestic electric industry and marketplace.

(g) HIGH-VOLTAGE TRANSMISSION LINES.—As part of the program described in subsection (a), the Secretary shall award a grant to a university research program to design and test, in consultation with the Tennessee Valley Authority, state-of-the-art optimization techniques for power flow through existing high voltage transmission lines.

Subtitle C—Renewable Energy

* * * * *

SEC. 936. RESEARCH AND DEVELOPMENT INTO INTEGRATING RENEWABLE ENERGY ONTO THE ELECTRIC GRID.

(a) *IN GENERAL.*—Not later than 180 days after the enactment of the Grid Modernization Research and Development Act of 2019, the Secretary shall establish a research, development, and demonstration program on technologies that enable integration of renewable energy generation sources onto the electric grid across multiple program offices of the Department. The program shall include—

- (1) forecasting for predicting generation from variable renewable energy sources;

(2) *development of cost-effective low-loss, long-distance transmission lines; and*

(3) *development of cost-effective advanced technologies for variable renewable generation sources to provide grid services.*

(b) *COORDINATION.—In carrying out this program, the Secretary shall—*

(1) *coordinate across all relevant program offices at the Department to achieve the goals established in this section, including the Office of Electricity; and*

(2) *comply with section 8 of the Grid Modernization Research and Development Act of 2019.*

(c) *ADOPTION OF TECHNOLOGIES.—In carrying out this section, the Secretary shall consider barriers to adoption and commercial application of technologies that enable integration of renewable energy sources onto the electric grid, including cost and other economic barriers, and shall coordinate with relevant entities to reduce these barriers.*

* * * * *

XX. PROCEEDINGS OF THE SUBCOMMITTEE MARKUP

MARKUPS:
H.R. 2986, BEST ACT;
H.R. 5374, ADVANCED GEOTHERMAL
RESEARCH AND DEVELOPMENT ACT OF 2019;
AND H.R. 5428, GRID MODERNIZATION
RESEARCH AND DEVELOPMENT ACT OF 2019

MARKUP
BEFORE THE
SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE, SPACE, AND
TECHNOLOGY
HOUSE OF REPRESENTATIVES
ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

DECEMBER 19, 2019

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Thursday, December 19, 2019

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**Markups on H.R. 2986, BEST Act;
H.R. 5374, Advanced Geothermal Research and
Development Act of 2019; and
H.R. 5428, Grid Modernization Research and
Development Act of 2019**

THURSDAY, DECEMBER 19, 2019

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to notice, at 10:46 a.m., in room 2318 of the Rayburn House Office Building, Hon. Conor Lamb [Chairman of the Subcommittee] presiding.

Chairman LAMB. Good morning. The Subcommittee will come to order. Without objection, the Chair is authorized to declare a recess at any time. Pursuant to Committee Rule 2(e) and House Rule 11, the Chair announces that he may postpone roll call votes. Pursuant to notice, the Subcommittee on Energy meets to consider the following measures: H.R. 2986, the *BEST Act*; H.R. 5374, the *Advanced Geothermal Research and Development Act of 2019*; and H.R. 5428, the *Grid Modernization Research and Development Act of 2019*.

We meet today to mark up three good bipartisan bills. The *BEST Act* is authored by our colleague from Illinois, Dr. Foster. It will authorize research, development, and demonstration of energy storage technologies, specifically aiming at advanced technologies with varying energy storage durations, and ensuring that the research covers a diverse set of technologies, including batteries, pumped hydro, and others. National labs, academia, private industry, and environmental groups all deserve credit because they were all engaged in the making of this bill. It is endorsed by the Energy Storage Association, Chamber of Commerce, ClearPath, and Duke Energy, among others.

Next is the *Advanced Geothermal Research and Development Act of 2019*, and we are authorizing DOE (Department of Energy) to research, develop, demonstrate geothermal energy technologies, and it's sponsored by our Ranking Member of the full Committee, Mr. Lucas. He will talk more about it, I'm sure, but it requires DOE to explore oil and gas technologies that could be used for geothermal, advancing the use of computer modeling, establishing up to three field research sites to advance the development and demonstration of enhanced geothermal energy technologies in varying geographies across the U.S. It's particularly important for encouraging exploration of this resource in the eastern U.S. We have received a lot of input supported by the Geothermal Resources Council, Chamber of Commerce, ClearPath, and Third Way. Very much appreciate Ranking Member Lucas' effort to reach across the aisle on this one, and that is why the Chair of the full Committee, Ms. Johnson, is an original co-sponsor. This week of all weeks I think we can applaud that bipartisan work.

Finally we will consider the *Grid Modernization Research and Development Act of 2019*. In order for us to use all the new energy technologies that we've been talking about and authorizing on this Committee all year, we also need to seriously advance our electric grid. This bill seeks to do that, addressing the R&D (research and development). I would like to thank my colleague from Washington, Ms. Herrera Beutler, for joining me in introducing this legislation, and I urge my colleagues on both sides of the aisle to support it. Look forward to advancing it out of our Subcommittee today.

[The prepared statement of Chairman Lamb follows:]

We meet today to markup three good bipartisan bills.

The first we will consider today, the *Better Energy Storage Technology Act*, or *BEST Act*, is authored by our colleague from Illinois, Dr. Foster. The bill will authorize DOE to conduct cross-cutting research, development, and demonstration of energy storage technologies. Specifically, the bill authorizes research aimed to advance technologies with varying energy storage durations, and ensures research covers a diverse set of technologies, including batteries, pumped hydro systems, and others. National labs, academia, private industry, and environmental groups were

all engaged in the making of this bill. The bill is now endorsed by the Energy Storage Association, the Chamber of Commerce, ClearPath, and Duke Energy, just to name a few.

The next bill on the roster is H.R. 5374. As its title suggests, the *Advanced Geothermal Research and Development Act of 2019* authorizes DOE to pursue research, development, and demonstration of geothermal energy technologies and is sponsored by the Ranking Member, Mr. Lucas. Amongst other activities, it requires DOE to explore oil and gas technologies that could be used for geothermal applications and advances the use of computer modeling to explore geothermal resources and systems.

The bill also authorizes DOE to establish up to three field research sites that will advance the development and demonstration of enhanced geothermal energy technologies in varying geographies across the U.S. This is a particularly important activity for spurring the exploration of this resource in the eastern U.S. The bill has received extensive stakeholder input and is supported by the Geothermal Resources Council, Chamber of Commerce, ClearPath, and Third Way. I appreciate Ranking Member Lucas's effort to reach across the aisle to cooperatively construct this bill, and that is why the Chair of the Full Committee, Ms. Johnson, is an original cosponsor. I applaud their continued bipartisan work on this committee.

Finally, we will consider my own legislation: the *Grid Modernization Research and Development Act of 2019*. In order for our country to utilize all the new energy technologies that we are developing and moving to market, we will need serious advancements to our electric grid. This bill seeks to address the research and development required to make those grid advancements. I'll speak more about this bill in just a minute, but I would like to thank my colleague from Washington, Ms. Herrera Beutler, for joining me in introducing this legislation.

I urge my colleagues on both sides of the aisle to support these bills and look forward to advancing them out of our Subcommittee today.

Chairman LAMB. I would now normally recognize the Ranking Member of the Subcommittee, Mr. Weber, for opening remarks, but I believe he's going to submit a statement for the record before he joins us.

[The prepared statement of Mr. Weber follows:]

Good morning. Thank you, Chairman Lamb, for the opportunity to speak on the three bills before us today: H.R. 2986, the *Better Energy Storage Technology Act*, H.R. 5374, the *Advanced Geothermal Research and Development Act*, and H.R. 5428, the *Grid Modernization Research and Development Act*.

H.R. 2986, the *Better Energy Storage Technology*, or *BEST Act*, directs the Department of Energy (DOE) to develop energy storage technologies through a cross-cutting research, development, and demonstration program.

Today, advanced renewable and distributed energy resources are changing the way that U.S. electricity is produced and delivered.

But as we all know, these sources are intermittent and dependent on the sun to shine or the wind to blow.

Without the capacity to efficiently store this energy at the grid scale, we limit the ability of renewable energy sources to meet U.S. energy needs. It is clear that advanced energy storage technology is the key to maximizing our clean energy resources and modernizing our electric grid, without sacrificing energy reliability and security.

That is why I'm pleased to see that the *BEST Act* authorizes critical, fundamental research that will enable U.S. researchers to test and validate grid-scale systems that can store and generate energy over a range of time, from 6 hours to several months.

I want to thank my colleagues Mr. Foster, Ms. Herrera Beutler, Mr. Casten, and Mr. Gonzalez for working together to produce this bipartisan legislation.

The next bill on the docket is H.R. 5374, the *Advanced Geothermal Energy Research and Development Act of 2019*. Introduced by Ranking Member Lucas and cosponsored by Chairwoman Johnson, H.R. 5374 authorizes DOE programs in a number of high-priority geothermal technology areas including, enhanced geothermal energy systems, subsurface technologies for geothermal energy production, reservoir thermal energy storage, and advanced computing to accelerate the development of geothermal energy.

This legislation also supports innovative experimental user facilities known as "Frontier Observatory for Research in Geothermal Energy" or FORGE sites.

With limited Federal dollars and a responsibility to spend those resources wisely, I believe that user facilities, like those authorized in this bill, can give us the high-

est return on our investment and produce advanced energy technologies that will greatly accelerate innovation in the private sector.

By making these strategic investments in advanced geothermal energy technologies, we can tap into a truly renewable source of baseload power that will help diversify our energy portfolio and strengthen American energy independence.

The final bill we will consider today is H.R. 5428, the *Grid Modernization Research and Development Act of 2019*, which was introduced by Chairman Lamb and co-sponsored by Representative Herrera Beutler.

H.R. 5428, establishes a research, development, and demonstration program at the Department of Energy, focused on grid modeling, sensing, resilience, reliability, and emergency response.

This work is already a critical priority for the Administration and the Department. Through the Department-wide Grid Modernization Initiative (GMI) and the Grid Modernization Lab Consortium (GMLC), DOE is uniquely positioned to drive innovation in technologies that will help counter grid vulnerabilities and provide necessary updates to our energy infrastructure.

Modernizing our grid will also require cooperation from many federal agencies, states, and industry partners. That is why I am glad to see that this legislation includes a technical assistance program to identify the evolving R&D needs of U.S. industry and the electric grid.

I want to thank all of my colleagues involved today for putting forward 3 bipartisan bills today that have been thoroughly reviewed by stakeholders and the Department. Thank you and I yield back the balance of my time.

Chairman LAMB. If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

[The prepared statement of Chairwoman Johnson follows:]

Good afternoon and thank you, Chairman Lamb, for holding this mark-up to advance legislation that prioritizes research activities in geothermal energy production.

Americans have used various forms of geothermal energy since the 1800s. Despite this long history, geothermal energy technologies have largely struggled to become or remain competitive in modern energy markets, yet huge potential exists for further advancement and commercialization.

In my home state of Texas, there is great potential for geothermal energy production that remains untapped, with naturally occurring large wells of hot water as well as other promising heat reservoirs below the ground.

Energy produced by geothermal technologies does not emit greenhouse gases. Just this Congress alone, this Committee has passed several bills that would reduce the impacts of climate change. I am hoping we can help a few more along today. Additionally, not only can geothermal technologies produce clean electricity, but they can also be used for industrial applications, such as through heat production for manufacturing processes or critical mineral extraction.

These are all reasons why I am pleased these issues received serious attention during a Subcommittee hearing held last month. That hearing brought together esteemed experts - one of which from the Great State of Texas I might add - who reinforced our understanding that geothermal energy production has huge potential as an essential resource in our clean energy technology portfolio.

I am glad that we are addressing this important issue today by considering the *Advanced Geothermal Research and Development Act* introduced by my friend Ranking Member Lucas, which I am proud to co-sponsor. Thank you, Mr. Lucas, for working with us and introducing this great piece of legislation. The bill includes research initiatives on oil and gas technology transfer to geothermal research, secondary use research areas such as minerals recovery and storage, and new areas of research in enhanced geothermal systems. It also authorizes groundbreaking new research activities in advanced geothermal computing and data science.

I want to thank Chairman Lamb once again for convening this mark-up, and I look forward to continuing to work together with my colleagues on both sides of the aisle to pass legislation that helps advance geothermal energy as well as a broad range of other clean energy technologies.

With that, I yield back.

[The prepared statement of Mr. Lucas follows:]

Thank you, Chairman Lamb. This morning, I am grateful for the opportunity to discuss my bill, H.R. 5374, the *Advanced Geothermal Research and Development Act of 2019*, which is cosponsored by Chairwoman Johnson and authorizes research, de-

velopment, and demonstration of innovative geothermal energy technologies at the Department of Energy (DOE).

Geothermal energy systems draw from the constant and naturally occurring heat that radiates beneath the surface of the earth. This heat is a source of clean and renewable energy that is always "on." Our country has significant geothermal energy resources, and if harnessed correctly, these resources can provide secure, base-load power and energy storage for Americans across the country.

Yet although the United States leads the world in installed geothermal capacity, geothermal energy contributes less than one percent to the total utility-scale U.S. electricity generation.

This is because today's geothermal energy technologies are often too expensive, time-consuming, or risky for industry to take to scale. While I've seen the potential of geothermal energy in my district in Oklahoma, more work needs to be done to allow the rest of the country to access the full power of this resource.

In order to effectively leverage these vast untapped energy resources, geothermal technologies and techniques must become more efficient and less expensive for American consumers. Fortunately, we are uniquely positioned to prioritize the basic and early stage research that leads to groundbreaking technology.

Federally funded research programs have a history of paving the way for industry innovation. So I am pleased to see DOE and its Geothermal Technologies Office taking the lead in this valuable science.

It is critically important to our clean energy future that they have the support they need to pursue research that industry cannot undertake.

My legislation will provide DOE with critical funding and program direction to enable innovative research in advanced geothermal technologies, strengthen the U.S. geothermal workforce, and encourage international collaboration. More specifically, it will authorize and expand the Department's early-stage research in enhanced geothermal systems and the major user facilities needed to support this work.

H.R. 5374 will also authorize a new program in advanced geothermal computing and data science R&D. This will leverage DOE's best-in-the-world computational capabilities to provide geothermal researchers with modeling and simulation tools that will allow them to more accurately understand complex subsurface systems.

With these tools, industry can improve the next generation of geothermal energy technologies, using advanced designs to save time and money in planning, and producing power more efficiently with less impact on the environment.

We know that American industry has the resources to successfully commercialize new technology. What they often lack is the infrastructure to conduct early stage research and test new technologies. This is where DOE, the national labs, and academia can help, providing experimental facilities and computational tools that will drive costs down and innovation forward.

If we want to ensure a diverse portfolio of clean energy technologies now and in the future, we in Congress should prioritize this important fundamental research.

I want to thank Chairwoman Johnson and her staff for working with me on this legislation. I believe this bill is an excellent example of our shared goals on this Committee, and I look forward to continuing to work with you all to support this common sense, productive, and bipartisan legislation. I yield back the balance of my time.

H.R. 5428

Chairman LAMB. We will now consider H.R. 5428, the *Grid Modernization Research and Development Act of 2019*. The Clerk will report the bill.

The CLERK. H.R. 5428, a bill to amend the *Energy Independence and Security Act of 2007*, and the *Energy Policy Act of 2005*, to direct Federal research in grid modernization and security, and for other purposes.

[The bill follows:]

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.....
 (Original Signature of Member)

116TH CONGRESS
 1ST SESSION

H. R. _____

To amend the Energy Independence and Security Act of 2007 and the Energy Policy Act of 2005 to direct Federal research on grid modernization and security, and for other purposes.

 IN THE HOUSE OF REPRESENTATIVES

M. _____ introduced the following bill; which was referred to the Committee on _____

A BILL

To amend the Energy Independence and Security Act of 2007 and the Energy Policy Act of 2005 to direct Federal research on grid modernization and security, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
 2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE; TABLE OF CONTENTS.**

4 (a) **SHORT TITLE.**—This Act may be cited as the
 5 “Grid Modernization Research and Development Act of
 6 2019”.

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2

1 (b) TABLE OF CONTENTS.—The table of contents for
 2 this Act is as follows:

- Sec. 1. Short title; table of contents.
- Sec. 2. Smart grid regional demonstration initiative.
- Sec. 3. Smart grid modeling, visualization, architecture, and controls.
- Sec. 4. Enhancing grid resilience and emergency response.
- Sec. 5. Hybrid energy systems.
- Sec. 6. Grid integration research and development.
- Sec. 7. Industry alliances.
- Sec. 8. Coordination of efforts.
- Sec. 9. Definitions.
- Sec. 10. Technical amendments; authorization of appropriations.

3 **SEC. 2. SMART GRID REGIONAL DEMONSTRATION INITIA-**
 4 **TIVE.**

5 Section 1304 of the Energy Independence and Secu-
 6 rity Act of 2007 (42 U.S.C. 17384) is amended—

7 (1) in subsection (a), by inserting “research,
 8 development, and demonstration” before “program”;

9 (2) in subsection (b)—

10 (A) by amending paragraph (1) to read as
 11 follows:

12 “(1) The Secretary shall establish a smart grid
 13 regional demonstration initiative (referred to in this
 14 subsection as the ‘Initiative’) composed of dem-
 15 onstration projects focused on cost-effective, ad-
 16 vanced technologies for use in power grid sensing,
 17 communications, analysis, power flow control, visual-
 18 ization, distribution automation, industrial control
 19 systems, dynamic line rating systems, grid redesign,

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3

1 and the integration of distributed energy re-
2 sources.”; and

3 (B) in paragraph (2)—

4 (i) in subparagraph (D), by striking
5 “and”;

6 (ii) in subparagraph (E), by striking
7 the period and inserting “; and”; and

8 (iii) by inserting at the end the fol-
9 lowing:

10 “(F) to encourage the commercial applica-
11 tion of advanced distribution automation tech-
12 nologies that improve system resilience.”.

13 **SEC. 3. SMART GRID MODELING, VISUALIZATION, ARCHI-
14 TECTURE, AND CONTROLS.**

15 Title XIII of the Energy Independence and Security
16 Act of 2007 (42 U.S.C. 17381 et seq.) is amended by in-
17 serting after section 1304 the following:

18 **“SEC. 1304a. SMART GRID MODELING, VISUALIZATION, AR-
19 CHITECTURE, AND CONTROLS.**

20 “(a) IN GENERAL.—Not later than 180 days after
21 the enactment of the Grid Modernization Research and
22 Development Act of 2019, the Secretary shall establish a
23 program of research, development, demonstration, and
24 commercial application on electric grid modeling, sensing,

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1 visualization, architecture development, and advanced op-
2 eration and controls.

3 “(b) MODELING RESEARCH AND DEVELOPMENT.—

4 The Secretary shall support development of models of
5 emerging technologies and systems to facilitate the secure
6 and reliable design, planning, and operation of the electric
7 grid for use by industry stakeholders. In particular, the
8 Secretary shall support development of—

9 “(1) models to analyze and predict the effects
10 of adverse physical and cyber events on the electric
11 grid;

12 “(2) coupled models of electrical, physical, and
13 cyber systems;

14 “(3) models of existing and emerging tech-
15 nologies being deployed on the electric grid due to
16 projected changes in the electric generation mix and
17 loads, for a variety of regional characteristics; and

18 “(4) integrated models of the communications,
19 transmission, distribution, and other interdependent
20 systems for existing, new, and emerging tech-
21 nologies.

22 “(c) SITUATIONAL AWARENESS RESEARCH AND DE-
23 VELOPMENT.—

24 “(1) IN GENERAL.—The Secretary shall sup-
25 port development of computational tools and tech-

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1 nologies to improve sensing, monitoring, and visual-
2 ization of the electric grid for real-time situational
3 awareness and decision support tools that enable im-
4 proved operation of the power system, including util-
5 ity, non-utility, and customer grid-connected assets,
6 for use by industry partners.

7 “(2) DATA USE.—In developing visualization
8 capabilities under this section, the Secretary shall
9 develop tools for industry stakeholders to use to ana-
10 lyze data collected from advanced measurement and
11 monitoring technologies, including data from phasor
12 measurement units and advanced metering units.

13 “(3) SEVERE EVENTS.—The Secretary shall
14 prioritize enhancing cyber and physical situational
15 awareness of the electric grid during adverse man-
16 made and naturally-occurring events.

17 “(d) ARCHITECTURE.—The Secretary shall conduct
18 research in collaboration with industry stakeholders to de-
19 velop model grid architectures to assist with wide-area
20 transmission and distribution planning that incorporate
21 expected changes to the modern electric grid. In sup-
22 porting the development of model grid architectures, the
23 Secretary shall—

24 “(1) analyze a variety of grid architecture sce-
25 narios that range from minor upgrades to existing

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1 transmission grid infrastructure to scenarios that in-
2 volve the replacement of significant portions of exist-
3 ing transmission grid infrastructure;

4 “(2) analyze the effects of the increasing pro-
5 liferation of renewable and other zero emissions en-
6 ergy generation sources, increasing use of distrib-
7 uted resources owned by non-utility entities, and the
8 use of digital and automated controls not managed
9 by grid operators;

10 “(3) include a variety of new and emerging dis-
11 tribution grid technologies, including distributed en-
12 ergy resources, electric vehicle charging stations, dis-
13 tribution automation technologies, energy storage,
14 and renewable energy sources;

15 “(4) analyze the effects of local load balancing
16 and other forms of decentralized control;

17 “(5) analyze the effects of changes to grid ar-
18 chitectures resulting from modernizing electric grid
19 systems, including communications, controls, mar-
20 kets, consumer choice, emergency response, elec-
21 trification, and cybersecurity concerns; and

22 “(6) develop integrated grid architectures that
23 incorporate system resilience for cyber, physical, and
24 communications systems.

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1 “(e) OPERATION AND CONTROLS RESEARCH AND
2 DEVELOPMENT.—The Secretary shall conduct research to
3 develop improvements to the operation and controls of the
4 electric grid, in coordination with industry partners. Such
5 activities shall include—

6 “(1) a training facility or facilities to allow grid
7 operators to gain operational experience with ad-
8 vanced grid control concepts and technologies;

9 “(2) development of cost-effective advanced op-
10 eration and control concepts and technologies, such
11 as adaptive islanding, dynamic line rating systems,
12 power flow controllers, network topology optimiza-
13 tion, smart circuit breakers, intelligent load shed-
14 ding, and fault-tolerant control system architectures;

15 “(3) development of real-time control concepts
16 using artificial intelligence and machine learning for
17 improved electric grid resilience; and

18 “(4) utilization of advanced data analytics in-
19 cluding load forecasting, power flow modeling, equip-
20 ment failure prediction, resource optimization, risk
21 analysis, and decision analysis.

22 “(f) COMPUTING RESOURCES AND DATA COORDINA-
23 TION RESEARCH AND DEVELOPMENT.—In carrying out
24 this section, the Secretary shall—

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1 “(1) leverage existing computing resources at
2 the National Laboratories;

3 “(2) develop voluntary standards for data
4 taxonomies and communication protocols in coordi-
5 nation with public and private sector stakeholders;
6 and

7 “(3) comply with section 8 of the Grid Mod-
8 ernization Research and Development Act of 2019.

9 “(g) INFORMATION SHARING.—None of the activities
10 authorized in this section shall require private entities to
11 share information or data with the Secretary.”.

12 **SEC. 4. ENHANCING GRID RESILIENCE AND EMERGENCY**
13 **RESPONSE.**

14 Title XIII of the Energy Independence and Security
15 Act of 2007 (42 U.S.C. 17381 et. seq.) is amended by
16 adding at the end the following:

17 **“SEC. 1310. GRID RESILIENCE AND EMERGENCY RESPONSE.**

18 “(a) IN GENERAL.—Not later than 180 days after
19 the enactment of the Grid Modernization Research and
20 Development Act of 2019, the Secretary shall establish a
21 research, development, and demonstration program to en-
22 hance resilience and strengthen emergency response and
23 management pertaining to the electric grid.

24 “(b) GRANTS.—The Secretary shall award grants to
25 eligible entities under subsection (c) on a competitive basis

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1 to conduct research and development with the purpose of
2 improving the resilience and reliability of electric grid by—

3 “(1) developing methods to improve community
4 and governmental preparation for and emergency re-
5 sponse to large-area, long-duration electricity inter-
6 ruptions, including through the use of energy effi-
7 ciency, storage, and distributed generation tech-
8 nologies;

9 “(2) developing tools to help utilities and com-
10 munities ensure the continuous delivery of electricity
11 to critical facilities;

12 “(3) developing tools to improve coordination
13 between utilities and relevant Federal agencies to
14 enable communication, information-sharing, and sit-
15 uational awareness in the event of a physical or
16 cyber attack on the electric grid;

17 “(4) developing technologies and capabilities to
18 withstand and address the current and projected im-
19 pact of the changing climate on electric grid infra-
20 structure, including extreme weather events and
21 other natural disasters;

22 “(5) developing technologies capable of early
23 detection of deteriorating electrical equipment on the
24 transmission and distribution grid, including detec-

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1 tion of spark ignition from wildfires and risks of
2 vegetation contact; and

3 “(6) assessing upgrades and additions needed
4 to electric grid infrastructure due to projected
5 changes in the electricity generation mix and elec-
6 tricity demand.

7 “(c) ELIGIBLE ENTITIES.—The entities eligible to re-
8 ceive grants under this section include—

9 “(1) an institution of higher education;

10 “(2) a nonprofit organization;

11 “(3) a National Laboratory;

12 “(4) a unit of State, local, or tribal government;

13 “(5) an electric utility or electric cooperative;

14 “(6) a retail service provider of electricity;

15 “(7) a private commercial entity;

16 “(8) a partnership or consortium of 2 or more
17 entities described in subparagraphs (1) through (7).

18 “(d) RELEVANT ACTIVITIES.—Grants awarded under
19 subsection (b) shall include funding for research and de-
20 velopment activities related to the purpose described in
21 subsection (b), such as—

22 “(1) development of technologies to use distrib-
23 uted energy resources, such as solar photovoltaics,
24 energy storage systems, electric vehicles, and

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1 microgrids to improve grid and critical end-user re-
2 silience;

3 “(2) analysis of past large-area, long-duration
4 electricity interruptions to identify common elements
5 and best practices for electricity restoration, mitiga-
6 tion, and prevention of future disruptions;

7 “(3) development of advanced monitoring, ana-
8 lytics, operation, and controls of electricity grid sys-
9 tems to improve electric grid resilience;

10 “(4) analysis of technologies, methods, and con-
11 cepts that can improve community resilience and
12 survivability of frequent or long-duration power out-
13 ages;

14 “(5) development of methodologies to maintain
15 cybersecurity during restoration of electric grid in-
16 frastructure and operation;

17 “(6) development of advanced power flow con-
18 trol systems and components to improve electric grid
19 resilience; and

20 “(7) any other relevant activities determined by
21 the Secretary.

22 “(e) TECHNICAL ASSISTANCE.—

23 “(1) IN GENERAL.—The Secretary shall provide
24 technical assistance to eligible entities for the com-
25 mercial application of technologies to improve the re-

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1 silience of the electric grid and commercial applica-
2 tion of technologies to help entities develop plans for
3 preventing and recovering from various power out-
4 age scenarios at the local, regional, and State level.

5 “(2) TECHNICAL ASSISTANCE PROGRAM.—The
6 technical assistance program established in para-
7 graph (1) shall include assistance to eligible entities
8 for—

9 “(A) the commercial application of tech-
10 nologies developed from the grant program es-
11 tablished in subsection (b), including municipal
12 and cooperative utilities;

13 “(B) the development of methods to
14 strengthen or otherwise mitigate adverse im-
15 pacts on electric grid infrastructure against
16 natural hazards;

17 “(C) the use of Department data and mod-
18 eling tools for various purposes; and

19 “(D) a resource assessment and analysis of
20 future demand and distribution requirements,
21 including development of advanced grid archi-
22 tectures and risk analysis.

23 “(3) ELIGIBLE ENTITIES.—The entities eligible
24 to receive technical assistance for commercial appli-
25 cation of technologies under this section include—

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1 “(A) representatives of all sectors of the
2 electric power industry, including electric utili-
3 ties, trade organizations, and transmission and
4 distribution system organizations, owners, and
5 operators;

6 “(B) State and local governments and reg-
7 ulatory authorities, including public utility com-
8 missions;

9 “(C) tribal and Alaska Native govern-
10 mental entities;

11 “(D) partnerships among entities under
12 subparagraphs (A) through (C);

13 “(E) regional partnerships; and

14 “(F) any other entities the Secretary
15 deems appropriate.

16 “(4) AUTHORITY.—Nothing in this section shall
17 authorize the Secretary to require any entity to
18 adopt any model, tool, technology, plan, analysis, or
19 assessment.

20 “(f) COORDINATION.—In carrying out this section,
21 the Secretary shall comply with section 8 of the Grid Mod-
22 ernization Research and Development Act of 2019.”.

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1 **SEC. 5. HYBRID ENERGY SYSTEMS.**

2 Title XIII of the Energy Independence and Security
3 Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is
4 amended by adding at the end the following:

5 **“SEC. 1311. HYBRID ENERGY SYSTEMS.**

6 “(a) IN GENERAL.—Not later than 180 days after
7 the enactment of the Grid Modernization Research and
8 Development Act of 2019, the Secretary shall establish a
9 research, development, and demonstration program to de-
10 velop cost-effective hybrid energy systems, including—

11 “(1) development of computer modeling to de-
12 sign different configurations of hybrid energy sys-
13 tems and to optimize system operation;

14 “(2) research on system integration needed to
15 plan, design, build, and operate hybrid energy sys-
16 tems, including interconnection requirements with
17 the electric grid;

18 “(3) development of hybrid energy systems for
19 various applications, including—

20 “(A) thermal energy generation and stor-
21 age for buildings and manufacturing;

22 “(B) electricity storage coupled with en-
23 ergy generation;

24 “(C) desalination;

25 “(D) production of liquid and gaseous
26 fuels; and

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1 “(E) production of chemicals such as am-
2 monia and ethylene;

3 “(4) development of testing facilities for hybrid
4 energy systems; and

5 “(5) research on incorporation of various tech-
6 nologies for hybrid energy systems, including nuclear
7 energy, renewable energy, storage, and carbon cap-
8 ture, utilization, and sequestration technologies.

9 “(b) STRATEGIC PLAN.—

10 “(1) IN GENERAL.—Not later than 1 year after
11 the date of the enactment of the Grid Modernization
12 Research and Development Act of 2019, the Sec-
13 retary shall submit to the Committee on Science,
14 Space, and Technology of the House of Representa-
15 tives and the Committee on Energy and Natural Re-
16 sources of the Senate a strategic plan that identifies
17 opportunities, challenges, and standards needed for
18 the development and commercial application of hy-
19 brid energy systems. The strategic plan shall in-
20 clude—

21 “(A) analysis of the potential benefits of
22 development of hybrid electric systems on the
23 electric grid;

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1 “(B) analysis of the potential contributions
2 of hybrid energy systems to different grid archi-
3 tecture scenarios;

4 “(C) research and development goals for
5 various hybrid energy systems, including those
6 identified in subsection (b);

7 “(D) assessment of policy and market bar-
8 riers to the adoption of hybrid energy systems;

9 “(E) analysis of the technical and eco-
10 nomic feasibility of adoption of different hybrid
11 energy systems; and

12 “(F) a 10-year roadmap to guide the pro-
13 gram established under subsection (a).

14 “(2) UPDATES.—Not less than once every 3
15 years for the duration of this research program, the
16 Secretary shall submit an updated version of the
17 strategic plan to the Committee on Science, Space,
18 and Technology of the House of Representatives and
19 the Committee on Energy and Natural Resources of
20 the Senate.

21 “(c) PROGRAM IMPLEMENTATION.—In carrying out
22 the research, development, demonstration, and commercial
23 application aims of section, the Secretary shall—

24 “(1) implement the recommendations set forth
25 in the strategic plan in subsection (b);

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1 “(2) coordinate across all relevant program of-
2 fices at the Department, including—

3 “(A) the Office of Energy Efficiency and
4 Renewable Energy;

5 “(B) the Office of Nuclear Energy; and

6 “(C) the Office of Fossil Energy;

7 “(3) leverage existing programs and resources
8 of the Department;

9 “(4) prioritize activities that accelerate the de-
10 velopment of integrated electricity generation, stor-
11 age, and distribution systems with net zero green-
12 house gas emissions; and

13 “(5) comply with section 8 of the Grid Mod-
14 ernization Research and Development Act of 2019.

15 “(d) HYBRID ENERGY SYSTEM DEFINED.—The term
16 ‘hybrid energy system’ means a system composed of 2 or
17 more co-located or jointly operated sub-systems of energy
18 generation, energy storage, or other energy technologies.”.

19 **SEC. 6. GRID INTEGRATION RESEARCH AND DEVELOP-**
20 **MENT.**

21 (a) INTEGRATING DISTRIBUTED ENERGY RE-
22 SOURCES ONTO THE ELECTRIC GRID.—Section 925(a) of
23 the Energy Policy Act of 2005 (42 U.S.C. 16215) is
24 amended by—

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1 (1) redesignating paragraphs (10) and (11) as
2 paragraphs (12) and (13), respectively; and

3 (2) inserting after paragraph (9) the following:

4 “(10) the development of cost-effective tech-
5 nologies that enable two-way information and power
6 flow between distributed energy resources and the
7 electric grid;

8 “(11) the development of technologies and con-
9 cepts that enable interoperability between distributed
10 energy resources and other behind-the-meter devices
11 and the electric grid;”.

12 (b) INTEGRATING RENEWABLE ENERGY ONTO THE
13 ELECTRIC GRID.—Subtitle C of title IX of the Energy
14 Policy Act of 2005 (42 U.S.C. 16231 et seq.) is amended
15 by adding at the end the following:

16 “SEC. 936. RESEARCH AND DEVELOPMENT INTO INTE-
17 GRATING RENEWABLE ENERGY ONTO THE
18 ELECTRIC GRID.

19 “(a) IN GENERAL.—Not later than 180 days after
20 the enactment of the Grid Modernization Research and
21 Development Act of 2019, the Secretary shall establish a
22 research, development, and demonstration program on
23 technologies that enable integration of renewable energy
24 generation sources onto the electric grid across multiple

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1 program offices of the Department. The program shall in-
2 clude—

3 “(1) forecasting for predicting generation from
4 variable renewable energy sources;

5 “(2) development of cost-effective low-loss, long-
6 distance transmission lines; and

7 “(3) development of cost-effective advanced
8 technologies for variable renewable generation
9 sources to provide grid services.

10 “(b) COORDINATION.—In carrying out this program,
11 the Secretary shall—

12 “(1) coordinate across all relevant program of-
13 fices at the Department to achieve the goals estab-
14 lished in this section, including the Office of Elec-
15 tricity; and

16 “(2) comply with section 8 of the Grid Mod-
17 ernization Research and Development Act of 2019.

18 “(c) ADOPTION OF TECHNOLOGIES.—In carrying out
19 this section, the Secretary shall consider barriers to adop-
20 tion and commercial application of technologies that en-
21 able integration of renewable energy sources onto the elec-
22 tric grid, including cost and other economic barriers, and
23 shall coordinate with relevant entities to reduce these bar-
24 riers.”

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1 (c) INTEGRATING ELECTRIC VEHICLES ONTO THE
2 ELECTRIC GRID.—Subtitle B of title I of the Energy Inde-
3 pendence and Security Act of 2007 (42 U.S.C. 17011 et
4 seq.) is amended by adding at the end the following:

5 **“SEC. 137. RESEARCH AND DEVELOPMENT INTO INTE-**
6 **GRATING ELECTRIC VEHICLES ONTO THE**
7 **ELECTRIC GRID.**

8 “(a) IN GENERAL.—The Secretary shall establish a
9 research, development, and demonstration program to ad-
10 vance the integration of electric vehicles, including plug-
11 in hybrid electric vehicles, onto the electric grid.

12 “(b) VEHICLES-TO-GRID INTEGRATION ASSESSMENT
13 REPORT.—Not later than 1 year after the enactment of
14 the Grid Modernization Research and Development Act of
15 2019, the Secretary shall submit to the Committee on
16 Science, Space, and Technology of the House of Rep-
17 resentatives and the Committee on Energy and Natural
18 Resources of the Senate a report on the results of a study
19 that examines the research, development, and demonstra-
20 tion opportunities, challenges, and standards needed for
21 integrating electric vehicles onto the electric grid.

22 “(1) REPORT REQUIREMENTS.—The report
23 shall include—

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1 “(A) an evaluation of the use of electric ve-
2 hicles to maintain the reliability of the electric
3 grid, including—

4 “(i) the use of electric vehicles for de-
5 mand response, load shaping, emergency
6 power, and frequency regulation; and

7 “(ii) the potential for the reuse of
8 spent electric vehicle batteries for sta-
9 tionary grid storage;

10 “(B) the impact of grid integration on
11 electric vehicles, including—

12 “(i) the impact of bi-directional elec-
13 tricity flow on battery degradation; and

14 “(ii) the implications of the use of
15 electric vehicles for grid services on origi-
16 nal equipment manufacturer warranties;

17 “(C) the impacts to the electric grid of in-
18 creased penetration of electric vehicles, includ-
19 ing—

20 “(i) the distribution grid infrastruc-
21 ture needed to support an increase in
22 charging capacity;

23 “(ii) strategies for integrating electric
24 vehicles onto the distribution grid while
25 limiting infrastructure upgrades;

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1 “(iii) the changes in electricity de-
2 mand over a 24-hour cycle due to electric
3 vehicle charging behavior;

4 “(iv) the load increases expected from
5 electrifying the transportation sector;

6 “(v) the potential for customer incen-
7 tives and other managed charging stations
8 strategies to shift charging off-peak;

9 “(vi) the technology needed to achieve
10 bi-directional power flow on the distribu-
11 tion grid; and

12 “(vii) the implementation of smart
13 charging techniques;

14 “(D) research on the standards needed to
15 integrate electric vehicles with the grid, includ-
16 ing communications systems, protocols, and
17 charging stations, in collaboration with the Na-
18 tional Institute for Standards and Technology;

19 “(E) the cybersecurity challenges and
20 needs associated with electrifying the transpor-
21 tation sector; and

22 “(F) an assessment of the feasibility of
23 adopting technologies developed under the pro-
24 gram established under subsection (a) at De-
25 partment facilities.

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1 “(2) RECOMMENDATIONS.—As part of the Ve-
2 hicles-to-Grid Integration Assessment Report, the
3 Secretary shall develop a 10-year roadmap to guide
4 the research, development, and demonstration pro-
5 gram to integrate electric vehicles onto the electric
6 grid.

7 “(3) CONSULTATION.—In developing this re-
8 port, the Secretary shall consult with relevant stake-
9 holders, including—

10 “(A) electric vehicle manufacturers;

11 “(B) electric utilities;

12 “(C) public utility commissions;

13 “(D) vehicle battery manufacturers;

14 “(E) electric vehicle supply equipment
15 manufacturers;

16 “(F) charging infrastructure manufactur-
17 ers;

18 “(G) the National Laboratories; and

19 “(H) other Federal agencies, as the Sec-
20 retary determines appropriate.

21 “(4) UPDATES.—The Secretary shall update
22 the report required under this section every 3 years
23 for the duration of the program under section (a)
24 and shall submit the updated report to the Com-
25 mittee on Science, Space, and Technology of the

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1 House of Representatives and the Committee on En-
2 ergy and Natural Resources of the Senate.

3 “(c) PROGRAM IMPLEMENTATION.—In carrying out
4 the research, development, demonstration, and commercial
5 application aims of section, the Secretary shall—

6 “(1) implement the recommendations set forth
7 in the report in subsection (b);

8 “(2) coordinate across all relevant program of-
9 fices at the Department to achieve the goals estab-
10 lished in this section, including the Office of Elec-
11 tricity; and

12 “(3) comply with section 8 of the Grid Mod-
13 ernization Research and Development Act of 2019.

14 “(d) TESTING CAPABILITIES.—The Secretary shall
15 coordinate with the National Laboratories to develop test-
16 ing capabilities for the evaluation, rapid prototyping, and
17 optimization of technologies enabling integration of elec-
18 tric vehicles onto the electric grid.”.

19 (d) RESEARCH AND DEVELOPMENT ON INTEGRATING
20 BUILDINGS ONTO THE ELECTRIC GRID.—Subtitle B of
21 title IV of the Energy Independence and Security Act of
22 2007 (42 U.S.C. 17081 et seq.) is amended by adding at
23 the end the following:

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1 **"SEC. 426. ADVANCED INTEGRATION OF BUILDINGS ONTO**
2 **THE ELECTRIC GRID.**

3 "(a) IN GENERAL.—The Secretary shall establish a
4 program of research, development, and demonstration to
5 enable components of commercial and residential buildings
6 to serve as dynamic energy loads on and resources for the
7 electric grid. The program shall focus on—

8 "(1) developing low-cost, low power, wireless
9 sensors to—

10 "(A) monitor building energy load;

11 "(B) forecast building energy need; and

12 "(C) enable building-level energy control;

13 "(2) developing data management capabilities
14 and standard communication protocols to further
15 interoperability at the building and grid-level;

16 "(3) developing advanced building-level energy
17 management of components through integration of
18 smart technologies, control systems, and data proc-
19 essing, to enable energy efficiency and savings;

20 "(4) optimizing energy consumption at the
21 building level to enable grid stability and resilience;

22 "(5) improving visualization of behind the
23 meter equipment and technologies to provide better
24 insight into the energy needs and energy forecasts of
25 individual buildings;

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1 “(6) reducing the cost of key components to ac-
2 celerate the adoption of smart building technologies;

3 “(7) protecting against cybersecurity threats
4 and addressing security vulnerabilities of building
5 systems or equipment; and

6 “(8) other areas determined appropriate by the
7 Secretary.

8 “(b) CONSIDERATIONS.—In carrying out the pro-
9 gram under subsection (a), the Secretary shall—

10 “(1) work with utility partners, building own-
11 ers, technology vendors, and building developers to
12 test and validate technologies and encourage the
13 commercial application of these technologies by
14 building owners; and

15 “(2) consider the specific challenges of enabling
16 greater interaction between components of—

17 “(A) small- and medium-sized buildings
18 and the electric grid; and

19 “(B) residential and commercial buildings
20 and the electric grid.

21 “(c) BUILDINGS-TO-GRID INTEGRATION REPORT.—
22 Not later than one year after the enactment of the Grid
23 Modernization Research and Development Act of 2019,
24 the Secretary shall submit to the Committee on Science,
25 Space, and Technology of the House of Representatives

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1 and the Committee on Energy and Natural Resources of
2 the Senate a report on the results of a study that examines
3 the research, development, and demonstration opportuni-
4 ties, challenges, and standards needed to enable compo-
5 nents of commercial and residential buildings to serve as
6 dynamic energy loads on and resources for the electric
7 grid.

8 “(1) REPORT REQUIREMENTS.—The report
9 shall include—

10 “(A) an assessment of the technologies
11 needed to enable building components as dy-
12 namic loads on and resources for the electric
13 grid, including how such technologies can be—

14 “(i) incorporated into new commercial
15 and residential buildings; and

16 “(ii) retrofitted in older buildings;

17 “(B) guidelines for the design of new
18 buildings and building components to enable
19 modern grid interactivity and improve energy
20 efficiency;

21 “(C) an assessment of barriers to the
22 adoption by building owners of advanced tech-
23 nologies enabling greater integration of building
24 components onto the electric grid; and

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1 “(D) an assessment of the feasibility of
2 adopting technologies developed under the pro-
3 gram established under subsection (a) at De-
4 partment facilities.

5 “(2) RECOMMENDATIONS.—As part of the re-
6 port, the Secretary shall develop a 10-year roadmap
7 to guide the research, development, and demonstra-
8 tion program to enable components of commercial
9 and residential buildings to serve as dynamic energy
10 loads on and resources for the electric grid.

11 “(3) UPDATES.—The Secretary shall update
12 the report required under this section every 3 years
13 for the duration of the program under subsection (a)
14 and shall submit the updated report to the Com-
15 mittee on Science, Space, and Technology of the
16 House of Representatives and the Committee on En-
17 ergy and Natural Resources of the Senate.

18 “(d) PROGRAM IMPLEMENTATION.—In carrying out
19 this section, the Secretary shall—

20 “(1) implement the recommendations from the
21 report in subsection (c);

22 “(2) coordinate across all relevant program of-
23 fices at the Department to achieve the goals estab-
24 lished in this section, including the Office of Elec-
25 tricity; and

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1 “(3) comply with section 8 of the Grid Mod-
2 ernization Research and Development Act of 2019.”.

3 **SEC. 7. INDUSTRY ALLIANCE.**

4 Title XIII of the Energy Independence and Security
5 Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is
6 amended by adding at the end the following:

7 **“SEC. 1312. INDUSTRY ALLIANCE.**

8 “(a) IN GENERAL.—Not later than 180 days after
9 the enactment of the Grid Modernization Research and
10 Development Act of 2019, the Secretary shall establish an
11 advisory committee (to be known as the ‘Industry Alli-
12 ance’) to advise the Secretary on the authorization of re-
13 search, development, and demonstration projects under
14 sections 1304 and 1304a.

15 “(b) MEMBERSHIP.—The Industry Alliance shall be
16 composed of members selected by the Secretary that, as
17 a group, are broadly representative of United States elec-
18 tric grid research, development, infrastructure, operations,
19 and manufacturing expertise.

20 “(c) RESPONSIBILITY.—The Secretary shall annually
21 solicit from the Industry Alliance—

22 “(1) comments to identify grid modernization
23 technology needs;

24 “(2) an assessment of the progress of the re-
25 search activities on grid modernization; and

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1 “(3) assistance in annually updating grid mod-
2 ernization technology roadmaps.”.

3 **SEC. 8. COORDINATION OF EFFORTS.**

4 In carrying out the amendments made by this Act,
5 the Secretary shall coordinate with relevant entities to the
6 maximum extent practicable, including—

- 7 (1) electric utilities;
8 (2) private sector entities;
9 (3) representatives of all sectors of the electric
10 power industry;
11 (4) transmission organizations;
12 (5) transmission owners and operators;
13 (6) distribution organizations;
14 (7) distribution asset owners and operators;
15 (8) State and local governments and regulatory
16 authorities;
17 (9) academic institutions;
18 (10) the National Laboratories;
19 (11) other Federal agencies;
20 (12) nonprofit organizations;
21 (13) the Federal Energy Regulatory Commis-
22 sion;
23 (14) the North American Reliability Corpora-
24 tion;
25 (15) independent system operators; and

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1 (16) programs and program offices at the De-
2 partment.

3 **SEC. 9. DEFINITIONS.**

4 Title XIII of the Energy Independence and Security
5 Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is
6 amended by adding at the end the following:

7 **“SEC. 1313. DEFINITIONS.**

8 “In this title, the following definitions apply:

9 “(1) **CRITICAL FACILITY.**—The term ‘critical
10 facility’ means a manmade structure that the Sec-
11 retary determines vital to socioeconomic activities
12 such that, if destroyed or damaged, such destruction
13 or damage could cause substantial disruption to
14 such socioeconomic activities.

15 “(2) **DISTRIBUTION AUTOMATION.**—The term
16 ‘distribution automation’ means systems and tech-
17 nologies that exert intelligent control over electrical
18 grid functions at the distribution level.

19 “(3) **RESILIENCE.**—The term ‘resilience’ means
20 the ability to withstand and reduce the magnitude or
21 duration of disruptive events, which includes the ca-
22 pability to anticipate, absorb, adapt to, or rapidly re-
23 cover from such an event, including from deliberate
24 attacks, accidents, and naturally occurring threats
25 or incidents.”.

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1 **SEC. 10. TECHNICAL AMENDMENTS; AUTHORIZATION OF**
 2 **APPROPRIATIONS.**

3 (a) TECHNICAL AMENDMENTS.—

4 (1) ENERGY INDEPENDENCE AND SECURITY
 5 ACT OF 2007.—Section 1(b) of the Energy Inde-
 6 pendence and Security Act of 2007 is amended in
 7 the table of contents—

8 (A) by inserting the following after the
 9 item related to section 136:

“Sec. 137. Research and development into integrating electric vehicles onto the electric grid.”.

10 (B) by inserting the following after the
 11 item related to section 425:

“Sec. 426. Advanced integration of buildings onto the electric grid.”.

12 (C) by inserting the following after the
 13 item related to section 1304:

“Sec. 1304a. Smart grid modeling, visualization, architecture, and controls.”;
 and

14 (D) by inserting the following after the
 15 item related to section 1309:

“Sec. 1310. Grid resilience and emergency response.

“Sec. 1311. Hybrid energy systems.

“Sec. 1312. Industry Alliance.

“Sec. 1313. Definitions.”.

16 (2) ENERGY POLICY ACT OF 2005.—Section
 17 1(b) of the Energy Policy Act of 2005 is amended
 18 in the table of contents by inserting the following
 19 after the item related to section 935:

“Sec. 936. Research and development into integrating renewable energy onto the electric grid.”.

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1 (b) AUTHORIZATION OF APPROPRIATIONS.—There
2 are authorized to be appropriated—

3 (1) to carry out sections 7 and 8 and the
4 amendments made by sections 2 and 3 of this Act—

5 (A) \$170,000,000 for fiscal year 2020;

6 (B) \$175,000,000 for fiscal year 2021;

7 (C) \$180,000,000 for fiscal year 2022;

8 (D) \$185,000,000 for fiscal year 2023;

9 and

10 (E) \$190,000,000 for fiscal year 2024;

11 (2) to carry out section 5 of this Act—

12 (A) \$20,000,000 for fiscal year 2020;

13 (B) \$21,000,000 for fiscal year 2021;

14 (C) \$22,050,000 for fiscal year 2022;

15 (D) \$23,153,000 for fiscal year 2023; and

16 (E) \$24,310,000 for fiscal year 2024; and

17 (3) to carry out section 6 of this Act—

18 (A) \$50,000,000 for fiscal year 2020;

19 (B) \$52,500,000 for fiscal year 2021;

20 (C) \$55,152,000 for fiscal year 2022;

21 (D) \$57,882,000 for fiscal year 2023; and

22 (E) \$60,775,000 for fiscal year 2024.

Chairman LAMB. Without objection, the bill is considered as read, and open to amendment at any point. I recognize myself to present remarks on the bill.

Happy that we are now considering the bipartisan *Grid Modernization Research and Development Act of 2019*, led by myself and Ms. Herrera Beutler of Washington. We all know electricity is critical to our modern economy. Our nation's grid is what powers hospitals, schools, factories, obviously homes. We've seen a lot of changes recently in how our electricity is generated, and how it gets delivered, and as the costs of energy generated from natural gas and renewable sources have gotten lower, these same sources are growing at a rapid rate. This trend is projected to continue for at least the next 30 years, and the system of power plants, transformers, wires, and sensors that carry our electricity today are not yet ready for that transformation, and I think many of us have seen that in different ways in our own districts. We need to invest in research that allows for advancements in adoption of new technologies, and that protects our critical electric infrastructure from natural disasters.

The Department of Energy has an important role to play in this transition. That's why I'm proud to sponsor this bill. We're setting forth a research agenda on topics in grid modernization, directing DOE to develop modeling, simulation, visualization tools to help with the successful operation and control of the grid. The bill also authorizes research and development activities to improve resilience and emergency response, which will help us develop tools and methods that local communities and utilities need to withstand and address the effects of natural disasters on the grid.

The bill also adds important new research on hybrid energy systems that will better integrate nuclear, renewable, storage, and carbon capture technologies onto the grid. This is critical, for the grid to adopt and integrate new technologies that will help us to achieve a cleaner energy future as quickly, cost-effectively, and efficiently as possible. It would also advance the integration of buildings and vehicles with the electrical grid, and direct the Secretary of Energy to establish an industry alliance that is broadly representative of U.S. expertise in electrical grid R&D, infrastructure, operations, and manufacturing to help the Secretary identify R&D needs, assess progress, and update relevant technology road maps about the electrical grid.

This bill will help our Nation. It'll help us to develop the tools and technologies we need to ensure resilience and reliability. It is endorsed by the Edison Electric Institute, the National Rural Electric Cooperative Association, Duke Energy, and the U.S. Chamber of Commerce. I want to thank all of these groups. I also want to thank the Republican Committee staff for working closely with the majority staff to make this bill stronger, and turn it into a true bipartisan piece of legislation. Especially want to thank Ms. Herrera Beutler for her support, and I'm grateful that we were able to come together to start to solve some of the Nation's most pressing challenges in energy.

Does anyone else wish to be recognized? Recognize the gentleman from California for 5 minutes.

Mr. MCNERNEY. I thank the Chairman, and I thank the Committee for moving this bill forward. It's very, very important. This last year in California we had severe wildfires. PG&E and other utilities had to shut down parts of the grid for days, and up to a week at a time. Now, this is going to help not only California, but these sorts of emergencies are going to happen throughout the country because our grid system is aging. We just need to incorporate modern technology so grid can be switched on and off quickly, and I think this is going to move that effort forward, so I urge my colleagues to support this important bill. Thank you, I yield back.

Chairman LAMB. Thank you. We will now proceed with the amendments in the order of the roster. The first amendment on the roster is an amendment offered by the gentleman from California. He is recognized to offer an amendment.

Mr. MCNERNEY. Mr. Chairman, I have an amendment at the desk.

Chairman LAMB. The Clerk will report the amendment.

The CLERK. Amendment No. 1, amendment to H.R. 5428, offered by Mr. McNerney.

[The amendment follows:]

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AMENDMENT TO H.R. 5428
OFFERED BY Mr. McNerney

Page 11, after line 2, insert the following (and re-designate succeeding paragraphs accordingly):

- 1 (2) analysis of non-technical barriers to greater
- 2 integration and use of technologies on the distribu-
- 3 tion grid;



Chairman LAMB. I ask unanimous consent to dispense with the reading. Without objection, so ordered. I recognize the gentleman for 5 minutes to explain the amendment.

Mr. MCNERNEY. I thank the Chairman. While the bill under discussion today addresses some of the technical barriers facing integration of certain components into the distribution grid, non-technical barriers remain. This is an issue that was raised in a 2017 National Academies report that focused on enhancing the resilience of the Nation's electric system. Namely, there exist certain contractual and regulatory barriers to unleashing the full range of use of distributed energy resources on the distribution grid, including for the restoration of power after an outage, which, as I just mentioned, is important in my State of California.

My amendment simply asks the Department of Energy to analyze these non-technical barriers in order to enable greater integration and use of the technologies on the distribution grid. Doing so will enable the DOE to better understand the role that these technologies can play in increasing the overall resilience of the grid, whether they be privately owned microgrids, rooftop solar projects, or devices that feed the energy from an electric vehicle back into the power grid.

Enhancing and ensuring grid resilience is an issue that I am very passionate about, and that's why I am a proud co-Chair of the bipartisan Grid Innovation Caucus, along with my good friend and colleague, Representative Bob Latta of Ohio. Together, we are focused on providing a forum for discussing solutions to the challenges facing the grid, and for educating Members of Congress, and their staff, about the importance of the electric grid, with relation to the economy, energy security, and advanced technologies being utilized to enhance grid capabilities. I urge my fellow Members to support my amendment, and I yield back.

Chairman LAMB. Is there further discussion on the amendment? The vote will occur on the amendment. All in favor say aye. Those opposed say no. The ayes have it, and the amendment is agreed to. Are there any other amendments? A reporting quorum being present, I move that the Energy Subcommittee of the Committee on Science, Space, and Technology report H.R. 5428, as amended, to the full Committee, with the recommendation that the bill be approved. Those in favor of the motion will signify by saying aye. Opposed, no. The ayes have it, and the bill is favorably reported.

Without objection, the motion to reconsider is laid upon the table. I ask unanimous consent that staff be authorized to make any necessary technical and conforming changes to the bill. Without objection, so ordered. Members will have 2 subsequent calendar days in which to submit supplemental, minority, or additional views on the measure.

I want to thank the Members for their attendance, and I want to wrap up the year 2019 in particular by thanking our excellent staff, who take good care of us all the time, have helped us pass a large number of authorization bills, almost entirely unanimously this year, which I think has been a bright light in this otherwise troubled Congress. Your work does not go unnoticed. It often, probably not often enough, goes unthanked, but we really do appreciate

it, and I hope you all have a restful holiday season. And I believe that the Ranking Member would like to be recognized.

Mr. WEBER. Thank you, Mr. Chairman, and I apologize for my tardiness. Turns out the dog had eaten my voting card, and so I want to thank you to holding this, and appreciate the staff very much, and all of the work that they've put in. They do make us look good.

Chairman LAMB. Some of us.

Mr. WEBER. Some of us, all right. Why did he look at me when he said that? Anyway, I would like to have my statement submitted for the record, if that's fine, and I appreciate you all, and I wish you all a very Merry Christmas, and I yield back.

Chairman LAMB. Without objection, so ordered. The hearing is now adjourned. Thank you.

[Whereupon, at 11:18 a.m., the Subcommittee was adjourned.]

XXI. PROCEEDINGS OF THE FULL COMMITTEE MARKUP

MARKUPS:
H.R. 2986, THE BETTER ENERGY STORAGE
TECHNOLOGY (BEST) ACT;
H.R. 4230, THE CLEAN INDUSTRIAL
TECHNOLOGY (CIT) ACT OF 2019;
H.R. 5374, THE ADVANCED GEOTHERMAL
RESEARCH AND DEVELOPMENT ACT OF 2019;
H.R. 5428, THE GRID MODERNIZATION
RESEARCH AND DEVELOPMENT
ACT OF 2019; AND
H.R. 5760, THE GRID SECURITY RESEARCH
AND DEVELOPMENT ACT

MARKUP

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND
TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTEENTH CONGRESS

SECOND SESSION

FEBRUARY 12, 2020

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C O N T E N T S

Wednesday, February 12, 2020

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**Markup on H.R. 2986,
Better Energy Storage Technology Act
or the BEST Act**

**Markup on H.R. 4230, Clean Industrial
Technology Act of 2019 or CIT Act of 2019**

**Markup on H.R. 5374,
Advanced Geothermal Research
and Development Act of 2019**

**Markup on H.R. 5428,
Grid Modernization Research
and Development Act of 2019**

**Markup on H.R. 5760,
Grid Security Research and Development Act**

WEDNESDAY, FEBRUARY 12, 2020

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Committee met, pursuant to notice, at 10 o'clock a.m., in room 2318 of the Rayburn House Office Building, Hon. Eddie Bernice Johnson [Chairwoman of the Committee] presiding.

Chairwoman JOHNSON. Good morning. The Committee will come to order. Without objection, the Chair is authorized to declare recess at any time. Pursuant to Committee rule and the House rules, the Chair announces that she may postpone roll call votes.

Pursuant to notice, the Committee meets to consider the following measures: H.R. 2986, *Better Energy Storage Technology Act*; H.R. 4230, *Clean Industrial Technology Act of 2019*; H.R. 5374, *Advanced Geothermal Research and Development Act of 2019*; H.R. 5428, *Grid Modernization Research and Development Act of 2019*; H.R. 5760, *Grid Security Research and Development Act*.

We welcome all to the Science Committee markup of five good, bipartisan bills. First, we will consider the *Better Energy Storage Technology Act (BEST ACT)*. The *BEST Act* authorizes the Department of Energy to conduct a crosscutting research, development, and demonstration program on energy storage technologies, including batteries and pumped hydro systems. The act requires DOE (Department of Energy) to create a 5-year strategic plan to coordinate research activities among DOE's technology offices.

Renewable energy technology can be intermittent. Strong winds die down, and sunny days turn cloudy. According to the Congressional Research Service, energy storage systems may be a key technology to enabling a reliable, low greenhouse-gas-emitting electric grid comprised of energy generation sources like wind and solar.

Next, we have H.R. 4230, the *Clean Industrial Technology Act of 2019*. The act authorizes an interagency, DOE-led research, development, and demonstration program to advance technologies that will help reduce emissions from the manufacturing sector, including steel and cement production, chemical production, and industrial heat. The research program will be carried out in collaboration with the stakeholders from industry and labor groups. Allowing American manufacturers to access technologies that make them increasingly sustainable will ensure that the domestic manufacturing industry will remain competitive throughout the 21st century.

We will then move to H.R. 5374, the *Advanced Geothermal Research and Development Act of 2019*. I will speak about this bill a little bit later.

Next is H.R. 5428, the *Grid Modernization Research and Development Act of 2019*, which authorizes a broad research, development, and demonstration program on a wide variety of topics pertaining to grid modernization, including smart grid modeling, planning, and controls; hybrid energy systems; and enhanced electric grid integration of technologies like vehicles and building components. Our Nation's electricity grid is undergoing a series of transformations, which includes adapting to a changing electricity generation mix, an increase in smart-grid technologies, and a growing need for improved resilience of the electric power grid. This bill will help lead our Nation in developing the technologies we need by setting forth a comprehensive research agenda by the DOE.

Finally, we'll be considering H.R. 5760, the *Grid Security Research and Development Act*. This bill is an updated version of a bill that Mr. Bera and I introduced, along with many of our Science Committee colleagues, in the previous two Congresses. H.R. 5760 will provide legislative guidance to activities carried out by the re-

cently established DOE Office of Cybersecurity, Energy Security, and Emergency Response. The bill authorizes an interagency research and development program to advance electric grid cybersecurity, physical security, grid resilience, and emergency response efforts. In particular, the bill authorizes activities on the cybersecurity testbeds, education and workforce training and standards, and guidance documents for energy sector cybersecurity practices.

I'm proud that today's bills are supported by a cross-section of interested groups. One or more of today's bills has been endorsed by organizations that include the National Audubon Society, the U.S. Chamber of Commerce, the Information Technology and Innovation Foundation, the Environmental Defense Fund, the National Rural Electric Cooperatives Association, Duke Energy, the Union of Concerned Scientists, the Natural Resources Defense Fund, and the National Association of Manufacturers.

Thank you.

[The statement of Chairwoman Johnson follows:]

Good morning, and welcome to today's Science Committee markup of five good, bipartisan bills.

First, we will consider H.R. 2986, the Better Energy Storage Technology Act. The BEST Act authorizes the Department of Energy to conduct a cross-cutting research, development, and demonstration program on energy storage technologies, including batteries and pumped hydro systems. The Act requires DOE create a 5-year strategic plan to coordinate research activities among DOE's technology offices.

Renewable energy technology can be intermittent. Strong winds die down, and sunny days turn cloudy. According to the Congressional Research Service, energy storage systems may be a key technology to enabling a reliable, low greenhouse gas emitting electric grid comprised of energy generation sources like wind and solar.

Next we have H.R. 4230, the Clean Industrial Technology Act of 2019. This act authorizes an intra-agency, DOE-led research, development, and demonstration program to advance technologies that will help reduce emissions from the manufacturing sector, including steel and cement production, chemical production, and industrial heat. The research program will be carried out in collaboration with stakeholders from industry and labor groups.

Allowing American manufacturers to access technologies that make them increasingly sustainable will ensure that the domestic manufacturing industry will remain competitive through the 21st Century.

We will then move on to H.R. 5374, the Advanced Geothermal Research and Development Act of 2019. I will speak about this bill a little later.

Next is H.R. 5428, the Grid Modernization Research and Development Act of 2019, which authorizes a broad research, development, and demonstration program on a wide variety of topics pertaining to grid modernization, including smart grid modeling, planning, and controls; hybrid energy systems; and enhanced electric grid integration of technologies like vehicles and building components.

Our nation's electricity grid is undergoing a series of transformations, which include adapting to a changing electricity generation mix, an increase in "smart grid" technologies, and a growing need to improve the resilience of the electric power grid. This bill will help lead our nation in developing the technologies we need by setting forth a comprehensive research agenda led by the DOE.

Finally, we'll be considering H.R. 5760, the Grid Security Research and Development Act. This bill is an updated version of a bill that Mr. Bera and I introduced, along with many of our Science Committee colleagues, in the previous two Congresses.

H.R. 5760 will provide legislative guidance to the activities carried out by the recently established DOE Office of Cybersecurity, Energy Security, and Emergency Response. The bill authorizes an interagency research and development program to advance electric grid cybersecurity, physical security, grid resilience, and emergency response efforts. In particular, the bill authorizes activities on cybersecurity testbeds, education and workforce training and standards, and guidance documents for energy sector cybersecurity practices.

I am proud that today's bills are supported by a cross-section of interested groups. One or more of today's bills has been endorsed by organizations that include: the

National Audubon Society, the U.S. Chamber of Commerce, the Information Technology & Innovation Foundation (ITIF), the Environmental Defense Fund (EDF), the National Rural Electric Cooperative Association, Duke Energy, the Union of Concerned Scientists, the Natural Resources Defense Fund, and the National Association of Manufacturers.

Chairwoman JOHNSON. I now recognize our Ranking Member for his opening remarks.

Mr. LUCAS. Thank you, Chairwoman Johnson, for holding today's full Committee markup.

The Science Committee has one of the best records in Congress for passing productive, bipartisan legislation, and I'm very pleased to see us upholding that tradition this morning. We've reached bipartisan agreement on the five energy bills being considered today.

Currently, the U.S. energy sector faces a number of critical challenges, and it can be difficult to find the best path forward in a world that increasingly demands cleaner, more reliable, and more affordable energy sources. But it is our job in Congress to set the priorities to address these challenges and focus our limited Federal resources where we can see the best return on investment.

To deliver truly effective solutions, we must take the long-term and big-picture approach. We must support research in fundamental science that drives innovation over a broad range of energy applications and strategically invest in the early stage clean-energy technologies that industry cannot support. We must also provide for R&D (research and development) to modernize and defend our critical energy infrastructure and address the complex energy needs of our Nation's industrial sectors. These are the initiatives that today's bills will address.

First, we'll consider this morning H.R. 2986, the *BEST Energy Storage Technology Act of 2019*. This legislation authorizes a cross-cutting research and development program at the Department of Energy to provide necessary direction on high-priority energy storage technology research and development activities. Advanced grid scale energy storage is an essential component of any comprehensive clean-energy strategy and a priority of the current Administration. Developing our grid scale energy storage ability will accelerate the growth in all kinds of energy production, which can make use of this technology.

Our second bill this morning is H.R. 4230, the *Clean Industrial Technology Act of 2019*. Our Nation's economic stability and national security are tied to the growth of the U.S. industrial sector, yet the demanding energy needs of industry can represent a unique challenge for our clean and secure future energy. This bill establishes a DOE program to support the development of innovative technologies and practices that will reduce industrial sector emissions while maintaining the effectiveness and competitiveness of U.S. industry. It also requires the Secretary to establish a comprehensive strategy to develop the mission and goals for this new program.

While I can't say I agree with every aspect of this legislation, I'd like to thank our friends across the aisle for meeting us at the table to come to an agreement. By having a good-faith discussion, we were able to add responsible funding levels and good governance provisions to H.R. 4230 that will make this legislation a bipartisan product.

Next, we'll consider my bill, H.R. 5374, the *Advanced Geothermal Research and Development Act of 2019*, which authorizes DOE's cutting-edge geothermal research and development activities. This bill establishes a geothermal computing program and includes funding for critical geothermal user facilities that will support the next generation of electricity generation from these vast and largely untapped renewable resources. I would like to thank Chairwoman Johnson for cosponsoring this legislation and working with me to refine it.

While many renewables like wind and solar are already seeing success in the market, early stage technologies like geothermal, which are often far too expensive and risky for industry to take to scale, require Federal support for R&D. By strategically investing in these promising technologies, we can continue to enhance our diverse domestic energy portfolio and bolster U.S. energy independence. While we support next-generation energy technologies and clean-energy strategies, we must also increase our investment in our critical energy infrastructure.

So, finally, the Committee will consider H.R. 5428, the *Grid Modernization Research and Development Act of 2019*, and H.R. 5760, the *Grid Security Research and Development Act*. Together, these two bills authorize DOE's critical work in strengthening our Nation's electric grid against rapidly changing technological challenges. The *Grid Security Research and Development Act* authorizes the Department's critical cybersecurity and emergency response R&D activities and directs DOE to work with relevant Federal agencies to develop cybersecurity best practices. The *Grid Modernization Research and Development Act* authorizes R&D into hybrid energy systems, grid integration, and smart grid modeling, modernizing the grid to improve its overall resilience and flexibility.

I'd like to take this opportunity to thank my good friends across the aisle for working with us on these bills. I appreciate that we can come together to focus on our shared interest in supporting commonsense legislation to maintain U.S. national security, environmental stewardship, economic prosperity, and energy security for years to come. And I'd like to again thank Chairwoman Johnson for holding this markup, and I yield back the balance of my time.

[The statement of Mr. Lucas follows:]

Thank you, Chairwoman Johnson, for holding today's full Committee mark-up.

The Science Committee has one of the best track records in Congress for passing productive, bipartisan legislation, and I'm very pleased to see us upholding that tradition this morning. We've reached bipartisan agreement on the five energy bills being considered today.

Currently, the U.S. energy sector faces a number of critical challenges, and it can be difficult to find the best path forward in a world that increasingly demands cleaner, more reliable, and more affordable energy sources. But it is our job in Congress to set the priorities to address these challenges and focus our limited federal funds where we can see the best return on investment.

To deliver truly effective solutions, we must take the long-term and big picture approach. We must support research in fundamental science that drives innovation over a broad range of energy applications, and strategically invest in the early-stage clean energy technologies that industry cannot support. We must also provide for R&D to modernize and defend our critical energy infrastructure and address the complex energy needs of our nation's industrial sectors. These are the initiatives that today's bills will address.

The first bill we will consider this morning is H.R. 2986, the "Better Energy Storage Technology Act of 2019." This legislation authorizes a cross-cutting research and development program at the Department of Energy (DOE) to provide necessary direction on high-priority energy storage technology research and development activities.

Advanced grid scale energy storage is an essential component of any comprehensive clean energy strategy and a priority of the current administration. Developing our grid scale energy storage ability will accelerate growth in all kinds of energy production, which can make use of this technology.

Our second bill this morning is H.R. 4230, the "Clean Industrial Technology Act of 2019." Our nation's economic stability and national security are tied to the growth of the U.S. industrial sector.

Yet the demanding energy needs of industry can represent a unique challenge for our clean and secure energy future. This bill establishes a DOE program to support the development of innovative technologies and practices that will reduce industrial sector emissions while maintaining the effectiveness and competitiveness of U.S. industry. It also requires the Secretary to establish a comprehensive strategy to develop the mission and goals for this new program.

While I can't say I agree with every aspect of this legislation, I would like to thank our friends across the aisle for meeting us at the table to come to an agreement. By having a good-faith discussion, we were able to add responsible funding levels and good governance provisions to H.R. 4230 that will make this legislation a bipartisan product.

Next we will consider my bill, H.R. 5374, the "Advanced Geothermal Research and Development Act of 2019" which authorizes DOE's cutting-edge geothermal research and development activities. This bill establishes a geothermal computing program and includes funding for critical geothermal energy user facilities that will support the next generation of electricity generation from these vast and largely untapped renewable resources. I would like to thank Chairwoman Johnson for cosponsoring this legislation and for working with me to refine it.

While many renewables like wind and solar are already seeing success in the market, early stage technologies like geothermal, which are often far too expensive and risky for industry to take to scale, require federal support for R&D. By strategically investing in these promising technologies we can continue to enhance our diverse domestic energy portfolio and bolster U.S. energy independence.

While we support next-generation energy technologies and clean energy strategies, we must also increase our investment in our critical energy infrastructure. So finally, the Committee will consider H.R. 5428, the "Grid Modernization Research and Development Act of 2019" and H.R. 5760, the "Grid Security Research and Development Act."

Together, these two bills authorize DOE's critical work in strengthening our nation's electric grid against rapidly changing technological challenges. The Grid Security Research and Development Act authorizes the Department's crucial cybersecurity and emergency response R&D activities and directs DOE to work with relevant Federal agencies to develop cybersecurity best practices. The Grid Modernization Research and Development Act authorizes R&D into hybrid energy systems, grid integration, and smart grid modeling - modernizing the grid to improve its overall resilience and flexibility.

I'd like to take this opportunity to thank my good friends across the aisle for working with us on these bills. I appreciate that we can come together to focus on our shared interest in supporting commonsense legislation to maintain U.S. national security, environmental stewardship, economic prosperity, and energy security for years to come. I'd like to again thank Chairwoman Johnson for holding this markup and I yield back the balance of my time.

Chairwoman JOHNSON. Thank you very much.

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Next, we have before us 5428 for consideration. The Chair will now consider the *Grid Modernization Research and Development Act of 2019*. And the clerk will report the bill.

The CLERK. Committee print to H.R. 5428——
[The bill follows:]

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COMMITTEE PRINT

[Showing the text of H.R. 5428 as forwarded by the
Subcommittee on Energy on December 19, 2019]

1 SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

2 (a) SHORT TITLE.—This Act may be cited as the
3 “Grid Modernization Research and Development Act of
4 2019”.

5 (b) TABLE OF CONTENTS.—The table of contents for
6 this Act is as follows:

- Sec. 1. Short title; table of contents.
- Sec. 2. Smart grid regional demonstration initiative.
- Sec. 3. Smart grid modeling, visualization, architecture, and controls.
- Sec. 4. Enhancing grid resilience and emergency response.
- Sec. 5. Hybrid energy systems.
- Sec. 6. Grid integration research and development.
- Sec. 7. Industry alliance.
- Sec. 8. Coordination of efforts.
- Sec. 9. Definitions.
- Sec. 10. Technical amendments; authorization of appropriations.

**7 SEC. 2. SMART GRID REGIONAL DEMONSTRATION INITIA-
8 TIVE.**

9 Section 1304 of the Energy Independence and Secu-
10 rity Act of 2007 (42 U.S.C. 17384) is amended—

11 (1) in subsection (a), by inserting “research,
12 development, and demonstration” before “program”;

13 (2) in subsection (b)—

14 (A) by amending paragraph (1) to read as
15 follows:

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1 “(1) The Secretary shall establish a smart grid
 2 regional demonstration initiative (referred to in this
 3 subsection as the ‘Initiative’) composed of dem-
 4 onstration projects focused on cost-effective, ad-
 5 vanced technologies for use in power grid sensing,
 6 communications, analysis, power flow control, visual-
 7 ization, distribution automation, industrial control
 8 systems, dynamic line rating systems, grid redesign,
 9 and the integration of distributed energy re-
 10 sources.”; and

11 (B) in paragraph (2)—

12 (i) in subparagraph (D), by striking
 13 “and”;

14 (ii) in subparagraph (E), by striking
 15 the period and inserting “; and”; and

16 (iii) by inserting at the end the fol-
 17 lowing:

18 “(F) to encourage the commercial applica-
 19 tion of advanced distribution automation tech-
 20 nologies that improve system resilience.”.

21 **SEC. 3. SMART GRID MODELING, VISUALIZATION, ARCHI-**
 22 **TECTURE, AND CONTROLS.**

23 Title XIII of the Energy Independence and Security
 24 Act of 2007 (42 U.S.C. 17381 et seq.) is amended by in-
 25 serting after section 1304 the following:

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1 . **“SEC. 1304a. SMART GRID MODELING, VISUALIZATION, AR-**
2 **CHITECTURE, AND CONTROLS.**

3 “(a) IN GENERAL.—Not later than 180 days after
4 the enactment of the Grid Modernization Research and
5 Development Act of 2019, the Secretary shall establish a
6 program of research, development, demonstration, and
7 commercial application on electric grid modeling, sensing,
8 visualization, architecture development, and advanced op-
9 eration and controls.

10 “(b) MODELING RESEARCH AND DEVELOPMENT.—
11 The Secretary shall support development of models of
12 emerging technologies and systems to facilitate the secure
13 and reliable design, planning, and operation of the electric
14 grid for use by industry stakeholders. In particular, the
15 Secretary shall support development of—

16 “(1) models to analyze and predict the effects
17 of adverse physical and cyber events on the electric
18 grid;

19 “(2) coupled models of electrical, physical, and
20 cyber systems;

21 “(3) models of existing and emerging tech-
22 nologies being deployed on the electric grid due to
23 projected changes in the electric generation mix and
24 loads, for a variety of regional characteristics; and

25 “(4) integrated models of the communications,
26 transmission, distribution, and other interdependent

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1 systems for existing, new, and emerging tech-
2 nologies.

3 “(c) SITUATIONAL AWARENESS RESEARCH AND DE-
4 VELOPMENT.—

5 “(1) IN GENERAL.—The Secretary shall sup-
6 port development of computational tools and tech-
7 nologies to improve sensing, monitoring, and visual-
8 ization of the electric grid for real-time situational
9 awareness and decision support tools that enable im-
10 proved operation of the power system, including util-
11 ity, non-utility, and customer grid-connected assets,
12 for use by industry partners.

13 “(2) DATA USE.—In developing visualization
14 capabilities under this section, the Secretary shall
15 develop tools for industry stakeholders to use to ana-
16 lyze data collected from advanced measurement and
17 monitoring technologies, including data from phasor
18 measurement units and advanced metering units.

19 “(3) SEVERE EVENTS.—The Secretary shall
20 prioritize enhancing cyber and physical situational
21 awareness of the electric grid during adverse man-
22 made and naturally-occurring events.

23 “(d) ARCHITECTURE.—The Secretary shall conduct
24 research in collaboration with industry stakeholders to de-
25 velop model grid architectures to assist with wide-area

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1 transmission and distribution planning that incorporate
2 expected changes to the modern electric grid. In sup-
3 porting the development of model grid architectures, the
4 Secretary shall—

5 “(1) analyze a variety of grid architecture sce-
6 narios that range from minor upgrades to existing
7 transmission grid infrastructure to scenarios that in-
8 volve the replacement of significant portions of exist-
9 ing transmission grid infrastructure;

10 “(2) analyze the effects of the increasing pro-
11 liferation of renewable and other zero emissions en-
12 ergy generation sources, increasing use of distrib-
13 uted resources owned by non-utility entities, and the
14 use of digital and automated controls not managed
15 by grid operators;

16 “(3) include a variety of new and emerging dis-
17 tribution grid technologies, including distributed en-
18 ergy resources, electric vehicle charging stations, dis-
19 tribution automation technologies, energy storage,
20 and renewable energy sources;

21 “(4) analyze the effects of local load balancing
22 and other forms of decentralized control;

23 “(5) analyze the effects of changes to grid ar-
24 chitectures resulting from modernizing electric grid
25 systems, including communications, controls, mar-

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1 kets, consumer choice, emergency response, elec-
2 trification, and cybersecurity concerns; and

3 “(6) develop integrated grid architectures that
4 incorporate system resilience for cyber, physical, and
5 communications systems.

6 “(e) OPERATION AND CONTROLS RESEARCH AND
7 DEVELOPMENT.—The Secretary shall conduct research to
8 develop improvements to the operation and controls of the
9 electric grid, in coordination with industry partners. Such
10 activities shall include—

11 “(1) a training facility or facilities to allow grid
12 operators to gain operational experience with ad-
13 vanced grid control concepts and technologies;

14 “(2) development of cost-effective advanced op-
15 eration and control concepts and technologies, such
16 as adaptive islanding, dynamic line rating systems,
17 power flow controllers, network topology optimiza-
18 tion, smart circuit breakers, intelligent load shed-
19 ding, and fault-tolerant control system architectures;

20 “(3) development of real-time control concepts
21 using artificial intelligence and machine learning for
22 improved electric grid resilience; and

23 “(4) utilization of advanced data analytics in-
24 cluding load forecasting, power flow modeling, equip-

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1 ment failure prediction, resource optimization, risk
2 analysis, and decision analysis.

3 “(f) COMPUTING RESOURCES AND DATA COORDINA-
4 TION RESEARCH AND DEVELOPMENT.—In carrying out
5 this section, the Secretary shall—

6 “(1) leverage existing computing resources at
7 the National Laboratories;

8 “(2) develop voluntary standards for data
9 taxonomies and communication protocols in coordi-
10 nation with public and private sector stakeholders;
11 and

12 “(3) comply with section 8 of the Grid Mod-
13 ernization Research and Development Act of 2019.

14 “(g) INFORMATION SHARING.—None of the activities
15 authorized in this section shall require private entities to
16 share information or data with the Secretary.”.

17 **SEC. 4. ENHANCING GRID RESILIENCE AND EMERGENCY**
18 **RESPONSE.**

19 Title XIII of the Energy Independence and Security
20 Act of 2007 (42 U.S.C. 17381 et. seq.) is amended by
21 adding at the end the following:

22 **“SEC. 1310. GRID RESILIENCE AND EMERGENCY RESPONSE.**

23 “(a) IN GENERAL.—Not later than 180 days after
24 the enactment of the Grid Modernization Research and
25 Development Act of 2019, the Secretary shall establish a

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1 research, development, and demonstration program to en-
2 hance resilience and strengthen emergency response and
3 management pertaining to the electric grid.

4 “(b) GRANTS.—The Secretary shall award grants to
5 eligible entities under subsection (c) on a competitive basis
6 to conduct research and development with the purpose of
7 improving the resilience and reliability of electric grid by—

8 “(1) developing methods to improve community
9 and governmental preparation for and emergency re-
10 sponse to large-area, long-duration electricity inter-
11 ruptions, including through the use of energy effi-
12 ciency, storage, and distributed generation tech-
13 nologies;

14 “(2) developing tools to help utilities and com-
15 munities ensure the continuous delivery of electricity
16 to critical facilities;

17 “(3) developing tools to improve coordination
18 between utilities and relevant Federal agencies to
19 enable communication, information-sharing, and sit-
20 uational awareness in the event of a physical or
21 cyber attack on the electric grid;

22 “(4) developing technologies and capabilities to
23 withstand and address the current and projected im-
24 pact of the changing climate on electric grid infra-

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1 structure, including extreme weather events and
2 other natural disasters;

3 “(5) developing technologies capable of early
4 detection of deteriorating electrical equipment on the
5 transmission and distribution grid, including detec-
6 tion of spark ignition from wildfires and risks of
7 vegetation contact; and

8 “(6) assessing upgrades and additions needed
9 to electric grid infrastructure due to projected
10 changes in the electricity generation mix and elec-
11 tricity demand.

12 “(c) ELIGIBLE ENTITIES.—The entities eligible to re-
13 ceive grants under this section include—

14 “(1) an institution of higher education;

15 “(2) a nonprofit organization;

16 “(3) a National Laboratory;

17 “(4) a unit of State, local, or tribal government;

18 “(5) an electric utility or electric cooperative;

19 “(6) a retail service provider of electricity;

20 “(7) a private commercial entity;

21 “(8) a partnership or consortium of 2 or more
22 entities described in subparagraphs (1) through (7).

23 “(d) RELEVANT ACTIVITIES.—Grants awarded under
24 subsection (b) shall include funding for research and de-

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1 velopment activities related to the purpose described in
2 subsection (b), such as—

3 “(1) development of technologies to use distrib-
4 uted energy resources, such as solar photovoltaics,
5 energy storage systems, electric vehicles, and
6 microgrids to improve grid and critical end-user re-
7 siliience;

8 “(2) analysis of non-technical barriers to great-
9 er integration and use of technologies on the dis-
10 tribution grid;

11 “(3) analysis of past large-area, long-duration
12 electricity interruptions to identify common elements
13 and best practices for electricity restoration, mitiga-
14 tion, and prevention of future disruptions;

15 “(4) development of advanced monitoring, ana-
16 lytics, operation, and controls of electricity grid sys-
17 tems to improve electric grid resilience;

18 “(5) analysis of technologies, methods, and con-
19 cepts that can improve community resilience and
20 survivability of frequent or long-duration power out-
21 ages;

22 “(6) development of methodologies to maintain
23 cybersecurity during restoration of electric grid in-
24 frastructure and operation;

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1 “(7) development of advanced power flow con-
2 trol systems and components to improve electric grid
3 resilience; and

4 “(8) any other relevant activities determined by
5 the Secretary.

6 “(c) TECHNICAL ASSISTANCE.—

7 “(1) IN GENERAL.—The Secretary shall provide
8 technical assistance to eligible entities for the com-
9 mercial application of technologies to improve the re-
10 siliency of the electric grid and commercial applica-
11 tion of technologies to help entities develop plans for
12 preventing and recovering from various power out-
13 age scenarios at the local, regional, and State level.

14 “(2) TECHNICAL ASSISTANCE PROGRAM.—The
15 technical assistance program established in para-
16 graph (1) shall include assistance to eligible entities
17 for—

18 “(A) the commercial application of tech-
19 nologies developed from the grant program es-
20 tablished in subsection (b), including municipal
21 and cooperative utilities;

22 “(B) the development of methods to
23 strengthen or otherwise mitigate adverse im-
24 pacts on electric grid infrastructure against
25 natural hazards;

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1 “(C) the use of Department data and mod-
2 eling tools for various purposes; and

3 “(D) a resource assessment and analysis of
4 future demand and distribution requirements,
5 including development of advanced grid archi-
6 tectures and risk analysis.

7 “(3) ELIGIBLE ENTITIES.—The entities eligible
8 to receive technical assistance for commercial appli-
9 cation of technologies under this section include—

10 “(A) representatives of all sectors of the
11 electric power industry, including electric utili-
12 ties, trade organizations, and transmission and
13 distribution system organizations, owners, and
14 operators;

15 “(B) State and local governments and reg-
16 ulatory authorities, including public utility com-
17 missions;

18 “(C) tribal and Alaska Native govern-
19 mental entities;

20 “(D) partnerships among entities under
21 subparagraphs (A) through (C);

22 “(E) regional partnerships; and

23 “(F) any other entities the Secretary
24 deems appropriate.

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1 “(4) **AUTHORITY.**—Nothing in this section shall
2 authorize the Secretary to require any entity to
3 adopt any model, tool, technology, plan, analysis, or
4 assessment.

5 “(f) **COORDINATION.**—In carrying out this section,
6 the Secretary shall comply with section 8 of the Grid Mod-
7 ernization Research and Development Act of 2019.”.

8 **SEC. 5. HYBRID ENERGY SYSTEMS.**

9 Title XIII of the Energy Independence and Security
10 Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is
11 amended by adding at the end the following:

12 **“SEC. 1311. HYBRID ENERGY SYSTEMS.**

13 “(a) **IN GENERAL.**—Not later than 180 days after
14 the enactment of the Grid Modernization Research and
15 Development Act of 2019, the Secretary shall establish a
16 research, development, and demonstration program to de-
17 velop cost-effective hybrid energy systems, including—

18 “(1) development of computer modeling to de-
19 sign different configurations of hybrid energy sys-
20 tems and to optimize system operation;

21 “(2) research on system integration needed to
22 plan, design, build, and operate hybrid energy sys-
23 tems, including interconnection requirements with
24 the electric grid;

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1 “(3) development of hybrid energy systems for
2 various applications, including—

3 “(A) thermal energy generation and stor-
4 age for buildings and manufacturing;

5 “(B) electricity storage coupled with en-
6 ergy generation;

7 “(C) desalination;

8 “(D) production of liquid and gaseous
9 fuels; and

10 “(E) production of chemicals such as am-
11 monia and ethylene;

12 “(4) development of testing facilities for hybrid
13 energy systems; and

14 “(5) research on incorporation of various tech-
15 nologies for hybrid energy systems, including nuclear
16 energy, renewable energy, storage, and carbon cap-
17 ture, utilization, and sequestration technologies.

18 “(b) STRATEGIC PLAN.—

19 “(1) IN GENERAL.—Not later than 1 year after
20 the date of the enactment of the Grid Modernization
21 Research and Development Act of 2019, the Sec-
22 retary shall submit to the Committee on Science,
23 Space, and Technology of the House of Representa-
24 tives and the Committee on Energy and Natural Re-
25 sources of the Senate a strategic plan that identifies

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1 opportunities, challenges, and standards needed for
2 the development and commercial application of hy-
3 brid energy systems. The strategic plan shall in-
4 clude—

5 “(A) analysis of the potential benefits of
6 development of hybrid electric systems on the
7 electric grid;

8 “(B) analysis of the potential contributions
9 of hybrid energy systems to different grid archi-
10 tecture scenarios;

11 “(C) research and development goals for
12 various hybrid energy systems, including those
13 identified in subsection (b);

14 “(D) assessment of policy and market bar-
15 riers to the adoption of hybrid energy systems;

16 “(E) analysis of the technical and eco-
17 nomic feasibility of adoption of different hybrid
18 energy systems; and

19 “(F) a 10-year roadmap to guide the pro-
20 gram established under subsection (a).

21 “(2) UPDATES.—Not less than once every 3
22 years for the duration of this research program, the
23 Secretary shall submit an updated version of the
24 strategic plan to the Committee on Science, Space,
25 and Technology of the House of Representatives and

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1 the Committee on Energy and Natural Resources of
2 the Senate.

3 “(c) PROGRAM IMPLEMENTATION.—In carrying out
4 the research, development, demonstration, and commercial
5 application aims of section, the Secretary shall—

6 “(1) implement the recommendations set forth
7 in the strategic plan in subsection (b);

8 “(2) coordinate across all relevant program of-
9 fices at the Department, including—

10 “(A) the Office of Energy Efficiency and
11 Renewable Energy;

12 “(B) the Office of Nuclear Energy; and

13 “(C) the Office of Fossil Energy;

14 “(3) leverage existing programs and resources
15 of the Department;

16 “(4) prioritize activities that accelerate the de-
17 velopment of integrated electricity generation, stor-
18 age, and distribution systems with net zero green-
19 house gas emissions; and

20 “(5) comply with section 8 of the Grid Mod-
21 ernization Research and Development Act of 2019.

22 “(d) HYBRID ENERGY SYSTEM DEFINED.—The term
23 ‘hybrid energy system’ means a system composed of 2 or
24 more co-located or jointly operated sub-systems of energy
25 generation, energy storage, or other energy technologies.”.

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1 **SEC. 6. GRID INTEGRATION RESEARCH AND DEVELOP-**
2 **MENT.**

3 (a) INTEGRATING DISTRIBUTED ENERGY RE-
4 SOURCES ONTO THE ELECTRIC GRID.—Section 925(a) of
5 the Energy Policy Act of 2005 (42 U.S.C. 16215) is
6 amended by—

7 (1) redesignating paragraphs (10) and (11) as
8 paragraphs (12) and (13), respectively; and

9 (2) inserting after paragraph (9) the following:

10 “(10) the development of cost-effective tech-
11 nologies that enable two-way information and power
12 flow between distributed energy resources and the
13 electric grid;

14 “(11) the development of technologies and con-
15 cepts that enable interoperability between distributed
16 energy resources and other behind-the-meter devices
17 and the electric grid;”.

18 (b) INTEGRATING RENEWABLE ENERGY ONTO THE
19 ELECTRIC GRID.—Subtitle C of title LX of the Energy
20 Policy Act of 2005 (42 U.S.C. 16231 et seq.) is amended
21 by adding at the end the following:

22 **“SEC. 936. RESEARCH AND DEVELOPMENT INTO INTE-**
23 **GRATING RENEWABLE ENERGY ONTO THE**
24 **ELECTRIC GRID.**

25 “(a) IN GENERAL.—Not later than 180 days after
26 the enactment of the Grid Modernization Research and

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1 Development Act of 2019, the Secretary shall establish a
2 research, development, and demonstration program on
3 technologies that enable integration of renewable energy
4 generation sources onto the electric grid across multiple
5 program offices of the Department. The program shall in-
6 clude—

7 “(1) forecasting for predicting generation from
8 variable renewable energy sources;

9 “(2) development of cost-effective low-loss, long-
10 distance transmission lines; and

11 “(3) development of cost-effective advanced
12 technologies for variable renewable generation
13 sources to provide grid services.

14 “(b) COORDINATION.—In carrying out this program,
15 the Secretary shall—

16 “(1) coordinate across all relevant program of-
17 fices at the Department to achieve the goals estab-
18 lished in this section, including the Office of Elec-
19 tricity; and

20 “(2) comply with section 8 of the Grid Mod-
21 ernization Research and Development Act of 2019.

22 “(c) ADOPTION OF TECHNOLOGIES.—In carrying out
23 this section, the Secretary shall consider barriers to adop-
24 tion and commercial application of technologies that en-
25 able integration of renewable energy sources onto the elec-

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1 tric grid, including cost and other economic barriers, and
2 shall coordinate with relevant entities to reduce these bar-
3 riers.”.

4 (c) INTEGRATING ELECTRIC VEHICLES ONTO THE
5 ELECTRIC GRID.—Subtitle B of title I of the Energy Inde-
6 pendence and Security Act of 2007 (42 U.S.C. 17011 et
7 seq.) is amended by adding at the end the following:

8 “SEC. 137. RESEARCH AND DEVELOPMENT INTO INTE-
9 GRATING ELECTRIC VEHICLES ONTO THE
10 ELECTRIC GRID.

11 “(a) IN GENERAL.—The Secretary shall establish a
12 research, development, and demonstration program to ad-
13 vance the integration of electric vehicles, including plug-
14 in hybrid electric vehicles, onto the electric grid.

15 “(b) VEHICLES-TO-GRID INTEGRATION ASSESSMENT
16 REPORT.—Not later than 1 year after the enactment of
17 the Grid Modernization Research and Development Act of
18 2019, the Secretary shall submit to the Committee on
19 Science, Space, and Technology of the House of Rep-
20 resentatives and the Committee on Energy and Natural
21 Resources of the Senate a report on the results of a study
22 that examines the research, development, and demonstra-
23 tion opportunities, challenges, and standards needed for
24 integrating electric vehicles onto the electric grid.

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1 “(1) REPORT REQUIREMENTS.—The report
2 shall include—

3 “(A) an evaluation of the use of electric ve-
4 hicles to maintain the reliability of the electric
5 grid, including—

6 “(i) the use of electric vehicles for de-
7 mand response, load shaping, emergency
8 power, and frequency regulation; and

9 “(ii) the potential for the reuse of
10 spent electric vehicle batteries for sta-
11 tionary grid storage;

12 “(B) the impact of grid integration on
13 electric vehicles, including—

14 “(i) the impact of bi-directional elec-
15 tricity flow on battery degradation; and

16 “(ii) the implications of the use of
17 electric vehicles for grid services on origi-
18 nal equipment manufacturer warranties;

19 “(C) the impacts to the electric grid of in-
20 creased penetration of electric vehicles, includ-
21 ing—

22 “(i) the distribution grid infrastruc-
23 ture needed to support an increase in
24 charging capacity;

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- 1 “(ii) strategies for integrating electric
- 2 vehicles onto the distribution grid while
- 3 limiting infrastructure upgrades;
- 4 “(iii) the changes in electricity de-
- 5 mand over a 24-hour cycle due to electric
- 6 vehicle charging behavior;
- 7 “(iv) the load increases expected from
- 8 electrifying the transportation sector;
- 9 “(v) the potential for customer incen-
- 10 tives and other managed charging stations
- 11 strategies to shift charging off-peak;
- 12 “(vi) the technology needed to achieve
- 13 bi-directional power flow on the distribu-
- 14 tion grid; and
- 15 “(vii) the implementation of smart
- 16 charging techniques;
- 17 “(D) research on the standards needed to
- 18 integrate electric vehicles with the grid, includ-
- 19 ing communications systems, protocols, and
- 20 charging stations, in collaboration with the Na-
- 21 tional Institute for Standards and Technology;
- 22 “(E) the cybersecurity challenges and
- 23 needs associated with electrifying the transpor-
- 24 tation sector; and

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1 “(F) an assessment of the feasibility of
2 adopting technologies developed under the pro-
3 gram established under subsection (a) at De-
4 partment facilities.

5 “(2) RECOMMENDATIONS.—As part of the Ve-
6 hicles-to-Grid Integration Assessment Report, the
7 Secretary shall develop a 10-year roadmap to guide
8 the research, development, and demonstration pro-
9 gram to integrate electric vehicles onto the electric
10 grid.

11 “(3) CONSULTATION.—In developing this re-
12 port, the Secretary shall consult with relevant stake-
13 holders, including—

14 “(A) electric vehicle manufacturers;

15 “(B) electric utilities;

16 “(C) public utility commissions;

17 “(D) vehicle battery manufacturers;

18 “(E) electric vehicle supply equipment
19 manufacturers;

20 “(F) charging infrastructure manufactur-
21 ers;

22 “(G) the National Laboratories; and

23 “(H) other Federal agencies, as the Sec-
24 retary determines appropriate.

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1 “(4) UPDATES.—The Secretary shall update
2 the report required under this section every 3 years
3 for the duration of the program under section (a)
4 and shall submit the updated report to the Com-
5 mittee on Science, Space, and Technology of the
6 House of Representatives and the Committee on En-
7 ergy and Natural Resources of the Senate.

8 “(c) PROGRAM IMPLEMENTATION.—In carrying out
9 the research, development, demonstration, and commercial
10 application aims of section, the Secretary shall—

11 “(1) implement the recommendations set forth
12 in the report in subsection (b);

13 “(2) coordinate across all relevant program of-
14 fices at the Department to achieve the goals estab-
15 lished in this section, including the Office of Elec-
16 tricity; and

17 “(3) comply with section 8 of the Grid Mod-
18 ernization Research and Development Act of 2019.

19 “(d) TESTING CAPABILITIES.—The Secretary shall
20 coordinate with the National Laboratories to develop test-
21 ing capabilities for the evaluation, rapid prototyping, and
22 optimization of technologies enabling integration of elec-
23 tric vehicles onto the electric grid.”.

24 (d) RESEARCH AND DEVELOPMENT ON INTEGRATING
25 BUILDINGS ONTO THE ELECTRIC GRID.—Subtitle B of

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1 title IV of the Energy Independence and Security Act of
2 2007 (42 U.S.C. 17081 et seq.) is amended by adding at
3 the end the following:

4 **“SEC. 426. ADVANCED INTEGRATION OF BUILDINGS ONTO**
5 **THE ELECTRIC GRID.**

6 “(a) IN GENERAL.—The Secretary shall establish a
7 program of research, development, and demonstration to
8 enable components of commercial and residential buildings
9 to serve as dynamic energy loads on and resources for the
10 electric grid. The program shall focus on—

11 “(1) developing low-cost, low power, wireless
12 sensors to—

13 “(A) monitor building energy load;

14 “(B) forecast building energy need; and

15 “(C) enable building-level energy control;

16 “(2) developing data management capabilities
17 and standard communication protocols to further
18 interoperability at the building and grid-level;

19 “(3) developing advanced building-level energy
20 management of components through integration of
21 smart technologies, control systems, and data pro-
22 cessing, to enable energy efficiency and savings;

23 “(4) optimizing energy consumption at the
24 building level to enable grid stability and resilience;

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1 “(5) improving visualization of behind the
2 meter equipment and technologies to provide better
3 insight into the energy needs and energy forecasts of
4 individual buildings;

5 “(6) reducing the cost of key components to ac-
6 celerate the adoption of smart building technologies;

7 “(7) protecting against cybersecurity threats
8 and addressing security vulnerabilities of building
9 systems or equipment; and

10 “(8) other areas determined appropriate by the
11 Secretary.

12 “(b) CONSIDERATIONS.—In carrying out the pro-
13 gram under subsection (a), the Secretary shall—

14 “(1) work with utility partners, building own-
15 ers, technology vendors, and building developers to
16 test and validate technologies and encourage the
17 commercial application of these technologies by
18 building owners; and

19 “(2) consider the specific challenges of enabling
20 greater interaction between components of—

21 “(A) small- and medium-sized buildings
22 and the electric grid; and

23 “(B) residential and commercial buildings
24 and the electric grid.

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1 “(c) BUILDINGS-TO-GRID INTEGRATION REPORT.—

2 Not later than one year after the enactment of the Grid
3 Modernization Research and Development Act of 2019,
4 the Secretary shall submit to the Committee on Science,
5 Space, and Technology of the House of Representatives
6 and the Committee on Energy and Natural Resources of
7 the Senate a report on the results of a study that examines
8 the research, development, and demonstration opportuni-
9 ties, challenges, and standards needed to enable compo-
10 nents of commercial and residential buildings to serve as
11 dynamic energy loads on and resources for the electric
12 grid.

13 “(1) REPORT REQUIREMENTS.—The report
14 shall include—

15 “(A) an assessment of the technologies
16 needed to enable building components as dy-
17 namic loads on and resources for the electric
18 grid, including how such technologies can be—

19 “(i) incorporated into new commercial
20 and residential buildings; and

21 “(ii) retrofitted in older buildings;

22 “(B) guidelines for the design of new
23 buildings and building components to enable
24 modern grid interactivity and improve energy
25 efficiency;

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1 “(C) an assessment of barriers to the
2 adoption by building owners of advanced tech-
3 nologies enabling greater integration of building
4 components onto the electric grid; and

5 “(D) an assessment of the feasibility of
6 adopting technologies developed under the pro-
7 gram established under subsection (a) at De-
8 partment facilities.

9 “(2) RECOMMENDATIONS.—As part of the re-
10 port, the Secretary shall develop a 10-year roadmap
11 to guide the research, development, and demonstra-
12 tion program to enable components of commercial
13 and residential buildings to serve as dynamic energy
14 loads on and resources for the electric grid.

15 “(3) UPDATES.—The Secretary shall update
16 the report required under this section every 3 years
17 for the duration of the program under subsection (a)
18 and shall submit the updated report to the Com-
19 mittee on Science, Space, and Technology of the
20 House of Representatives and the Committee on En-
21 ergy and Natural Resources of the Senate.

22 “(d) PROGRAM IMPLEMENTATION.—In carrying out
23 this section, the Secretary shall—

24 “(1) implement the recommendations from the
25 report in subsection (c);

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1 “(2) coordinate across all relevant program of-
2 fices at the Department to achieve the goals estab-
3 lished in this section, including the Office of Elec-
4 tricity; and

5 “(3) comply with section 8 of the Grid Mod-
6 ernization Research and Development Act of 2019.”.

7 **SEC. 7. INDUSTRY ALLIANCE.**

8 Title XIII of the Energy Independence and Security
9 Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is
10 amended by adding at the end the following:

11 **“SEC. 1312. INDUSTRY ALLIANCE.**

12 “(a) IN GENERAL.—Not later than 180 days after
13 the enactment of the Grid Modernization Research and
14 Development Act of 2019, the Secretary shall establish an
15 advisory committee (to be known as the ‘Industry Alli-
16 ance’) to advise the Secretary on the authorization of re-
17 search, development, and demonstration projects under
18 sections 1304 and 1304a.

19 “(b) MEMBERSHIP.—The Industry Alliance shall be
20 composed of members selected by the Secretary that, as
21 a group, are broadly representative of United States elec-
22 tric grid research, development, infrastructure, operations,
23 and manufacturing expertise.

24 “(c) RESPONSIBILITY.—The Secretary shall annually
25 solicit from the Industry Alliance—

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1 “(1) comments to identify grid modernization
2 technology needs;

3 “(2) an assessment of the progress of the re-
4 search activities on grid modernization; and

5 “(3) assistance in annually updating grid mod-
6 ernization technology roadmaps.”.

7 **SEC. 8. COORDINATION OF EFFORTS.**

8 In carrying out the amendments made by this Act,
9 the Secretary shall coordinate with relevant entities to the
10 maximum extent practicable, including—

11 (1) electric utilities;

12 (2) private sector entities;

13 (3) representatives of all sectors of the electric
14 power industry;

15 (4) transmission organizations;

16 (5) transmission owners and operators;

17 (6) distribution organizations;

18 (7) distribution asset owners and operators;

19 (8) State and local governments and regulatory
20 authorities;

21 (9) academic institutions;

22 (10) the National Laboratories;

23 (11) other Federal agencies;

24 (12) nonprofit organizations;

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1 (13) the Federal Energy Regulatory Commis-
2 sion;

3 (14) the North American Reliability Corpora-
4 tion;

5 (15) independent system operators; and

6 (16) programs and program offices at the De-
7 partment.

8 **SEC. 9. DEFINITIONS.**

9 Title XIII of the Energy Independence and Security
10 Act of 2007 (42 U.S.C. 17381 et. seq.), as amended, is
11 amended by adding at the end the following:

12 **“SEC. 1313. DEFINITIONS.**

13 “In this title, the following definitions apply:

14 “(1) **CRITICAL FACILITY.**—The term ‘critical
15 facility’ means a manmade structure that the Sec-
16 retary determines vital to socioeconomic activities
17 such that, if destroyed or damaged, such destruction
18 or damage could cause substantial disruption to
19 such socioeconomic activities.

20 “(2) **DISTRIBUTION AUTOMATION.**—The term
21 ‘distribution automation’ means systems and tech-
22 nologies that exert intelligent control over electrical
23 grid functions at the distribution level.

24 “(3) **RESILIENCE.**—The term ‘resilience’ means
25 the ability to withstand and reduce the magnitude or

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1 duration of disruptive events, which includes the ea-
2 pability to anticipate, absorb, adapt to, or rapidly re-
3 cover from such an event, including from deliberate
4 attacks, accidents, and naturally occurring threats
5 or incidents.”.

6 **SEC. 10. TECHNICAL AMENDMENTS; AUTHORIZATION OF**
7 **APPROPRIATIONS.**

8 (a) TECHNICAL AMENDMENTS.—

9 (1) ENERGY INDEPENDENCE AND SECURITY
10 ACT OF 2007.—Section 1(b) of the Energy Inde-
11 pendence and Security Act of 2007 is amended in
12 the table of contents—

13 (A) by inserting the following after the
14 item related to section 136:

“Sec. 137. Research and development into integrating electric vehicles onto the
electric grid.”.

15 (B) by inserting the following after the
16 item related to section 425:

“Sec. 426. Advanced integration of buildings onto the electric grid.”.

17 (C) by inserting the following after the
18 item related to section 1304:

“Sec. 1304a. Smart grid modeling, visualization, architecture, and controls.”;
and

19 (D) by inserting the following after the
20 item related to section 1309:

“Sec. 1310. Grid resilience and emergency response.

“Sec. 1311. Hybrid energy systems.

“Sec. 1312. Industry Alliance.

“Sec. 1313. Definitions.”.

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1 (2) ENERGY POLICY ACT OF 2005.—Section
2 1(b) of the Energy Policy Act of 2005 is amended
3 in the table of contents by inserting the following
4 after the item related to section 935:

“Sec. 936. Research and development into integrating renewable energy onto
the electric grid.”.

5 (b) AUTHORIZATION OF APPROPRIATIONS.—There
6 are authorized to be appropriated—

7 (1) to carry out sections 7 and 8 and the
8 amendments made by sections 2 and 3 of this Act—

9 (A) \$170,000,000 for fiscal year 2020;
10 (B) \$175,000,000 for fiscal year 2021;
11 (C) \$180,000,000 for fiscal year 2022;
12 (D) \$185,000,000 for fiscal year 2023;

13 and

14 (E) \$190,000,000 for fiscal year 2024;

15 (2) to carry out section 5 of this Act—

16 (A) \$20,000,000 for fiscal year 2020;
17 (B) \$21,000,000 for fiscal year 2021;
18 (C) \$22,050,000 for fiscal year 2022;
19 (D) \$23,153,000 for fiscal year 2023; and
20 (E) \$24,310,000 for fiscal year 2024; and

21 (3) to carry out section 6 of this Act—

22 (A) \$50,000,000 for fiscal year 2020;
23 (B) \$52,500,000 for fiscal year 2021;
24 (C) \$55,152,000 for fiscal year 2022;

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- 1 (D) \$57,882,000 for fiscal year 2023; and
- 2 (E) \$60,775,000 for fiscal year 2024.



Chairwoman JOHNSON. Without objection, the bill is considered as read and open to any amendment at any point.

I recognize the gentleman from Pennsylvania, Mr. Lamb, to briefly speak on his bill.

Mr. LAMB. Thank you, Madam Chairwoman. And I want to thank my Republican cosponsor, Representative Herrera Beutler, and the entire Republican Committee staff for their work with us on this bill.

I think if you think about the work that this Committee has done in the last couple of years, we have sought to improve the authorization funding levels, focus on various sources of energy, and it remains to be done how we optimize the mix of those sources of energy on the grid on a day-to-day basis.

And I think if you think about the future where we have more renewables that can produce more power on 1 day based on wind and solar conditions and less power on the next day based on unpredictable weather factors, as we get more storage online with research like we're authorizing today in the other bills, as we develop all of these new technologies, you will still need a system of wires and transformers and sensors that can give us the optimum mix, almost the moneyball of our energy grid if you will.

So I think that's where our focus should be on this bill. I'm happy to be part of it. I also think going forward, as we see more electrification of manufacturing processes, I would bet that everyone in here has a company in their district which has built its own microgrid to be the primary source of energy. I know we're doing that potentially at Pittsburgh International Airport and integrating individual microgrids into the optimal mix of our overall grid.

These are going to be big challenges, and I think we have a lot of work to do to make sure we do that in a way that serves our climate goals and also serves the important goals of keeping energy cheap and affordable for business interests, as well as homeowners. All of these things are important.

And then last I'll just mention of course we know that the grid itself is going to be at a greater physical risk going forward depending on which part of the country you're in, whether it's fires. In my part of the country it has more to do with landslides and intense rainstorms. Every single year it seems like now we're losing power lines and losing parts of the grid for long periods of time as a result of that.

So some of this research would also help us strengthen the resiliency of the grid going forward in a difficult climate environment, and I think that's why it has been endorsed by a broad array of concerned groups, BPC Action, Duke Energy, Edison Electric Institute, Union for Concerned Scientists, Rural Electric Cooperative Association, and the United States Chamber of Commerce. So I thank all of them for their support as well. This is a great example of bipartisan legislation that we can all get behind.

And I yield back to the Chairwoman and thank her for her support.

Chairwoman JOHNSON. Thank you very much.

Anyone else seeking time? Ms. Stevens.

Ms. STEVENS. Thank you, Madam Chair. I seek to strike the last word.

This is another exciting and important piece of legislation that we're putting through our Committee here today, the *Grid Modernization Research and Development Act*, a bipartisan piece of legislation that's going to identify research needs, assess progress on research activities, and update relevant technology roadmaps. And this legislation came together in a very remarkable and admirable way, through the leadership of my friend and colleague Conor Lamb, who up until recently was serving as the Subcommittee Chair for our Energy Committee here on House Science.

And it's worth allocating a few words to the leadership that Conor brings not only to this Committee as a whole but to this Congress. We all remember when Conor came into the body. He came in, and it was a trying time for the country. And it was a trying time in his district. And he came in as a beacon of trust and hope, and he has brought us to a better place through helping us get this legislation done and in partnership with Ms. Herrera Beutler and other cosponsors.

And I think all of us should be reminded why we are here. We are here to get things done on behalf of the taxpayers and the American public who is counting on us.

The Science Committee sometimes doesn't make the headline news, although we are the drivers of a large segment of our country's GDP (gross domestic product) and our innovation capabilities. And I think that time will come when individuals will look back to the legislation that the 116th Congress passed through this Committee, and they will look back at the leadership of Conor Lamb, who made this bipartisan, who made it so that we could have this fabulous piece of R&D.

We're so glad we're doing basic research here together, and we're looking forward to the applications in the next phase. Thank you.

Mr. WEBER. Will the gentlelady yield?

Ms. STEVENS. I will yield.

Mr. WEBER. Is the gentlelady from Michigan saying that because Conor came in, it was a trying time? I just was wanting to verify that. I yield back.

Ms. STEVENS. I am happy to clarify that he came in and made it better.

Chairwoman JOHNSON. Thank you very much.

Mr. OLSON. Would the gentlelady yield for one statement?

Ms. STEVENS. Absolutely.

Mr. OLSON. Your comments about Conor come as no surprise because, before he came to Congress, he was a proud member of the United States Marine Corps in the Department of the Navy, *semper fi*. I yield back.

Ms. STEVENS. *Semper fi*.

Chairwoman JOHNSON. Any other requests for comment?

Without objection, the bill is now considered. Yes, we will proceed with amendments as listed on the roster. The first amendment on the roster is offered by the gentlelady from Texas, Ms. Fletcher. She's recognized to offer the amendment.

Ms. FLETCHER. Thank you, Madam Chairwoman. I have an amendment at the desk.

Chairwoman JOHNSON. The clerk will read the amendment.

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The CLERK. Amendment No. 1, amendment to Committee print
of H.R. 5428 offered by Ms. Fletcher.
[The amendment of Ms. Fletcher follows:]

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AMENDMENT TO
COMMITTEE PRINT OF H.R. 5428
OFFERED BY Mrs. Fletcher

Page 7, after line 2, insert the following (and redesignate subsections (f) and (g) as subsections (g) and (h), respectively):

1 “(f) INTEROPERABILITY RESEARCH AND DEVELOP-
2 MENT.—The Secretary shall conduct research and devel-
3 opment on tools and technologies that improve the inter-
4 operability and compatibility of new and emerging compo-
5 nents, technologies, and systems with existing electric grid
6 infrastructure.”.



Chairwoman JOHNSON. The—I ask unanimous consent to dispense with the reading, and without objection, so ordered.

I recognize Ms. Fletcher for five minutes to explain her amendment.

Ms. FLETCHER. Thank you, Madam Chairwoman. Thank you for holding this markup this morning and advancing all of the important legislation that we are addressing here this morning. I'm introducing an amendment today to H.R. 5428, the *Grid Modernization Research and Development Act* that we've been discussing. This amendment would direct the Department of Energy to conduct research on the important topic of interoperability.

The number of devices and systems connecting to the electric grid is increasing rapidly. When we talk about a smart grid, this is really what we're referring to, a future electric grid that is dynamic, flexible, and automated. In order to achieve this vision, we need a strategy for integrating devices and systems that work together to ensure that we have a reliable, resilient electric grid.

In March of 2018, DOE published an Interoperability Strategic Vision that set forth a plan for advancing integration of distributed energy resources and other energy technologies onto the electric grid. This was a step in the right direction, and this amendment will help support DOE in these efforts and will ensure that this important research area is given the attention that it deserves. Thank you. And with that, I yield back.

Chairwoman JOHNSON. Thank you. Any further discussion on the amendment?

Mr. WEBER. Madam Chair?

Chairwoman JOHNSON. Mr. Weber.

Mr. WEBER. I move to strike the last word.

Chairwoman JOHNSON. The gentleman is recognized.

Mr. WEBER. Madam Chair, I want to say that I'm supporting her amendment and that I would like to, kind of in the spirit of bipartisanship and as we do on the floor of the House, when we adjourn from this hearing today, that we adjourn in honor of her 29th birthday tomorrow. Happy birthday, Lizzie.

Ms. FLETCHER. Thank you, Mr. Weber.

Chairwoman JOHNSON. Thank you very much. Any other requests for time?

If there is no further discussion, the vote occurs on the amendment.

All in favor, say aye.

Those opposed, no.

The ayes have it, and the amendment is agreed to.

Are there any other amendments?

A recording—reporting quorum being present, I move that the Committee on Science, Space, and Technology report H.R. 5428, as amendment—amended to the House and the recommendation that the bill be approved.

Those in favor of the motion will signify by saying aye.

Those opposed, say no.

The ayes have it, and the bill is favorably reported.

Without objection, the motion to reconsider is laid upon the table. I ask unanimous consent that staff be authorized to make any nec-

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essary technical and conforming changes to the bill. Without objection, so ordered.

Members will have two subsequent calendar days in which to submit supplemental minority or additional views on this measure.

