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Summary and Analysis of S. 2657, the American Energy Innovation Act

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Issues in the 116th Congress reflect the ongoing debate over the federal role in energy policy, particularly related to research and development (R&D), development of fossil and renewable energy on federal lands, and the role of federal regulation, particularly as it relates to greenhouse gas emissions.

Members of the House and Senate have introduced bills on a range of energy topics, and the Chairman and Ranking Member of the Senate Committee on Energy and Natural Resources (ENR) have proposed major legislation integrating many of these topics. On February 27, 2020, ENR leadership introduced S.Amdt. 1407, a substitute amendment for S. 2657, titled the American Energy Innovation Act, which incorporates language from energy bills reported by the committee. Cloture on the bill was invoked on March 2, 2020, and on March 5 several amendments were adopted. On March 9, 2020, a cloture on S.Amdt. 1407 was denied on a 47-44 vote.

Energy issues addressed in the bill include:

- Energy efficiency in buildings, schools, and industrial/manufacturing facilities;
- Federal agency energy efficiency;
- Research and development of renewable and nuclear energy technologies;
- Research, development, and demonstration of efficient and alternative fuel vehicles;
- Reauthorization and amendment of the Weatherization Assistance Program;
- Modernization and security of electricity infrastructure;
- Energy storage;
- Carbon capture, utilization, and storage (CCUS);
- “Clean” (generally meaning low-carbon) energy workforce development;
- Promotion of small-scale liquefied natural gas (LNG) exports;
- Deployment of “smart manufacturing” to increase the productivity and energy efficiency of U.S. manufacturing;
- Amendments to Department of Energy (DOE) loan programs; and
- Programs to provide energy sector employment for veterans, and to use artificial intelligence and supercomputing to improve veterans’ health.

The bill remains on the Senate calendar, although since discussion of the bill was suspended several major events have occurred: on March 11 the World Health Organization declared COVID-19 a pandemic leading to limits on personal and other travel, as well as a range of economic activities; during the month of March crude oil prices dropped by more than 50% because of declining demand and a lack of consensus among OPEC and other oil producers to limit production; U.S. gasoline and jet fuel product supplied (a proxy for consumption) dropped dramatically in the subsequent weeks, reaching levels not seen since at least the 1990s; and electricity demand in most parts of the country also declined. Whether these factors have sustained effects for U.S. energy is unclear, but they may influence any future discussion of U.S. energy policy.

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Background: Comprehensive Energy Policy

Congress has enacted several broad energy policy laws since the 1970s, most recently the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140). These laws have addressed a wide range of topics, including energy efficiency in vehicles, appliances, consumer goods, and buildings; development of energy and mineral resources on federal lands; incentives for the production and/or use of renewable energy; limits on export of energy resources; and research and development of advanced energy technologies. Since the enactment of EISA, the U.S. energy landscape has changed dramatically, with growing U.S. energy production from natural gas, petroleum, and renewable energy, and a significant decline in coal production and use.

In the 114th and 115th Congresses, the House and Senate considered broad energy legislation. In the 114th Congress, both the House and Senate passed versions of S. 2012, although the Conference Committee did not reach agreement. In the 115th Congress, a related bill, S. 1460, was introduced in the Senate but was not brought to the floor. These bills would have addressed a variety of energy topics, including energy efficiency in federal buildings, data centers, manufacturing facilities, and schools; water conservation/efficiency; electric grid cybersecurity; liquefied natural gas (LNG); grid energy storage; renewable energy; critical minerals; nuclear research and development (R&D); and energy workforce development.

In the 116th Congress, Members of the House and Senate have introduced bills on a range of energy topics, many of which were reported by the Senate Committee on Energy and Natural Resources (ENR) in the 1st Session.

On February 27, 2020, the ENR Chairman and Ranking Member introduced S.Amdt. 1407, a substitute amendment to S. 2657, titled the American Energy Innovation Act.¹ The amendment incorporates language from a range of energy bills reported by the committee. Cloture was invoked on the bill on March 2, 2020, and on March 5 several amendments to the amendment were adopted. On March 9, 2020, cloture on S.Amdt. 1407 was denied on a 47-44 vote.

The American Energy Innovation Act would reauthorize existing programs and establish new programs, mainly through the Department of Energy (DOE), on energy efficiency and conservation in buildings, public schools, federal agencies, and industrial and manufacturing facilities. It would also reauthorize and amend the Weatherization Assistance Program (WAP), and establish programs to promote retraining and other assistance for workers affected by shifts in the U.S. energy system, and for U.S. veterans. The amendment would promote federal research, development, and demonstration (RD&D) on renewable energy technologies, nuclear energy, and carbon capture, utilization, and storage (CCUS). Electric grid modernization, cybersecurity, and resilience are also included in the proposal.

This report provides a summary and analysis of the energy bill which was debated on the Senate floor starting March 2, 2020. The report refers to the March 5 version of S.Amdt. 1407, the substitute amendment to S. 2657. It compares the language in S.Amdt. 1407 to bills reported by ENR in the 1st Session of the 116th Congress. In some cases, there is no comparable ENR bill.

The bill remains on the Senate calendar, although since discussion of the bill was suspended several major events have occurred: on March 11 the World Health Organization declared COVID-19 a pandemic leading to limits on personal and other travel, as well as a range of economic activities; during the month of March crude oil prices dropped by more than 50% because of declining demand and a lack of consensus among OPEC and other oil producers to

¹ The introduced and reported versions of S. 2657 are titled the Advanced Geothermal Innovation Leadership Act of 2019. S. 2657 is the vehicle for the combined energy package.

limit production; U.S. gasoline and jet fuel product supplied (a proxy for consumption) dropped dramatically in the subsequent weeks, reaching levels not seen since at least the 1990s; and total electricity demand in many parts of the country also declined. Whether these factors have sustained effects for U.S. energy is unclear, but they may influence any future discussion of U.S. energy policy.

Title I—Innovation

Subtitle A—Efficiency

Part I—Energy Savings and Industrial Competitiveness²

Part 1 of the Subtitle A addresses energy efficiency policies for buildings, industry, and federal agencies, among other provisions. According to the U.S. Energy Information Administration (EIA), the building and industrial sectors collectively consume approximately 72% of all U.S. primary energy consumption.³ The residential and commercial buildings sector accounts for 39% of all U.S. primary energy consumption, and the industrial sector accounts for 33%.⁴ Increased adoption of energy-efficiency technologies by these sectors could potentially realize significant energy savings and reduce emissions to the environment. DOE estimates that building energy use could be reduced by more than 20% through implementation of technologies that are known to be cost-effective.⁵ In 2020, the National Academies estimated that implementing existing, cost-effective efficiency technologies in the industrial sector could reduce energy consumption by 14-22%.⁶ A more recent study by EIA estimated that industrial sector energy intensity could be reduced by 44% globally between 2018 and 2040.⁷ Challenges to energy efficiency include market forces that do not incentivize investment in energy efficiency, a lack of information or awareness of energy saving opportunities and investment returns, and some policy approaches that reward selling energy and discourage investment in energy efficiency.

Provisions in Part 1 build upon the Energy Savings and Industrial Competitiveness Act of 2019 and upon congressional action from previous versions of the bill introduced in the 112th, 113th, 114th, and 115th Congresses.⁸ S. 2137, the Energy Savings and Industrial Competitiveness Act of

² Prepared by Corrie E. Clark, Analyst in Energy Policy, unless otherwise noted.

³ The *building sector* is an end-use energy consumption segment of the nation's energy system that is comprised of residential and commercial buildings. The *industrial sector* is an end-use energy consumption segment of the nation's energy system that is comprised of energy-intensive manufacturing, non-energy-intensive manufacturing, and nonmanufacturing activities. EIA, "Table A2. Energy Consumption by Sector and Source," *Annual Energy Outlook*, 2020, https://www.eia.gov/outlooks/aeo/excel/aeotab_2.xlsx.

⁴ See EIA, "Table A2. Energy Consumption by Sector and Source," *Annual Energy Outlook*, 2020, https://www.eia.gov/outlooks/aeo/excel/aeotab_2.xlsx.

⁵ DOE, "Chapter 5: Increasing Efficiency of Building Systems and Technologies," *Quadrennial Technology Review*, September 2015, p. 2, at <https://energy.gov/sites/prod/files/2017/03/f34/qtr-2015-chapter5.pdf>.

⁶ National Academy of Sciences, National Academy of Engineering, and National Research Council. 2010. *Real Prospects for Energy Efficiency in the United States*. Washington, DC: The National Academies Press, p.15, at <https://doi.org/10.17226/12621>.

⁷ Energy intensity refers to energy use per unit of gross value added. The projection is for International Energy Agency (IEA) countries and other major economies as determined by IEA. IEA. 2018. *Energy Efficiency 2018: Analysis and Outlooks to 2040*, IEA, Paris, p. 101, at <https://www.iea.org/reports/energy-efficiency-2018>.

⁸ For more information on previous versions of the Energy Savings and Industrial Competitiveness Act, see CRS Report R44911, *The Energy Savings and Industrial Competitiveness Act: S. 385 and H.R. 1443*, by Corrie E. Clark.

2019, was reported by ENR on October 23, 2019. Some provisions from S. 2137 are not included in S.Amdt. 1407.

Subpart A – Buildings

Chapter 1 – Building Efficiency

Subpart A, Chapter 1 contains several provisions for buildings and energy efficiency. The chapter does not include provisions from S. 2137 that pertain to building energy codes that have previously raised opposition. Those provisions would have made DOE’s state certification process for model building energy codes consistent for both commercial buildings and residential buildings. Additional language would have directed DOE to establish energy savings targets in the code development process and to establish a new grant program to facilitate adoption and implementation of updated building energy codes. Some supporters state that the provisions, “which would strengthen federal support for voluntary building energy codes, account for the vast majority of the efficiency gains in [S. 2137].”⁹ Some opponents state that DOE’s role should be as “technical advisor,” and expressed concern that the language in S. 2137 directing DOE to support the model building energy code development process by establishing national aggregate energy savings targets would “[deny] the code consensus bodies freedom in decision-making.”¹⁰

Sec. 1001. Commercial building energy consumption information sharing.

Both the EIA and the U.S. Environmental Protection Agency (EPA) collect commercial building energy performance data. EIA conducts the Commercial Buildings Energy Consumption Survey (CBECS), a national sample survey that collects information on U.S. commercial buildings, including energy-related building characteristics, energy consumption, and energy expenditures.¹¹ Respondent information provided to CBECS is confidential. EPA collects commercial building energy and water performance data on a voluntary basis as part of the ENERGY STAR Program.¹² Using the ENERGY STAR Portfolio Manager tool, commercial building owners or managers can document a building’s energy and water performance, compare a building’s performance to a typical building with a similar function, and submit performance data for consideration and certification with the ENERGY STAR label. For a building to receive the ENERGY STAR label, it must be verified to perform among the top 25% of similar buildings nationwide; EPA relies upon EIA’s CBECS for data on typical building performance. In August 2018, EPA updated performance metrics for U.S. buildings in ENERGY STAR Portfolio Manager based on data collected for EIA’s 2012 CBECS.¹³

Section 1001 would direct EIA and EPA to enter into an information-sharing agreement. The section would direct the agreement to provide access to the EIA to building-specific data within

⁹ Alliance to Save Energy, “Alliance Calls for Stronger Efficiency Provisions in Senate Energy Bill,” February 27, 2020, <https://www.ase.org/news/alliance-calls-stronger-efficiency-provisions-senate-energy-bill>.

¹⁰ National Association of Home Builders (NAHB), *Federal Intrusion in Energy Codes Hurts Housing Affordability*, at <https://www.nahb.org/-/media/NAHB/advocacy/docs/industry-issues/federal-intrusion-in-energy-codes-hurts-housing-affordability.pdf>; NAHB, “Take Action to Prevent the Federal Government from Hijacking Building Codes,” March 2, 2020, <http://nahbnow.com/2020/02/take-action-to-prevent-the-federal-government-from-hijacking-building-codes/>.

¹¹ CBECS includes building types such as schools, hospitals, correctional institutions, buildings used for religious worship, stores, restaurants, warehouses, and office buildings. For more information on the CBECS, see <https://www.eia.gov/consumption/commercial/about.php>.

¹² For more information on ENERGY STAR, see CRS In Focus IF10753, *ENERGY STAR Program*, by Corrie E. Clark.

¹³ EPA, “Updates to ENERGY STAR® metrics with new market data,” <https://www.energystar.gov/buildings/facility-owners-managers/existing-buildings/use-portfolio-manager/update-energy-star-scores-cbeecs>.

the Portfolio Manager database, to describe the manner in which EIA will incorporate the data into any future CBECS, and to describe and compare methodologies to maximize the quality of data collected by EIA and EPA. The section also directs EIA and EPA to protect submitted information according to existing public law.

This language in Section 1001 is identical to language in Section 103 of S. 2137 as reported by ENR on October 23, 2019.

Sec. 1002. Energy efficiency materials pilot program.

Section 1002 would authorize the creation of a grant program to provide matching funds for nonprofits that retrofit buildings with energy efficiency improvements, including renewable energy generation, improved lighting, heating and air conditioning systems, and insulation. Criteria for awarding grants would be based upon the expected energy savings from improvements, the cost-effectiveness of the improvements, the evaluation and verification plan, financial need, and matching contribution.

This language in Section 1002 is nearly identical to language in S. 520, a bill to require the Secretary of Energy to establish an energy efficiency materials pilot program, which was reported by ENR on August 16, 2019. Similar provisions were introduced in the 113th, 114th, and 115th Congresses.¹⁴

Sec. 1003. Coordination of energy retrofitting assistance for schools.

Section 1003 would require DOE to coordinate and provide information on existing federal programs that could assist states, local educational agencies, and schools in initiating, developing, and financing energy efficiency, renewable energy, and energy retrofitting projects for schools. DOE would be required to coordinate and consult with appropriate federal agencies, to develop and maintain an online resource with relevant information, and to report to Congress on the implementation of this section.

This language in Section 1003 is nearly identical to language in Section 121 of S. 2137 as reported and Section 2 of S. 253, the Streamlining Energy Efficiency for Schools Act, as reported. Differences between Section 1003 and Section 121 of S. 2137 pertain to the definition of a school. Section 1003 would include a school operated by the Bureau of Indian Education under the definition of a school while S. 2137 would include a school operated by the Bureau of Indian Affairs under the definition of a school.¹⁵ S. 2137 was reported by ENR on October 23, 2019. Differences between Section 1003 and Section 2 of S. 253 pertain to language in S. 253 that would have required DOE to identify duplicative programs across federal agencies, which was not included in Section 1003. S. 253 was reported by ENR on September 19, 2019.

Sec. 1004. Grants for energy efficiency improvements and renewable energy improvements at public school facilities.

Section 1004 would authorize a competitive grant program to be administered by DOE to make energy improvements at schools. Energy improvement would include any improvement, repair, renovation, or installation that results in energy cost savings. It could also include an energy

¹⁴ See U.S. Congress, Senate Committee on Energy and Natural Resources, *Energy Efficiency Materials Pilot Program Act*, report to accompany S. 520, 116th Cong., 1st sess., August 16, 2019, S.Rept. 116-72.

¹⁵ The Bureau of Indian Affairs (BIA) and the Bureau of Indian Education (BIE) are both within the U.S. Department of the Interior and administered by the Assistance Secretary of Indian Affairs. For more information on Indian education, see CRS Report RL34205, *Indian Elementary-Secondary Education: Programs, Background, and Issues*, by Cassandra Dortch.

improvement that leads to an improvement in teacher and student health and results in a reduction in energy costs. The installation of renewable energy technologies, the installation of zero-emissions vehicle infrastructure, and the purchase or lease of zero-emissions vehicles would qualify as energy improvements. Awardees would be required to submit a report to DOE describing the use of funds, cost savings realized by the energy improvements, the results of any audit, the use of any utility programs and public benefit funds, and the use of performance tracking for energy improvements. Wage requirements for contractors and subcontractors would be consistent with Davis-Bacon Act wage requirements.¹⁶ DOE would be required to develop and publish guidelines and best practices for the program and may provide technical assistance to eligible entities for implementation of guidelines and best practices. Section 1004 would authorize \$100 million annually for FY2021-FY2025.

This language in Section 1004 is similar to language in Section 2 of S. 1890, the Renew America's Schools Act of 2019, as reported. S. 1890 was reported by ENR on December 18, 2019. Section 1004 includes an expanded section of requirements for the best practices that DOE would develop that are not included in S. 1890. In addition, S. 1890 did not include the requirement that an energy improvement that leads to an improvement in teacher and student health also result in a reduction in energy costs.

Sec. 1005. Smart building acceleration.

Section 1005 would promote the adoption of smart building technology. According to the bill, a “smart building” has an energy system that is flexible and automated; allows for remote monitoring and analysis; takes a systems-based approach to building operations for control of energy generation, consumption, and storage; communicates with utilities or other entities as appropriate; protects the health and safety of building occupants and workers; and is cybersecure. The section would direct the Secretary to establish the Federal Smart Building Program, which would implement smart building technology, and demonstrate the costs and benefits of smart buildings. DOE may expand awards made under the Federal Energy Management Program (FEMP) and the Better Building Challenge to recognize those federal agency achievements that accelerate the adoption of smart building technologies. DOE would also be directed to conduct a survey of privately owned smart buildings throughout the United States and evaluate their costs and benefits. DOE would conduct an R&D program to address the barriers to the integration of advanced building technologies to accelerate smart building adoption. Section 1005 would also require DOE to demonstrate policies and approaches that accelerate the transition to smart buildings through the Better Building Challenge.

The language in Section 1005 is nearly identical to language in S. 2335, the Smart Building Acceleration Act of 2019, as reported by ENR on October 24, 2019. Section 1005 does not include congressional findings included in Section 2 of the S. 2335.

Chapter 2—Worker Training and Capacity Building

Sec. 1011. Building training and assessment centers.

Section 1011 would direct DOE to provide grants to colleges and universities to establish building training and assessment centers, to promote building energy efficiency and

¹⁶ The Davis-Bacon Act set certain minimum labor standards for workers employed in federal contract construction: notably, that contractors must pay their employees not less than the locally prevailing wage. For more information on the Davis-Bacon Act, see CRS Report 94-408, *The Davis-Bacon Act: Institutional Evolution and Public Policy*, by William G. Whittaker.

environmental performance, and to coordinate with industrial research and assessment centers.¹⁷ To the maximum extent practicable, the section would direct DOE to collocate building training and assessment centers with industrial assessment centers. The section would authorize \$10 million to be made available until expended.

Section 1011 is identical to language in Section 111 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Sec. 1012. Career skills training.

Section 1012 would direct DOE to award grants to eligible entities to pay the federal share of career skills training programs (50%) to train and certify students to install energy efficient building technologies. Eligible entities would include nonprofit partnerships that include equal participation of industry and labor organizations and may include other organizations such as workforce investment boards, community-based organizations, qualified service and conservation corps, and education institutions. The section would authorize \$10 million to be made available until expended.

Section 1012 is nearly identical to language in Section 112 of S. 2137, as reported, with the exception that Section 112 of S. 2137 provides the following reference to technologies listed under 112(b) Establishment: “including technologies described in subsection (b)(3) of section 307 of the Energy Conservation and Production Act (42 U.S.C. §6836).”

Subpart B—Industrial Efficiency and Competitiveness

The industrial sector accounts for approximately 33% of U.S. primary energy consumption.¹⁸ The EIA conducts a national sample survey, the Manufacturing Energy Consumption Survey (MECS), approximately every four years. According to the EIA, U.S. manufacturing energy intensity decreased by approximately 4% from 2010 to 2014.¹⁹ During the same time period, total primary energy use for U.S. manufacturing increased by approximately 4% from 2010 to 2014.²⁰ This is the first measured four-year increase in manufacturing energy consumption since 2002 according to MECS data.²¹ DOE’s Advanced Manufacturing Office (AMO) administers programs to improve the energy and material efficiency, productivity and competitiveness of manufacturing. AMO’s activities include R&D projects, convening R&D consortia, and providing technical assistance.

Subpart B would provide additional authority for industrial efficiency programs at DOE. This subpart is largely consistent with provisions in S. 2137, the Energy Savings and Industrial

¹⁷ DOE industrial assessment centers conduct energy assessments for eligible manufacturers to identify opportunities to improve energy efficiency, productivity, and competitiveness and to reduce waste. The draft bill would also make changes to the authorization for the industrial research and assessment centers; see “Sec. 1022. Future of Industry program and industrial research and assessment centers.”

¹⁸ EIA estimates that the industrial sector consumed 32.5 quadrillion Btu of energy in 2019. See Table A2 in EIA, *Annual Energy Outlook, 2020*, at https://www.eia.gov/outlooks/aeo/section_appendices.cfm.

¹⁹ Publicly available data are from 2014. The most recent survey collected data for 2018; data from that survey is not available at this time. EIA reports that U.S. manufacturing overall fuel intensity decreased by 4.4% from 3.016 thousand British thermal units (Btu) per dollar of output in 2010 to 2.882 thousand Btu in 2014.

²⁰ DOE, *Manufacturing Energy and Carbon Footprint (2010 MECS)*, June 2015, https://www.energy.gov/sites/prod/files/2018/11/f57/manufacturing_energy_footprint-2010_0.pdf; DOE, *Manufacturing Energy and Carbon Footprint (2014 MECS)*, April 2019, https://www.energy.gov/sites/prod/files/2019/06/f64/Manufacturing%20Energy%20Footprint-2014_Latest_compliant.pdf.

²¹ EIA, “Preliminary Estimates Show That U.S. Manufacturing Energy Consumption Increased Between 2010 and 2014,” (October 13, 2016), https://www.eia.gov/consumption/manufacturing/reports/2014/pre_estimates/.

Competitiveness Act of 2019, as reported by ENR on October 23, 2019, with the exception of Section 1023, which does not appear in S. 2137. Sections 1021, 1022, 1024, and 1026 are identical to language in S. 2137, as reported. Section 1023 is nearly identical to language in S. 2425, the CHP Support Act of 2019, as reported by ENR on December 17, 2019, with the exception of the years for authorized appropriations. Section 1025 is similar to language in H.R. 2659.

Sec. 1022. Future of Industry program and industrial research and assessment centers.

Section 1022 would direct DOE to expand the industrial research and assessment centers, create Centers of Excellence for the highest-performing industrial research and assessment centers, and improve coordination with the National Institute of Standards and Technology (NIST), FEMP, and the Building Technologies Program within DOE. DOE would increase partnerships with the DOE National Laboratories, energy service providers, and technology providers, identify opportunities to reduce greenhouse gas emissions, and promote sustainable manufacturing. The section would direct DOE to provide funding to outreach and coordination efforts. DOE would also be directed to pay for half the cost of associated internship programs and associated apprenticeship programs. The section would also direct the Administrator of the Small Business Administration to expedite consideration of loans from eligible small businesses. The section would also include water and wastewater treatment facilities within the definition of an “energy-intensive industry.”

Section 1022 is identical to language in S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Sec. 1023. CHP Technical Assistance Partnership Program.

Section 1023 would amend section 375 of the Energy Policy and Conservation Act (EPCA, P.L. 94-163) to establish the CHP Technical Assistance Partnership Program.²² The program would include the existing 10 regional combined heat and power (CHP) technical assistance partnerships, any others that DOE would establish, and any supporting activities within the technical partnership program of DOE’s AMO.

Section 1023 would establish criteria for the program, which would encourage deployment of CHP, waste heat to power,²³ and efficient district energy technologies and provide project specific support. Language would direct the program to make funds available to universities, research centers, and other institutions to ensure continued effectiveness of regional CHP Technical Assistance Partnerships. Allowable uses of those funds would include the research, development, and distribution of informational materials relevant to manufacturers, commercial buildings, institutional facilities, and federal sites; supporting mission goals of the Department of Defense (DOD) relating to CHP and microgrid technologies; maintaining and updating CHP databases and websites; conducting workshops and seminars; providing onsite CHP technology deployment assessments; identifying opportunities for hybrid renewable CHP; providing appropriate engineering support; assisting organizations in overcoming barriers to deployment; and assisting with field validation and performance evaluation clean energy technologies. Section 1023 would authorize appropriations for \$12 million for each of FY2020-FY2024.

²² CHP refers to combined heat and power, which is the concurrent generation of electricity or mechanical power and useful thermal energy from a single source of energy. CHP systems are considered to be efficient as the thermal energy that is used would otherwise be wasted in a conventional power system.

²³ “Waste heat to power (WHP) is the process of capturing heat discarded by an existing industrial process and using that heat to generate power.” Neeharika Naik-Dhungel, *Waste Heat to Power Systems*, EPA, Washington, DC, May 30, 2012.

Section 1023 is nearly identical to language in S. 2425, the CHP Support Act of 2019, as reported by ENR on December 17, 2019, except that authorization period is one year later in Section 1023, reflecting the different dates the legislation was introduced.

Sec. 1024. Sustainable manufacturing initiative.

Section 1024 would direct DOE to provide technical assessments to manufacturers to maximize energy efficiency, minimize waste, improve water efficiency, and conserve natural resources. DOE would also coordinate with the private sector and carry out a joint industry-government partnership program for R&D in sustainable manufacturing and industry technologies and processes.

Section 1024 is identical to language in S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Sec. 1025. High efficiency gas turbines.

Section 1025 would direct the Secretary to establish a multiyear, multiphase program within the Fossil Energy Program to research, develop, and demonstrate technologies that improve the efficiency of gas turbines to be used in power generation systems and aviation. Section 1025 would specify program elements such as supporting gas turbine design for small-scale and utility-scale electric power generation, technology demonstration, field demonstrations, performance assessments, increasing fuel flexibility to enable high proportions of hydrogen or other renewable gas fuels, enhancing foundational knowledge needed for low-emission combustion systems, and increasing operational flexibility. Section 1025 would establish program goals in two phases. Phase one goals would be to develop and demonstrate advanced high efficiency gas turbines with efficiencies of at least 65% for combined cycle turbines and 47% for simple cycle turbines; for aviation gas turbines, phase one goals would be to reduce fuel burn by 25%. Phase two goals would increase efficiency goals to 67% for combined cycle turbines and to 50% for simple cycle turbines. The section would authorize appropriations for \$50 million for each of FY2021-FY2025.

Section 1025 is similar to language in H.R. 2659, which was introduced in the House on May 10, 2019. Among the differences between the bills, H.R. 2659 would direct the Fossil Energy Program to establish a program to improve the efficiency of gas turbines for power generation systems and does not mention aviation applications.

Subpart C—Federal Agency Energy Efficiency²⁴

Sec. 1031. Energy and water performance requirements for Federal buildings.

Since the 1970s, Congress has mandated energy requirements for federal agencies. Legislation required reductions in fossil fuel consumption and increases in renewable energy use, and energy efficiency targets for government fleets and buildings. Congress enacted the National Energy Conservation Policy Act (NECPA, P.L. 95-619), which, among other actions, established a program to retrofit federal buildings to improve energy efficiency. Federal agencies were required to reduce building energy intensity incrementally from FY2006 through FY2015. By FY2015, federal agencies should have reached an energy intensity reduction of 30% compared to FY2003. Federal agencies may typically *exclude* buildings that have a dedicated energy process that overwhelms other building consumption, such as one designed for a national security function or for the storage of historical artifacts.

²⁴ Prepared by Heather Greenley, Analyst in Energy Policy.

Section 1031 would amend NECPA (42 U.S.C. 8253), extending existing energy efficiency improvement targets to federal building through FY2028, requiring federal agencies to reduce building energy consumption incrementally from FY2021 through FY2028 compared to FY2018. By FY2028, federal buildings would be required to reach a 20% reduction in energy use. Section 1031 would also add water use reduction targets through 2030. Each federal agency would be required to improve water efficiency at a rate of 2% per fiscal year. Exclusions are provided for buildings with energy *and* water intensive activities. Section 1031 also includes recommendations, reporting requirements, evaluation roles for energy managers, exceptions for recommissioning or retrocommissioning, and performance contracting requirements.

The language in Section 1031 is nearly identical to language in Section 421 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019; and S. 1706, the Energy Savings Through Public-Private Partnerships Act, as reported by ENR on September 24, 2019. S. 2137 outlines the various targets and the considerations for federal energy managers, including evaluation requirements, whereas the language on performance contracting can be found in S. 1706. Section 1031 would require federal agencies to use performance contracts for at least 50% of energy or water saving measures identified by energy managers.

Sec. 1032. Federal Energy Management Program.

Federal agencies report energy and water consumption annually to DOE's Federal Energy Management Program (FEMP). FEMP collects this data and helps agencies meet federally mandated energy and water reduction goals. FEMP helps federal agencies identify affordable solutions to improvement through trainings. Federal agencies can request assistance from FEMP to improve energy management.

Section 1032 would authorize FEMP in statute, and details FEMP's authorizations and roles. FEMP would continue to maintain and track energy and water management through an online database, and continue to develop and implement trainings, among other duties. Additionally, Section 1032 would authorize appropriations of \$36 million for each of FY2021 through FY2031. Section 1032's language is nearly identical to Section 422 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019. The main difference is that authorization periods are one year later in Section 1032, reflecting the different dates the legislation was introduced.

Sec. 1033. Use of Energy and Water Efficiency Measures in Federal Buildings.

The Energy Policy Act of 1992 (EPAAct92, P.L. 102-486) amended NECPA and authorized alternative financing methods for federal energy projects, including energy savings performance contracts (ESPCs) and utility energy service contracts (UESCs), among other provisions. An ESPC is a multiyear contract between a federal agency and an energy service company. In general, under an ESPC, a federal agency agrees to pay an amount not to exceed the current annual utility costs for a fixed period (up to 25 years) to an energy service company, which finances and installs facility improvements. In return, the contractor assumes the performance risks of energy conservation measures made during the contract period, and guarantees that the improvements will generate energy cost savings sufficient to pay for the improvements over the length of the contract, as well as providing the energy services company a return on the investment. After the end of the contract, the agency benefits from reduced energy costs because of the improvements. A UESC is a contract between a federal agency and the serving utility.

Under a UESC, the utility arranges financing for efficiency projects and renewable energy projects, and the costs are repaid by the agency over the length of the contract.²⁵

Section 1033 would amend NECPA to require DOE to report to the President and Congress on the status of ESPCs and UESCs of each agency, including information on quantity and investment value, savings, forecast, and any data discrepancies. Further, Section 1033 would provide additional authority to federal agencies allowing the acceptance, transfer, and application of proceeds from any energy and water incentive including renewable energy certificates (RECs) to fund these contracts. RECs are created when a qualified renewable source of energy generates a megawatt-hour of electricity.²⁶ Additionally, Section 1033 would expand the definition of “energy savings” by amending 42 U.S.C. §8287c to include RECs as well as revenue generated from energy or water reductions or more efficient equipment.

Section 1033 is identical to language in S. 1706, the Energy Savings Through Public-Private Partnerships Act, as reported by ENR on September 24, 2019.

Sec. 1034. Federal building energy efficiency performance standards; certification system and level for green buildings.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the International Code Council (ICC) manage model building energy code development. Each model code, or example standard, is typically updated every three years through a public consensus process. ASHRAE is responsible for maintaining standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings. The ICC is responsible for maintaining the International Energy Conservation Code (IECC), which contains separate provisions for commercial buildings and for low-rise residential buildings. DOE supports and participates in the model building energy code development processes administered by ASHRAE and the ICC. The development processes rely on stakeholder engagement to propose changes and provide feedback to the committees on proposed changes. These consensus standards are developed and published to define minimum performance values.

Section 1034 would amend 42 U.S.C. §6834 by adding a definition of “major renovation” to include modifications to the energy systems of a building that can achieve compliance with applicable energy standards. It would also set revised energy-efficiency standards for federal buildings. These standards would update from the 2004 ASHRAE Standard 90.1 and the 2004 IECC to the most recently published edition. The Secretary of Energy, in consultation with the Administrator of General Services and the Secretary of Defense, would also review and compare private sector green building certification systems.

Section 1034 would strike and replace paragraph (D) of 42 U.S.C. §6834, thereby rescinding a fossil energy elimination requirement for new federal buildings. EISA Section 433 currently

²⁵ See CRS Report R45411, *Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs)*, by Corrie E. Clark.

²⁶ Each REC has a unique identification number and provides data (e.g., the resource type, service date, location, etc.) that is traceable and certifiable. RECs can be traded and have monetary value. They are used by utilities to comply with state renewable electricity standards. Thus, RECs can help improve the return on investment for renewable projects. The ownership of these credits is often a contract stipulation associated with the project for the developer. State and/or local renewable requirements play a role in determining the contract stipulations for the credit ownership. For more information, see Office of Federal Sustainability Council on Environmental Quality, *Federal Renewable Energy Certificate Guide*, June 16, 2016, p. 4.

requires federal agencies to reduce fossil fuel consumption in new or majorly renovated buildings by specified amounts.²⁷

The language in Section 1034 is nearly identical to Section 432 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019. The language is also similar to bills introduced in the 115th Congress: The Energy Savings and Industrial Competitiveness Act, S. 385 and H.R. 1443.²⁸

Sec. 1035. Energy-efficient and energy-saving information technologies.

EISA Section 527 (42 U.S.C. §17143) requires federal agencies to report to the Office of Management and Budget (OMB) on the status and implementation of energy efficiency improvements, energy reduction costs, and greenhouse gas (GHG) emissions. Subsequently, EISA Section 528 (42 U.S.C. §17144) directs OMB to provide a summary of this information and an evaluation of progress for the federal government to the House Committee on Oversight and Government Reform and to the Senate Committee on Governmental Affairs.²⁹ The Director of OMB compiles the compliance status of the EISA requirements and description of each into an agency scorecard.³⁰

Section 1035 would amend NECPA by adding language to require the OMB Director, the EPA Administrator, and the Secretary of Energy to collaborate with each federal agency to develop an implementation strategy for the maintenance, purchase, and use of energy-efficient and energy-saving information technologies.³¹ Additionally, Section 1035 would direct the OMB Director to establish performance goals and best practices to meet those goals, including the consideration of utilizing ESPCs and UESCs.

The language in Section 1035 is nearly identical to Section 301 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Sec. 1036. High-performance green Federal buildings.

The Office of Federal High-Performance Green Buildings, within the General Services Administration (GSA), coordinates activities relating to such buildings across federal agencies (42 U.S.C. §17092).³² The office delivers actionable information to improve building performance and conducts assessments on existing green buildings. GSA has several green-

²⁷ 42 U.S.C. §6834(a)(3)(D)(i) applies only to new and majorly renovated buildings that are (1) “public buildings” or (2) those that cost at least \$2,500,000 adjusted for inflation.” In FY2020, these buildings are supposed to reduce fossil fuel consumption by 80% with an ultimate goal of 100% by FY2030, relative to a similar building’s consumption levels in FY2003. DOE proposed a rulemaking for comment on this legislation on October 15, 2010. However, the rulemaking was not finalized, and no further action has been taken since December 2014 when the comment period closed. Without a finalized rule, it is difficult to track and evaluate the progress toward this goal. For more information, see U.S. Department of Energy, “Fossil Fuel-Generated Energy Consumption Reduction for New Federal Buildings and Major Renovations of Federal Buildings, Proposed Rule,” 79 *Federal Register*, October 14, 2014, pp. 61693-61735.

²⁸ For more information, see CRS Report R44911, *The Energy Savings and Industrial Competitiveness Act: S. 385 and H.R. 1443*, by Corrie E. Clark.

²⁹ Now known as the House Committee on Oversight and Reform and the Senate Committee on Homeland Security and Governmental Affairs, respectively.

³⁰ For a scorecard example, see U.S. Department of Defense, FY2018 OMB Scorecard for Efficient Federal Operations/Management, accessed March 10, 2020, available at <https://www.sustainability.gov/images/scorecards/dod-scorecard-fy2018.png>.

³¹ Information Technology as defined in 40 U.S.C. §11101.

³² For more information on green buildings, see CRS Report R40147, *Infrastructure: Green Building Overview and Issues*, by Eric A. Fischer and Danielle A. Arostegui.

building programs and projects that are the result of collaborations with other agencies and offices. The Director of the Office of Federal High-Performance Green Buildings provides recommendations to the Secretary of Energy on rating and certification systems that can be used by agencies to meet federal green building requirements, based on the results of a study to be conducted by the office every five years.³³ The office coordinates with DOE on commercial high-performance green building activities.

Section 1036 would amend 42 U.S.C. §17092(h) to require the Director of the Office of Federal High-Performance Green Buildings to conduct an ongoing review, providing the Secretary of Energy with a list of certification systems most likely to encourage a comprehensive and environmentally sound approach to the certification of green buildings. Additionally, these systems criteria would include sourcing of grown, harvested, or mined materials, and reward responsible sourcing.

The language in Section 1036 is nearly identical to Section 411 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Sec. 1037. Energy efficient data centers.

According to DOE, data centers are energy-intensive compared to other building types.³⁴ DOE estimates that data centers accounted for approximately 2% of total U.S. electricity use in 2014. Data centers in the United States consumed an estimated 70 billion kWh, and are projected to consume approximately 73 billion kWh in 2020.³⁵ The growth in cloud computing services has led to commitments by some data-centric companies to power data centers with renewable energy.³⁶ Although there are no national efficiency requirements for data centers, the federal government has taken steps to improve the efficiency of its own data centers.³⁷ In 2010, the Federal Data Center Consolidation Initiative (DCCI) was established. The Federal Information Technology Acquisition Reform Act (FITARA, P.L. 113-291) was enacted on December 19, 2014, to establish a long-term framework through which federal IT investments could be tracked, assessed, and managed, to significantly reduce wasteful spending and improve project outcomes.³⁸ The DCCI was superseded by the Data Center Optimization Initiative (DCOI) in 2016.³⁹ The DCCI established and the DCOI maintains requirements for agencies to develop and

³³ 42 U.S.C. §6834(a)(3); 42 U.S.C. §17092.

³⁴ Data centers typically consume 10 to 50 times the energy per floor space of a typical commercial office building. DOE, “Data Centers and Servers,” accessed December 27, 2018, <https://www.energy.gov/eere/buildings/data-centers-and-servers/>.

³⁵ Shehabi, A., Smith, S.J., Horner, N., Azevedo, I., Brown, R., Koomey, J., Masanet, E., Sartor, D., Herrlin, M., Lintner, W., United States Data Center Energy Usage Report, Lawrence Berkeley National Laboratory, Berkeley, California, 2016, LBNL-1005775, http://eta-publications.lbl.gov/sites/default/files/lbnl-1005775_v2.pdf, p. ES-1.

³⁶ See Apple Inc., “Apple Now Globally Powered by 100 Percent Renewable Energy,” press release, April 9, 2018, <https://www.apple.com/newsroom/2018/04/apple-now-globally-powered-by-100-percent-renewable-energy/>; Brad Smith, “New Solar Deal Moves Us Ahead of Schedule in Creating a Cleaner Cloud,” Microsoft On the Issues, March 21, 2018, <https://blogs.microsoft.com/on-the-issues/2018/03/21/new-solar-deal-moves-us-ahead-of-schedule-in-creating-a-cleaner-cloud/>.

³⁷ For more information, see CRS Report R45863, *Bitcoin, Blockchain, and the Energy Sector*, by Corrie E. Clark and Heather L. Greenley.

³⁸ Title VIII, Subtitle D of the National Defense Authorization Act (NDAA) for Fiscal Year 2015, P.L. 113-291.

³⁹ U.S. Office of Management and Budget, “Memorandum for Heads of Executive Departments and Agencies: Data Center Optimization Initiative,” August 1, 2016, https://obamawhitehouse.archives.gov/sites/default/files/omb/memoranda/2016/m_16_19_1.pdf.

report on strategies “to consolidate inefficient infrastructure, optimize existing facilities, improve security posture, achieve cost savings, and transition to more efficient infrastructure.”⁴⁰

Section 1037 would amend 42 U.S.C. §17112 to direct the Secretary of Energy and the EPA Administrator to consult with stakeholders to carry out a voluntary national information program on energy-efficient data centers including a study to assess progress in energy-efficiency improvement, and analyze the impact of information technologies, cloud platforms, and social media on energy usage. Section 1037’s study would update the Lawrence Berkeley National Laboratory’s *United States Data Center Energy Usage Report*, from June 2016, within the next four years. It would also include an evaluation of water usage in data centers and recommendations for reduction. Section 1037 would also direct the Secretary of Energy to maintain a data center energy practitioner program to certify qualified practitioners to evaluate energy use in federal data centers. Agencies would be required to consider having a practitioner evaluate data centers once every four years. Section 1037 would make energy usage data from federal data centers available and accessible to the public, but also protect proprietary information.

The language in Section 1037 is nearly identical to Section 302 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Subpart D—Rebates and Certifications

Sec. 1041 Third-Party Certification Under Energy Star Program.

ENERGY STAR® is a voluntary labeling program for energy-efficient products, homes, buildings, and manufacturing plants that is managed jointly by EPA and DOE.⁴¹

Section 1041 would direct the EPA Administrator to revise certification requirements for program partners that have complied with all ENERGY STAR requirements for 18 months such that third-party certification for listing a product would not be required (although other documentation may be required to facilitate product listing and performance verification). The section would also require termination of the exemption if it is determined that any ENERGY STAR program requirements have been violated for two models within a two-year period, and the resumption of third-party certification would be required for at least three years. This would not prevent EPA from using third parties for ENERGY STAR program administration.

Section 1041 is identical to section 401 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019.

Sec. 1042. Extended Product System Rebate Program.

Electric motors are used in the U.S. industrial, commercial, residential, and transportation sectors. The industrial sector is responsible for approximately 44% of all motor-drive system electrical energy consumption in the United States.⁴² In 2018, the U.S. industrial sector’s total electricity consumption was more than 25% of end-use electrical consumption in the United States.⁴³ Within

⁴⁰ Ibid., p. 2. For more on the data center optimization initiative, see CRS Report R44843, *The Current State of Federal Information Technology Acquisition Reform and Management*, by Patricia Moloney Figliola.

⁴¹ For more information on the ENERGY STAR program, see CRS In Focus IF10753, *ENERGY STAR Program*, by Corrie E. Clark.

⁴² DOE EERE Advanced Manufacturing Office, *Premium Efficiency Motor Selection and Application Guide: A Handbook for Industry*, DOE/GO-102014-4107, Washington, DC, February 2014, pp. 1-2.

⁴³ EIA, *Monthly Energy Review*, February 2020. Table 7.6. Available at

the industrial sector, motor-driven equipment consumed approximately 63% of the total electrical energy, and this energy use was approximately 17% of the total U.S. electrical energy use.⁴⁴

Section 1042 would direct DOE to establish a rebate program for qualified extended product systems. The section defines a qualified extended product system as a system that includes an electric motor and electronic control that reduce energy use by at least 5% as compared to base levels. The section would establish a maximum aggregate rebate per entity not to exceed \$25,000 per calendar year. The section would authorize \$5 million per year for two years, available until expended.

Section 1042 is nearly identical to Section 211 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019. S. 2137 includes commercial or industrial machinery or equipment that was placed back into service during calendar year 2020 or 2021. Section 1042 includes commercial or industrial machinery or equipment that was placed back into service during calendar year 2021 or 2022.

Sec. 1043. Energy Efficiency Transformer rebate program.

Section 1043 would establish a rebate program to incentivize the replacement of energy inefficient transformers with energy efficient transformers. Qualified energy inefficient transformers would be defined as a transformer that does not meet or exceed applicable energy conservation standards and meets certain requirements for date of manufacture. Qualified energy efficient transformers meet or exceed applicable energy conservation standards. Section 1043 would authorize \$5 million per year for FY2021 and FY2022, to be available until expended.

Section 1043 is nearly identical to Section 221 of S. 2137, the Energy Savings and Industrial Competitiveness Act of 2019, as reported by ENR on October 23, 2019. The language in S. 2137 would authorize appropriations for FY2020 and FY2021, while the Section 1043 of the draft bill would authorize appropriations for FY2021 and FY2022.

Subpart E—Miscellaneous

Sec. 1051. State energy conservation plans.⁴⁵

DOE administers the State Energy Program, which provides funding and technical assistance to states, the District of Columbia, and U.S. territories to promote the efficient use of energy and reduce the rate of growth of energy demand through the development and implementation of specific state energy programs. The program is authorized under Part D of the Energy Policy and Conservation Act (EPCA, P.L. 94-163). Part D (section 361 et seq.) of EPCA authorizes the Secretary of Energy “to establish procedures and guidelines for the development and implementation of specific state energy conservation programs and to provide federal financial and technical assistance to the states in support of such programs.”

Section 1051 would strike the existing paragraph 362(d)(3) of EPCA, which says that state energy plans can include programs to increase transportation efficiency and the use of alternative fuels. The replacement language would expand those options to include programs designed to “help reduce carbon emissions in the transportation sector” and increase vehicle electrification.

http://www.eia.gov/totalenergy/data/monthly/pdf/sec7_19.pdf.

⁴⁴ Percentages are based upon data from 2006; see DOE EERE Advanced Manufacturing Office, *Premium Efficiency Motor Selection and Application Guide: A Handbook for Industry*, DOE/GO-102014-4107, Washington, DC, February 2014, pp. 1-2.

⁴⁵ Prepared by Mark Holt, Specialist in Energy Policy.

Sec. 1052. Report on electrochromic glass.⁴⁶

Electrochromic (EC or “smart”) glass has the ability to switch from clear to tinted, potentially lowering building heating or cooling loads and reducing interior glare.⁴⁷ An electrical charge sent through the glass causes the glass to react by lightening or darkening. EC window systems can be manually or automatically controlled, depending on system design.

Section 1052 would require Secretary to study the potential benefits of EC glass to reduce energy consumption in commercial buildings, improve workplace comfort and employee health, and provide benefits for hospital patients and staff. A report to Congress would be required by one year after enactment.

Sec. 1053. Advance appropriations required.⁴⁸

The text requires that funding authorized by Part I of Title I be available only to the extent it is “provided in advance in appropriations Acts.” This language in Section 1053, which appears in other bills as well, may reiterate that this authorization by itself does not provide any funding.

Part II—Weatherization

The Weatherization Assistance Program (WAP) enables low-income families to permanently reduce their energy consumption by making their dwellings more energy efficient. The WAP was established in 1976 and authorized in Title IV of the Energy Conservation and Production Act (ECPA, P.L. 94-385). The WAP is a formula grant program: funding flows from DOE to state governments and then to local governments and weatherization agencies. DOE program guidelines specify that a variety of energy efficiency measures are eligible for support under the program. The measures include insulation, space-heating equipment, energy-efficient windows, water heaters, and efficient air conditioners.

Sec. 1101. Weatherization Assistance Program.

Section 1101 would reauthorize the WAP. The section would clarify that renewable energy technologies are to be included in the definition of weatherization materials. The section would amend section 413(b) of ECPA to authorize DOE to account for the non-energy benefits of weatherization improvements—such as improvements to health and safety—when determining appropriate standards and procedures for WAP. Section 1101 would add a new Section 414(c) of ECPA to authorize DOE to request that grant recipients review and encourage the use of private contractors. A new Section 414(d) would authorize the creation of a financial assistance program within WAP for enhancement and innovation. Additional provisions, if enacted, would make changes to the program including increasing the amount of a WAP grant that can be used for administrative purposes from 10% to 15% and changing the eligibility requirements for reweatherization of any dwelling to 15 years after the previous weatherization was completed. The section would also authorize an annual appropriation of \$350 million for FY2021-FY2025.

The language in Section 1101 is similar to language in S. 983, the Weatherization Enhancement and Local Energy Efficiency Investment and Accountability Act of 2019 as reported by ENR on September 10, 2019; however, there are differences. Section 1101 would remove the requirement to coordinate with the Director of the Community Services Administration, which was housed in

⁴⁶ Prepared by Brent D. Yacobucci, Section Research Manager, Energy and Minerals Section.

⁴⁷ DOE, Office of Energy Efficiency and Renewable Energy (EERE), Advanced Manufacturing Office (AMO), *Electrochromic Windows - Advanced Processing Technology*, accessed March 13, 2020, <https://www.energy.gov/eere/amo/electrochromic-windows-advanced-processing-technology>.

⁴⁸ Prepared by Mark Holt, Specialist in Energy Policy.

the former Department of Health, Education, and Welfare and is no longer active. The responsibilities of the Community Services Administration is now included within the Department of Health and Human Services. Section 1101 would also direct the Secretary to encourage eligible entities to hire and retain employees from the community where weatherization services are being provided and from underrepresented communities and groups. Another difference is a funding distribution requirement that would require the full amount of assistance for a given fiscal year to be distributed to recipients within 60 days after the date on which funds have been made available to provide assistance. Section 1101 would also require additional information to be included in annual reporting to Congress including the number of multifamily buildings where individual dwelling units were weatherized and the number of individual dwelling units in multifamily buildings weatherized in the previous year.

Subtitle B—Renewable Energy⁴⁹

Sec. 1201. Hydroelectric production incentives and efficiency improvements.⁵⁰

Hydropower is one of many energy sources that could be leveraged to further diversify the economy's electricity portfolio. DOE estimates there could be 13 gigawatts (GW) of new hydropower generation capacity (e.g., from adding power at existing dams and canals, upgrading existing plants) by 2050.⁵¹ Some of this new capacity could come from nonfederal hydropower projects, which are regulated by FERC. There are financial, environmental, regulatory, and technological concerns related to the additional development of hydropower.⁵²

Section 1201 would amend and reauthorize two hydropower programs: the Hydroelectric Production Incentives Program and the Hydroelectric Efficiency Improvement Program. Both programs were established in EAct05 (P.L. 109-58), and were authorized to receive appropriations through FY2015. DOE oversees both programs.

The Hydroelectric Production Incentives Program—Section 242 of EAct05—provides funding for projects that add hydroelectricity generation to existing dams and conduits.⁵³ The program allows the Secretary of Energy to make incentive payments to the owner or operator of a qualified hydroelectric facility.⁵⁴ A qualified hydroelectric facility is defined as a turbine or other generating device owned or solely operated by a nonfederal entity, which generates hydroelectricity for sale and is added to an existing dam or conduit. An existing dam or conduit is defined as any dam or conduit constructed prior to August 8, 2005, that does not require construction or the enlargement of impoundment or diversion structures in connection with the installation of the turbine or other generating device. Payments are based on the amount of electricity generated during the incentive period at a rate of 1.8 cents/kilowatt-hour with

⁴⁹ Prepared by Ashley J. Lawson, Analyst in Energy Policy, unless otherwise noted.

⁵⁰ Prepared by Kelsi Bracmort, Specialist in Natural Resources and Energy Policy.

⁵¹ DOE analysis estimates that U.S. hydropower could grow from 101 GW of capacity to nearly 150 GW by 2050 with 13 GW coming from new hydropower generation capacity and 36 GW from new pumped storage capacity. DOE, *Hydropower Vision: A New Chapter for America's First Renewable Electricity Source*, DOE/GO-102016-4869, July 2016, <https://www.energy.gov/sites/prod/files/2018/02/f49/Hydropower-Vision-021518.pdf>.

⁵² Ibid; Oak Ridge National Laboratory, *Small Hydropower in the United States*, ORNL/TM-2015/326, September 2015, <https://info.ornl.gov/sites/publications/files/Pub56556.pdf>.

⁵³ 42 U.S.C. §15881.

⁵⁴ DOE, *U.S. Department of Energy Water Power Technologies Office Guidance on Implementing Section 242 of the Energy Policy Act of 2005*, April 2019, <https://www.energy.gov/sites/prod/files/2019/05/f62/hydro-guidelines-cy18.pdf>.

adjustments for inflation. A facility may not receive more than \$750,000 in a calendar year. The eligibility period for payments is limited to facilities that begin operations within 10 fiscal years starting in FY2006. A facility may receive payments for a period of 10 fiscal years. No payments are to be made after an expiration period of 20 fiscal years starting with FY2006. The program is authorized to be appropriated \$10 million annually for FY2006-FY2015. Congress has appropriated funds for the program.⁵⁵ DOE maintains a list of annual selected recipients for the program.⁵⁶

Section 1201 would amend the Hydroelectric Production Incentives Program. It would modify the definition of a qualified hydroelectric facility to mean a turbine or other generating device owned or solely operated by a nonfederal entity that (1) generates hydroelectricity for sale and (2) is added to an existing dam or conduit, *or* has a generation capacity of no more than 20 megawatts (MW) for which the entity has received a construction authorization from FERC and is to be constructed in an area where there is inadequate electric service. The bill would increase the eligibility window from 10 to 22 fiscal years starting in FY2006. It would also increase the expiration period of the program from 20 to 32 fiscal years starting with FY2006. Among other things, the bill would authorize appropriations for the program for FY2021-FY2036.

The Hydroelectric Efficiency Improvement Program—Section 243 of EAct05—incentivizes efficiency improvements at existing hydroelectric facilities.⁵⁷ More specifically, the program allows the Secretary to provide payments to owners or operators of hydroelectric facilities at existing dams to be used for capital improvements at these facilities to improve their efficiency by at least 3%. Incentive payments may not exceed 10% of the cost of the capital improvement. Only one payment may be made for the improvements at a single facility. A payment may not exceed \$750,000 for the improvements at a single facility. The program is authorized to be appropriated \$10 million annually for FY2006-FY2015. Section 1201 would amend the program to authorize appropriations for FY2021-FY2036.

Section 1201 is similar to S. 859, the Reliable Investment in Vital Energy Reauthorization (RIVER) Act, as reported by ENR on September 10, 2019. Key differences include a limit of 10 MW to qualify for the incentives program under S. 859 (as opposed to 20 MW in Section 1201), and authorizations of appropriations that would start two years later in Section 1201 than in S. 859.

Sec. 1202. Marine energy research and development.

Section 1202 would amend an existing DOE research program on marine energy. Marine energy sources are currently not in commercial use in the United States, although the technical resource potential is large.⁵⁸ DOE reports “the [marine and hydrokinetic] industry is at an early stage of technological development due to the fundamental scientific and engineering challenges of

⁵⁵ For example, Congress provided \$7 million for the program for FY2020. See “Explanatory Statement on Appropriations Regarding H.R. 1865 Further Consolidated Appropriations Act, 2020,” *Congressional Record*, vol. 165 (December 17, 2019), p. H11244.

⁵⁶ DOE, *EAct 2005 Section 242 Hydro Incentive Program*, March 18, 2020, <https://www.energy.gov/eere/water/epact-2005-section-242-hydro-incentive-program>.

⁵⁷ 42 U.S.C. §15882.

⁵⁸ The resource potential varies by type of marine energy technology. For estimates and discussion, see DOE, *Quadrennial Technology Review 2015*.

generating power from dynamic, low-velocity and high-density waves and currents, all while surviving corrosive marine environments.”⁵⁹

Generally, Section 1202 would emphasize later stages of technology development more than current law. For example, Section 1202 would “establish and expand critical testing infrastructure.” Section 1202 also includes specific marine energy technology applications (e.g., marine aquaculture, desalination, community microgrids in isolated power systems) that are not mentioned in current law.

Section 1202 would establish a new National Marine Energy Center associated with an institution of higher education to conduct marine energy research activities, including housing testing facilities. DOE currently supports three National Marine Energy Centers, in accordance with provisions in EISA.⁶⁰ Section 1202 would direct DOE to continue to support these three centers while also adding a fourth center. Section 1202 specifies cost-sharing requirements for all centers and requires them to demonstrate the need for federal support. Current law does not specify cost-sharing requirements but does require a demonstration of need.

Section 1202 would amend the definition of “marine energy,” though this change would likely have minimal impacts on program implementation. Section 1202 would expand the definition of marine energy to also include hydrokinetic energy from non-marine bodies of water (e.g., rivers, lakes).⁶¹ Under current law, “marine energy” and “hydrokinetic energy” are used as separate terms; for example, in the relevant subtitle section heading in the Energy Independence and Security Act of 2007 (EISA; P.L. 110-441).

Current law requires DOE to consult with the Department of the Interior (DOI) and the National Oceanic and Atmospheric Administration (NOAA) in its marine energy research program, overall. Current law also requires DOE to consult with the U.S. Coast Guard regarding potential navigational impacts. Section 1202 additionally requires consultation with the Federal Energy Regulatory Commission (FERC) regarding the program overall.

Section 1202 further requires a DOE study, in consultation with the Department of Commerce and the Department of Transportation. The study would examine how marine energy technologies could support (1) economic development in the maritime transportation sector; (2) resilience and disaster recovery for maritime infrastructure, including that serving ports; and (3) scientific missions at sea, including those in the Arctic.

Section 1202 would authorize \$320 million for FY2021-FY2022 for the marine energy research program and the National Marine Energy Centers (combined). For comparison, current law authorizes \$250 million for FY2008-FY2012.

⁵⁹ DOE, *Marine and Hydrokinetic: Report to Congress*, September 2018.

⁶⁰ The current National Marine Energy Centers are: the Pacific Marine Energy Center, jointly operated by Oregon State University, the University of Washington, and the University of Alaska Fairbanks; the Southeast National Marine Renewable Energy Center, operated by Florida Atlantic University; and Hawaii National Marine Renewable Energy Center, operated by the University of Hawaii: Manoa.

⁶¹ Hydrokinetic energy is a type of energy derived from the motion of water. This motion can have many natural causes, including waterfalls, tides, and river currents. Hydrokinetic energy technologies convert this energy into a useable form, such as electric energy (i.e., electricity). Marine energy can be hydrokinetic because oceans have tides and currents (i.e., ocean water moves). Another marine energy source (ocean thermal) comes from the temperature difference between shallow and deep waters. Other renewable energy sources such as offshore wind and solar may be located in marine environments, but they are not usually described as a type of marine energy.

Section 1202 is nearly identical to S. 1821, the Marine Energy Research and Development Act of 2019, as reported by ENR on October 23, 2019. A related bill in the House is H.R. 3203, the Marine Energy Research and Development Act of 2019.

Sec. 1203. Advanced geothermal innovation leadership.

Section 1203 would reauthorize an existing DOE research program on geothermal energy. The reauthorized program would primarily focus on expanding use of conventional geothermal energy technologies and developing new technologies for enhanced geothermal systems (EGS).⁶² The United States is believed to have a large EGS potential, but technology development is still required to produce energy from these resources.

Geothermal energy can be used to generate electricity, to provide heat for direct use (e.g., heating for commercial or industrial facilities), and to heat and cool buildings through geothermal heat pumps. In 2019, geothermal energy generated less than 1% of U.S. electricity.⁶³ The share of building heating and cooling needs supplied by geothermal energy is likely smaller than the share of electricity supplied by geothermal energy.

Section 1203 would direct the United States Geological Survey (USGS) to update its assessment of U.S. geothermal resource potential, last conducted in 2008.⁶⁴ The update is to focus on increasing the resolution of geothermal energy resource maps, assessing non-energy aspects such as mineral coproduction potential and induced seismicity risks, and improving data for Alaska, Hawaii, and Puerto Rico in particular.

Section 1203 would promote technology development through (1) a new Oil and Gas Technology Transfer Initiative; (2) a Coproduction of Geothermal Energy and Minerals Production Prize Competition; (3) DOE-supported testing sites; and (4) a demonstration program. The technology transfer initiative would aim to demonstrate use of oil and gas drilling and other operations for geothermal energy development. The prize competition would award up to \$10 million for cost-effective and environmentally friendly ways to remove minerals from geothermal brines. The DOE-supported testing sites are to include continued support for the current testing site in Milford, UT, and support for a new testing site. The demonstration program is to fund at least four projects demonstrating different types of technologies in different geologic settings. At least one demonstration project is to be located east of the Mississippi River.

Section 1203 would take other actions to promote development and deployment of geothermal energy, including:

- establishing a voluntary, industry-wide repository of drilling data;
- establishing a new R&D program for geothermal heat pumps and direct use of geothermal energy;
- establishing a financial assistance program to promote use of geothermal heat pumps and direct use of geothermal energy, especially in economically distressed areas; and
- expanding the High Cost Region Geothermal Energy Grant Program.

⁶² Enhanced geothermal systems (EGS), sometimes called engineered geothermal systems, are man-made systems created to produce electricity from geothermal reservoirs that may not be economical due to a lack of water or permeability.

⁶³ EIA, *Electric Power Monthly*, February 2020.

⁶⁴ The USGS, DOE, and academic institutions have all conducted various assessments and studies of U.S. geothermal resources since 2008, though no single study has been as comprehensive in scope as the 2008 USGS study.

Other provisions in Section 1203 promote geothermal energy development on federal lands, including:

- directing DOI, DOE, USDA, and other relevant federal agencies to establish national goals for geothermal energy capacity on public lands;
- allowing noncompetitive leasing for coproduction of geothermal to holders of oil and gas leasing permits (after meeting determination of national energy security interest);
- categorically excluding most geothermal test wells from certain requirements under the National Environmental Policy Act (as is currently the case for some oil and gas exploration wells); and
- establishing an inter-agency Geothermal Energy Permitting Coordination Program to “improve Federal permit coordination and reduce regulatory timelines.”

Section 1203 would authorize \$825 million for FY2021-FY2025 for geothermal research activities. Of this amount, \$25 million would be for the prize competition and \$5 million would be for the drilling data repository. For comparison, current law authorizes \$450 million for geothermal energy research activities in FY2008-FY2012. The section separately authorizes \$25 million for FY2021-FY2025 for the High Cost Region Geothermal Energy Grant Program. For comparison, current law authorizes “such sums as are necessary to carry out this section.”

Section 1203 is largely identical to S. 2657, the Advanced Geothermal Innovation Leadership (AGILE) Act of 2019, as reported by ENR on December 17, 2019.⁶⁵ Some of the provisions in S. 2657 are similar to provisions in H.R. 5374, the Advanced Geothermal Research and Development Act of 2019. The committee report for S. 2657⁶⁶ states that the bill follows many recommendations included in a 2019 DOE report, *GeoVision: Harnessing the Heat Beneath Our Feet*.

Sec. 1204. Wind energy research and development.

Section 1204 would remove existing program goals for wind energy research at DOE (which date back to the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989, P.L. 101-218) and replace them with new goals. Use of wind energy in the United States has grown in recent years, due to a combination of state and federal policy incentives and cost declines. In 2019, wind energy generated approximately 7% of U.S. electricity.⁶⁷ Wind energy’s share of electricity generation is expected to grow further in coming years.

Section 1204 would establish a wind energy research program to “improve the energy efficiency, cost effectiveness, reliability, resilience, security, integration, manufacturability, and recyclability of wind energy technologies.” Some of these program goals, such as recyclability, reflect concerns that have been raised recently regarding the growing use of wind energy in the United States.⁶⁸ Other program goals, such as cost effectiveness, have long been an area of research focus at DOE.

⁶⁵ S. 2657 is the vehicle for floor discussion of S.Amdt. 1407, the American Energy Innovation Act.

⁶⁶ U.S. Congress, Senate Committee on Energy and Natural Resources, *Advanced Geothermal Innovation Leadership Act of 2019*, committee print, 116th Cong., 2nd sess., January 7, 2020, S.Rept. 116-197.

⁶⁷ EIA, *Electric Power Monthly*, February 2020.

⁶⁸ For example, Chris Martin, “Wind Turbine Blades Can’t Be Recycled, So They’re Piling Up in Landfills,” *Bloomberg Green*, February 5, 2020.

Section 1204 would require DOE to establish (within 180 days) program targets related to near-term (up to 2 years), mid-term (up to 7 years), and long-term (up to 15 years) challenges facing the wind industry. Section 1204 specifies that DOE should seek to advance a variety of wind energy technologies, including those located onshore, offshore, distributed, and off-grid.⁶⁹ Section 1204 also specifies that DOE should prioritize research projects that are (1) located in diverse geographic regions; (2) in collaboration with Indian tribes (and affiliated organizations), territories, or freely associated states, or in economically distressed areas; (3) can be replicated in a variety of regions and climates; and (4) have the potential to increase domestic manufacturing or exports.

Section 1204 would also authorize a grant program for wind technician worker training, for both onshore and offshore wind technologies. Eligible entities, including institutions of higher education, government research agencies, and tribal organizations, could purchase wind energy equipment with DOE grants for purposes of worker training.

Section 1204 includes other program goals and requirements that are not discussed here. Generally, they relate to manufacturing and operating wind energy equipment.

Section 1204 would authorize \$600 million for FY2021-FY2025 for wind energy research activities at DOE.

Section 1204 is nearly identical to S. 2660, the Wind Energy Research and Development Act of 2019, as reported by ENR on December 18, 2019. Section 1204 adds distributed and off-grid wind technologies to the set of wind energy technologies to be covered by the program. Minor text changes throughout the section reflect this expanded scope (compared to S. 2660). A related bill in the House is H.R. 3609, the Wind Energy Research and Development Act of 2019.

Sec. 1205. Solar energy research and development.

Section 1205 would remove existing program goals for solar energy research at DOE (which date back to a 1974 law, the Solar Energy Research, Development, and Demonstration Act, P.L. 93-473) and replace them with new goals. Use of solar energy in the United States has grown in recent years, due to a combination of state and federal policy incentives and cost declines. In 2019, solar energy generated approximately 3% of U.S. electricity.⁷⁰ Solar energy's share of electricity generation is expected to grow further in coming years.

Section 1205 would establish a solar energy research program at DOE to “improve the energy efficiency, cost effectiveness, reliability, resilience, security, integration, manufacturability, and recyclability of solar energy technologies.” These purposes are identical to purposes Section 1204 would give to a reauthorized DOE wind research program. Section 1205 would direct DOE's solar research program to focus on improving solar energy technology performance (including recyclability), improving grid integration,⁷¹ reducing negative environmental impacts, promoting

⁶⁹ Section 1204 does not define “distributed” or “off-grid.” Those terms generally refer to smaller technologies located within distribution systems (and therefore not connected to the bulk power transmission system), and technologies connected to neither a distribution system nor a transmission system, respectively. Distributed and off-grid technologies may be integrated into a microgrid, though that is not a requirement.

⁷⁰ EIA, *Electric Power Monthly*, February 2020.

⁷¹ Unlike some other energy sources, solar energy is variable (i.e., sunlight is not always available for electricity generation), and that variability creates challenges for electric grid operators. These challenges, and the solutions to them, are broadly described as grid integration. For more information, see CRS In Focus IF11257, *Variable Renewable Energy: An Introduction*, by Ashley J. Lawson.

the domestic solar industry, and promoting commercialization and export of solar energy technologies.

Section 1205 would require DOE to establish (within 180 days) program targets related to near-term (up to 2 years), mid-term (up to 7 years), and long-term (up to 15 years) challenges facing “the advancement of solar energy systems.” Section 1205 specifies that DOE should seek to advance a variety of advanced solar technologies. The text specifically mentions perovskites, a material that has received congressional attention in the 116th Congress.⁷² The text also specifically mentions concentrated solar power, solar heating and cooling, and other nonelectric applications for solar energy, such as in the agriculture, transportation, industrial, and fuels sectors. Section 1205 specifies priorities for solar research activities that are identical to those Section 1204 would establish for wind. Namely, section 1205 specifies that DOE should prioritize research projects that are (1) located in diverse geographic regions; (2) in collaboration with Indian tribes (and affiliated organizations), territories, or freely associated states, or in economically distressed areas; (3) can be replicated in a variety of regions and climates; and (4) have the potential to increase domestic manufacturing or exports.

Section 1205 would also direct DOE to award grants for research activities related to advanced solar energy manufacturing technologies and techniques. One of the priorities for such grants would be operating in partnership with Indian tribes (and affiliated organizations), territories, or freely associated states, or in economically distressed areas. Reducing U.S. reliance on imports of solar energy equipment, particularly solar photovoltaic cells from China, has been an area of interest for the Obama and Trump Administrations, and for some Members of Congress.⁷³

Section 1205 includes other program goals and requirements that are not discussed here. Generally, they relate to recycling and monitoring the materials used in solar energy technologies, including the country of origin of such materials.

Section 1205 would authorize \$1,350 million for FY2021-FY2025 for solar energy research at DOE.

Section 1205 is nearly identical to S. 2668, the Solar Energy Research and Development Act of 2019, as reported by ENR on December 17, 2019. A related bill in the House is H.R. 3597, the Solar Energy Research and Development Act of 2019.

Subtitle C—Energy Storage⁷⁴

Electricity, as it is currently produced, is largely a commodity resource that is interchangeable with electricity from any other source. Since opportunities for the large-scale storage of electricity are few, it is essentially a just-in-time resource, produced as needed to meet the demand of electricity-consuming customers. Climate change mitigation has increased the use of renewable energy sources for electricity generation. While energy storage is seen as an enabling technology with the potential to better integrate intermittent and variable wind and solar resources, energy

⁷² For example, U.S. Congress, House Committee on Science, Space, and Technology, Subcommittee on Energy, *Advancing the Next Generation of Solar and Wind Energy Technologies*, 116th Cong., 1st sess., May 15, 2019. In lab tests, perovskite materials convert light energy to electricity more efficiently than the silicon-based materials widely used today. Perovskites, however, currently face cost, stability, and environmental challenges that prevent their commercial use.

⁷³ For example, the United States has applied tariffs on imported solar energy equipment since 2012. Further discussion is in CRS Report R46196, *Solar Energy: Frequently Asked Questions*, coordinated by Ashley J. Lawson.

⁷⁴ Prepared by Richard J. Campbell, Specialist in Energy Policy.

storage resources would have to be charged by low- or zero-emission or renewable sources of electricity to ensure a reduction of greenhouse gases.⁷⁵

Energy storage is being increasingly investigated for its potential to provide benefits to the interstate transmission grid, and perhaps to local distribution systems and thus to retail electric customers. The ability to store energy presents an opportunity to add flexibility in how electricity is produced and used, and provides an alternative to address peak loads on the system. By using renewable electricity stored at times of low-demand, electricity saved can be used at times of high demand. In addition to providing power on demand, energy storage technologies have the potential to provide ancillary services to the electricity grid to ensure the reliability and stability of the power system, and better match generation to demand for electricity. Hydropower pumped storage (HPS), compressed air energy storage, and cryogenic energy storage are examples of technologies that store potential (or kinetic) energy. These are examples of the mostly large, monolithic systems used for energy storage today that do not store electricity directly, but provide a means of producing electricity by use of a stored medium (e.g., water or air).⁷⁶ According to the Federal Energy Regulatory Commission (FERC), approximately 24 HPS systems are currently operating with a total installed capacity of over 16.5 Gigawatts. HPS is approximately 94% of existing U.S. energy storage capacity.⁷⁷

Modular battery technologies generally store electrical energy in chemical media that can be converted to electricity. These technologies consist of standardized individual cells with relatively small power and voltage capacities that are typically aggregated to serve larger power loads. Lead-acid batteries and lithium ion (Li Ion) cells are the most used modular battery technologies for utility scale (i.e., projects of one megawatt or greater in capacity) applications on the electric grid. However, battery technologies, in general, can provide energy for only a few hours, and vary with regard to the time required to recharge battery systems. While Li Ion battery systems are currently the most prevalent form of modular storage, and a key technology for electric vehicles, several issues exist with system cost, materials used, and the safety of these systems.⁷⁸ Procurement of cobalt for Li Ion batteries has also been controversial due to child labor and safety concerns in many Congolese artisanal mines.⁷⁹

Sec. 1301. Better energy storage technology.

Section 1301 would require the Secretary of Energy to establish a program (Energy Storage System Research, Development, and Deployment) focusing on RD&D of energy storage systems designed for large-scale commercial deployment, with deployment cost targets established by the Secretary. The program would also address energy storage goals for hourly and subhourly durations required to provide reliability services to the grid, capable of daily durations (with the

⁷⁵ Greenhouse gases are any gases that absorb infrared radiation in the atmosphere. There are six main greenhouse gases discussed in the context of climate change: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases—sulfur hexafluoride (SF₆), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Carbon dioxide is the most prevalent GHG, and is produced mainly by combustion of fossil fuels. U.S. Environmental Protection Agency, *Greenhouse Gas Emissions—Overview of Greenhouse Gases*, April 11, 2019, <https://www.epa.gov/ghgemissions/overview-greenhouse-gases>.

⁷⁶ See CRS Report R45980, *Electricity Storage: Applications, Issues, and Technologies*, by Richard J. Campbell.

⁷⁷ FERC, *Pumped Storage Projects*, January 31, 2020, <https://www.ferc.gov/industries/hydropower/gen-info/licensing/pump-storage.asp>.

⁷⁸ *Ibid.*

⁷⁹ Antony Loewenstein, “From Blackwater to Batteries,” *ForeignPolicy.com*, January 25, 2019, <https://foreignpolicy.com/2019/01/25/from-blackwater-to-batteries-erik-prince-congo-drc-minerals-cobalt-afghanistan-mercenaries/>.

capacity to discharge energy for a minimum of six hours), and a system lifetime of at least 20 years under regular operation. Other goals of the program would include the development of 20-year lifetime storage systems capable of weekly or monthly durations (with the capacity to discharge energy for 10 to 100 hours, at a minimum), and the development of longer-term storage systems (with the capability to address seasonal variations in supply and demand). Among other goals, the program would focus on RD&D of distributed energy storage technologies and applications, including transportation energy storage technologies and applications, and vehicle-to-grid integration. Cost-effective systems and methods for the reclamation, recycling, and disposal of energy storage materials, including lithium, cobalt, nickel, and graphite would be included in the program. New pumping and generating equipment designs would be a focus to advance HPS, and closed-loop hydropower⁸⁰ systems using mines and quarries. The Energy Secretary would be required to develop a 10-year strategic plan to guide the program that would be submitted to the Senate Committee on Energy and Natural Resources, and the House Committees on Energy and Commerce and Science, Space, and Technology.

The Energy Secretary would be required to enter agreements for energy storage demonstration pilot projects (Energy Storage Demonstration Projects Pilot Grant Program) with “eligible entities” that include states, Indian tribes, tribal organizations, institutions of higher learning, and electric utilities. Competitive grants would be available to the eligible entities for the demonstration projects.

A joint program (Long-Duration Demonstration Initiative and Joint Program) for long-term energy storage demonstration projects would be established by DOE (through the Director of the Advanced Research Projects Agency–Energy) with DOD (through the Director of the Environmental Security Technology Certification Program (ESTCP)). Projects would be regionally diverse, with a range of technologies applied at various levels from the bulk power system to distribution systems, microgrids, and other off grid applications. The Director of ESTCP would be required to develop metrics for the program, and ensure that projects apply to a variety of conditions and environments.

The Energy Secretary would be required to establish a program (Technical Planning and Assistance Program) to assist eligible entities (including electric cooperatives, municipal utilities, and investor-owned utilities) in identifying, evaluating, planning, designing, and procuring energy storage systems. Among other goals, the program would be focused on strengthening the reliability and resiliency of energy infrastructure, and reducing the cost of energy storage systems. The program would competitively award grants to eligible entities to obtain technical and planning assistance from outside experts. A report describing the progress of the program would be submitted to Congress, and be made available to the public, not less than every two years.

An annual competition (Energy Storage Materials Recycling Prize) with cash prizes would be authorized for critical energy storage materials (including lithium, cobalt, nickel, and graphite) to advance recycling of these materials.

FERC would be required to issue a regulation to identify the eligibility of, and process for, electric storage resources so that these resources could receive cost-recovery through FERC-jurisdictional rates for energy and ancillary services.⁸¹ FERC would also be required to convene a technical conference on the potential for electric storage to improve electric system operations.

⁸⁰ With closed-loop pumped hydropower systems, neither the upper reservoir nor the lower reservoir is located on a dammed stream.

⁸¹ In 2018, FERC issued its final version of Order No. 841 to remove what it saw as barriers to the participation of

Sec. 1301 is substantially similar to S. 1602, the Better Energy Storage Technology Act, as reported by ENR on October 22, 2019. Some provisions are similar to bills introduced and discussed by the ENR Subcommittee on Energy on July 9, 2019, and incorporated in to the reported version of S. 1602. These bills are S. 1593, the Promoting Grid Storage Act of 2019; and S. 2048, the Joint Long-Term Storage Act of 2019.

Sec. 1302. Bureau of Reclamation pumped storage hydropower development.

The Secretary of the Interior would be directed not to issue a lease of power privilege⁸² for a proposed HPS project unless the proposed lessee and the Tribes (identified under this section as the Confederated Tribes of the Colville Reservation, and the Spokane Tribe of Indians of the Spokane Reservation) have entered into a study plan agreement. Alternatively, the Interior Secretary or the Director of the Office of Hearings and Appeals may make a final determination for a study plan agreement. The Secretary of the Interior would be required to make an initial determination no later than 60 days after receiving the study plan that approves or rejects the study. The initial decision would be subject to an objection process. A final determination would be required no later than 120 days after an objection. If the initial determination raised no objections, it would become final.

The language in Section 1302 is identical to language in S. 1751, the Bureau of Reclamation Pumped Storage Hydropower Development Act (S. 1751), as reported by ENR on October 23, 2019.

Subtitle D—Carbon Capture, Utilization, and Storage⁸³

This subtitle would expand the scope of DOE research activities related to carbon capture. Currently, DOE’s research activities focus on (1) capturing carbon dioxide (CO₂) emitted when coal is combusted, for example, in a power plant; and (2) sequestering (i.e., storing) CO₂ underground. This subtitle would expand that scope to also include (1) capturing CO₂ emitted when natural gas is combusted, for example, in a power plant; (2) capturing CO₂ emitted from industrial facilities outside the electric power sector; (3) developing new uses for coal outside the electric power sector; (4) developing new uses for CO₂; and (5) developing carbon removal technologies (i.e., technologies that can remove CO₂ from the atmosphere).⁸⁴

Much interest in carbon capture, utilization, and storage (CCUS) comes from its potential to address climate change by preventing CO₂ emissions into the atmosphere. This potential has received increasing attention, in part because of some recent analyses by prominent international

electric storage resources in RTO/ISO markets. See CRS Report R45980, *Electricity Storage: Applications, Issues, and Technologies*, by Richard J. Campbell.

⁸² “A Bureau of Reclamation (Reclamation) lease of power privilege (LOPP) is a contractual right given to a non-federal entity to use a Reclamation asset (e.g. dam or conduit) for electric power generation consistent with Reclamation project purposes. A LOPP project must not impair the efficiency of Reclamation generated power or water deliveries, jeopardize public safety, or negatively affect any other Reclamation project purpose.” Bureau of Reclamation, *Hydropower Program*, February 5, 2020, <https://www.usbr.gov/power/LOPP/>.

⁸³ Prepared by Ashley J. Lawson, Analyst in Energy Policy.

⁸⁴ Carbon removal technologies are distinct from carbon capture technologies in two key ways. First, carbon capture technologies *prevent* the release of CO₂ to the atmosphere. Carbon removal technologies *remove* CO₂ from the atmosphere even if that CO₂ was released many years ago. Second, carbon capture technologies are located at the site of CO₂ emissions, for example, a power plant. Carbon removal may theoretically occur anywhere, although some carbon removal options have significant constraints on their location. For example, forest management for purposes of carbon removal can only occur in locations suitable for forest growth.

research organizations.⁸⁵ Some interest in CCUS also comes from supporters of fossil fuel industries, especially the coal industry. Many supporters see CCUS as a means of enhancing fossil fuels' commercial competitiveness (domestically and internationally) in the face of increasing numbers of policies to restrict greenhouse gas emissions and other market pressures. On the other hand, some advocates for climate change policies oppose carbon capture. Those advocates may have other concerns with the production and use of fossil fuel (e.g., environmental impacts of coal mining or oil and gas development), and they may prefer climate change policies that exclusively promote renewable energy sources.

Likewise, much interest in carbon removal comes from its potential to address climate change, and this potential has received increasing attention.⁸⁶ Some see it as a more expensive option to address climate change, compared to other options such as increased energy efficiency or increased use of renewable energy sources. Some also see carbon removal as unable to address other concerns over fossil fuel use, such as environmental or health concerns.

The provisions of subtitle D are broadly similar to provisions in S. 1201, the Enhancing Fossil Fuel Energy Carbon Technology (EFFECT) Act of 2019, as reported by ENR on September 24, 2019. Specific comparisons are discussed in the context of individual sections. In general, authorizations of appropriations are one year earlier in the EFFECT Act than in Subtitle D, reflecting the different dates the legislation was introduced.

Sec. 1401. Fossil energy.

DOE's Office of Fossil Energy (FE) supports activities related to coal, natural gas, and petroleum. Current law directs FE to "carry out research, development, demonstration, and commercial application programs" in order to improve "the efficiency, effectiveness, and environmental performance of fossil energy production, upgrading, conversion, and consumption."⁸⁷

Section 1401 would expand the objectives for FE programs. The proposed new objectives all focus on various aspects of CCUS and carbon removal, and are consistent with the new research programs that would be added for CCUS and carbon removal, as described in the next four sections.

Sec. 1402. Establishment of coal and natural gas technology program.

Current law directs DOE to "conduct a program of technology research, development, demonstration, and commercial application for coal and power systems."⁸⁸ Section 1402 would replace the current "coal and related technologies program" at DOE with a "coal and natural gas technology program." The new program would focus on technologies related to the use of coal and natural gas, especially CCUS technologies. Section 1402 would require DOE carry out activities in four stages of technology innovation: R&D, large-scale pilot projects, demonstration projects, and front-end engineering and design. The section also provides considerations DOE

⁸⁵ For example, Intergovernmental Panel on Climate Change (IPCC), *Global Warming of 1.5°C*, 2018 examined scenarios that could limit global warming to no more than 1.5°C above pre-industrial temperatures by 2100. Several of those scenarios included widespread use of carbon capture and carbon removal technologies. International Energy Agency, *Exploring Clean Energy Pathways: The Role of CO₂ Storage*, 2019 similarly studied future energy scenarios and found that scenarios with relatively high amounts of carbon capture reduced emissions at lower costs compared to scenarios with lower amounts of carbon capture.

⁸⁶ For example, Energy Futures Initiative, *Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies*, 2019.

⁸⁷ 42 U.S.C. §16291(a).

⁸⁸ 42 U.S.C. §16292.

should take into account when developing program goals and objectives, and provides additional requirements for the demonstration program it establishes.

No deadlines are specified in Section 1402 for when demonstration carbon capture facilities should be operational. Nor does the section specify how CO₂ from demonstration facilities should be stored or whether demonstration facilities should also include carbon utilization options. One potential use of captured CO₂ is for a process called enhanced oil recovery (EOR), whereby CO₂ is injected into aging oil wells. Some of the injected CO₂ remains stored underground, and additional oil is produced. Debate around EOR focuses on the environmental and human health impacts associated with oil production. Oil producers have used EOR for many decades with CO₂ from natural sources, though use of CO₂ captured from power plants is relatively new.

Section 1402 would require consultation within DOE and with interested entities, including coal and natural gas producers and consumers, organizations that promote the use of coal and natural gas, environmental organizations, organizations representing workers, and organizations representing consumers. Additionally, the section would require DOE to undertake international collaborations, submit a report to Congress on the program goals and objectives, and regularly report to Congress on DOE's progress in achieving program goals and objectives.

The section authorizes appropriations for four or five years, depending on the component of the program.

- R&D: a total of \$910 million for FY2021-FY2025.
- Large-scale pilot projects: a total of \$1,488 million for FY2021-F2025.
- Demonstration projects: a total of \$1,700 million for FY2021-FY2025.
- Front-end engineering and design programs: a total of \$200 million for FY2021-FY2024.

Much of the text of Section 1402 is identical to S. 1201, the EFFECT Act of 2019, as reported by ENR on September 24, 2019. Some of the provisions in section 1402 also mirror provisions in S. 1685, the Launching Energy Advancement and Development through Innovations for Natural Gas Act of 2019, as reported by ENR on September 25, 2019.

A few text differences between Section 1402 and the EFFECT Act would cause minimal differences in implementation. For example, the EFFECT Act refers to "plants" in several places while Section 1402 refers to "electric generation facilities" instead. The term "electric generation facilities" is more precise because a single power plant can have multiple generation facilities (i.e., the machine and associated equipment that produce electricity).

Some text differences, though, might lead to differences in implementation. Section 1402 includes requirements for demonstration projects that the EFFECT Act does not have. Specifically, the requirements that at least two of the five demonstration projects be at coal electric generation facilities and at least two be at natural gas electric generation facilities. This requirement would limit DOE's flexibility in choosing demonstration projects. It would also ensure that demonstration projects use different energy sources.

The concept of demonstration projects for CCUS on natural gas electric generation facilities mirrors that in S. 1685. One provision in that bill would establish a DOE demonstration program to fund at least three CCUS projects on natural gas electric generation facilities.

Section 1402 also adds carbon capture for natural gas reformers (which can produce hydrogen from natural gas) to the list of considerations for program goals and objectives.⁸⁹ The EFFECT Act does mention hydrogen production as a desirable goal, but it does not specify any particular type of hydrogen production pathway.

Sec. 1403. Carbon storage validation and testing.

Section 1403 would amend current law regarding DOE's CCUS research program. Current law established a CCUS research program (to last 10 years, beginning in 2005) for technologies that could be used by facilities using coal. Section 1403 would modify the program replacing the existing Large-Scale Carbon Dioxide Sequestration Testing program with a new Carbon Storage Validation and Testing program. The draft would redefine "large-scale carbon sequestration" as a project demonstrating the ability to inject and sequester CO₂ into geologic formations with a "goal of sequestering not less than 50 million metric tons ... over a 10-year period." Currently, "large-scale" means more than 1 million tons of CO₂ "from industrial sources annually or a scale that demonstrates the ability to inject and sequester several million metric tons of industrial source carbon dioxide for a large number of years."⁹⁰

Section 1403 would further establish a new research program for carbon storage focused on assessing U.S. capacity for geological sequestration, developing monitoring tools, evaluating health and safety risks, and related topics. Regarding U.S. capacity for geological sequestration, the amendment specifies eight onshore and offshore geologic settings to be included in the assessment. The carbon storage research program would also include a demonstration program for large-scale carbon sequestration projects (using the new definition of large-scale). Existing regional carbon sequestration partnerships would be eligible to receive funding under the new demonstration program. The National Energy Technology Laboratory would be tasked with acting as a "clearinghouse" for information related to carbon storage demonstration projects. DOE would also be allowed to transition demonstration projects to "integrated commercial storage complexes." Such transitions would be aimed at identifying storage sites capable of accepting "large volumes of carbon dioxide" for "commercial contracts" and improving understanding of "technical and commercial viability" of geologic storage.

For DOE's CCUS research program, Section 1403 would authorize a total of \$580.192 million for FY2021-FY2024. For comparison, current law authorizes \$1,200 million for FY2008-FY2012.⁹¹

Much of the text of Section 1403 is identical to S. 1201, the EFFECT Act of 2019, as reported by the ENR on September 24, 2019. One key difference is that the definition of "large-scale carbon sequestration" is more specific in Section 1403 than in the EFFECT Act (and both definitions are different than current law). Section 1403 defines large-scale carbon sequestration as that with a goal of sequestering at least 50 million metric tons of carbon dioxide over a 10-year period. The EFFECT Act's definition, though, is the ability to sequester "several million metric tons of carbon dioxide for not less than a 10-year period."

Another difference is that Section 1403 would not require a report on carbon dioxide capture contracting authority that the EFFECT Act would require. The EFFECT Act would require a

⁸⁹ Section 1402 refers to "technologies for the capture of carbon dioxide produced during the production of hydrogen from natural gas." This hydrogen production process is generally called natural gas reforming. Steam methane reforming is a commonly cited example of natural gas reforming.

⁹⁰ 42 U.S.C. §16293(c)(3)(D).

⁹¹ 42 U.S.C. §16293(d).

report assessing options for the federal government to contract with power plants equipped with CCUS. The report would also identify costs and benefits of such options.

Sec. 1404. Carbon utilization program.

Section 1404 would establish a new DOE research program focused on carbon utilization. The new program would:

- assess and monitor potential lifecycle changes in greenhouse gas emissions and “other environmental safety indicators” (which are not defined) associated with EOR;⁹²
- identify and assess novel uses for carbon, such as converting carbon and carbon dioxide to industrial products;
- identify and assess carbon capture technologies for industrial systems; and
- identify and assess alternative uses for raw coal and processed coal products.

Section 1404 calls for new two-year demonstration programs to “accelerate the commercial deployment of coal-carbon products.” The demonstration programs are to be located “in each of the 2 major coal-producing regions of the United States.” The section does not define “coal-carbon products.”⁹³ The section also calls for a study within 180 days by the National Academies of Sciences, Engineering, and Medicine (NAS) assessing “barriers and opportunities relating to commercializing carbon, coal-derived carbon, and carbon dioxide in the United States.”

This section would combine research activities into alternative (i.e., non-power) uses for coal and uses for CO₂ into a single program. Likewise, the NAS study that the section would require is to study commercialization and other challenges facing both coal-derived carbon products and CO₂. Generally, these two industries have little overlap. In other words, research activities in coal-derived carbon products are not likely to benefit participants in the CO₂ industry (including CO₂ producers like power plants), and vice versa. Section 1404 does not specify how the proposed carbon utilization program’s R&D portfolio should be divided between these areas, though the proposed demonstration program is to be solely focused on coal-carbon products.

Section 1404 would promote research activities in carbon capture for industrial facilities. Section 1402 also would promote research activities in carbon capture for industrial facilities. Neither section specifies many details of such research activities, so it is unclear from the text how much program overlap might occur.

Section 1404 would authorize a total of approximately \$158 million over FY2021-FY2025 for the carbon utilization program.

Much of the text of Section 1404 is identical to S. 1201, the EFFECT Act of 2019, as reported by ENR on September 24, 2019. A key difference is that Section 1404 would require demonstration programs “to accelerate the commercial deployment of coal-carbon products,” as described in the section summary above. The EFFECT Act does not include such a program.

⁹² Enhanced oil recovery (EOR) is discussed in “Section 1402.” Briefly, EOR is a process whereby CO₂ is injected into oil wells in order to increase oil production. The injected CO₂ remains stored underground.

⁹³ Many products can be made from coal (and its component parts), including carbon fibers, medical sensors, and fertilizers. Historic markets for these products, and options to accelerate U.S. manufacturing of these products, are discussed in National Coal Council, *Coal in a New Carbon Age: Powering a Wave of Innovation in Advanced Products and Manufacturing*, May 2019. The National Coal Council serves as an advisory group to DOE. DOE requested a study by the National Coal Council on “coal to products” in August 2018.

Section 1404 would authorize appropriations of \$4 million more each year than the EFFECT Act. Further, both bills would require a NAS study, but Section 1404 would include in the study opportunities for commercialization of coal-derived products. The EFFECT Act does not include this topic in the scope of the NAS study.

Section 1404 is less specific than the EFFECT Act regarding what kind of carbon- or CO₂-derived products should be studied. Section 1404 mentions “commercial and industrial products and other products with potential market value” while the EFFECT Act names examples of “commercial and industrial products.”⁹⁴

Section 1404 is more specific than the EFFECT Act regarding the scope of research into alternative uses for coal. Section 1404 would direct DOE to “identify and assess alternative uses for raw coal and processed coal products in all phases,” and it then provides examples. The EFFECT Act, though, would direct DOE to “identify and assess alternative uses for coal,” and it provides the same examples.

Sec. 1405. Carbon removal.

Section 1405 would establish a new research program focused on removing CO₂ from the atmosphere. Carbon removal is seen as an option to address climate change. It is distinct from preventing the release of greenhouse gases into the atmosphere. DOE is to lead the carbon removal program in coordination with the Department of Agriculture (USDA) and other “appropriate Federal agencies.” DOE is also to coordinate internally, with participation by the Office of Fossil Energy, the Office of Science, and the Office of Energy Efficiency and Renewable Energy.

The proposed carbon removal program is to research six specific carbon removal technologies:

- direct air capture (DAC) and storage;
- bioenergy with carbon capture and sequestration (BECCS);
- enhanced geological weathering;
- agricultural practices;
- forest management and afforestation; and
- planned or managed carbon sinks, including natural and artificial.

Section 1405 would also establish an Air Capture Technology Prize Competition, for technologies that can capture carbon dioxide from “dilute media” (e.g., the atmosphere). DOE is to consult with the EPA Administrator in establishing the competition. The section authorizes \$15 million for the competition. Section 1405 does not specify how the competition should be implemented (e.g., performance standards, timeline); these would be left to the Secretary to determine.⁹⁵

Section 1405 further directs DOE to award competitive grants for the operation of at least one Direct Air Capture Test Center to “provide unique testing capabilities for innovative direct air capture and storage technologies.” The center(s) should promote DAC through R&D, developing engineering design and economic analysis, and supporting pilot and demonstration projects.

⁹⁴ S. 1201, the EFFECT Act of 2019, states the new carbon utilization program should identify potential products “such as chemicals, plastics, building materials, fuels, cement, products of coal use in power systems or other applications, or other products with demonstrated market value.”

⁹⁵ Various aspects of prize competition implementation are considered critical to the competition’s success in inducing technology innovation. For further discussion see CRS Report R45271, *Federal Prize Competitions*, by Marcy E. Gallo.

Additionally, the center(s) should maintain public records of pilot and full-scale plant performance. For purposes of the center(s), pilot projects are defined as DAC systems capable of capturing 10-100 tons of CO₂ per year, and demonstration projects are defined as DAC systems capable of capturing at least 1,000 tons annually. For perspective, an existing DAC pilot plant in Canada is reportedly capable of capturing one ton a day, or several hundred tons annually.⁹⁶

Section 1405 would authorize total appropriations of approximately \$347 million for FY2021-FY2025, including the \$15 million for the prize competition.

Much of the text of section 1405 is identical to S. 1201, the EFFECT Act of 2019, as reported by ENR on September 24, 2019. A few text differences between Section 1405 and the EFFECT Act would cause minimal differences in implementation. Section 1405 has modified language directing DOE to coordinate internally among the Office of Fossil Energy, the Office of Science, and the Office of Energy Efficiency and Renewable Energy. The EFFECT Act has identical language, but further requires the program be “cross-cutting in nature.” The EFFECT Act does not define what it means to be cross-cutting in nature. Further, Section 1405 removes “grazing practices” from the list of carbon removal options to be pursued by the new program (compared to the EFFECT Act). It keeps “agricultural practices.” The EFFECT Act would establish the Air Capture Technology Prize Competition within one year, but Section 1405 would establish the competition within two years. Otherwise, the requirements for the competition are the same.

Similarly, the EFFECT Act would direct DOE to award grants for DAC test center(s) within one year, but Section 1405 gives DOE two years. Section 1405 also simplifies the language describing the types of projects to be supported by the test center(s). Section 1405 describes these projects as “large-scale pilot and demonstration projects” while the EFFECT Act describes them as “pilot plant and full-scale demonstration projects ... that represent the scale of technology development beyond laboratory testing, but not yet advanced to test under operational conditions at commercial scale.” Pilot-scale and demonstration-scale projects are generally understood to be in between the size of laboratory-scale and commercial-scale projects. Specific sizes, operational characteristics, and other measures vary by technology. Section 1405 would define pilot and demonstration projects by the amount of CO₂ (in tons) they can capture annually. These definitions are the same as in the EFFECT Act.

Subtitle E—Nuclear⁹⁷

DOE conducts R&D on two major categories of nuclear energy: nuclear fission, in which heavy nuclei, such as uranium-235, are split into smaller nuclei, and nuclear fusion, in which light hydrogen nuclei are forced together under tremendous heat and pressure. Most applied nuclear energy R&D focuses on fission, within the DOE Office of Nuclear Energy, while basic research on nuclear fusion is mostly under the DOE Office of Science. Many of the newly authorized programs in Subtitle E are intended to encourage the commercialization of advanced reactor technology, generally defined as fission reactors with improvements over existing commercial reactors, and fusion reactors, which do not currently exist for power production.

Sec. 1501. Light water reactor sustainability program.

Light water reactor sustainability R&D focuses on improving the economics and lifespan of existing commercial nuclear reactors, which are cooled by ordinary (light) water. Research areas include materials for reactor components, risk analysis, predictive maintenance, and physical

⁹⁶ Carbon Engineering, *Frequently Asked Questions*, accessed March 4, 2020, <https://carbonengineering.com/frequently-asked-questions/>.

⁹⁷ Prepared by Mark Holt, Specialist in Energy Policy.

security. This program also includes research on flexible plant operation, in which reactors could switch between producing electricity, hydrogen, and process heat. The program was appropriated \$47 million for FY2020. Section 1501 would authorize DOE's Light Water Sustainability Program by name and substantially increase the level of detail about the program over the current description in the Energy Policy Act of 2005 (EPA05, P.L. 109-58). The provisions are the same as in S. 2368, the Nuclear Energy Renewal Act of 2019, as reported by ENR December 17, 2019.

Sec. 1502. Nuclear energy research, development and demonstration.

DOE's Advanced Reactor Technologies program conducts R&D on reducing "long-term technical barriers for multiple reactor technology concepts with a focus on innovative technologies," according to the program's FY2021 budget justification.⁹⁸ The program was appropriated \$55 million in FY2020. Section 1502 would add an authorization for the "Advanced Reactor Technologies Development Program" to other nuclear energy research authorizations in existing law (42 U.S.C. 16272). DOE would be required to carry out the program in consultation with the Nuclear Regulatory Commission. This section is the same as language in S. 2368, the Nuclear Energy Renewal Act of 2019, as reported by ENR December 17, 2019.

Sec. 1503. Advanced fuels development.

Highly radioactive nuclear fuel discharged from reactor cores (called "spent" or "used" nuclear fuel) consists of most of the original uranium in the fuel, plutonium produced from some of the uranium, and other radioactive materials. DOE's Material Recovery and Waste Form Development program conducts R&D on separation of the uranium, plutonium, and other materials in spent fuel. Some of this research focuses on recovering high-assay low enriched uranium (HALEU) for advanced reactors. HALEU is enriched in the isotope uranium-235 in the range of 5% to just below 20%, in contrast to conventional reactor fuel, which has an enrichment of between 3%-5%. Appropriations for this program in FY2020 total \$30 million. DOE conducts related R&D programs on accident tolerant fuels and other advanced fuels. Accident tolerant fuels would use improved cladding and materials that could survive accident conditions longer than existing commercial nuclear fuel, potentially giving reactor operators more time to react to accidents. Accident tolerant and other advanced fuels could be used in existing commercial reactors or advanced reactors, depending on the fuel design. For FY2020, DOE was appropriated \$95.6 million for accident tolerant fuel R&D and \$30 million for R&D on tristructural-isotropic (TRISO) fuel, in which uranium fuel pellets have a triple coating of silicon carbide and other materials. For FY2021, DOE is requesting \$36 million for accident tolerant fuel and \$34 million for TRISO fuel.

Section 1503 would modify the authorization in existing law (42 U.S.C. 16273) to specifically name Material Recovery and Waste Form Development, with modified program criteria. Appropriations for the program would be authorized at \$40 million per year for FY2021-FY2025. Section 1503 adds new authorizing provisions for Advanced Fuels R&D. This program would include fuel for existing commercial reactors that would have improved performance and accident tolerance, as well as fuel for advanced reactors that could improve the use of fuel resources (such as through recovery of uranium and plutonium from spent fuel) and nuclear weapons proliferation resistance (to reduce the potential weapons use of recovered plutonium). Appropriations for the Advanced Fuels R&D program would be authorized at \$120 million per year for FY2021-FY2025.

⁹⁸ DOE, *FY 2021 Congressional Budget Justification*, vol. 3, part 2, DOE/CF-0164, February 2020, p. 34, https://www.energy.gov/sites/prod/files/2020/02/f72/doe-fy2021-budget-volume-3-part-2_2.pdf.

This section is the same as language in S. 2368, the Nuclear Energy Renewal Act of 2019, as reported by ENR December 17, 2019, except the authorization periods are one year later in Section 1503, reflecting the different dates the legislation was introduced.

Sec. 1504. Nuclear science and engineering support.

DOE’s Radiological Facilities Management Program includes the Research Reactor Infrastructure (RRI) subprogram, which “provides project management, technical support, quality engineering and inspection, and nuclear material support to 25 research reactors located at 24 U.S. universities.”⁹⁹ The RRI subprogram was appropriated \$9 million for FY2020. DOE also provides nuclear student research fellowships through the Integrated University Program, which is funded at \$5 million in FY2020.

Section 1504 would authorize activities under DOE’s RRI subprogram, using language nearly identical to the description in the DOE FY2021 budget request, at \$15 million per year from FY2021 through FY2025. This section also would establish a Nuclear Energy Apprenticeship Subprogram, to provide graduate-level training “aligned with the critical needs of the Department.” The apprenticeship program would be authorized at \$5 million per year from FY2021 through FY2025.

This section is the same as language in S. 2368 the Nuclear Energy Renewal Act of 2019, as reported by ENR December 17, 2019, except the authorization periods are one year later in Section 1503.

Sec. 1505. University Nuclear Leadership Program.

The Integrated University Program, authorized by the Energy and Water Development and Related Agencies Appropriations Act, 2009 (42 U.S.C. 16274a), is a joint program of DOE, DOE’s National Nuclear Security Administration (NNSA), and the Nuclear Regulatory Commission (NRC). The program is authorized to make grants for multi-year university nuclear research. Appropriations for the program were authorized at \$45 million per year from FY2009 through FY2019, evenly divided among the three agencies. For FY2020, the program was appropriated \$21 million, and no funds are requested for FY2021.

Section 1505 would replace the existing authorization language to rename the program the University Nuclear Leadership Program. It would define the term “advanced nuclear reactor” to include fission reactors with “significant improvements” over existing reactors and to include fusion reactors. Funding could be used for scholarships, fellowships, and R&D projects at institutions of higher education related to advanced nuclear reactors and fuel cycle technologies and to nuclear science and engineering in general. Annual appropriations would be authorized at \$30 million for DOE (with half for NNSA) and \$15 million for NRC for FY2021 and every year thereafter.

This section is the same as language in S. 903, the Nuclear Energy Leadership Act, as reported by ENR on September 24, 2019, except that and the findings are omitted and the authorization periods are one year later, reflecting the different dates the legislation was introduced.

Sec. 1506. Versatile, reactor-based fast neutron source.

The Versatile Test Reactor (VTR) is a nuclear reactor planned by DOE to provide a source of fast (high energy) neutrons for “accelerated testing and qualification of advanced nuclear fuels,

⁹⁹ DOE, *FY2021 Congressional Budget Justification*, vol. 3, part 2, DOE/CF-0164, February 2020, p. 83, https://www.energy.gov/sites/prod/files/2020/02/f72/doe-fy2021-budget-volume-3-part-2_2.pdf.

materials, instrumentation, and sensors.” DOE estimates the project will cost between \$3 billion and \$6 billion and be completed between 2026 and 2030. The FY2021 funding request for VTR design, construction, and other project costs is \$295 million.¹⁰⁰

Section 1506 would amend a provision in EAct05 (42 U.S.C. 16275(c)) so that it would authorize DOE to provide a “versatile reactor based fast neutron source,” which is the VTR project. The provision is identical to language in S. 903, the Nuclear Energy Leadership Act, as reported by ENR on September 24, 2019.

Sec. 1507. Advanced nuclear reactor research and development goals.

[See Sec. 1508]

Sec. 1508. Nuclear energy strategic plan.

In the explanatory statement on DOE’s FY2020 appropriations, Congress established a new appropriations sub-account within the DOE Nuclear Energy account for an Advanced Reactors Demonstration Program. The new sub-account included \$160 million for DOE to begin two advanced nuclear reactor demonstration projects, with a cost-share of at least 50% from nonfederal sources. Another \$30 million was provided for grants to reduce the technical risk of two to five additional reactor demonstration proposals, with a nonfederal cost-share of at least 20%.¹⁰¹ DOE did not request further funding for the advanced reactor demonstrations for FY2021.¹⁰²

Section 1507 would require DOE to demonstrate “different advanced nuclear reactor technologies,” defined as including improved fission reactors and fusion reactors. DOE would be required to enter into agreements to complete at least two demonstration projects by the end of 2025 and establish a program for an additional demonstration to become operational by the end of 2035. Section 1508 would require DOE to prepare a 10-year strategic plan for the Office of Nuclear Energy, including the advanced reactor demonstration program. These sections are the same as language in S. 903, the Nuclear Energy Leadership Act, as reported by ENR on September 24, 2019.

Sec. 1509. Advanced nuclear fuel security program.

DOE currently has a program to develop enough HALEU fuel for the development of advanced nuclear reactor concepts that would require such fuel. Two fuel production approaches are currently being pursued. First, highly enriched uranium (HEU) contained in certain materials in DOE inventories could be blended with other uranium to produce HALEU. The other approach would use centrifuges to enrich natural or other uranium to HALEU levels. DOE received \$40 million in FY2020 for the centrifuge program and is requesting the same amount in FY2021.¹⁰³

Section 1509 would require DOE to establish a program to make HALEU available for advanced nuclear reactors through sale, resale, transfer, or lease. HALEU containing at least two metric tons of uranium-235 would be made available by the end of 2022, increasing to at least 10 metric

¹⁰⁰ DOE, *FY2021 Congressional Budget Justification*, vol. 3, part 2, DOE/CF-0164, February 2020, p. 104, https://www.energy.gov/sites/prod/files/2020/02/f72/doe-fy2021-budget-volume-3-part-2_2.pdf.

¹⁰¹ House Committee on Appropriations, *Further Consolidated Appropriations Act, 2020*, Committee Print on H.R. 1865/P.L. 116-94, January 2020, p. 461, <https://www.govinfo.gov/content/pkg/CPRT-116HPRT38679/pdf/CPRT-116HPRT38679.pdf>.

¹⁰² DOE, *FY2021 Congressional Budget Justification*, vol. 3, part 2, DOE/CF-0164, February 2020, p. 94, https://www.energy.gov/sites/prod/files/2020/02/f72/doe-fy2021-budget-volume-3-part-2_2.pdf.

¹⁰³ DOE, *FY2021 Congressional Budget Justification*, vol. 3, part 2, DOE/CF-0164, February 2020, p. 50, https://www.energy.gov/sites/prod/files/2020/02/f72/doe-fy2021-budget-volume-3-part-2_2.pdf.

tons, cumulatively, by the end of 2025. DOE would also be required to develop one or more HALEU transportation packages that could be certified by NRC. This section is the same as language in S. 903, the Nuclear Energy Leadership Act, as reported by ENR on September 24, 2019.

Sec. 1510. International nuclear energy cooperation.

DOE maintains nuclear energy relationships with energy agencies in other countries through a variety of multilateral agreements, such as the International Framework for Nuclear Energy Cooperation, and numerous bilateral nuclear energy R&D cooperation agreements.

Section 1510 would require DOE to carry out a program to “develop bilateral collaboration initiatives with a variety of countries” through existing multilateral and bilateral agreements and through “any other international collaborative effort with respect to advanced nuclear reactor operations and safety.” DOE would be required to establish a subprogram to support efforts by countries to develop peaceful nuclear energy programs, focusing on countries “that have increased civil nuclear cooperation with Russia and China.” The subprogram would be modeled after the State Department’s International Military Education and Training program. Appropriations would be authorized at \$5.5 million per year from FY2021 through FY2025.

This section is the same as language in S. 2368, the Nuclear Energy Renewal Act of 2019, as reported by ENR December 17, 2019, except that the authorization periods are one year later.

Sec. 1511. Integrated Energy Systems Program.

DOE has conducted research on integrated energy systems that would allow nuclear technology to complement other energy technologies, such as through the production of hydrogen for energy storage, transportation, and industrial uses.¹⁰⁴ According to DOE, integrating nuclear energy with renewable energy could help match renewable electricity generation with grid requirements, and produce thermal energy at a variety of temperatures.¹⁰⁵

Section 1511 would require DOE to establish an Integrated Energy Systems Program that would conduct R&D on integrating nuclear energy with renewable energy, fossil energy, and energy storage technologies. This section is the same as S. 2702, the Integrated Energy Systems Act of 2019 as reported by ENR on December 17, 2020, except that the definitions are omitted and a paragraph was added to specify heat generation as a research area for the program.

Subtitle F—Industrial Technologies

Part I—Innovation¹⁰⁶

The International Energy Agency (IEA) estimates that the industrial sector accounted for 24% of global CO₂ emissions and 37% of total global end-use energy in 2017.¹⁰⁷ Domestically, industrial

¹⁰⁴ Idaho National Laboratory, “INL Selected to Partner with Three Utilities on First-of-a-Kind Integrated Energy Systems,” news release, September 11, 2019, <https://inl.gov/article/inl-selected-to-partner-with-three-utilities-on-first-of-a-kind-integrated-energy-systems/>.

¹⁰⁵ DOE Office of Nuclear Energy, “Changing the Game by Linking Nuclear and Renewable Energy Systems,” December 8, 2016, <https://www.energy.gov/ne/articles/changing-game-linking-nuclear-and-renewable-energy-systems>.

¹⁰⁶ Prepared by Corrie E. Clark, Analyst in Energy Policy.

¹⁰⁷ International Energy Agency (IEA, 2019), “Tracking Industry,” IEA, Paris <https://www.iea.org/reports/tracking-industry>.

end-use accounted for 27% of U.S. CO₂ emissions from fossil fuel combustion and 35% of total end-use energy in 2018.¹⁰⁸

The DOE's Advanced Manufacturing Office (AMO) administers a research, development, demonstration, and deployment program focused on energy-related advanced manufacturing technologies and practices. AMO conducts research across 14 technology areas, supports public-private research and development consortia including national manufacturing institutes, and provides energy efficiency technical assistance to manufacturers.

Subtitle F would authorize a program at DOE to increase U.S. technological and economic competitiveness and to develop technologies that would reduce emissions of non-power industrial sectors. The language in Subtitle F is nearly identical to provisions in S. 2300, the Clean Industrial Technology Act of 2019, which was reported by ENR on October 24, 2019.

Sec. 1602. Coordination of research and development of energy efficient technologies for industry.

Section 1602 would amend Section 6(a) of the American Energy Manufacturing Technical Corrections Act (P.L. 112-210, 42 U.S.C. §6351). This provision would replace the "Industrial Technologies Program" with the "Advanced Manufacturing Office" to be consistent with the name of the program at DOE that has conducted the majority of the Department's industrial energy research.¹⁰⁹ The provision would also direct the Secretary to establish collaborative research and development partnerships with other programs throughout the Department.

The language in Section 1602 is identical to Section 6 of S. 2300, the Clean Industrial Technology Act of 2019, which was reported by ENR on October 24, 2019.

Sec. 1603. Industrial emissions reduction technology development program.

Section 1603 would amend subtitle D of title IV of EISA (P.L. 110-140) to add a new section after Section 454 (titled "Sec. 455. Industrial Emissions Reduction Technology Development Program."). The section would authorize a crosscutting industrial emissions reduction technology research, development, demonstration, and commercial application program.¹¹⁰ The purpose of the program would be to increase the technological and economic competitiveness of U.S. industry and manufacturing, increase the viability and competitiveness of industrial technology exports, and achieve emissions reduction in nonpower industrial sectors. The section would direct the Secretary to coordinate with other relevant federal agencies, the Industrial Technology Innovation Advisory Committee that would be established in Section 1604 of S. 2657 (see "Sec. 1604. Industrial Technology Innovation Advisory Committee"), and the energy intensive industries program, which is established in EISA Section 452.

If implemented, the program as described in Section 1603 would focus on seven areas to achieve emissions reduction:

¹⁰⁸ U.S. EPA, *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018*, p. 14, <https://www.epa.gov/ghgemissions/draft-inventory-us-greenhouse-gas-emissions-and-sinks-1990-2018>; U.S. EIA, (2019) "U.S. energy consumption by source and sector, 2018," https://www.eia.gov/totalenergy/data/monthly/pdf/flow/css_2018_energy.pdf.

¹⁰⁹ The Industrial Technologies Program was renamed the Advanced Manufacturing Office in FY2014; see DOE, *Department of Energy FY2015 Congressional Budget Request*, DOE/CF-0098, vol. 3, March 2014, p. 18.

¹¹⁰ "Emissions reduction" would include the reduction of net greenhouse gases with the exception of water vapor emitted to the atmosphere by energy services and industrial processes; "emissions reduction" would not include the elimination of embodied carbon in industrial manufacturing products.

1. Industrial production processes;
2. Alternative materials;
3. Net-zero emissions liquid and gaseous fuels;
4. Shipping, aviation, and long distance transportation;
5. Carbon capture processes for industrial applications;
6. Other technologies that achieve net-zero emissions in nonpower industrial sectors; and
7. High-performance computing to develop advanced materials and manufacturing processes.

The language in Section 1603 is nearly identical to Section 3 of S. 2300, the Clean Industrial Technology Act of 2019, which was reported by ENR on October 24, 2019.

Sec. 1604. Industrial Technology Innovation Advisory Committee.

Section 1604 would amend subtitle D of title IV of EISA to add a new section after 455 (titled “Sec. 456 Industrial Technology Innovation Advisory Committee.”). The section would direct the Secretary in consultation with the Director of the Office of Science and Technology Policy to establish an Industrial Technology Innovation Advisory Committee. The section would establish the duties of the committee, which include advising the Secretary by identifying and evaluating technology being developed by the private sector related to the focus areas of the Industrial Emissions Reduction Technology Development Program. The committee would also identify technology gaps; survey and analyze factors that prevent technology adoption; recommend technology screening criteria to encourage technology adoption; and develop a strategic plan. The section would require the committee to periodically submit a report to the Secretary on the progress of the industrial emissions reduction technology program and for the Secretary to submit a copy of any report to Congress.

The language in Section 1604 is nearly identical to Section 4 of S. 2300, the Clean Industrial Technology Act of 2019, which was reported by ENR on October 24, 2019.

Sec. 1605. Technical assistance program to implement industrial emissions reduction.

Section 1605 would amend subtitle D of title IV of EISA to add a new section after 456 (titled “Sec. 457 Technical Assistance Program to Implement Industrial Emissions Reduction.”). The section would direct the Secretary to establish a program within 180 days of enactment to provide technical assistance to an eligible entity to adopt emission reduction technologies, establish priorities or goals to accelerate development and evaluation of relevant technology, develop collaborations, review appropriate emissions reduction technologies available, develop a roadmap to implement emissions reduction technologies, and any other appropriate activity as determined by the Secretary. An eligible entity would include a state, territory or possession of the United States, local government, state or local office, tribal organization, institution of higher education, and a private entity.

The language in Section 1605 is nearly identical to Section 5 of S. 2300, the Clean Industrial Technology Act of 2019, which was reported by ENR on October 24, 2019.

Part II—Smart Manufacturing¹¹¹

While the language in the amendment directs actions by the Secretary of Energy and not a particular DOE office or agency, the current activities of the AMO are consistent with the Smart Manufacturing efforts identified in Part II. The AMO supports R&D projects, R&D consortia, and early-stage technical partnerships with national laboratories, companies (for-profit and not-for-profit), state and local governments, and universities through competitive, merit reviewed funding opportunities designed to investigate new manufacturing technologies. In particular, AMO is responsible for the Department’s Clean Energy Institutes, which are part of the larger multi-agency Manufacturing USA network of 15 manufacturing institutes. One of DOE’s institutes is the Clean Energy Smart Manufacturing Innovation Institute (CESMII), which was launched in 2016. The focus of this Institute is R&D to develop technologies and solutions that can capture, share, and process in real-time the increasing amounts of information available at manufacturing facilities.

The provisions in these sections largely mirror those in two identical bills, S. 715 and H.R. 1633. Both bills are titled the Smart Manufacturing Leadership Act. S. 715 was reported by ENR on September 10, 2019. H.R. 1633 was introduced March 7, 2019, and referred to multiple committees.

Sec. 1611. Definitions.

This section would provide definitions for a number of terms used in this section: energy management system, industrial assessment center, information and communication technology, institution of higher education, North American Industry Classification System, small and medium manufacturers, and smart manufacturing.

In general, Section 3 of H.R. 1633 and Section 3 of S. 715 are similar to Sec. 1611, except that they also define the term “National Laboratory.” Section 3 of H.R. 1633 and Section 3 of S. 715 also clarifies that “Secretary” refers to the Secretary of Energy—this definition is included in Section 2 of the amendment.

Sec. 1612. Development of national smart manufacturing plan.

The Secretary of Energy would be directed to produce, in consultation with the National Academies of Sciences Engineering, and Medicine, a National Smart Manufacturing Plan, within three years of enactment. The plan is to focus on smart manufacturing technology development and deployment to improve the productivity and energy efficiency of U.S. manufacturing. Section 1612 would direct the Secretary to identify areas in which DOE and other federal agencies can improve the speed of development, deployment, and adoption of smart manufacturing technologies and processes; improve energy efficiency and reduce environmental impacts; and improve the competitiveness and strength of the U.S. manufacturing sector. The plan would include an assessment of previous and current actions by DOE related to smart manufacturing; the establishment of voluntary interconnection protocols and performance standards; the use of smart manufacturing for energy efficiency and emissions reductions in supply chains; actions to improve cybersecurity in smart manufacturing infrastructure; the deployment of existing research results; the leveraging of existing high-performance computing infrastructure; and consideration of the impact of smart manufacturing on existing and future manufacturing jobs. The provision would require the Secretary to produce updates to the plan not less frequently than every two years. During the development of the initial plan, the Secretary would be required to submit

¹¹¹ Prepared by John F. Sargent Jr., Specialist in Science and Technology Policy.

annual progress reports to Congress. The section would authorize the use of unobligated DOE funds for these purposes.

S. 2657 generally includes the same provisions included in Section 4 of H.R. 1633 and Section 4 of S. 715. In places where H.R. 1633 and S. 715 refer to “grants,” Section 1612 uses the broader term “financial assistance.” In addition, Section 1612 excludes the term “energy management assistance” from the list of items for which the financial assistance is authorized. Also, Section 1612 includes a provision that would require consideration of the impact of smart manufacturing on existing and future manufacturing jobs that is not in H.R. 1633 or S. 715.

Sec. 1613. Leveraging existing agency programs to assist small and medium manufacturers.

DOE currently supports Industrial Assessment Centers (IACs) at 31 universities around the country. The IACs provide small and medium-sized manufacturers with a no-cost energy assessment to identify opportunities to improve productivity and competitiveness, reduce waste, and save energy.

The Secretary of Energy would be directed to expand the scope of technologies covered by the DOE IACs to include smart manufacturing technologies and practices, and to equip the directors of IACs with the training and tools needed to provide technical assistance to manufacturers regarding smart technologies and practices, including energy management systems. Section 1613 would authorize the use of unobligated DOE funds for these purposes.

Section 1613 includes the same provisions included in Section 5 of H.R. 1633 and Section 5 of S. 715.

Sec. 1614. Leveraging smart manufacturing infrastructure at National Laboratories.

The Secretary would be required to conduct a study, within 180 days of enactment, of how DOE can increase access to existing high-performance computing resources of the National Laboratories particularly for small and medium manufacturers. The Secretary of Energy would be directed to focus on increasing manufacturers’ access to the computing facilities of the National Laboratories while ensuring the information of the manufacturers is protected and the security of the National Laboratories is maintained. The Secretary would be directed to provide a report to Congress within a year of enactment describing the results of the study. The Secretary would be directed to facilitate small and medium manufacturers’ access to the National Laboratories to allow them to fully use the labs’ computing resources for enhancing U.S. manufacturing competitiveness.

Section 1614 includes the same provisions included in Section 6 of H.R. 1633 and Section 6 of S. 715.

Sec. 1615. State leadership grants.

The Secretary of Energy would be authorized to provide financial assistance on a competitive basis to states for the purpose of establishing programs to be used as models for supporting the implementation of smart manufacturing technologies. To be eligible to receive financial assistance, states would be required to submit an application to the Secretary at such time and in such manner as the Secretary may require. Applications for financial assistance would be evaluated on the basis of merit using criteria developed by the Secretary, including (1) technical merit, innovation, and impact; (2) research approach, work plan, and deliverables; (3) academic and private sector partners; and (4) alternate sources of funding. The grants would be authorized for no more than \$2 million over three years; states would be required to provide matching funds of at least 30%. States could use these funds to facilitate access to high-performance computing resources for small and medium-sized manufacturers and to provide assistance to small and

medium-sized manufacturers to implement smart manufacturing technologies and practices. The Secretary would be directed to conduct semi-annual evaluations of each award to determine the effectiveness of the programs funded with the financial assistance and to provide guidance to states on ways to better execute the program of the state. The program would be authorized \$10 million per year for fiscal years 2021 through 2024.

In general, Section 1615 includes similar provisions to those in Section 7 of H.R. 1633 and Section 7 of S. 715. This section however, provides a different set of criteria for evaluating state applications for funding excluding “plans for dissemination of results” and “the permanence of the infrastructure to be put in place by the project” and adding “technical merit, innovation, and impact” and “research approach, work plan, and deliverables.” In addition, Section 1615 would cap awards to states at \$2 million, whereas H.R. 1633 and S. 715 cap awards at \$3 million. This section also does not include one of the permissible uses of funds—“to fund research and development of transformational manufacturing processes and materials technology that advance smart manufacturing”—that is included in H.R. 1633 and S. 715.

Sec. 1616. Report.

The Secretary would be required to submit an annual report to Congress, also made available to the public, on progress in advancing smart manufacturing in the United States.

Section 1616 includes the same provision included in Section 8 of H.R. 1633 and Section 8 of S. 715.

Subtitle G—Vehicles¹¹²

Most of the more than 16.9 million new passenger vehicles sold in the United States in 2018 were internal combustion engine vehicles.¹¹³ In 2017, the transportation sector contributed 1,866 million metric tons of carbon dioxide equivalent across passenger vehicles, medium- and heavy-duty vehicles, aircraft, trains, and ships and boats.¹¹⁴ In part to address concerns of reducing greenhouse gas emissions, federal programs have been established to support increased development, production, purchase, and use of alternatives to petroleum-based fuels and internal combustion engines in transportation. These programs include tax deductions and credits for vehicle purchases and installation of alternative fueling stations, incentives for manufacturers to produce alternative fuel vehicles, investment in research and development for alternative fuel technology, and mandates for the use of biofuels.

Subtitle G would authorize a total of \$1,698,379,000 between FY2021 and FY2025 for the DOE to support research, development, engineering, demonstration, and commercial application activities for innovative vehicles and related technologies that would improve fuel efficiency and emissions for all vehicles produced in the United States, as well as reduce reliance on petroleum-based fuels in the transportation sector. Within 18 months from enactment and annually through 2025, the Secretary would be required to report to Congress on technologies developed and adopted as a result of activities authorized by this subtitle.

¹¹² Prepared by Melissa N. Diaz, Analyst in Energy Policy.

¹¹³ Oak Ridge National Laboratory, *Transportation Energy Data Book*, 37th ed. August 2019, Table 6.02.

¹¹⁴ *Carbon dioxide equivalent* measurement allows for comparison of emissions across greenhouse gases with different weights and global warming potentials. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017*, April 11, 2019, Table 2-10.

The language in Subtitle G is nearly identical to the language in S. 1085, the Vehicle Innovation Act of 2019, which was reported by ENR on July 16, 2019. Authorizations of appropriations in this subtitle would begin one fiscal year later than the Vehicle Innovation Act of 2019.

Sec. 1705. Vehicle research and development.

Section 1705 would establish vehicle research and development programs for passenger and commercial vehicle “materials, technologies, and processes with the potential to substantially reduce or eliminate petroleum use and [emissions],” and advanced manufacturing technologies and practices. Grants awarded under this section would prioritize technologies that “provide the greatest aggregate fuel savings” and “provide the greatest increase in United States employment.” For any technologies pertaining to secondary uses and innovative recycling of vehicle batteries, this section would direct the Secretary to establish demonstration projects. A pilot demonstration program would be required within 21 months from enactment for technologies most “likely to contribute to the development of a secondary market for batteries.” In carrying out this section, the Secretary would be required to consider partnerships and collaboration with industry participants, as well as relevant offices within the agency, other agencies, and state and local government entities.

Sec. 1706. Medium- and heavy-duty commercial and transit vehicles program.

[See Sec. 1708]

Sec. 1707. Class 9 truck and trailer systems demonstration.

[See Sec. 1708]

Sec. 1708. Technology testing and metrics.

Sections 1706 through 1708 would establish programs for advanced technologies for medium- and heavy-duty vehicles. The medium- and heavy-duty commercial and transit vehicles program would establish a cooperative research and development program between DOE, other relevant federal agencies, and industry participants. Section 1707 would establish a competitive grant program specifically for demonstrations of integration of advanced systems onto Class 8 truck and trailer platforms. Applicant teams may consist of manufacturers, customers, researchers, and other relevant industry participants. Section 1708 would direct the Secretary to coordinate with partners described in Section 1706 to establish standards for evaluating advanced heavy vehicles technologies.

Sec. 1709. Nonroad systems pilot program.

Section 1709 would direct the Secretary to establish a nonroad systems pilot program for research and development of technologies to “improve total machine or system efficiency for nonroad mobile equipment including agricultural, construction, air, and sea port equipment.” This section would also direct the Secretary to establish channels to share relevant information with the on-highway equipment and vehicle sectors.

Subtitle H—Department of Energy

Sec. 1801. Veteran’s Health Initiative.¹¹⁵

The Department of Energy (DOE) and the Department of Veterans Affairs (VA) have been partnering since at least 2017 “to drive technology innovation and transform health care delivery

¹¹⁵ Prepared by Laurie A. Harris, Analyst in Science and Technology Policy.

for Veterans.”¹¹⁶ The goal of the partnership has been to bring together VA health care and genomic data with DOE’s expertise in high performance computing (HPC), artificial intelligence (AI), and data analytics. The goal of the initial partnership project—Million Veterans Program Computational Health Analytics for Medical Precision to Improve Outcomes Now (MVP CHAMPION)—was to establish a scientific computing environment to house and provision MVP data to researchers nationally and create an environment to foster big data science.

Section 1801 would direct the Secretary of Energy to establish and carry out a research program in AI and HPC “focused on the development of tools to solve large-scale data analytics and management challenges associated with veteran’s healthcare, and to support the efforts of the [VA] to identify potential health risks and challenges utilizing data on long-term healthcare, health risks, and genomic data collected from veteran populations.” Section 1801 would also authorize the Secretary of Energy to enter into memoranda of understanding with VA and other entities to maximize research and development (R&D) effectiveness and require reports on these activities within two years after enactment.

The language in Section 1801 is largely similar to the language in S. 143 and H.R. 617, the Department of Energy Veterans’ Health Initiative Act. S. 143 was reported by ENR on August 16, 2019. H.R. 617 passed the House of Representatives and was reported by ENR on December 17, 2019.

Sec. 1802. Small Scale LNG Access.¹¹⁷

DOE is authorized to grant export permits for natural gas as a commodity. FERC has jurisdiction over the permitting of facilities used to export natural gas. Section 1802 addresses the DOE permit required to export natural gas, not the FERC permit. As part of DOE’s permitting process, if the natural gas exports are going to a country with which the United States has a free trade agreement that requires national treatment for gas, then the approval is assumed in the public interest and expedited. If the natural gas is going to a country that does not have a free trade agreement with the United States then DOE must determine that the exports are in the U.S. public interest.

Section 1802 would grant exports up to 51,750,000,000 cubic feet of natural gas (51.75 billion cubic feet (BCF) or equivalent to 0.142 BCF per day) the same expedited permitting process as exports to free trade countries. This does not include any countries subject to U.S. sanctions.

Section 1802 is substantially similar to language in S. 816, the Small-Scale LNG Access Act of 2019, as reported by ENR on August 1, 2019.

Sec. 1803. Appalachian Energy for National Security.¹¹⁸

U.S. production of natural gas liquids (NGLs), such as ethane, propane, butane, etc., has been increasing with the advent of shale gas and tight oil. As NGL production has risen, the markets for them have changed. U.S. NGL consumption has increased, especially in the petrochemicals and fertilizer sectors. Exports of ethane have begun and exports of other NGLs have increased, and infrastructure is being expanded, particularly in the northeast region encompassing the Marcellus, Utica, and Rogersville shale plays. According to data from the U.S. Energy Information Administration (EIA), shale gas production from 2008 to 2019 in this area has grown by orders of magnitude.

¹¹⁶ Department of Energy, “DOE and VA Team Up to Improve Healthcare for Veterans,” May 18, 2017, at <https://www.energy.gov/articles/doe-and-va-team-improve-healthcare-veterans>.

¹¹⁷ Prepared by Michael Ratner, Specialist in Energy Policy.

¹¹⁸ Prepared by Michael Ratner, Specialist in Energy Policy.

Section 1803 would require a study to be undertaken related to the building of NGL, specifically ethane, and petrochemical infrastructure. The Secretary of Energy is responsible for the study and its coordination. The study is to identify potential economic, security, trade, and geopolitical benefits and risks of any project. Status updates and a final report must be submitted to the relevant House and Senate Committees with one year after the date of enactment.

Section 1803 is identical to Section 3 of S. 1064, the Appalachian Energy for National Security Act as reported by ENR on August 16, 2019.

Sec. 1804. Energy and water for sustainability.¹¹⁹

Energy generation in part depends on the availability of water for fuel production, mining, hydropower, and power plant cooling, and energy is needed to treat, pump, and distribute water and to collect, treat, and discharge wastewater.¹²⁰ The interdependence between energy and water is often referred to as the energy-water nexus, or the water-energy nexus. While comprehensive data on energy use by the water sector and water use by the energy sector may be limited or geographically specific,¹²¹ the relationship between the energy sector and the water sector is generally recognized.

Congress has authorized several federal agencies to address energy-water nexus issues using various approaches.¹²² The Energy Policy Act of 2005 (EPA05) directed DOE to carry out research and development activities regarding water-related issues of energy production and the energy-related issues associated with water supply.¹²³ The act requires DOE to consult other relevant federal agencies on such activities. The SECURE Water Act of 2009 required DOE, in consultation with the Department of the Interior (DOI), to assess the water supplies needed for hydropower generation at federal power marketing administration projects; established a water conservation grant program at the Bureau of Reclamation within DOI; and established a national water resource assessment program at the U.S. Geological Survey to, among other goals, forecast the availability of water for future uses, such as energy production.¹²⁴

In 2012, the U.S. Government Accountability Office (GAO) found that federal efforts regarding energy and water resource planning were uncoordinated and identified “a need for enhanced research and data efforts that could benefit from greater interagency cooperation.”¹²⁵ DOE

¹¹⁹ Prepared by Elena H. Humphreys, Analyst in Environmental Policy.

¹²⁰ For more information about these topics, see CRS Report R43200, *Energy-Water Nexus: The Water Sector's Energy Use*, by Claudia Copeland and Nicole T. Carter, and CRS Report R43199, *Energy-Water Nexus: The Energy Sector's Water Use*, by Nicole T. Carter.

¹²¹ U.S. Government Accountability Office (GAO), *Energy-Water Nexus: Amount of Energy Needed to Supply, Use, and Treat Water Is Location-Specific and Can Be Reduced by Certain Technologies and Approaches*, GAO-11-225, March 23, 2011, p. 10, <https://www.gao.gov/products/GAO-11-225>. GAO, *Energy-Water Nexus: Coordinated Federal Approach Needed to better Manage Energy and Water Tradeoffs*, GAO-12-880, September 2012, <http://www.gao.gov/assets/650/648306.pdf>.

¹²² Congress authorized two voluntary labeling programs for energy-efficient or water-efficient products, *ENERGY STAR* and *WaterSense*, respectively. *ENERGY STAR* was authorized in EPA05 (P.L. 109-58, Section 131). For more information about *ENERGY STAR*, see CRS In Focus IF10753, *ENERGY STAR Program*, by Corrie E. Clark. *WaterSense*, established as an EPA initiative, was authorized in America's Water Infrastructure Act of 2018 (AWIA; P.L. 115-270), Section 4306. For more information about *WaterSense*, see CRS In Focus IF11128, *WaterSense® Program: Congressional Authorization*, by Elena H. Humphreys.

¹²³ Energy Policy Act of 2005, P.L. 109-58, Section 979; 42 U.S.C. §16319.

¹²⁴ Omnibus Public Land Management Act of 2009, P.L. 111-11, Title IX, Subtitle F; 42 U.S.C. §§10361-10370.

¹²⁵ GAO, *Energy-Water Nexus: Coordinated Federal Approach Needed to Better Manage Energy and Water Tradeoffs*, GAO-12-880, September 2012, p. 27, <http://www.gao.gov/assets/650/648306.pdf>.

responded to GAO's recommendation that the department would "continue to engage other agencies relevant to the energy water nexus."¹²⁶ In recent Congresses, Members have introduced numerous bills intended to increase coordination among federal agencies and departments on energy-water nexus issues, increase federal research and data on energy and water interactions, and otherwise variously address the energy-water nexus.

Section 1804(a) would direct DOE and DOI to establish a non-regulatory Interagency Coordination Committee on the Nexus of Energy Water Sustainability (NEWS Committee), and an associated NEWS Office, which would be located at DOE. The authority to establish the NEWS Committee and NEWS Office would be repealed seven years after enactment. The NEWS Committee would serve as a forum for developing federal goals and activities, in coordination with the National Science and Technology Council, on energy-water nexus research, development, and demonstration (RD&D) activities. It would be directed to develop an energy-water nexus RD&D strategic plan, in consultation and coordination with stakeholders; coordinate federal agencies and departments on energy-water nexus RD&D activities; facilitate data collection, management, and dissemination of information on energy-water nexus RD&D activities among federal departments and agencies; and promote information exchange among federal agencies, among other responsibilities. The NEWS Office would be required to provide a crosscut budget to specified congressional committees on federal program-, project-, and activity-level basic and applied RD&D activities to advance energy-water nexus science and technologies. Five years after establishment, the NEWS Office would be required to review the NEWS Committee and report to relevant congressional committees on the results of the NEWS Committee and provide a recommendation whether the NEWS Committee should continue.

Section 1804(b) would require DOE to integrate water considerations into the department's energy RD&D programs and projects in several ways. The section would require DOE to integrate water considerations by (1) advancing technologies that minimize freshwater withdrawals and consumption, increase water use efficiency, and utilize nontraditional water sources; (2) considering the effects of climate variability on water supplies for energy production; and (3) improving understanding of energy-water nexus.

Section 1804(c) would amend the EPAct05 (P.L. 109-58) to direct DOE to establish a smart energy and water efficiency pilot program. This competitive grant program would support technology-based solutions that would improve the net energy balance of various types of water systems, allow for the installation of automated systems that provide real-time data on water and energy use, and improve energy-water conservation through internet-connected technologies. This section specifies selection criteria for DOE to use in reviewing grant applications. DOE would be required to provide technical and policy assistance to grant recipients, perform annual evaluations of grants and provide these evaluations to Congress, and develop best practices based on the grant evaluations. This section authorizes the appropriation of \$15 million, available until expended, to support this grant program.

The language in Section 1804(a) and (c) is nearly identical to Section 2 and 3 of S. 2799, the Nexus of Energy and Water for Sustainability Act of 2019, which was reported by ENR on January 7, 2020. The language in Section 1804(b) is nearly identical to Section 2 of S. 2978 and H.R. 34, the Energy and Water Research Integration Act of 2019. The House passed H.R. 34 on

¹²⁶ Ibid., p. 33. In 2014, DOE issued a report on the energy-water nexus, called *The Water-Energy Nexus: Challenges and Opportunities*. (Department of Energy, *The Water-Energy Nexus: Challenges and Opportunities*, June 2014, <https://www.energy.gov/downloads/water-energy-nexus-challenges-and-opportunities>.) DOE maintains a website, "Energy-Water Nexus Crosscut," at <https://www.energy.gov/energy-water-nexus-crosscut> and provided an energy-water nexus crosscut budget for the President's FY2017 Budget Request.

July 23, 2019. The language in Section 1804(c) is similar to the Smart Energy and Water Efficiency Act of 2019 (H.R. 2019; H.R. 2665; and H.R. 2741, Section 32401).

Sec. 1805. Technology transitions.¹²⁷

Congress has established various mechanisms—primarily through the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480) and subsequent amendments—to facilitate the transfer of technology and research generated from federal laboratories to the private sector where it can be further developed and commercialized. EAct05 (P.L. 109-58) required the appointment of a technology transfer coordinator to oversee and advise the Secretary of Energy “on all matters relating to technology transfer and commercialization.”¹²⁸ Additionally, P.L. 109-58 required DOE to develop goals and an execution plan for advancing technology transfer and commercialization activities across the department.

Section 1805 would amend P.L. 109-58 to statutorily establish the Office of Technology Transitions at DOE.¹²⁹ It would require that the mission of the office be to expand the commercial impact of DOE research investments and to commercialize technologies that reduce greenhouse gas emissions, in addition to “technologies that support other missions of the Department.” The section would require that the office be overseen by a Chief Commercialization Officer appointed by the Secretary of Energy. It would also require the Secretary of Energy to “conduct a review of all applied energy research and development programs under the Department that focus on researching and developing technologies that reduce emissions.” The Office of Technology Transitions and the Chief Commercialization Officer would continue to execute the duties previously assigned to the technology transfer coordinator, including administering and overseeing the Technology Commercialization Fund and the Technology Transfer Working Group.

The language in Section 1805 is nearly identical to that of S. 2688, the Technology Transitions Act of 2019, which was reported by ENR on December 17, 2019.

Sec. 1806. Energy Technology Commercialization Fund Cost-Sharing.¹³⁰

According to GAO, one of the primary challenges identified by national laboratories in the transfer of technologies to the marketplace is the “lack of funding to develop and demonstrate promising technologies in order to attract partners willing to commercialize them.”¹³¹ The Technology Commercialization Fund established under Section 1001 of EAct05 (P.L. 109-58) required that 0.9% of the funds made available each fiscal year for DOE’s applied energy research, development, demonstration, and commercial application activities be used to match funds from private partners for the promotion of “promising energy technologies for commercial purposes.”

Section 1806 would amend the cost-sharing requirements associated with the use of the Technology Commercialization Fund. It would require that cost sharing be conducted in accordance with Section 988 of P.L. 109-58. In general, Section 988 requires not less than 20% nonfederal cost share for research and development activities and 50% nonfederal cost share for

¹²⁷ Prepared by Marcy E. Gallo, Analyst in Science and Technology Policy.

¹²⁸ 42 U.S.C. §16391.

¹²⁹ The Office of Technology Transitions was originally established by the Secretary of Energy in 2015.

¹³⁰ Prepared by Marcy E. Gallo, Analyst in Science and Technology Policy.

¹³¹ GAO, *Technology Transfer: Clearer Priorities and Greater Use of Innovative Approaches Could Increase the Effectiveness of Technology Transfer at Department of Energy Laboratories*, GAO-09-548, June 16, 2009, p. 22, <https://www.gao.gov/products/GAO-09-548>.

demonstration and commercial application activities. DOE can lower or waive these requirements in certain circumstances.

Sec. 1807. State loan eligibility.¹³²

Title XVII of EAct05 (P.L. 109-58, 42 U.S.C. Chapter 149, Subchapter XV) established a program that provides incentives for innovative technologies and authorizes DOE to enter into loan guarantee agreements with projects that comply with certain eligibility criteria. Two distinct loan program activities are and have been managed as part of the Title XVII program: (1) Section 1703 loan guarantees (project eligibility criteria that is applied to the Title XVII program), and (2) Section 1705 loan guarantees (a temporary loan guarantee authority that ended on September 30, 2011).¹³³ The majority of Title XVII loan guarantee volume to date has been for projects that received guarantees under the temporary 1705 authority.

Section 1703 refers to the section of EAct05 that outlines the criteria for projects to be eligible for a loan guarantee. Generally, eligible projects must (1) avoid, reduce, or sequester air pollutants or anthropogenic greenhouse gas emissions, and (2) employ “new or significantly improved technologies.” Additionally, most projects that might receive a loan guarantee are required to pay the entire credit subsidy cost (an estimate of potential government losses) associated with the loan guarantee.¹³⁴ Employing new technologies generally increases project finance risk and typically translates into higher credit subsidy costs. The combined requirements of employing new or improved technologies and projects having to pay the credit subsidy cost creates some challenges for certain projects looking to use the loan guarantee program as a source of project finance. To date, only one project has received a loan guarantee under the 1703 authority.¹³⁵

Section 1807 of the bill would amend the statutory framework for the DOE Title XVII loan guarantee program. The section would allow projects that receive financial support or credit enhancement from a *State Energy Financing Institution*—as defined in the bill and including similar organizations established by an Indian Tribal entity or an Alaska Native Corporation—to be eligible to receive a Title XVII loan guarantee.¹³⁶ For such projects, the requirement to “employ new or significantly improved technologies” would not apply. Projects that might receive a loan guarantee under the Section 1807 amendment would not be able to utilize credit subsidy cost appropriations that are currently available for certain 1703-eligible projects. However, the proposed Title XVII amendments could stimulate additional loan activity within the

¹³² Prepared by Phillip Brown, Specialist in Energy Policy.

¹³³ The American Recovery and Reinvestment Act of 2009 (ARRA 2009; P.L. 111-5) amended Title XVII of EAct 2005 by establishing the Section 1705 loan guarantee program for rapid deployment of renewable energy and electricity transmission systems.

¹³⁴ The Federal Credit Reform Act of 1990 (FCRA, Title V of the Congressional Budget Act of 1970, P.L. 93-344, as amended) requires that appropriations—to include appropriations for credit subsidy costs and/or setting loan authority limits—be made prior to the federal government making new loan guarantee commitments. 42 U.S.C. §16512 (b)(1) states that no guarantees shall be made unless a credit subsidy cost appropriation has been made, the borrower pays the full credit subsidy cost, or a combination of the two. For Section 1703, there is currently \$161 million of credit subsidy cost appropriations available for renewable energy and efficient energy (RE&EE) projects.

¹³⁵ The Vogtle nuclear power project in Georgia has received approximately \$12 billion in loan guarantees.

¹³⁶ State Energy Financing Institution is defined in the bill as follows: “The term ‘State energy financing institution’ means a quasi-independent entity or an entity within a State agency or financing authority established by a State (i) to provide financing support or credit enhancements, including loan guarantees and loan loss reserves, for eligible projects; and (ii) to create liquid markets for eligible projects, including warehousing and securitization, or take other steps to reduce financial barriers to the deployment of existing and new eligible projects.”

program, which currently has approximately \$23.9 billion of remaining loan authority, for projects that employ commercially available technology.

Section 1807 is identical to language in S. 2399 as reported by ENR on December 18, 2019.

Sec. 1808. ARPA-E reauthorization.¹³⁷

The Advanced Research Projects Agency–Energy (ARPA-E), was authorized in 2007 by the America COMPETES Act (P.L. 110-69) to “overcome the long-term and high-risk technological barriers in the development of energy technologies.” The organization, staffing, and other characteristics of ARPA-E were modeled on the Defense Advanced Research Projects Agency (DARPA). Early advocates argued that such an agency would support transformational “out-of-the-box” research, with high risk but high potential impact, that industry by itself would not support.¹³⁸ Those advocates argued that ARPA-E should be distinct both from DOE’s basic research-oriented Office of Science and from DOE’s applied energy offices (Energy Efficiency and Renewable Energy, Fossil Energy, and Nuclear Energy), which they perceived as evolutionary rather than transformational. Over the decade since ARPA-E was first funded in FY2009, supporters have pointed to ARPA-E projects that had no other funding source and have been successfully commercialized, while critics have argued that at least some ARPA-E projects would have been more appropriately funded by the private sector. The Trump Administration has proposed eliminating funding for ARPA-E in FY2021; Congress rejected similar Administration proposals in FY2018, FY2019, and FY2020.

Section 1808 would amend the ARPA-E authorizing statute (42 U.S.C. §16538) in several ways. It would add improving the “resilience, reliability, and security” of energy infrastructure to the listed goals of the agency. It would broaden the agency’s scope from “energy technology projects” and “early-stage energy research” to “advanced technology projects” and “early-stage advanced research.” It would provide additional direction about the content of the agency’s annual report and require the submission of a quadrennial strategic vision roadmap. It would require recipients of ARPA-E research awards to demonstrate either that they have attempted to secure private financing or that their projects are not independently commercially viable. It would require an evaluation of how well ARPA-E is achieving its goals and mission.¹³⁹ Finally, it would authorize appropriations for ARPA-E for each year from FY2021 through FY2025, rising by about 15% per year.

The language in Section 1808 is nearly identical to that of S. 2714, the ARPA-E Reauthorization Act of 2019, which was reported by ENR on January 7, 2020. Similar language also appears in three House bills: H.R. 4019, the ARPA-E Reauthorization Act of 2019, ordered reported by the House Committee on Science, Space, and Technology on October 17, 2019; H.R. 3915, the ARPA-E Reauthorization and Reform Act of 2019, introduced on July 23, 2019; and Section 211 of H.R. 5685, the Securing American Leadership in Science and Technology Act of 2020, introduced on January 28, 2020.

¹³⁷ Prepared by Daniel Morgan, Specialist in Science and Technology Policy.

¹³⁸ See, for example, National Academy of Sciences, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (2007), p. 8.

¹³⁹ For the previous such evaluation, see National Academy of Sciences, *An Assessment of ARPA-E* (2017).

Sec. 1809. Adjusting strategic petroleum reserve mandated drawdowns.¹⁴⁰

The U.S. Strategic Petroleum Reserve (SPR) is a federally owned and managed oil stockpile that was created to (1) “reduce the impact of disruptions in supplies of petroleum products,” and (2) “carry out obligations of the United States under the international energy program.”¹⁴¹ Since 2015, seven laws have been enacted that cumulatively mandate the sale of 271 million barrels of SPR oil during FY2017-FY2028. Proceeds from mandated sales are used to fund a variety of legislative priorities. These mandated sales represent nearly 39% of SPR stocks held at the beginning of 2017. Congress has also authorized up to \$2 billion of SPR oil sales during FY2017-FY2020 to pay for SPR modernization activities.

Section 1809 would amend three of the seven laws (P.L. 115-270, P.L. 115-23, and P.L. 115-97) that mandate SPR crude oil sales by adjusting the fiscal years in which some or all of the mandated sales are currently scheduled to occur. The cumulative effect of this section would shift 82 million barrels of mandated sales currently planned for FY2026, FY2027, and FY2028 to occur in FY2029 and FY2030. These amendments do not change the total volume of SPR mandated sales. However, shifting out the timing of SPR mandated sales to later years has a budgetary effect. According to a Congressional Budget Office (CBO) cost estimate, changing the timing of these mandated SPR oil sales would decrease direct spending by \$460 million.¹⁴² The change in direct spending is likely a function of CBO’s oil price assumptions used to calculate the budget estimate.

Sec. 1810. Western Area Power Administration pilot project.¹⁴³

The Western Area Power Administration (WAPA) is a federal Power Marketing Administration (PMA) under DOE.¹⁴⁴ However, other than following the accounting guidance of the Uniform System of Accounts, PMAs are not subject to FERC’s reporting requirements.¹⁴⁵ Electric utilities subject to FERC’s jurisdiction must submit financial and operational information annually (via FERC Form 1 under 18 C.F.R. §141.1), and quarterly (via FERC Form 3-Q under 18 C.F.R. §141.400). Additionally, the reporting requirements of the Securities and Exchange Commission apply to firms whose stock is traded publicly.

Section 1810 would require the WAPA Administrator to establish a seven-year pilot project to summarize WAPA’s financial information and make an information database available to customers. The database would begin with FY2008, be updated annually, and be publicly available on WAPA’s website. The database would provide information on rates charged to customers for power and transmission service, the amount of capacity or energy sold, and provide a detailed accounting of WAPA’s financial transactions. Overhead and expenditures would be reported in the database, including costs related to contract staff and independent consultants. Charges to the WAPA regions from WAPA’s headquarters office for all annual and capital costs would be reported, as would information on expenses incurred on behalf of other federal agencies

¹⁴⁰ Prepared by Phillip Brown, Specialist in Energy Policy.

¹⁴¹ 42 U.S.C. Chapter 77, Subchapter I, Part B. For additional background information, see CRS Report R42460, *The Strategic Petroleum Reserve: Authorization, Operation, and Drawdown Policy*, by Robert Pirog.

¹⁴² Congressional Budget Office, “An Amendment to S. 2657, American Energy Innovation Act of 2020,” Cost Estimate, March 2, 2020, at <https://www.cbo.gov/publication/56218>.

¹⁴³ Prepared by Richard J. Campbell, Specialist in Energy Policy.

¹⁴⁴ For more information, see CRS Report R45548, *The Power Marketing Administrations: Background and Current Issues*, by Richard J. Campbell.

¹⁴⁵ Federal Energy Regulatory Commission, *Accounting Matters*, March 9, 2020, <https://www.ferc.gov/enforcement/acct-matts.asp>.

or programs or third parties for the administration of programs not related to the marketing, transmission, or wheeling¹⁴⁶ of federal hydropower resources.

WAPA's total unobligated balances for each fiscal year would be reported within each project and cost center by purpose or function. The anticipated level of unobligated balances that WAPA expects to retain at the end of the fiscal year would be reported. However, amounts in the Upper Colorado River Basin Fund established by section 5(a) 12 of the Colorado River Storage Project Act (43 U.S.C. 620d(a)), would be excluded from this requirement

Sec. 1811. Timing for distribution of financial assistance under the State energy program.¹⁴⁷

Section 1811 pertains to the State Energy Program (SEP, which DOE administers. SEP provides funding and technical assistance to states, the District of Columbia, and U.S. territories to promote the efficient use of energy and reduce the rate of growth of energy demand. Section 1811 would require that DOE distribute the full amount of assistance for a given fiscal year to recipients within 60 days after the date on which funds have been made available.

Section 1811 is identical to section 2(b) of S. 185, the Investing in State Energy Act, as introduced. Section 2 of S. 185 pertains to the timing of distribution of financial assistance for both the Weatherization Assistance Program (Subsection a) and SEP (Subsection b). S. 185 was introduced and referred to ENR on January 17, 2019.

Sec. 1812. Established Program to Stimulate Competitive Research.¹⁴⁸

EPA92 directed DOE to operate an Experimental Program to Stimulate Competitive Research (EPSCoR) and established objectives for the program, including to assist “those States that historically have received relatively little Federal [R&D] funding; and have demonstrated a commitment to develop their research bases and improve science and engineering research and education programs at their universities and colleges.”¹⁴⁹ The program places particular emphasis on increasing the number of professionals in energy-related fields and building relationships between professionals in EPSCoR jurisdictions and scientists from DOE national laboratories.¹⁵⁰

Section 1812 would amend EPA92 to reauthorize DOE's EPSCoR program and provide additional direction and authorizations to the Secretary of Energy in carrying out the program. It would direct EPSCoR to make grants to eligible entities to support applied energy R&D in all areas of environmental management and basic science sponsored by DOE, including specified areas. It would also require the Secretary of Energy to develop a program implementation plan within 270 days of enactment of the act and contract with an outside entity to assess and report on the effectiveness of the EPSCoR program within six years.

Sec. 1813. Bakken and Three Forks natural gas liquids report.¹⁵¹

The Bakken and Three Forks shale formations in North Dakota and Montana are two of the most prolific oil producing formations in the United States. The resources in these tight formations were released with the development of hydraulic fracturing and horizontal drilling in what has

¹⁴⁶ Wheeling is the “transmission of electricity by an entity that does not own or directly use the power it is transmitting.” See FERC, *Glossary*, December 8, 2016, <https://www.ferc.gov/resources/glossary.asp#W>.

¹⁴⁷ Prepared by Corrie E. Clark, Analyst in Energy Policy.

¹⁴⁸ Prepared by Laurie A. Harris, Analyst in Science and Technology Policy.

¹⁴⁹ P.L. 102-486, Title XXII, §2203(b)(3); 42 U.S.C. 13503(b)(3).

¹⁵⁰ See DOE's EPSCoR program website at <https://science.osti.gov/bes/epscor/About>.

¹⁵¹ Prepared by Michael Ratner, Specialist in Energy Policy.

become known as the “shale revolution.” In addition to the rise in oil production from these formations, there has been a significant rise in associated natural gas production and production of natural gas liquids (NGLs). NGLs include ethane, propane, butane, and other hydrocarbons known as pentanes. Propane, in particular, is used in the U.S. Midwest for drying crops in the fall and heating in the winter. In 2014, because of a wet fall and cold winter, the federal government¹⁵² and several states declared emergencies due to a shortage of propane.

Section 1813 would require the Secretary of Energy to submit to Congress “a report that assesses the feasibility of establishing a storage and distribution hub for natural gas liquids or any natural liquids component (including propane) in the vicinity of the Bakken and Three Forks shale plays....” The report is to include an evaluation of “possible locations, economic feasibility, geologic and aboveground storage capabilities, infrastructure needs, and economic and security benefits.”

Sec. 1814. Wind Blade Recycling Prize Competition.¹⁵³

Prize competitions are a tool for incentivizing the achievement of scientific and technological innovation by offering monetary and nonmonetary benefits (e.g., recognition) to competition participants. Prize competitions have a long history of use in both the public and private sectors, but have gained popularity in recent years.¹⁵⁴

Section 1814 would require the Secretary of Energy to establish a prize competition “to advance the recycling of wind blade materials.” It would require the Secretary to establish objective, merit-based criteria for awarding cash prizes, including criteria that prioritize the advancement of methods or technologies with the greatest potential for large-scale commercial deployment. The section would also require the Secretary to announce each prize competition and the requirements of such competitions in the *Federal Register*, assemble a panel of qualified judges to select the competition winner or winners, and report to Congress on the awarding of any prizes under the competition. The section would authorize \$2 million for the Wind Blade Recycling Prize Competition

Title II—Supply Chain Security

Subtitle A—Mineral Security¹⁵⁵

Sec. 2101. Mineral security.

Numerous lists have been created, based on varying criteria, of those minerals and materials of critical importance to the economy and national security. Critical minerals are used in many electronics, defense and aerospace materials, permanent magnet motors, and rechargeable batteries. A recent federal definition used to create a list of critical minerals was stated in

¹⁵² Darin G. Jones, Field Administrator, *Emergency Declaration 49 CFR § 390.23 & Extension of State Declarations Notice 49 § CFR 290.25*, U.S. Department of Transportation, Federal Motor Carrier Safety Administration, Midwestern Service Center, Matteson, IL, January 19, 2014, <https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/MSC-regional-emergency-declaration-14-01-19-508.pdf>.

¹⁵³ Prepared by Marcy E. Gallo, Analyst in Science and Technology Policy.

¹⁵⁴ For more information, see CRS Report R45271, *Federal Prize Competitions*, by Marcy E. Gallo.

¹⁵⁵ Prepared by Brandon S. Tracy, Analyst in Energy Policy.

Executive Order 13817.¹⁵⁶ This definition notes two defining characteristics of minerals deemed critical: importance to economic and national security, and a vulnerable supply chain.

Section 2101 would establish a process by which critical minerals and materials are identified, namely by instructing DOI, acting through USGS, to publish and accept public comments on the draft versions of the methodology used to identify critical minerals; the resulting list of critical minerals; and a list of critical minerals recoverable as byproducts. After reviewing and incorporating public comments, as appropriate, the DOI would publish final versions of the methodology and the two lists. The USGS would be required to complete resource assessments of the identified critical minerals. This section would also require the DOI to establish a more timely and efficient mining permitting process.

Section 2101 would also establish a DOE research program “to promote the efficient production, use, and recycling of critical minerals throughout the supply chain; and to develop alternatives to critical minerals.” DOI would be required to report on current critical mineral resources and production, and produce related forecasts for these minerals over a 10-year horizon. The section would direct DOI to work with the Department of Labor to produce an assessment of the domestic availability of technically trained personnel necessary for critical mineral exploration, and to design an interdisciplinary educational program on critical minerals that would support the critical mineral supply chain through relevant workforce training and education, including the establishment of a competitive grant program for higher education institutions related to critical minerals.

This section is similar to Title I of S. 1317, the American Mineral Security Act, as reported by ENR on October 22, 2019.

Sec. 2102. Rare earth element advanced coal technologies.

Since FY2014, DOE has conducted R&D on the use of coal and coal by-products as sources of rare-earth elements. This section would formally authorize the program at DOE.

This section is similar to Title II of S. 1317, the American Mineral Security Act, as reported by ENR on October 22, 2019.

Sec. 2103. Monitoring mineral investments under Belt and Road Initiative of People’s Republic of China.

Section 2103 would require the Director of National Intelligence, in consultation with other agencies, to annually submit a report (and inform appropriate congressional committees) covering Chinese mineral investment activities and strategies, as part of its Belt and Road initiative, noting the potential for market disruptions and conflicts with related U.S. initiatives.

Subtitle B—Cybersecurity and Grid Security and Modernization¹⁵⁷

Part I—Cybersecurity and Grid Security

Sec. 2201. Incentives for advanced cybersecurity technology investment.

Electricity generation is vital to the commerce and daily functioning of the United States. The U.S. electric power grid comprises all of the power plants generating electricity, together with the transmission and distribution lines and systems that bring power to end-use customers. The bulk

¹⁵⁶ Executive Order 13817, “A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,” 82 *Federal Register* 60836, December 26, 2017.

¹⁵⁷ Prepared by Richard J. Campbell, Specialist in Energy Policy.

power system faces new and evolving cybersecurity threats. Cyber threats can come from direct attacks aimed at the electric grid or other critical infrastructure that could impact the operations or security of the grid. Arguably, the greatest cyber threats to the grid have been intrusions focused on manipulating industrial control system (ICS) networks. Cyber intrusions on the electric grid have resulted in malware on ICS networks with the capability of causing damage or taking over certain aspects of system control or functionality.¹⁵⁸

Congress gave FERC authority to oversee the reliability of the bulk power system under EPAct05 (P.L. 109-58). FERC can approve or remand back reliability standards proposed by the Electric Reliability Organization (ERO), which bulk-power system owners and operators must follow to help ensure the reliable operation of the grid. The North American Electric Reliability Corporation (NERC) currently serves as the ERO, and proposes mandatory and enforceable reliability standards for Critical Infrastructure Protection (which include physical and cybersecurity).

Section 2201 would authorize FERC (in consultation with the Secretary of Energy, NERC, industry stakeholders and regulators) to conduct a study to identify FERC-jurisdictional incentive-based rate treatments¹⁵⁹ to encourage (1) investment by public utilities in advanced cybersecurity technology,¹⁶⁰ and (2) participation by public utilities in cybersecurity threat information (e.g., information relating to advanced cybersecurity technology or proposed advanced cybersecurity technology that is generated by or provided to FERC or another federal agency). In issuing a rule under this section, FERC may provide other incentives (in consultation with the Secretaries of Energy and Homeland Security) for investments in advanced cybersecurity technology or information sharing programs to reduce cybersecurity risks to defense critical electric infrastructure or other FERC-jurisdictional facilities critical to public safety, national defense, or homeland security. Any rate approved under this rule would be subject to ratepayer protections in the Federal Power Act (FPA) Sections 205 and 206.

The language in Section 2201 is nearly identical to language in S. 2556, the Protecting Resources on the Electric Grid with Cybersecurity Technology (PROTECT) Act of 2019, as reported by ENR on December 17, 2019.

Sec. 2202. Rural and municipal utility advanced cybersecurity grant and technical assistance program.

Arguably, publicly owned utilities¹⁶¹ and electric distribution systems could have the greatest unmet needs for hardening against cybersecurity threats. This largely reflects the continually changing challenge of protecting against cybersecurity risks, the advanced age of many electric distribution systems, and the lower levels of financial resources generally available to smaller, public entities.

¹⁵⁸ See CRS Report R45312, *Electric Grid Cybersecurity*, by Richard J. Campbell.

¹⁵⁹ For example, FERC provides incentive-based rate treatments to bolster investment in the nation's electric transmission infrastructure. See FERC, *Transmission Investment*, February 19, 2020, <https://www.ferc.gov/industries/electric/indus-act/trans-invest.asp>.

¹⁶⁰ “The term ‘advanced cybersecurity technology’ is defined in the section as any technology, operational capability, or service, including computer hardware, software, or a related asset, that enhances the security posture of public utilities through improvements in the ability to protect against, detect, respond to, or recover from a cybersecurity threat.

¹⁶¹ “A class of ownership found in the electric power industry. This group includes those utilities operated by municipalities and State and Federal power agencies.” See EIA, *Glossary*, 2020, <https://www.eia.gov/tools/glossary/index.php?id=P>.

Section 2202 would require the Secretary of Energy (in consultation with FERC, NERC, and the Electricity Subsector Coordinating Council) to establish the “Rural and Municipal Utility Advanced Cybersecurity Grant and Technical Assistance Program” to provide grants and technical assistance to, and enter into cooperative agreements with, eligible entities¹⁶² to protect against, detect, respond to, and recover from cybersecurity threats. Provision of grants and technical assistance would be prioritized to eligible entities.

The language in Section 2202 is nearly identical to language in the Protecting Resources on the Electric Grid with Cybersecurity Technology (PROTECT) Act of 2019 (S. 2556), as reported by the Senate Committee on Energy and Natural Resources on December 17, 2019.

Similar grants for cybersecurity and infrastructure security to state, local, tribal and territorial governments were proposed through S. 1846, the Department of Homeland Security in the State and Local Government Cybersecurity Act of 2019, as passed by the Senate on November 21, 2019.

Sec. 2203. State energy security plans.

According to the National Association of State Energy Officials, a state energy plan is a package of strategic goals with recommended policy and programs to help states comprehensively address energy supply and demand challenges, target opportunities to support economic development, ensure a reliable energy supply, minimize societal costs, and maximize the benefits of energy production and efficient utilization.¹⁶³ However, not all states have energy security plans that consider the changing nature of physical and cybersecurity threats to energy infrastructure.

Section 2203 would provide federal financial assistance to states to develop, implement, review, and revise state plans to secure the energy infrastructure of the state against all physical and cybersecurity threats. This assistance would focus on the mitigation of the risk of energy supply disruptions to the state; enhancement of the response to, and recovery from, energy disruptions; and to ensure that the state has a reliable, secure, and resilient energy infrastructure.

States would not be eligible for federal financial assistance under this section, for a fiscal year, unless the governor of a state submits to the Secretary of Energy a state energy security plan (after an annual review of the state energy security plan by the governor) with any necessary revisions to such plan; or a certification that no revisions to such plan are necessary. The Secretary of Energy (in consultation with the Secretary of Homeland Security) may provide technical assistance for the development, implementation or the revision of a state energy plan, upon the request of a state governor.

The language in Section 2203 is almost identical to the language in S. 2094, the Enhancing State Energy Security Planning and Emergency Preparedness Act of 2019, as reported by ENR on October 22, 2019.

¹⁶² The section defines eligible entities as rural electric cooperatives; utilities owned by a political subdivision of a State (such as a municipally owned electric utility); utilities owned by any agency, authority, corporation, or instrumentality of one or more political subdivisions of a state; a not-for-profit entity that is in a partnership with not fewer than six of the preceding entities; and an investor-owned electric utility that sells less than 4,000,000 megawatt hours of electricity per year.

¹⁶³ National Association of State Energy Officials, *NASEO's State Energy Planning Guidelines*, 2018, https://www.naseo.org/Data/Sites/1/sepguidelines_2018_final.pdf.

Sec. 2204. Enhancing grid security through public private partnerships.

A timely and accurate sharing of information on cyber and physical security threats to the grid is necessary to achieve electric grid security. The effects of a wide-scale cyberattack, in concert with a targeted physical attack, may be mitigated somewhat by ongoing preparation and threat scenario practices. Providing timely information to electric utilities can also help with an evaluation of the seriousness of the threat, and an appropriate response.¹⁶⁴

Section 2204 would require the Secretary of Energy (in consultation with the Secretary of Homeland Security, state regulatory authorities, industry stakeholders, and the Electric Reliability Organization) to carry out a program to (1) develop, and provide for voluntary implementation of, maturity models, self-assessments, and auditing methods for assessing the physical security and cybersecurity of electric utilities; (2) assist with threat assessment; and (3) cybersecurity training for electric utilities. The program would also provide technical assistance for electric utilities subject to the program; provide training to electric utilities to address and mitigate cybersecurity supply chain management risks; advance the cybersecurity of third party vendors in partnerships with electric utilities; and increase opportunities for sharing best practices and data collection within the electric sector. The bill would require information provided to, or collected by, the federal government under this section to be exempt from disclosure. The bill would also require the Secretary to submit to Congress a report on the cybersecurity needs of electric distribution systems.

The language in Section 2204 is nearly identical to language in S. 2095, the Enhancing Grid Security through Public-Private Partnerships Act, as reported by ENR on October 22, 2019.

Sec. 2205. Enhanced grid security.

The electric utility industry increasingly depends on Operational Technology (OT) and Information Technology (IT) systems for the safe and efficient production and delivery of electricity. OT and IT systems rely on hardware devices and software systems, procured from a variety of manufacturers and vendors, often from international sources. The security of the design, manufacture, and patch management practices of these devices and systems is a potential vulnerability due to their global nature, and the general lack of consistent oversight of standards and practices to prevent impaired or compromised functionality.¹⁶⁵

Section 2205 would require the Secretary of Energy (in consultation with the Secretary of Homeland Security and other appropriate federal agencies, the energy sector, the states, and other stakeholders) to carry out a program to develop advanced cybersecurity applications and technologies for the energy sector. The program would identify and mitigate vulnerabilities, including dependencies on other critical infrastructure; impacts from weather and fuel supply; and advancing the security of field devices and third-party control systems. The program established by this section would also seek to leverage electric grid architecture as a means to assess risks to the energy sector, including by implementing an all-hazards approach to communications infrastructure, control systems architecture, and power systems architecture. Pilot demonstration projects would be included in the program, and the development of workforce development curricula for energy sector-related cybersecurity to establish a cybertesting and mitigation program to identify vulnerabilities of products in the supply chain to known threats.

¹⁶⁴ See CRS Report R45312, *Electric Grid Cybersecurity*, by Richard J. Campbell.

¹⁶⁵ *Ibid.*

The Energy Secretary, in consultation with the Federal Acquisition Security Council, would also be required to carry out a program to oversee third-party cybertesting, and to develop procurement guidelines for energy sector supply chain components.

The Energy Secretary may also carry out a program to enhance and periodically test the emergency response capabilities of the Department, and the coordination of the Department with other agencies, the National Laboratories, and private industry.

Another provision in this section would require the Secretary of Energy (in consultation with the Secretary of Homeland Security) to develop an advanced energy security program to secure energy networks, including electric, natural gas, and oil exploration, transmission, and delivery.

The language in Section 2205 is nearly identical to language in S. 2333, the Energy Cybersecurity Act of 2019, as reported by ENR on October 23, 2019.

Part II—Grid Modernization

Sec. 2210. Grid storage program.

Energy storage is being increasingly investigated for its potential to provide benefits to the interstate transmission grid, and perhaps to local distribution systems and thus to retail electric customers. The ability to store energy presents an opportunity to add flexibility in how electricity is produced and used, and provides an alternative to address peak loads on the system using renewable electricity stored at low-demand times. In addition to providing power on demand, energy storage technologies have the potential to provide ancillary services to the electricity grid to ensure the reliability and stability of the power system, and better match power generation to the demand for electricity.

Section 2210 would authorize the Secretary of Energy to conduct an RD&D program on electric grid energy storage that addresses the principal challenges identified in the 2013 DOE *Strategic Plan for Grid Energy Storage*.¹⁶⁶ The Grid Storage Program established by this section would, among other goals, focus on research on materials and types of storage devices from mechanical devices and chemical; power conversion technologies, and development of industry standards to compare the storage capacity cycle length and capabilities; and research validation and testing techniques. The program would also provide analyses of storage technology costs and benefits, and establish standards for storage device performance and safety codes.

There are several bills in the Senate addressing various energy storage R&D programs. Among these are:

- S. 1593, the Promoting Grid Storage Act of 2019, was introduced on May 22, 2019. The bill would require DOE to establish a program for the research of energy storage systems, components, and materials, and a technical assistance and competitive grant program. Hearings were held on the bill on July 9, 2019.
- S. 1602, the Better Energy Storage Technology Act, would establish a 10-year RD&D program for grid-scale energy storage systems in DOE. The bill was reported by ENR on October 22, 2019.

The language in Section 2210 is nearly identical Section 3 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019, except the authorization periods are one year later in Section 2210, reflecting the different dates the legislation was introduced.

¹⁶⁶ U.S. Department of Energy, *Grid Energy Storage*, December 2013, <https://www.energy.gov/sites/prod/files/2014/09/f18/Grid%20Energy%20Storage%20December%202013.pdf>.

Sec. 2211. Technology demonstration on the distribution system.

The U.S. electric grid is aging and is in need of modernization in many areas. Many might argue that the part of the electric grid most in need of modernization are distribution systems. Distribution systems bring electric energy to consumers, and can send customer-sited energy production back to the grid. New technologies for generating or using electricity are arising that can potentially enable customers to have greater choice and control over energy use. A modernized electric distribution system would facilitate customer choice, and likely improve the efficiency of the entire grid.¹⁶⁷

Section 2211 would authorize the Secretary of Energy to establish a grant program for eligible projects to modernize electric distribution systems. Projects eligible for the grants under the program would be chosen based on their capability to improve the visibility, control, performance and efficiency of the future electric grid, and must demonstrate applicability to two or more energy resources (such as renewable energy, microgrids, energy storage or electric vehicles). Eligible projects would incorporate communications and information technologies that are secure, and capable of serving different energy resources.

The language in Section 2211 is nearly identical to Section 4 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019.

Sec. 2212. Micro-grid and hybrid micro-grid systems program.

A microgrid may be defined as “any collection of interconnected loads and distributed energy resources (i.e., distributed generation) within clearly defined electrical boundaries that can be controlled as a single entity and that can operate in both grid-connected or island mode (i.e., non-grid connected).” Thus, power is generated and consumed in a localized distribution system. Many colleges and universities use microgrids because they can choose the power generation technology (for example, natural gas-fueled or renewable), manage energy costs, and have control over how the system is operated (e.g., as combined heat and power, or as power generation sources only). The ability of microgrids to operate independently of the larger electric grid can improve reliability and resilience, as most microgrids are expected to continue to be grid-connected and only operate in island mode when costs or power outages necessitate. While the decision to adopt microgrids may be based on the desire to reduce energy costs, microgrids are not necessarily cheap to build or operate, especially for the colleges or small communities seen as projected civilian customers.¹⁶⁸

Section 2212 would authorize the Secretary of Energy to establish a program to promote the development of hybrid micro-grid systems (capable of using renewable energy or fossil fuels) for isolated communities, and micro-grid systems to increase the resilience of critical infrastructure. The program would be conducted in several phases, beginning with a feasibility assessment to determine use of a dual fuel hybrid or a single energy source microgrid system. This would be followed by the design of an implementation plan for hybrid microgrids serving isolated communities, and planning for the development of microgrids to improve the resilience of critical infrastructure (for example, telecommunications system cannot operate without electricity). The remaining program phases would look at cost-shared demonstration projects, cyber and physical security planning, and sharing of benefits analysis information. The implementation strategy would examine how best to economically displace conventional generation sources, and the needs for infrastructure and personnel to support hybrid microgrids, examining how these may impact

¹⁶⁷ For more information, see CRS Report R43742, *Customer Choice and the Power Industry of the Future*, by Richard J. Campbell.

¹⁶⁸ *Ibid.*

defense, homeland security, economic development or environmental interests, and consider opportunities to leverage existing interagency efforts or other considerations. The program would be carried out in collaboration with states, Indian tribes, and other relevant stakeholders. The Energy Secretary would submit an annual report to the Senate Committee on Energy and Natural Resources and the House Committee on Energy and Commerce on efforts to implement the program. The Secretary of Energy would also be required to award grants to not fewer than 10 municipal governments or isolated communities each year to assist those municipal governments and isolated communities with dual fuel hybrid or single energy source microgrid development.

The language in Section 2212 is nearly identical to Section 5 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019.

A related bill, S. 1742, the Distributed Energy Demonstration Act of 2019, would require the Secretary of Energy to establish a grant program to support projects designed to advance the integration and optimization of distributed energy resources, including microgrid and networked microgrid systems. The bill was introduced June 5, 2019, and referred to ENR.

Sec. 2213. Electric grid architecture, scenario development, and modeling.

The modernization of the U.S. electrical grid to accommodate today’s power flows, serve reliability needs, and meet future projected uses is leading to the incorporation of electronic intelligence capabilities for power control purposes and operations monitoring. The “Smart Grid” is the name given to this evolving intelligent electric power network, with digital technologies increasingly replacing analog devices, thus enabling Smart Grid hardware and software functions.

The Smart Grid is viewed as a modernization of the nation’s power grid by the Edison Electric Institute (EEI), the trade association of the U.S. investor-owned utilities, which serves approximately 68% of U.S. electricity customers. EEI states that “[t]he modern grid will utilize telecommunications and information technology infrastructure to enhance the reliability and efficiency of the electric delivery system. The smart grid will meet the growing electricity needs of our digital economy more effectively.”¹⁶⁹

Section 2213 would authorize the Secretary of Energy to establish and facilitate a collaborative process to develop model grid architecture and a set of future scenarios for the electric grid to examine the impacts of different combinations and quantities of distributed energy resources and large-scale, central generation on the electric grid. The grid architecture and scenarios developed shall account for differences in market structure, including an examination of the potential for stranded costs in each type of market structure. Based on the findings of the grid architecture study, the Secretary of Energy would be required to determine whether any additional standards are necessary to ensure the interoperability of grid systems and associated communications networks. The Secretary of Energy would also make recommendations for additional standards, as may be appropriate, to the Electric Reliability Organization (currently the North American Electric Reliability Corporation) under Section 215 of the Federal Power Act (16 U.S.C. §824o).¹⁷⁰

The language in Section 2213 is nearly identical to Section 6 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019.

¹⁶⁹ EEI, “What Is the Smart Grid?” 2017, <http://smartgrid.eei.org/Pages/FAQs.aspx#grid>.

¹⁷⁰ The Federal Energy Regulatory Commission was given responsibility for the reliability of the bulk power system by Congress under Section 215 of the Federal Power Act (16 U.S.C. 824o). The ERO authors “reliability standards,” and FERC either approves them or remands back reliability standards deemed insufficient to the ERO for improvements.

Sec. 2214. Voluntary model pathways.

In 2007, Congress enacted EISA (P.L. 110-140). EISA directed the National Institute of Standards and Technology (NIST) to develop a set of standards to help ensure the compatibility of Smart Grid technologies. FERC was authorized to adopt a set of interoperability standards that NIST would develop based on recommendations of the Smart Grid Federal Advisory Committee (SGAC). In 2010, NIST developed a set of recommended interoperability standards, and presented these to FERC.¹⁷¹ However, FERC did not adopt the recommended standards largely due to cybersecurity and other concerns expressed by industry and state stakeholders.¹⁷² The SGAC continued to work on developing and recommending standards that might meet interoperability and cybersecurity goals. However, the SGAC was eliminated as an advisory committee as of September 2019,¹⁷³ under Executive Order 13875 issued by President Trump to cut federal advisory boards.¹⁷⁴

Section 2214 would require the Energy Secretary, in consultation with a steering committee (representing a diverse range of interests in the public, private, and academic sectors) to develop a voluntary model pathway for modernizing the electric grid through a collaborative, public-private effort that produces policy pathways for a diverse range of technologies that can be adapted for state and regional applications by regulators and policymakers. The goal of this effort would be to facilitate the modernization of the electric grid and its associated communications networks to ensure a reliable, resilient, affordable, safe, and secure electric grid.

The language in Section 2214 is nearly identical to Section 7 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019.

Sec. 2215. Performance metrics for electricity infrastructure providers.

Section 2215 would require the Secretary of Energy, in consultation with the steering committee established under Section 2214(a)(3), to submit a report to the Senate Committee on Energy and Natural Resources and the House Committee on Energy and Commerce. This report would include (1) an evaluation of the performance of the electric grid as of the date of the report; and (2) a description of the projected range of measurable costs and benefits associated with the scenarios developed under Section 2213. In developing metrics for the evaluation and projections under subsection (a), the Secretary shall consider standard methodologies for calculating improvements or deteriorations in the performance metrics (including reliability, grid efficiency, power quality, and financial incentives), and standard methodologies for calculating potential costs and measurable benefits value to ratepayers considering new tools and models, considering improvements from advanced grid technologies.

The language in Section 2215 is nearly identical to Section 8 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019.

¹⁷¹ The proposed standards focused on protocols for data exchange between devices, networks and control centers, and common data formats to facilitate substation automation, communication, and addressing the cybersecurity implications of all proposed standards.

¹⁷² U.S. Government Accountability Office, *Electricity Grid Modernization*, GAO-11-117, January 2011, p. 17, <https://www.ferc.gov/industries/electric/indus-act/smart-grid/gao-report.pdf>.

¹⁷³ Miranda Green, "Trump Officials Eliminate Board That Advised on Smart Grid Innovation," *The Hill*, October 9, 2019, <https://thehill.com/policy/energy-environment/465001-trump-officials-eliminate-board-that-advised-on-smart-grid>.

¹⁷⁴ The White House, *Executive Order on Evaluating and Improving the Utility of Federal Advisory Committees*, June 14, 2019, <https://www.whitehouse.gov/presidential-actions/executive-order-evaluating-improving-utility-federal-advisory-committees/>.

Sec. 2216. Voluntary state, regional, and local electricity distribution planning.

High winds, especially when combined with precipitation from seasonal storms, can cause damage to electricity utility systems, resulting in service interruptions to large numbers of electricity customers. Depending on the severity of the storm and resulting impairment, power outages can last a few hours or extend to periods of several days. Since the most severe system disruptions can result in region-wide power outages, coordinated planning by electric power entities to ensure the compatibility of electricity systems can improve resilience and speed recovery from such events.

On the request of a state, regional organization, or electric utility, the bill would require the Secretary of Energy to provide assistance to states, regional organizations, and electric utilities to facilitate the development of state, regional, and local electricity distribution plans. The Secretary of Energy may provide this assistance by conducting a resource assessment and analysis of future demand and distribution requirements; and by developing open source tools for state, regional, and local planning and operations. The assessment would be required to include the evaluation of the physical security, cybersecurity, and associated communications needs of an advanced distribution management system and the integration of distributed energy resources, and analysis of risks in an all-hazards approach that includes communications infrastructure, control systems architecture, and power systems architecture. The Secretary of Energy would be required to provide technical assistance to states, regional reliability entities, and other distribution asset owners and operators in assisting the development of State and regional electricity distribution plans.

The language in Section 2216 is nearly identical to Section 9 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019.

Sec. 2217. Authorization of appropriations.

Section 2217 would authorize \$200 million annually for FY2021-FY2029 to carry out Sections 2211 through 2216. Section 2217 is identical to Section 10 of S. 2332, the Grid Modernization Act of 2019, as reported by ENR on October 24, 2019, except that authorization periods are one year later in Section 2217, reflecting the different dates the legislation was introduced.

Sec. 2218. Study on the implementation of microgrids in wildfire risk areas.

Many regions of the United States are susceptible to wildfires during droughts, with lightning being a frequent cause. Electric transmission lines travel from power plant substations to electric distribution substations via utility easements called rights-of-way (ROW). To mitigate the risks of power outages or damage, the ROW is kept clear of trees or vegetation that can contact the transmission line. Some have advocated building microgrids, and deploying more distributed energy technologies to reduce the need for transmission lines.¹⁷⁵

Section 2218 would require the Secretary of Energy to conduct a study relating to the implementation of microgrids in wildfire risk areas, including assessments of the means by which utilities can better plan for that implementation; any permitting changes at the local, state, or federal level that are necessary for that implementation; and any other barriers to that implementation. The study results would be made publicly available.

¹⁷⁵ For more information, see CRS Insight IN11189, *California Wildfires and Bulk Electric System Reliability*, by Richard J. Campbell.

Sec. 2219. Net metering study and evaluation.

Net metering is a policy that allows electricity customers with their own generation capacity to be financially compensated for the energy they produce. Net metering is widely regarded as having an important role in deployment of distributed generation, especially solar energy. State and local governments have authority to establish net metering policies, and some have done so for many years.¹⁷⁶

The Secretary would be required to contract with the National Academies to conduct a study of the opportunities and challenges associated with net metering, and evaluate the expected medium- and long-term impacts of net metering. The study would address developments in net metering, including the emergence of new technologies and alternatives to existing metering systems that provide for measurement of electric energy consumption by electricity consumers. Among other goals, the study would also evaluate remote systems for sending electric energy usage information to an electric utility, analyze successful net metering business models, examine consumer and industry incentives for net metering, and assess how net metering promotes the use of distributed renewable generation.

The language in Section 2219 is nearly identical to language in S. 346, the National Evaluation of Techniques for Making Energy Technologies More Efficient and Resilient Act of 2019, which introduced on February 6, 2019, and referred to ENR.

Subtitle C—Workforce Development¹⁷⁷

Sec. 2302. Addressing insufficient compensation of employees and other personnel of the Federal Energy Regulatory Commission.¹⁷⁸

The FERC has jurisdiction over the permitting of interstate natural gas pipelines, LNG import/export terminals, and nonfederal hydroelectric generation projects. The commission also oversees the reliability and security of the nation’s bulk electric power system through mandatory standards. These functions require hundreds of FERC staff with highly-specialized expertise in disciplines such as engineering, geology, and environmental protection. However, according to FERC testimony, the agency “has experienced difficulties recruiting and retaining staff in the Washington, DC area due to compensation constraints.”¹⁷⁹ For example, approximately 30% of FERC engineers left the agency during fiscal years 2016-2019.¹⁸⁰ These workforce challenges reflect a broader workforce environment also affecting other federal agencies regulating energy infrastructure, such as the Pipeline and Hazardous Materials Safety Administration within the Department of Transportation.¹⁸¹ Turnover of FERC’s technical staff has raised concern in Congress about the commission’s ability to review natural gas and hydropower infrastructure

¹⁷⁶ For more information, see CRS Report R46010, *Net Metering: In Brief*, by Ashley J. Lawson.

¹⁷⁷ Prepared by David H. Bradley, Specialist in Labor Economics, unless otherwise noted.

¹⁷⁸ Prepared by Paul W. Parfomak, Specialist in Energy and Infrastructure Policy.

¹⁷⁹ Anton C. Porter, Executive Director, Federal Energy Regulatory Commission, testimony before the Senate Committee on Energy and Natural Resources, Subcommittee on Energy legislative hearing, September 11, 2019.

¹⁸⁰ *Ibid.*

¹⁸¹ U.S. Department of Transportation, Office of Inspector General, “PHMSA Has Improved Its Workforce Management but Planning, Hiring, and Retention Challenges Remain,” Report No. ST2018010, November 21, 2017. The report’s “economic analysis confirmed a significant salary gap between private industry and Federal salaries, resulting in strong competition with the industry” for oil, gas, and pipeline engineers.

permits, oversee FERC-permitted projects, and carry out its power market regulatory functions expeditiously and effectively.¹⁸²

Section 2302 would authorize the FERC Chairman to set compensation for certain categories of employees at a higher level than currently allowed under current civil service statutes if the Chairman certifies that existing compensation “is insufficient to retain or attract employees and other personnel to allow the Commission to carry out [its] functions ... in a timely, efficient, and effective manner” (§2302 (a)). Such certification would apply only to employees “of a scientific, technological, engineering, or mathematical nature.” It would also include requirements for specifying maximum “reasonable” compensation, setting a five-year limit, being no broader than necessary, and including an explanation for the inadequacy of other approaches.

The language in Section 2302 is nearly identical to the language in Section 2 of S. 607, the Timely Review of Infrastructure Act, which was reported by ENR October 22, 2019. One particular objection raised during committee consideration was that the bill would single out FERC staff for special treatment while many other federal agencies could make similar arguments about the need for higher pay in technical positions, as noted above. Whether federal employees, in general, are overpaid or underpaid relative to their private sector counterparts has been an ongoing subject of debate in Congress.¹⁸³

Sec. 2303. Report on the authority of the Secretary to implement flexible compensation models.

Section 2303 would require the Secretary of Energy to submit a report to Congress that examines the full scope of hiring authority granted by the Office of Personnel Management to the Secretary to implement flexible compensation models throughout the Department of Energy. The flexible compensation models (e.g., pay for performance) are intended to improve “hiring, recruiting, and retaining employees responsible for conducting work of a scientific, technological, engineering, or mathematical nature.” The report must be submitted within 180 days of enactment.

Section 2303 is nearly identical to Section 3 of S. 607, the Timely Review of Infrastructure Act, which was reported by ENR October 22, 2019.

Section 2304. 21st Century Energy Workforce Advisory Board.

Section 2304 would require the Secretary to establish the “21st Century Energy Workforce Advisory Board” (the Board) to create a strategy for DOE to support and develop a skilled energy workforce. The Board would be required to have at least 10 but not more than 15 members, including at least one representative from a labor organization with experience in the energy sector. Other members of the Board would be required to have expertise in workforce development, energy industries, organized labor, or recruiting underrepresented populations into the workforce.

The Board would be required to develop strategies to:

- determine the Department’s role in meeting the current and future labor needs of the energy sector, including consulting the Department of Labor to develop guidelines for necessary skills for the energy workforce;
- provide opportunities for students to qualify to work in the energy sector;

¹⁸² See, for example, Office of Senator Bill Cassidy, “Cassidy, Murkowski, Gardner Reintroduce Legislation to Expedite FERC Review of Energy Infrastructure Applications,” press release, February 28, 2019.

¹⁸³ For further details, see, for example, Congressional Budget Office, *Comparing the Compensation of Federal and Private-Sector Employees, 2011 to 2015*, April 2017.

- identify ways that the Department can work with federal agencies and nongovernment entities to support energy workforce development; and
- develop opportunities for the Department and the National Laboratories to improve outreach and training to minority-serving institutions, veterans, underrepresented groups of workers, and displaced energy sector workers.

As part of its work, the Board would be required to submit a report to the Secretary within one year of its establishment, and every two years thereafter until the Board terminates in 2025, to provide findings and proposals for workforce development in the energy sector. Upon review of the report the Secretary would submit the report to Congress and make it publicly available.

Section 2304 would also require the Secretary to conduct a nationally representative, voluntary survey of employers in the energy, energy efficiency, and motor vehicle sectors in order to analyze employment and demographics in these sectors, including the number of employees who devote a “substantial portion of working hours” to compliance matters. In conducting the survey and analysis, the Secretary would be required to consult with other federal agencies with expertise in statistical analysis and labor and business associations with experience in energy industries. Subsequent to the survey and analysis, the Secretary would be required to make publicly available annual reports entitled “U.S. Energy and Employment Report” that includes employment and demographic data for the energy sector, the energy efficiency sector, and the motor vehicle sector.

Section 2304 is similar to Section 3 of S. 2334, the 21st Century Energy Workforce Act of 2019, as reported by ENR on October 24, 2019. Differences between the two sections include some purposes of the Board, the number of board members, and reports required from the Board and DOE.

Section 2305. National Laboratory jobs access pilot program.

Section 2305 would require the Secretary, in consultation with the Secretary of Labor, to develop a pilot program of competitive grants to fund part of the costs to develop customized and competency-based training for individuals that provide employer-driven or recognized postsecondary credentials. Specifically, grants under this section would have the following parameters:

- Purpose: to train individuals to work as technicians at the National Laboratories or covered facilities of the National Nuclear Security Administration and establish pre-apprenticeship and apprenticeship programs with the National Laboratories or covered facilities of the National Nuclear Security Administration.
- Eligible Entities: entities that have expertise in operating apprenticeship programs, relationships with a National Laboratory or covered facility of the National Nuclear Security Administration, and the ability to recruit, train, and place individuals for work in the energy sector.
- Priority Applicants: apprenticeship programs in institutions of higher education that include math and science curricula; entities that work with transitioning military members and veterans; entities that work with Native Americans; consortia that include a state-supported entity; entities that work with minority-serving institutions; and providers of support services, introductory energy workforce training, or training for displaced energy workers.
- Authorization of Appropriations: \$5 million for each of FY2021-FY2025.

Section 2305 is similar to Section 4 of S. 2334, the 21st Century Energy Workforce Act of 2019, as reported by ENR on October 24, 2019. Key differences between the two sections include the maximum amount for an individual grant each year (\$2 million in S. 2334, \$500,000 in Section 2305), the maximum federal cost sharing (65% in S. 2334, 50% in Section 2405), and the amount of authorized appropriations (\$20 million annually for FY2020-FY2024 in S. 2334, \$5 million annually for FY2021-FY2025 in Section 2305).

Section 2306. Clean Energy Workforce Pilot Program.

Section 2306 would require the Secretary of Labor to establish a pilot program of competitive grants to provide partial federal funding for on-the-job training (OJT) and pre-apprenticeship programs to prepare individuals to work in occupations related to renewable energy, energy efficiency, or the reduction of greenhouse gas emissions. Specifically, grants under this section would have the following parameters:

- Purpose: to subsidize the costs to eligible entities to provide OJT to new or existing employees in energy efficiency and related fields and subsidize the costs to eligible entities to establish pre-apprenticeship programs that recruit minorities, women, and veterans and assist these individuals in program completion.
- Eligible Entities: business, labor organization, or community partnership entities that are involved in or provide services related to energy efficiency, renewable energy, grid modernization, or reduction in greenhouse gas emissions.
- Priority Applicants: entities that recruit local employees who are minorities, women, or transitioning from fossil energy jobs; entities with fewer than 100 employees, and pre-apprenticeship programs with successful records of recruiting and placing minorities, women, and veterans.
- Authorization of Appropriations: \$15 million for each of FY2021-FY2023.

Section 2306 is substantially similar to S. 2393, the Clean Energy Jobs Act of 2019, as reported by ENR on December 18, 2019. The key difference is the inclusion of apprenticeship programs in Section 2306.

Section 2307. Energy-Ready Vets Program.

Section 2307 would require the Secretary to establish a program to prepare qualifying veterans for careers in the energy industry. Specifically, the program under this section would have the following parameters:

- Purpose: to provide standardized training courses based on existing industry-recognized certification and training programs to prepare eligible veterans for careers in the energy sector, including low-carbon emissions, cybersecurity, and industry infrastructure. The courses, which would be provided by the Secretary and administered through the Department of Defense's SkillBridge program, would provide job training, support services, and opportunities for internships. Successful completion would require participants to earn a certificate or credential.
- Eligible Participants: veterans discharged or released from active military, naval, or air service during the most recent one-year period or veterans discharged, or veterans released from active military, naval, or air service during the two-year period immediately preceding the most recent one-year period who receive approval from the Secretary to participate.

- Authorization of Appropriations: There is not an authorization of appropriations for this section.

The program established in Section 2307 is substantially similar to that in S. 876, the Energy Jobs for our Heroes Act of 2019, as reported by ENR on December 17, 2019. S. 876 also includes language on programs to recognize commercial entities that hire program participants; and to assist industry in developing certification and training programs.

Section 2308. Wind Workforce Training Grant Program.

Section 2308 would amend Title XI of the EPAAct05¹⁸⁴ to require the Secretary to establish a competitive grant program to assist entities in preparing individuals for work in the wind industry sector. Specifically, grants under this section would have the following parameters:

- Purpose: provide funds to entities to purchase wind component equipment and to conduct a range of training, referral, and tuition assistance services to individuals to prepare for wind industry occupations.
- Eligible Entities: community colleges, technical schools, institution of higher education or labor organizations that offer a wind training program.
- Priority Applicants: entities that form partnerships with other eligible entities, enter into memoranda of understanding with a wind industry employer to further workforce development, or assist workers dislocated from the fossil fuel, nuclear, or fishing industries.
- Authorization of Appropriations: \$5 million for each of FY2021-FY2025.

Section 2308 is similar to language in Section 2 of S. 2415, the Wind Workforce Modernization and Training Act of 2019, as introduced on August 1, 2019. Differences include a wider range of activities eligible for grants in Section 2308 and different levels of authorized appropriations (\$2 million annually for FY2019-FY2024 in S. 2415, \$5 million annually for FY2021-FY2025 in Section 2308).

Section 2309. Veterans in Wind Energy.

Section 2309 would amend Title XI of EPAAct05¹⁸⁵ to require the Secretary to establish a program to prepare veterans for careers in the wind energy industry. The Secretary would be required to model this new program off of the Solar Ready Vets pilot program, which was developed by DOE to provide training in the solar energy industry to active duty servicemembers transitioning to civilian careers.

This section is substantially similar to Section 3 of S. 2415, the Wind Workforce Modernization and Training Act of 2019, as introduced on August 1, 2019, except the authorization periods are two years later in Section 2309, reflecting the different dates the legislation was introduced.

Sec. 2310. Study and report on wind workforce.

Section 2310 would require the Secretary to convene a task force of stakeholders to conduct a study and issue a report on the wind industry workforce. Specifically, components of this section would include:

- Study: assessment of the needs of the onshore and offshore wind industry workforce and a comprehensive list that includes each type of position in this

¹⁸⁴ 42 U.S.C. §16411 et seq.

¹⁸⁵ 42 U.S.C. §16411 et seq.

- industry, existing gaps in this workforce, and a description of the skill sets required for each type of position in this industry.
- **Stakeholders:** representatives from the Departments of Defense, Education, Labor, and Veterans Affairs; training providers with wind workforce training; state and local governments; ports; vessel operators; labor organizations; nonprofit organizations; and the wind industry.
 - **Report:** must be issued within one year of enactment of this act and must include findings of the required study and recommendations for a credentialing program that reflect best practices for wind workforce training programs.
 - **Authorization of Appropriations:** \$500,000 to carry out this study and report.

Section 2310 is similar to Section 4 of S. 2415, the Wind Workforce Modernization and Training Act of 2019, as introduced on August 1, 2019. Differences include the addition of supply chain, port and support vessel considerations, and the inclusion of port and vessel operators as stakeholders.

Title III – Code Maintenance

Secs. 3001-3040.

Title III contains sections that would strike various sections of the U.S. Code, generally related to expired programs or studies required under previous statutes. Many of these programs and studies were authorized or required under EPL92 (P.L. 102-486) or prior energy laws.

Appendix A. Authorizations of Appropriations

Table A-1. Appropriations Authorized in S. 2657 (S.Amdt. 1407) by Fiscal Year

\$ Millions

Section	No Year ^a	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	Total
Title I—Innovation														
Subtitle A— Efficiency														
Part I														
Subpart A														
Chapter I														
Sec. 1002			10	10	10	10	10							50
Sec. 1004			100	100	100	100	100							500
Chapter II														
Sec. 1101 ^b	10													10
Sec. 1102 ^b	10													10
Subpart B														
Sec. 1022 ^c			30	30	30	30	30	30	30	30	30	30	30	360
Sec. 1023			12	12	12	12	12							60
Sec. 1025			50	50	50	50	50							250
Subpart C														
Sec. 1032			36	36	36	36	36	36	36	36	36	36	36	396
Subpart D														
Sec. 1042 ^d			5	5										10
Sec. 1043 ^e			5	5										10

Section	No Year ^a	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	Total
Part II														
Sec. 1101			350	350	350	350	350							1,750
Subtitle A— Subtotal	20		598	598	588	588	588	66	66	66	66	66	66	3,376
Subtitle B— Renewable Energy														
Sec. 1202			160	160										320
Sec. 1203			170	170	170	170	170							850
Sec. 1204			120	120	120	120	120							600
Sec. 1205			270	270	270	270	270							1,350
Subtitle B— Subtotal			720	720	560	560	560							3,120
Subtitle C— Energy Storage														
Sec. 1301		10	280	280	280	280	270							1,400
Subtitle C— Subtotal		10	280	280	280	280	270							1,400
Subtitle D— Carbon Capture, Utilization, and Storage														
Sec. 1402			727	727	972	972	900							4,298
Sec. 1403			105	110.3	115.8	121.6	127.6							580.2
Sec. 1404			29	30.3	31.6	32.9	34.4							158.1
Sec. 1405			75	63.5	66.2	69.5	72.9							347.0

Section	No Year ^a	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	Total
Subtitle D— Subtotal			936	931	1,185.5	1,196.0	1,134.9							5,383.4
Subtitle E— Nuclear														
Sec. 1503			160	160	160	160	160							800
Sec. 1504			20	20	20	20	20							100
Sec. 1505 ^f			45	45	45	45	45	45	45	45	45	45	45	495
Sec. 1510			5.5	5.5	5.5	5.5	5.5							27.5
Subtitle E— Subtotal			230.5	230.5	230.5	230.5	230.5	45	45	45	45	45	45	1422.5
Subtitle F— Industrial Technologies														
Sec. 1614			10	10	10	10								40
Subtitle F— Subtotal			10	10	10	10								40
Subtitle G— Vehicles														
Sec. 1703			313.6	326.1	339.2	352.7	366.8							1,698.4
Subtitle G— Subtotal			313.6	326.1	339.2	352.7	366.8							1,698.4
Subtitle H— Department of Energy														
Sec. 1801 ^g			42	15	15	15	15							102
Sec. 1804 ^b	15													15
Sec. 1808			428	497	567	651	750							2,893

Section	No Year ^a	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	Total
Sec. 1814 ^b	2													2
Subtitle H— Subtotal	17		470	512	582	666	765							3,012
Title I—Subtotal	37	10	3,558.1	3,607.6	3775.1	3883.2	3915.3	111	111	111	111	111	111	19,452.2
Title II—Supply Chain Security														
Subtitle A—Mineral Security														
Sec. 2101			55	55	55	55	55	55	55	55	55			495
Sec. 2102			23	23	23	23	23	23	23					161
Subtitle A— Subtotal			78	78	78	78	78	78	78	55	55			656
Subtitle B—Cybersecurity and Grid Security and Modernization														
Part I														
Sec. 2202			50	50	50	50	50							250
Sec. 2203			90	90	90	90	90							450
Sec. 2205			100	100	100	100	100	100	100	100	100			900
Part II														
Sec. 2210			50	50	50	50	50	50	50	50	50			450
Sec. 2217			200	200	200	200	200	200	200	200	200			1,800
Subtitle B— Subtotal			490	490	490	490	490	350	350	350	350			3,850

Section	No Year ^a	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	Total
Subtitle C— Workforce Development														
Sec. 2305			5	5	5	5	5							25
Sec. 2306			15	15	15									45
Sec. 2308			5	5	5	5	5							25
Sec. 2309			2	2	2	2	2							10
Sec. 2310	0.5													0.5
Subtitle C— Subtotal	0.5		27	27	27	12	12							105.5
Title II—Subtotal	0.5		595	595	595	580	580	428	428	405	405			4,611.5
Total	37.5	10	4,153.1	4,202.6	4,370.1	4,463.2	4,495.3	539	539	516	516	111	111	24,063.8

Source: CRS analysis of S.Amdt. 1407 dated March 5, 2020.

Notes: Columns and rows may not sum due to rounding.

- a. Authorizations for which no fiscal year is specified.
- b. To remain available until expended.
- c. No start or end year specified. Text authorizes \$30 million for each fiscal year, to remain available until expended.
- d. Initial year depends on date of enactment; “There is authorized ... for each of the first 2 full fiscal years following the date of enactment of this Act, to remain available until expended.”
- e. To remain available until expended; “Termination of Effectiveness.—The authority provided by this section terminates on December 31, 2022.”
- f. No end year; “For fiscal year 2021 and each fiscal year thereafter.”
- g. \$25 million authorized “during the period of fiscal years 2021 through 2025” for veteran’s health R&D—appropriations authorized to Secretary of Veterans Affairs, while subsection directs Secretary of Energy to “establish and carry out” the R&D program; \$15 million authorized for each of FY2021-FY2025 to DOE for interagency collaboration.

Appendix B. Abbreviations

AMO—Advanced Manufacturing Office

ARPA-E—Advanced Research Projects Agency–Energy

ASHRAE—American Society of Heating, Refrigerating, and Air-Conditioning Engineers

BECSS—Bioenergy with carbon capture and sequestration

CBO—Congressional Budget Office

CCUS—Carbon capture, utilization, and storage

DAC—Direct air capture

DCCI—Data Center Consolidation Initiative

DCOI—Data Center Optimization Initiative

DOD—Department of Defense

DOE—Department of Energy

DOI—Department of the Interior

EI—Edison Electric Institute

EGS—Enhanced geothermal systems

EIA—Energy Information Administration

EISA—Energy Independence and Security Act of 2007

ENR—Senate Committee on Energy and Natural Resources

EOR—Enhanced Oil Recovery

EPA—Environmental Protection Agency

EPAct92—Energy Policy Act of 1992

EPAct05—Energy Policy Act of 2005

EPSCoR—Experimental Program to Stimulate Competitive Research

EPSC—Energy savings performance contract

ESTCP—DOD Environmental Security Technology Certification Program

FE—Office of Fossil Energy

FEMP—Federal Energy Management Program

FERC—Federal Energy Regulatory Commission

FITARA—Federal Information Technology Acquisition Reform Act

GAO—Government Accountability Office

GHG—Greenhouse gas

GW—Gigawatts

HPS—Hydropower pumped storage

ICC—International Code Council
IEA—International Energy Agency
IECC—International Energy Conservation Code
NAS—National Academies of Sciences, Engineering, and Medicine
NECPA—National Energy Conservation Policy Act
NIST—National Institute of Standards and Technology
NNSA—National Nuclear Security Administration
NRC—Nuclear Regulatory Commission
OMB—Office of Management and Budget
PMA—Power Marketing Administration
R&D—Research and development
RD&D—Research, development, and demonstration
REC—Renewable energy certificate
ROW—Utility right-of-way
SEP—State Energy Program
SGAC—Smart Grid Federal Advisory Committee
SPR—Strategic Petroleum Reserve
UESC—Utility energy service contract
USDA—U.S. Department of Agriculture
USGS—U.S. Geological Survey
VA—Department of Veterans Affairs
WHP—Waste heat to power
WAPA—Western Area Power Administration

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