

[DISCUSSION DRAFT]

118TH CONGRESS
1ST SESSION

H. R. _____

To direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application with respect to clean hydrogen and fuel cell energy, low-emission fuels, and coproducts, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

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

A BILL

To direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application with respect to clean hydrogen and fuel cell energy, low-emission fuels, and coproducts, and for other purposes.

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

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “**[To Be Supplied]**
5 Act”.

1 **SEC. 2. DEFINITIONS.**

2 In this Act:

3 (1) CLEAN HYDROGEN.—The term “clean hy-
4 drogen” means hydrogen produced from any source
5 that results in a significant reduction in lifecycle
6 greenhouse gas and criteria air pollutant emissions
7 compared to conventional fuel options.

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

10 (3) ELIGIBLE ENTITY.—The term “eligible enti-
11 ty” means—

12 (A) an institution of higher education, in-
13 cluding historically Black colleges and univer-
14 sities, minority-serving institutions, Hispanic-
15 serving institutions, Tribal colleges or univer-
16 sities, emerging research institutions, and com-
17 munity colleges;

18 (B) a National Laboratory (as such term
19 is defined in section 2 of the Energy Policy Act
20 of 2005 (42 U.S.C. 15801);

21 (A) a Federal research agency;

22 (B) a State research agency;

23 (C) a research agency associated with a
24 territory or Freely Associated State;

25 (D) a nonprofit research organization;

26 (E) a private sector entity;

1 (F) any other entity, as determined by the
2 Secretary; or

3 (G) a consortium of two or more entities
4 described in subparagraphs (A) through (F).

5 (4) HISPANIC-SERVING INSTITUTION.—The
6 term “Hispanic-serving institution” has the meaning
7 given such term in section 502(a) of the Higher
8 Education Act of 1965 (20 U.S.C. 1101a(a)).

9 (5) HISTORICALLY BLACK COLLEGE OR UNI-
10 VERSITY.—The term “historically Black college or
11 university” has the meaning given the term “part B
12 institution” in section 322 of the Higher Education
13 Act of 1965 (20 U.S.C. 1061).

14 (6) HYDROGEN CARRIER.—The term “hydrogen
15 carrier” means a substance that meets one or both
16 of the following descriptions:

17 (A) Molecules that have been synthesized
18 from hydrogen.

19 (B) Reversible liquid, solid, or gas chemical
20 states that store hydrogen in a state other than
21 as free hydrogen molecules.

22 (7) HYDROGEN-RELATED TECHNOLOGIES.—The
23 term “hydrogen-related technologies” means tech-
24 nologies relating to the production, purification, dis-
25 tribution, storage, and use of hydrogen for heat, sta-

1 tionary power, transportation, industrial chemical
2 feedstocks, or energy storage, including fuel cell
3 technologies.

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

8 (9) MINORITY-SERVING INSTITUTION.—The
9 term “minority-serving institution” includes the en-
10 tities described in any of paragraphs (1) through (7)
11 of section 371(a) of the Higher Education Act of
12 1965 (20 U.S.C. 1067q(a)).

13 (10) NON-PROFIT ORGANIZATION.—The term
14 “non-profit organization” means an organization de-
15 scribed in section 501(c)(3) of the Internal Revenue
16 Code of 1986 and exempt from tax under section
17 501(a) of such Code.

18 (11) SECRETARY.—The term “Secretary”
19 means the Secretary of Energy.

20 (12) TRIBAL COLLEGE OR UNIVERSITY.—The
21 term “Tribal college or university” has the meaning
22 given such term in section 316(b) of the Higher
23 Education Act of 1965 (20 U.S.C. 1059c(b)).

1 **SEC. 3. CLEAN HYDROGEN AND FUEL CELL TECHNOLOGY**
2 **RESEARCH AND DEVELOPMENT PROGRAM.**

3 (a) IN GENERAL.—The Secretary, in consultation
4 with the heads of relevant Federal agencies, shall conduct
5 a program of research, development, demonstration, and
6 commercial application of clean hydrogen and fuel cell
7 technologies to enable production, distribution, and use of
8 clean hydrogen, including in energy storage, industrial ap-
9 plications, building, power, and transportation sector ap-
10 plications, and to advance the development of related hy-
11 drogen infrastructure. In carrying out such program, the
12 Secretary shall award financial assistance through a com-
13 petitive, merit-reviewed process and consider applications
14 from eligible entities.

15 (b) PROGRAM COMPONENTS.—In carrying out the
16 program under subsection (a), the Secretary shall coordi-
17 nate with the heads of relevant Federal agencies to deter-
18 mine a comprehensive set of technical milestones for the
19 activities and focus on research and development chal-
20 lenges across the hydrogen supply chain for various appli-
21 cations, including clean hydrogen production, the supply
22 of hydrogen, storage of hydrogen, transportation of hydro-
23 gen, and end uses of hydrogen that advance the following:

24 (1) Clean hydrogen production from a wide va-
25 riety of energy sources.

1 (2) Clean hydrogen transportation, distribution,
2 and end use efficiency.

3 (3) Clean hydrogen and hydrogen-related tech-
4 nologies for the production of the following:

5 (A) High- and low-temperature heat in in-
6 dustry and the built environment, including
7 low-emission production of cement, iron, steel,
8 and other metals.

9 (B) Improved environmental performance
10 of petroleum-based transportation fuels with
11 clean hydrogen.

12 (C) Sustainable chemical products and ma-
13 terials.

14 (D) Sustainable synthetic fuels.

15 (E) Energy storage for electric grid flexi-
16 bility and long duration energy storage.

17 (4) Hydrogen blending for power generation, in-
18 dustrial use, and other end use applications relating
19 to fuel cell performance, reliability, durability, and
20 cost.

21 (5) Fuel cell technologies for transportation and
22 stationary applications.

23 (6) Domestic fuel cell manufacturing capabili-
24 ties.

1 (7) Hydrogen and hydrogen carrier technologies
2 as a fuel for electric transportation and stationary
3 applications powered by fuel cells.

4 (8) Dynamic control systems needed to inte-
5 grate clean hydrogen production and end users with
6 sources of reliable and affordable low-emission
7 power.

8 (9) Computational tools for lifecycle assess-
9 ments and economic analysis of the entire supply
10 chain of clean hydrogen production and utilization.

11 (10) Hydrogen fueling of various vehicle classes
12 and vocations.

13 (11) Safe, durable, and affordable materials for
14 hydrogen-related technologies.

15 (12) Methods for integrating carbon capture
16 and storage and waste by-product treatment tech-
17 nologies, including considerations for produced
18 water, into clean hydrogen system processes.

19 (c) ACTIVITIES.—In carrying out the program under
20 subsection (a), the Secretary shall carry out research, de-
21 velopment, demonstration, and commercial application ac-
22 tivities to advance the following:

23 (1) Clean hydrogen production, including the
24 following:

1 (A) Production from hydrocarbons to car-
2 bon-free hydrogen or to hydrogen with carbon
3 capture and sequestration, which may include
4 the following:

5 (i) Development of nonprecious and
6 nontoxic metal catalysts and electrodes.

7 (ii) Development of effective reactor
8 design.

9 (iii) Use of heat from noncombustion
10 sources.

11 (iv) Development of advanced mate-
12 rials of construction for improved reactor
13 performance and lifetimes and reduced
14 capital costs.

15 (v) Reduction of water usage.

16 (vi) Development of catalytic proc-
17 esses to convert natural gas to carbon-free
18 hydrogen and solid carbon materials.

19 (vii) Development of suitable treat-
20 ment of waste by-products.

21 (B) Production from nuclear power and
22 heat, including from advanced nuclear reactors.

23 (C) Production from biomass and organic
24 carbon waste conversion, which may include

1 biomass-derived liquid reformation and biomass
2 gasification with a focus on the following:

3 (i) Optimizing processes and address-
4 ing challenges related to different biomass
5 feedstock characteristics, including biomass
6 and waste blends.

7 (ii) Improvement of energy conversion
8 efficiency.

9 (iii) Development and optimization of
10 catalysts for given feedstocks.

11 (D) Production from a direct hydrogen
12 carrier, such as ammonia or methanol with car-
13 bon capture and sequestration, and liquid or-
14 ganic hydrogen carriers.

15 (E) Biological hydrogen production, which
16 may include the following:

17 (i) Dark or photo-assisted fermenta-
18 tion.

19 (ii) Microbial electrolysis.

20 (iii) Bio- or bio-inspired photolysis.

21 (iv) Hybrid systems combining mul-
22 tiple bio- or bio-inspired processes.

23 (F) Production of clean hydrogen at a
24 place of consumption where demand from many
25 use cases can be satisfied, including airports

1 supplying air-side aircraft, support vehicles, and
2 ground-side services for hydrogen electric buses,
3 trucks, and cars.

4 (G) Production from water splitting, in-
5 cluding the following:

6 (i) Fresh, salt, and wastewater and
7 steam electrolysis using low-emission elec-
8 tricity sources.

9 (ii) Development of catalysts using al-
10 ternatives to rare earth metals.

11 (iii) Thermochemical water splitting
12 using low-emission power sources.

13 (H) Production from renewable energy
14 sources.

15 (I) Production of hydrogen carriers.

16 (J) Production from integrated energy sys-
17 tems (as such term is defined in section 1310
18 of the Energy Independence and Security Act
19 of 2007 (42 U.S.C. 17387)).

20 (2) Hydrogen storage, including the following:

21 (A) Gas compression and liquefaction, in-
22 cluding improving liquefaction efficiency.

23 (B) Chemical storage, including the fol-
24 lowing:

25 (i) Porous materials.

1 (ii) Liquid hydrogen carriers, which
2 may include the following:

3 (I) Liquid organic hydrogen car-
4 riers with needed improvement of the
5 chemistry of dehydrogenation through
6 catalyst development.

7 (II) Liquid ammonia with needed
8 improvement of the fundamental
9 chemistry of dehydrogenation and hy-
10 drogen purity after dehydrogenation.

11 (C) A wide variety of physical storage
12 methodologies for hydrogen, including liquid hy-
13 drogen, hydrogen carriers, and hydrogen blends
14 in the form of a solid, liquid, or gas, including
15 distribution tanks, on site storage, storage on-
16 board vehicles, and geologic storage.

17 (D) Development of advanced storage ma-
18 terials and systems for large-scale hydrogen
19 storage, including long-duration storage, with a
20 focus on low-cost, ambient-temperature, and
21 high-energy density materials and systems.

22 (E) Assessment of regional geology, includ-
23 ing seismic assessments, infrastructure require-
24 ments, and materials of construction for the
25 storage of hydrogen in geologic formations, in-

1 including salt domes, caverns, depleted oil gas
2 reservoirs, aquifers, surface porous media, and
3 natural gas storage sites.

4 (F) Assessment of hydrogen and hydrogen
5 blend storage processes, including physical,
6 chemical, and biological processes within geo-
7 logical formations, that could impact the lon-
8 gevity and reversibility of geologic storage.

9 (G) Development of advanced tools and
10 technologies to convert or transform natural gas
11 geologic storage sites into hydrogen storage
12 sites.

13 (H) Metal hydride materials, such as mag-
14 nesium-containing systems with a focus on the
15 following:

16 (i) Improvement of kinetics of hydro-
17 gen uptake and release.

18 (ii) Decreasing working temperatures,
19 to ambient or near ambient conditions.

20 (3) Hydrogen transportation, delivery, and fuel-
21 ing infrastructure, including the following:

22 (A) Improvement in energy efficiency,
23 maintenance of hydrogen purity, and minimiza-
24 tion of potential hydrogen leakage, including
25 from hydrogen carriers.

1 (B) Advancing a wide range of distribution
2 methods, including transmission by pipeline,
3 transmission of liquid hydrogen carriers, and
4 transmission of hydrogen blends.

5 (C) Advancing the feasibility of retrofitting
6 or the modification of existing energy infra-
7 structure, including existing natural gas trans-
8 portation infrastructure, for the purpose of
9 transportation and storage of significant quan-
10 tities of hydrogen and hydrogen blends.

11 (D) Development and improvement of hy-
12 drogen and hydrogen fuel specific sensor tech-
13 nologies to detect and mitigate potential risks.

14 (4) Clean hydrogen utilization, including the
15 following:

16 (A) Power generation utilization, including
17 the retrofit or development of hydrogen fueled
18 turbines, reversible fuel cells or hybrid cycle
19 fuel cells, and hydrogen blends for power appli-
20 cations.

21 (B) Energy storage, including the develop-
22 ment of long-term energy storage systems for
23 grid, back-up power, microgrid and other appli-
24 cations.

25 (C) Transportation fuel utilization.

1 (D) Industrial utilization, including the
2 utilization of hydrogen and hydrogen blends for
3 a wide variety of applications.

4 (E) Agricultural utilization.

5 (F) Other applications, as determined by
6 the Secretary.

7 (5) Advanced manufacturing technologies and
8 methods for clean hydrogen and hydrogen-related
9 technologies.

10 (6) Hydrogen carrier recycling and reuse.

11 (7) Safe, durable, and affordable materials for
12 clean hydrogen, hydrogen carrier, and hydrogen-re-
13 lated technologies.

14 (8) Advanced technologies and methods for safe
15 hydrogen transportation, distribution, and utiliza-
16 tion, such as hydrogen infrastructure monitoring
17 and controls and combustion characterization tech-
18 nologies.

19 (9) Other research areas that advance the pur-
20 poses of the program, as determined by the Sec-
21 retary.

22 (d) FUEL CELL RESEARCH, DEVELOPMENT, AND
23 DEMONSTRATION.—

24 (1) IN GENERAL.—In carrying out with the
25 program under subsection (a), the Secretary shall

1 support research, development, demonstration, and
2 commercial application activities to advance fuel cell
3 technologies for transportation and stationary appli-
4 cations with a focus on reducing fuel cell system cost
5 and improving overall system efficiency and dura-
6 bility over a wide range of operating conditions.

7 (2) TOOLS, TECHNOLOGIES, AND METHODS.—

8 In carrying out paragraph (1), the Secretary shall
9 develop tools, technologies, and methods for the fol-
10 lowing:

11 (A) Fuel cell durability, which may include
12 the following:

13 (i) Improving understanding of cata-
14 lyst and membrane degradation and miti-
15 gating performance degradation, including
16 at high and low power conditions.

17 (ii) Improving fuel cell tolerance to
18 air, fuel, and system-derived impurities.

19 (iii) Improving stationary fuel cells to
20 achieve greater than 80,000 hours of dura-
21 bility, including improving durability under
22 start-up and transient operation for high-
23 temperature fuel cells.

1 (iv) Improving fundamental under-
2 standing of failure mechanisms to develop
3 mitigation strategies.

4 (v) Activities to update and accelerate
5 testing protocols to enable projection of
6 durability.

7 (vi) Improving system balance-of-plant
8 component efficiency, responsiveness, adap-
9 tation to fuel cell aging conditions,
10 reactant's impurity, environmental varia-
11 bility, and durability.

12 (B) Development of lower cost fuel cell ma-
13 terials, components, and assemblies.

14 (C) Fuel cell performance, which may in-
15 clude research to improve the performance and
16 efficiency of the following:

17 (i) Cathodes.

18 (ii) Water quality controls.

19 (iii) Stack water management, includ-
20 ing membranes in fuel cells to enable effec-
21 tive water management and operation in
22 low humidity and subfreezing environ-
23 ments.

1 (iv) System thermal and water man-
2 agement, including research to improve the
3 following:

4 (I) Heat utilization, cooling, and
5 humidification techniques.

6 (II) Efficiency of heat recovery
7 systems, system designs, advanced
8 heat exchangers, and higher tempera-
9 ture operation of current systems.

10 (III) Techniques to manage
11 water during start-up and shutdown
12 at subfreezing temperatures.

13 (IV) Management of nonuniform
14 conditions caused by variable thermal
15 and current density gradients.

16 (v) System air management.

17 (vi) System start-up and shutdown
18 time and transient operation.

19 (vii) Utilizing direct hydrogen car-
20 riers, such as ammonia, methane, and
21 methanol.

22 (viii) Reversible fuel cells.

23 (D) Catalyst and electrode design, which
24 may include the following:

- 1 (i) Developing catalysts that reduce or
2 eliminate platinum-group metal loading
3 while maintaining or improving upon per-
4 formance and durability.
- 5 (ii) Increasing durability and stability
6 of catalysts during potential cycling.
- 7 (iii) Increasing tolerance of catalysts
8 to air, fuel, and other system derived im-
9 purities.
- 10 (iv) Increasing catalyst utilization.
- 11 (v) Developing catalysts and catalyst
12 support with high durability at high
13 voltages.
- 14 (vi) Design and demonstration of scal-
15 able production of novel catalysts.
- 16 (vii) Optimization of electrode design
17 and assembly for efficient water and ther-
18 mal management.
- 19 (E) Electrolyte synthesis and development.
- 20 (F) Fuel cell membrane development, in-
21 cluding polymer electrolyte member and alkaline
22 electrolyte member development.
- 23 (G) Membrane electrode materials, assem-
24 blies, cells, and other stack components, includ-

1 ing demonstration of small-scale production of
2 novel membrane electrode assemblies.

3 (H) Solid oxide fuel cell development, in-
4 cluding the following:

5 (i) Cell development on individual cell
6 components that increases power density,
7 reduces degradation, and reduces costs.

8 (ii) Balance-of-plant and stack compo-
9 nents that improve reliability and
10 robustness and reduce degradation and
11 costs.

12 (iii) Systems development.

13 (I) Protonic ceramic fuel cell development.

14 (J) Other research areas that advance the
15 purposes of the program, as determined by the
16 Secretary.

17 (e) TESTING AND VALIDATION.—In carrying out the
18 program under subsection (a), the Secretary, in consulta-
19 tion with the Director of the National Institute of Stand-
20 ards and Technology, shall support the development of
21 standardized testing and technical validation of hydrogen
22 and hydrogen-related technologies, including fuel cell tech-
23 nologies, through collaboration with one or more National
24 Laboratories, and one or more eligible entities.

1 (f) LEVERAGING.—In carrying out the program
2 under subsection (a), the Secretary shall leverage re-
3 sources and expertise from across the Department, includ-
4 ing the following:

5 (1) The Office of Energy Efficiency and Renew-
6 able Energy.

7 (2) The Basic Energy Sciences Program, Ad-
8 vanced Scientific Computing Research Program, and
9 the Biological and Environmental Research Program
10 of the Office of Science.

11 (3) The Office of Fossil Energy.

12 (4) The Office of Nuclear Energy.

13 (5) The Advanced Research Projects Agency—
14 Energy.

15 (6) The Office of Clean Energy Demonstra-
16 tions.

17 (g) STANDARD OF REVIEW.—In carrying out the pro-
18 gram under subsection (a), the Secretary shall periodically
19 determine the status of achievement of the comprehensive
20 set of technical milestones referred to in subsection (b).

21 **SEC. 4. CLEAN HYDROGEN DEMONSTRATION PROJECTS.**

22 (a) IN GENERAL.—In carrying out the program
23 under section 3, the Secretary shall establish a demonstra-
24 tion program under which the Secretary, through a com-
25 petitive merit review process, shall select eligible entities

1 to carry out not more than six demonstration projects that
2 involve clean hydrogen and hydrogen-related technologies.

3 (b) PROJECT CRITERIA.—Of the demonstration pro-
4 grams carried out pursuant to subsection (a), three shall
5 be designed as clean hydrogen hybrid use demonstration
6 projects that—

7 (1) demonstrate configurations of different
8 commercial and preproduction hydrogen with wind,
9 solar, nuclear, fossil, or other energy technologies for
10 combined use, including evaluation and modeling of
11 performance under load demands relevant to urban
12 and rural communities;

13 (2) serve as an incubator for novel energy tech-
14 nologies and the combined use of such technologies;
15 and

16 (3) demonstrate configuration with advanced
17 nuclear reactors for combined use, including evalua-
18 tion and modeling of performance under load de-
19 mands relevant to urban and rural communities.

20 (c) SELECTION REQUIREMENTS.—In selecting eligi-
21 ble entities for the demonstration programs carried out
22 pursuant to subsection (a), the Secretary shall, to the
23 maximum extent practicable—

1 (1) encourage regional variety among eligible
2 entities, including participation by such entities lo-
3 cated in rural States;

4 (2) encourage technological variety among eligi-
5 ble entities;

6 (3) ensure that selected demonstration pro-
7 grams are coordinated with and expand on existing
8 technology demonstration programs of the Depart-
9 ment;

10 (4) prioritize demonstration programs that le-
11 verage and are complementary to existing energy in-
12 frastructure, such as existing power plants and
13 power installations, fleet vehicle centers, microgrids,
14 or industrial facilities; and

15 (5) prioritize demonstration programs that le-
16 verage matching funds from non-Federal sources.

17 **SEC. 5. TECHNOLOGY TRANSFER INITIATIVE.**

18 (a) IN GENERAL.—The Secretary shall support an
19 initiative among the Office of Fossil Energy, the Office
20 of Nuclear Energy, the Office of Energy Efficiency and
21 Renewable Energy, and the private sector to research, de-
22 velop, and demonstrate relevant advanced technologies
23 and operation techniques used in the oil and gas sector
24 for use in clean hydrogen development.

1 (b) PRIORITIES.—In carrying out subsection (a), the
2 Secretary shall prioritize technologies with the greatest po-
3 tential to significantly increase the use and lower the cost
4 of clean hydrogen in the United States, including the cost
5 and speed of retrofitting existing energy infrastructure,
6 carbon capture storage and utilization, fuel conversion,
7 fuel blends, storage, and construction.

8 **SEC. 6. NIST CROSS-CUTTING RESEARCH.**

9 (a) IN GENERAL.—The Director of the National In-
10 stitute of Standards and Technology (NIST), in consulta-
11 tion with the Secretary of Energy, Secretary of Transpor-
12 tation, and other heads of the appropriate Federal and
13 multilateral agencies, shall carry out the following:

14 (1) Support NIST intramural basic measure-
15 ment science and research to advance the following:

16 (A) Analytical methods to evaluate the be-
17 havior of hydrogen fuel and its impact on cur-
18 rent and developmental storage, transmission,
19 and blending processes and infrastructure.

20 (B) Measurement technologies to enhance
21 hydrogen management and safety.

22 (C) New data tools, techniques, and proc-
23 esses to enable a more cost-efficient and safe
24 hydrogen energy environment.

1 (D) All other areas determined by the Di-
2 rector to be critical to the development of tech-
3 nologies to promote a healthy, profitable, and
4 safe hydrogen energy industry.

5 (2) Support activities to inform and expand the
6 development of innovative hydrogen storage, trans-
7 mission, and export technologies.

8 (3) Convene the private sector, institutions of
9 higher education, non-profit organizations, National
10 Laboratories, and other Federal agencies engaged in
11 the hydrogen industry to develop coordinated strate-
12 gies, voluntary best practices, and standards, where
13 appropriate, for the storage, transmission, and ex-
14 port of hydrogen.

15 (4) Establish or expand collaborative partner-
16 ships or consortia with other government agencies
17 engaged in hydrogen research and development, in-
18 stitutions of higher education, National Labora-
19 tories, and the private sector to enhance the capa-
20 bilities of the domestic hydrogen industry.

21 (b) CONTROLS.—In carrying out subsection (a), the
22 Director shall ensure proper security controls are in place
23 to protect sensitive information, as appropriate.

24 **SEC. 7. HYDROGEN INNOVATION CENTER.**

25 (a) OPERATION.—

1 (1) IN GENERAL.—In carrying out the program
2 under section 3, the Secretary, in accordance with
3 paragraph (2), shall operate through the Office of
4 Science of the Department a national Hydrogen In-
5 novation Center (referred to in this section as the
6 “Center”).

7 (2) SELECTION; ADMINISTRATION.—

8 (A) IN GENERAL.—The Secretary shall se-
9 lect on a competitive, merit-reviewed basis, an
10 entity to administer the Center. In making such
11 selection, the Secretary shall solicit and con-
12 sider applications from such entities.

13 (B) ENTITY DEFINED.—For purposes of
14 this paragraph, the term “entity” means a Na-
15 tional Laboratory, an institution of higher edu-
16 cation, a Federal research agency, a multi-insti-
17 tutional collaboration, or other appropriate enti-
18 ty (as determined by the Secretary).

19 (3) FOCUS.—The Center shall focus on funda-
20 mental research and development activities, includ-
21 ing the following:

22 (A) Theory, modeling, and simulation of
23 the following:

24 (i) The physics and chemistry of
25 multi-scale hydrogen interactions.

1 (ii) The behavior of hydrogen fuel cell
2 membranes.

3 (iii) Catalytic pathways for hydrogen
4 production.

5 (iv) Photochemical processes and com-
6 plex photoredox systems.

7 (B) The development of analytical tools to
8 characterize and predict hydrogen-materials
9 interactions.

10 (C) The potential physical, chemical, and
11 biological effects of geologic hydrogen storage.

12 (D) The development of advanced com-
13 puter modeling to design different configura-
14 tions of energy systems and optimize systems
15 operations for clean hydrogen production in dif-
16 ferent electricity markets.

17 (E) The development of novel fuel cell
18 membranes and integrated nanoscale architec-
19 tures for hydrogen fuel cell technologies.

20 (F) Advanced catalytic research and de-
21 sign, with considerations given to nanoscale
22 catalysts, enzyme catalysts, biocatalysts, cata-
23 lyst-solid carbon separation, and innovative syn-
24 thetic techniques.

1 (G) The advancement of organic semi-
2 conductors for photovoltaic and photocatalytic
3 applications.

4 (H) Examination of the molecular mecha-
5 nisms of biological hydrogen production.

6 (I) The development of bio-hybrid systems
7 scalable to hydrogen production facilities.

8 (J) The development of novel materials for
9 hydrogen storage, including chemical storage
10 with complex hydrides and nanostructured ma-
11 terials, with a focus on the following:

12 (i) Improvement of kinetics of hydro-
13 gen absorption and desorption.

14 (ii) Decreasing working temperatures.

15 (b) DURATION.—The Center shall receive support for
16 a period of not more than five years, subject to the avail-
17 ability of appropriations.

18 (c) RENEWAL.—Upon the expiration of any period of
19 support of the Center, the Secretary may renew such sup-
20 port, on a merit-reviewed basis, for a period of not more
21 than five years.

22 (d) TERMINATION.—Consistent with existing authori-
23 ties of the Department, the Secretary may terminate the
24 Center for cause during any period of support.

1 **SEC. 8. REPORTING.**

2 (a) **TECHNOLOGIES DEVELOPED.**—Not later than
3 one year after the date of the enactment of this Act and
4 every two years thereafter through 2027, the Secretary
5 shall submit to the Committee on Science, Space, and
6 Technology of the House of Representatives and the Com-
7 mittee on Energy and Natural Resources of the Senate
8 a report regarding the technologies and knowledge devel-
9 oped and demonstrated as a result of the program carried
10 out under section 3 with a particular emphasis on whether
11 such technologies were successfully adopted for commer-
12 cial applications, and if so, whether the supply chains of
13 such technologies are domestic.

14 (b) **ADDITIONAL MATTERS.**—Not later than two
15 years after the date of the enactment of this Act and every
16 two years thereafter through 2027, the Secretary shall
17 submit to the Committee on Science, Space, and Tech-
18 nology of the House of Representatives and the Committee
19 on Energy and Natural Resources of the Senate a report
20 describing activities undertaken pursuant to this Act, in-
21 cluding relating to the following:

- 22 (1) The status of public-private partnerships.
- 23 (2) Progress of such activities in meeting goals
24 and timelines.
- 25 (3) The status of demonstration projects.

1 **SEC. 9. ADDITIONAL PROVISIONS.**

2 (a) **EDUCATION AND OUTREACH.**—In carrying out
3 the program under section 3, the Secretary shall support
4 and expand education and outreach activities to dissemi-
5 nate information relating to hydrogen and fuel cell energy
6 technologies and the hydrogen and fuel cell energy work-
7 force.

8 (b) **TECHNICAL ASSISTANCE.**—In carrying out the
9 program under section 3, the Secretary shall provide tech-
10 nical assistance and analyze activities for eligible entities
11 to support the commercial application of advances in hy-
12 drogen and fuel cell energy systems development and oper-
13 ations, which may include activities that support expand-
14 ing access to advanced clean hydrogen and fuel cell energy
15 technologies for rural, Tribal, and disadvantaged commu-
16 nities.

17 (c) **PUBLIC-PRIVATE PARTNERSHIPS.**—In carrying
18 out the activities described in this Act, the Secretary shall
19 pursue partnerships with private industry, private founda-
20 tions, and other appropriate private entities to—

21 (1) ensure the United States maintains techno-
22 logical competitiveness in developing advanced clean
23 hydrogen and fuel cell technologies;

24 (2) enhance the impact and advancement of the
25 hydrogen economy investments and contributions to

1 United States economic competitiveness and secu-
2 rity; and

3 (3) make available infrastructure, expertise, and
4 financial resources to the United States' hydrogen
5 and fuel cell technologies scientific and engineering
6 research and education enterprise.

7 (d) INTERNATIONAL HYDROGEN ENERGY DEVELOP-
8 MENT.—In carrying out the program under section 3, the
9 Secretary, in coordination with the heads of other appro-
10 priate Federal and multilateral agencies (including the
11 United States Agency for International Development)
12 shall support collaborative efforts with international part-
13 ners to facilitate and accelerate the transition to clean and
14 efficient energy and mobility systems using fuel cells and
15 hydrogen technologies through research, development,
16 demonstration, and commercial application activities.

17 (e) COORDINATION.—To the maximum extent prac-
18 ticable, the Secretary shall carry out the program under
19 section 3 in coordination with other relevant programs and
20 capabilities of the Department and other Federal research
21 programs, including activities authorized in sections 803,
22 805, and 808 of the Energy Policy Act of 2005 (42 U.S.C.
23 16152, 16154, and 16157) and in subtitle B of title III
24 of division D of the Infrastructure Investment and Jobs
25 Act (PL 117–58).