

117TH CONGRESS
2D SESSION

H. R. 9446

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

DECEMBER 6, 2022

Mr. TONKO (for himself and Mrs. BICE of Oklahoma) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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 “Department of Energy
5 Clean Hydrogen and Fuel Cell Research, Development,
6 and Demonstration Act of 2022”.

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 (C) a Federal research agency;

22 (D) a State research agency;

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

25 (F) a nonprofit research organization;

26 (G) a private sector entity;

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

3 (I) 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) SECRETARY.—The term “Secretary”
 14 means the Secretary of Energy.

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

19 **SEC. 3. CLEAN HYDROGEN AND FUEL CELL TECHNOLOGY**
 20 **RESEARCH AND DEVELOPMENT PROGRAM.**

21 (a) IN GENERAL.—The Secretary, in consultation
 22 with the heads of relevant Federal agencies, shall conduct
 23 a program of research, development, demonstration, and
 24 commercial application of clean hydrogen and fuel cell
 25 technologies to enable production, distribution, and use of

1 clean hydrogen, including in energy storage, industrial ap-
2 plications, building, power, and transportation sector ap-
3 plications, and to advance the development of related hy-
4 drogen infrastructure. In carrying out such program, the
5 Secretary shall award financial assistance through a com-
6 petitive, merit-reviewed process and consider applications
7 from eligible entities.

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

17 (1) Clean hydrogen production from diverse en-
18 ergy sources.

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

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

23 (A) High- and low-temperature heat in in-
24 dustry and the built environment, including

1 low-emission production of cement, iron, steel,
2 and other metals.

3 (B) Improved environmental performance
4 of petroleum-based transportation fuels with
5 clean hydrogen.

6 (C) Sustainable chemical products and ma-
7 terials.

8 (D) Sustainable synthetic fuels.

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

11 (4) Hydrogen blending for power generation, in-
12 dustrial use, and other end use applications relating
13 to fuel cell performance, reliability, durability, and
14 cost.

15 (5) Fuel cell technologies for transportation and
16 stationary applications.

17 (6) Domestic fuel cell manufacturing capabili-
18 ties.

19 (7) Hydrogen and hydrogen carrier technologies
20 as a fuel for electric transportation and stationary
21 applications powered by fuel cells.

22 (8) Dynamic control systems needed to inte-
23 grate clean hydrogen production and end users with
24 sources of reliable and affordable low-emission
25 power.

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

4 (10) Hydrogen fueling of various vehicle classes
5 and vocations.

6 (11) Safe, durable, and affordable materials for
7 hydrogen-related technologies.

8 (12) Methods for integrating carbon capture
9 and storage and waste by-product treatment tech-
10 nologies, including considerations for produced
11 water, into clean hydrogen system processes.

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

16 (1) Clean hydrogen production, including the
17 following:

18 (A) Production from water splitting, in-
19 cluding the following:

20 (i) Fresh, salt, and, wastewater and
21 steam electrolysis using low-emission elec-
22 tricity sources.

23 (ii) Development of catalysts using al-
24 ternatives to rare earth metals.

1 (iii) Thermochemical water splitting
2 using low-emission power sources.

3 (B) Production from biomass and organic
4 carbon waste conversion, which may include
5 biomass-derived liquid reformation and biomass
6 gasification with a focus on the following:

7 (i) Optimizing processes and address-
8 ing challenges related to different biomass
9 feedstock characteristics, including biomass
10 and waste blends.

11 (ii) Improvement of energy conversion
12 efficiency.

13 (iii) Development and optimization of
14 catalysts for given feedstocks.

15 (C) Production from a direct hydrogen car-
16 rier, such as ammonia or methanol with carbon
17 capture and sequestration, and liquid organic
18 hydrogen carriers.

19 (D) Biological hydrogen production, which
20 may include the following:

21 (i) Dark or photo-assisted fermenta-
22 tion.

23 (ii) Microbial electrolysis.

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

1 (iv) Hybrid systems combining mul-
2 tiple bio- or bio-inspired processes.

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

7 (i) Development of nonprecious and
8 nontoxic metal catalysts and electrodes.

9 (ii) Development of effective reactor
10 design.

11 (iii) Use of heat from noncombustion
12 source.

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

17 (v) Reduction of water usage.

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

21 (vii) Development of suitable treat-
22 ment of waste by-products.

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 nuclear power and
5 heat, including from advanced nuclear reactors.

6 (H) Production from renewable energy
7 sources.

8 (I) Production of hydrogen carriers.

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

13 (2) Hydrogen storage, including the following:

14 (A) Gas compression and liquefaction, in-
15 cluding improving liquefaction efficiency.

16 (B) Chemical storage, including the fol-
17 lowing:

18 (i) Porous materials.

19 (ii) Liquid hydrogen carriers, which
20 may include the following:

21 (I) Liquid organic hydrogen car-
22 riers with needed improvement of the
23 chemistry of dehydrogenation through
24 catalyst development.

1 (II) Liquid ammonia with needed
2 improvement of the fundamental
3 chemistry of dehydrogenation and hy-
4 drogen purity after dehydrogenation.

5 (C) Diverse physical storage methodologies
6 for hydrogen, including liquid hydrogen, hydro-
7 gen carriers, and hydrogen blends in the form
8 of a solid, liquid, or gas, including distribution
9 tanks, on site storage, storage onboard vehicles,
10 and geologic storage.

11 (D) Development of advanced storage ma-
12 terials and systems for large-scale hydrogen
13 storage, including long-duration storage, with a
14 focus on low-cost, ambient-temperature, and
15 high-energy density materials and systems.

16 (E) Assessment of regional geology, includ-
17 ing seismic assessments, infrastructure require-
18 ments, and materials of construction for the
19 storage of hydrogen in geologic formations, in-
20 cluding salt domes, caverns, depleted oil gas
21 reservoirs, aquifers, surface porous media, and
22 natural gas storage sites.

23 (F) Assessment of hydrogen and hydrogen
24 blend storage processes, including physical,
25 chemical, and biological processes within geo-

logical formations, that could impact the longevity and reversibility of geologic storage.

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

(H) Metal hydride materials, such as magnesium-containing systems with a focus on the following:

(i) Improvement of kinetics of hydrogen uptake and release.

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

(3) Hydrogen transportation, delivery, and fueling infrastructure, including the following:

(A) Improvement in energy efficiency, maintenance of hydrogen purity, and minimization of potential hydrogen leakage, including from hydrogen carriers.

(B) Advancing a diverse range of distribution methods, including transmission by pipeline, transmission of liquid hydrogen carriers, and transmission of hydrogen blends.

(C) Advancing the feasibility of retrofitting or the modification of existing energy infra-

1 structure, including existing natural gas trans-
2 portation infrastructure, for the purpose of
3 transportation and storage of significant quan-
4 tities of hydrogen and hydrogen blends.

5 (D) Development and improvement of hy-
6 drogen and hydrogen fuel specific sensor tech-
7 nologies to detect and mitigate potential risks.

8 (4) Clean hydrogen utilization, including the
9 following:

10 (A) Power generation utilization, including
11 the retrofit or development of hydrogen fueled
12 turbines, reversible fuel cells or hybrid cycle
13 fuel cells, and hydrogen blends for power appli-
14 cations.

15 (B) Energy storage, including the develop-
16 ment of long-term energy storage systems for
17 grid, back-up power, microgrid and other appli-
18 cations.

19 (C) Transportation fuel utilization.

20 (D) Industrial utilization, including the
21 utilization of hydrogen and hydrogen blends for
22 diverse applications.

23 (E) Agricultural utilization.

24 (F) Other applications, as determined by
25 the Secretary.

1 (5) Advanced manufacturing technologies and
2 methods for clean hydrogen and hydrogen-related
3 technologies.

4 (6) Hydrogen carrier recycling and reuse.

5 (7) Safe, durable, and affordable materials for
6 clean hydrogen, hydrogen carrier, and hydrogen-re-
7 lated technologies.

8 (8) Advanced technologies and methods for safe
9 hydrogen transportation, distribution, and utiliza-
10 tion, such as hydrogen infrastructure monitoring
11 and controls and combustion characterization tech-
12 nologies.

13 (9) Other research areas that advance the pur-
14 poses of the program, as determined by the Sec-
15 retary.

16 (d) FUEL CELL RESEARCH, DEVELOPMENT, AND
17 DEMONSTRATION.—

18 (1) IN GENERAL.—In carrying out with the
19 program under subsection (a), the Secretary shall
20 support research, development, demonstration, and
21 commercial application activities to advance fuel cell
22 technologies for transportation and stationary appli-
23 cations with a focus on reducing fuel cell system cost
24 and improving overall system efficiency and dura-
25 bility over a wide range of operating conditions.

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

2 In carrying out paragraph (1), the Secretary shall
3 develop tools, technologies, and methods for the fol-
4 lowing:

5 (A) Fuel cell durability, which may include
6 the following:

7 (i) Improving understanding of cata-
8 lyst and membrane degradation and miti-
9 gating performance degradation, including
10 at high and low power conditions.

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

13 (iii) Improving stationary fuel cells to
14 achieve greater than 80,000 hours of dura-
15 bility, including improving durability under
16 start-up and transient operation for high-
17 temperature fuel cells.

18 (iv) Improving fundamental under-
19 standing of failure mechanisms to develop
20 mitigation strategies.

21 (v) Activities to update and accelerate
22 testing protocols to enable projection of
23 durability.

24 (vi) Improving system balance-of-plant
25 component efficiency, responsiveness, adap-

1 tation to fuel cell aging conditions,
2 reactant's impurity, environmental varia-
3 bility, and durability.

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

6 (C) Fuel cell performance, which may in-
7 clude research to improve the performance and
8 efficiency of the following:

9 (i) Cathodes.

10 (ii) Water quality controls.

11 (iii) Stack water management, includ-
12 ing membranes in fuel cells to enable effec-
13 tive water management and operation in
14 low humidity and subfreezing environ-
15 ments.

16 (iv) System thermal and water man-
17 agement, including research to improve the
18 following:

19 (I) Heat utilization, cooling, and
20 humidification techniques.

21 (II) Efficiency of heat recovery
22 systems, system designs, advanced
23 heat exchangers, and higher tempera-
24 ture operation of current systems.

1 (III) Techniques to manage
2 water during start-up and shutdown
3 at subfreezing temperatures.

4 (IV) Management of nonuniform
5 conditions caused by variable thermal
6 and current density gradients.

7 (v) System air management.

8 (vi) System start-up and shutdown
9 time and transient operation.

10 (vii) Utilizing direct hydrogen car-
11 riers, such as ammonia, methane, and
12 methanol.

13 (viii) Reversible fuel cells.

14 (D) Catalyst and electrode design, which
15 may include the following:

16 (i) Developing catalysts that reduce or
17 eliminate platinum-group metal loading
18 while maintaining or improving upon per-
19 formance and durability.

20 (ii) Increasing durability and stability
21 of catalysts during potential cycling.

22 (iii) Increasing tolerance of catalysts
23 to air, fuel, and other system derived im-
24 purities.

25 (iv) Increasing catalyst utilization.

1 (v) Developing catalysts and catalyst
2 support with high durability at high
3 voltages.

4 (vi) Design and demonstration of scal-
5 able production of novel catalysts.

6 (vii) Optimization of electrode design
7 and assembly for efficient water and ther-
8 mal management.

9 (E) Electrolyte synthesis and development.

10 (F) Fuel cell membrane development, in-
11 cluding polymer electrolyte member and alkaline
12 electrolyte member development.

13 (G) Membrane electrode materials, assem-
14 blies, cells, and other stack components, includ-
15 ing demonstration of small-scale production of
16 novel membrane electrode assemblies.

17 (H) Solid oxide fuel cell development, in-
18 cluding the following:

19 (i) Cell development on individual cell
20 components that increases power density,
21 reduces degradation, and reduces costs.

22 (ii) Balance-of-plant and stack compo-
23 nents that improve reliability and
24 robustness and reduce degradation and
25 costs.

1 (iii) Systems development.

2 (I) Protonic ceramic fuel cell development.

3 (J) Other research areas that advance the
4 purposes of the program, as determined by the
5 Secretary.

6 (e) TESTING AND VALIDATION.—In carrying out the
7 program under subsection (a), the Secretary, in consulta-
8 tion with the Director of the National Institute of Stand-
9 ards and Technology, shall support the development of
10 standardized testing and technical validation of hydrogen
11 and hydrogen-related technologies, including fuel cell tech-
12 nologies, through collaboration with one or more National
13 Laboratories, and one or more eligible entities.

14 (f) LEVERAGING.—In carrying out the program
15 under subsection (a), the Secretary shall leverage re-
16 sources and expertise from across the Department, includ-
17 ing the following:

18 (1) The Office of Energy Efficiency and Renew-
19 able Energy.

20 (2) The Basic Energy Sciences Program, Ad-
21 vanced Scientific Computing Research Program, and
22 the Biological and Environmental Research Program
23 of the Office of Science.

24 (3) The Office of Fossil Energy.

25 (4) The Office of Nuclear Energy.

1 (5) The Advanced Research Projects Agency—
2 Energy.

3 (6) The Office of Clean Energy Demonstra-
4 tions.

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

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

10 (a) IN GENERAL.—In carrying out the program
11 under section 3, the Secretary shall establish a demonstra-
12 tion program under which the Secretary, through a com-
13 petitive merit review process, shall select eligible entities
14 to carry out not more than six demonstration projects that
15 involve clean hydrogen and hydrogen-related technologies.

16 (b) PROJECT CRITERIA.—Of the demonstration pro-
17 grams carried out pursuant to subsection (a), two shall
18 be designed as clean hydrogen hybrid use demonstration
19 projects that—

20 (1) demonstrate configurations of different
21 commercial and preproduction hydrogen with wind,
22 solar, nuclear, fossil, or other energy technologies for
23 combined use, including evaluation and modeling of
24 performance under load demands relevant to urban
25 and rural communities; and

1 (2) serve as an incubator for novel energy tech-
2 nologies and the combined use of such technologies.

3 (c) SELECTION REQUIREMENTS.—In selecting eligi-
4 ble entities for the demonstration programs carried out
5 pursuant to subsection (a), the Secretary shall, to the
6 maximum extent practicable—

7 (1) encourage regional diversity among eligible
8 entities, including participation by such entities lo-
9 cated in rural States;

10 (2) encourage technological diversity among eli-
11 gible entities;

12 (3) ensure that selected demonstration pro-
13 grams are coordinated with and expand on existing
14 technology demonstration programs of the Depart-
15 ment;

16 (4) prioritize demonstration programs that le-
17 verage and are complementary to existing energy in-
18 frastructure, such as existing power plants and
19 power installations, fleet vehicle centers, microgrids,
20 or industrial facilities; and

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

23 (d) AUTHORIZATION OF APPROPRIATIONS.—From
24 amounts authorized to be appropriated pursuant to sec-
25 tion 9, \$30,000,000 for each of fiscal years 2023 through

1 2027 shall be made available to the Secretary to carry out
2 this section.

3 **SEC. 5. HYDROGEN INNOVATION CENTER.**

4 (a) OPERATION.—

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

11 (2) SELECTION; ADMINISTRATION.—

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

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

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

1 (A) Theory, modeling, and simulation of
2 the following:

3 (i) The physics and chemistry of
4 multi-scale hydrogen interactions.

5 (ii) The behavior of hydrogen fuel cell
6 membranes.

7 (iii) Catalytic pathways for hydrogen
8 production.

9 (iv) Photochemical processes and com-
10 plex photoredox systems.

11 (B) The development of analytical tools to
12 characterize and predict hydrogen-materials
13 interactions.

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

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

21 (E) The development of novel fuel cell
22 membranes and integrated nanoscale architec-
23 tures for hydrogen fuel cell technologies.

24 (F) Advanced catalytic research and de-
25 sign, with considerations given to nanoscale

1 catalysts, enzyme catalysts, biocatalysts, cata-
2 lyst-solid carbon separation, and innovative syn-
3 thetic techniques.

4 (G) The advancement of organic semi-
5 conductors for photovoltaic and photocatalytic
6 applications.

7 (H) Examination of the molecular mecha-
8 nisms of biological hydrogen production.

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

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

15 (i) Improvement of kinetics of hydro-
16 gen absorption and desorption.

17 (ii) Decreasing working temperatures.

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

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

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

4 (e) AUTHORIZATION OF APPROPRIATIONS.—Of
 5 amounts authorized to be appropriated to the Office of
 6 Science, \$15,000,000 for each of fiscal years 2023
 7 through 2027 shall be made available to the Secretary to
 8 carry out this section.

9 **SEC. 6. STUDY TO EXAMINE RESEARCH PATHWAYS FOR HY-**
 10 **DROGEN PRODUCTION WITH NET-ZERO**
 11 **GREENHOUSE GAS EMISSIONS.**

12 (a) IN GENERAL.—Not later than 90 days after the
 13 date of the enactment of this Act, the Secretary shall enter
 14 into an agreement with the National Academies of
 15 Sciences, Engineering, and Medicine (referred to in this
 16 section as the “National Academies”) under which the Na-
 17 tional Academies shall conduct a study to examine re-
 18 search pathways for hydrogen production processes with
 19 net-zero direct and indirect greenhouse gas emissions as
 20 a part of a low-carbon energy future. Such study shall—

21 (1) analyze and assess research needed to lever-
 22 age potential contributions of hydrogen production
 23 processes with net-zero direct and indirect green-
 24 house gas emissions;

1 (2) examine lifecycle impacts of such processes
2 on energy consumption and emissions; and

3 (3) identify additional research activities and
4 provide recommendations to support net direct and
5 indirect greenhouse gas emission reductions across
6 hydrogen production processes, including research to
7 address—

8 (A) potential environmental impacts associ-
9 ated with hydrogen production using new and
10 existing evaluation metrics, including lifecycle
11 impacts on local and regional air and water
12 quality and estimates of hazardous air pollut-
13 ants impacts on and benefits to United States
14 communities, including urban, small, rural,
15 Tribal, and disadvantaged communities;

16 (B) infrastructure challenges;

17 (C) scientific and technical barriers to
18 achieve greater net greenhouse gas emission re-
19 ductions in present and future production proc-
20 esses; and

21 (D) socioeconomic costs and benefits of
22 zero-carbon liquid fuel production and use sys-
23 tems, including fiscal, monetized health, and job
24 impacts.

1 (b) REPORT.—The agreement entered into under
2 subsection (a) shall include a requirement that the Na-
3 tional Academies, not later than 24 months after the date
4 of the enactment of this Act, submit to the Committee
5 on Science, Space, and Technology of the House of Rep-
6 resentatives and the Committee on Energy and Natural
7 Resources of the Senate a report on the results of the
8 study conducted pursuant to such agreement.

9 **SEC. 7. REPORTING.**

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

22 (b) ADDITIONAL MATTERS.—Not later than two
23 years after the date of the enactment of this Act and every
24 two years thereafter through 2027, the Secretary shall
25 submit to the Committee on Science, Space, and Tech-

1 nology of the House of Representatives and the Committee
2 on Energy and Natural Resources of the Senate a report
3 describing activities undertaken pursuant to this Act, in-
4 cluding relating to the following:

5 (1) The status of public-private partnerships.

6 (2) Progress of such activities in meeting goals
7 and timelines.

8 (3) The status of demonstration projects.

9 **SEC. 8. ADDITIONAL PROVISIONS.**

10 (a) **EDUCATION AND OUTREACH.**—In carrying out
11 the program under section 3, the Secretary shall support
12 and expand education and outreach activities to dissemi-
13 nate information relating to hydrogen and fuel cell energy
14 technologies and the hydrogen and fuel cell energy work-
15 force.

16 (b) **TECHNICAL ASSISTANCE.**—In carrying out the
17 program under section 3, the Secretary shall provide tech-
18 nical assistance and analyze activities for eligible entities
19 to support the commercial application of advances in hy-
20 drogen and fuel cell energy systems development and oper-
21 ations, which may include activities that support expand-
22 ing access to advanced clean hydrogen and fuel cell energy
23 technologies for rural, Tribal, and disadvantaged commu-
24 nities.

1 (c) PUBLIC-PRIVATE PARTNERSHIPS.—In carrying
2 out the activities described in this Act, the Secretary shall
3 pursue partnerships with private industry, private founda-
4 tions, and other appropriate private entities to—

5 (1) ensure the United States maintains techno-
6 logical competitiveness in developing advanced clean
7 hydrogen and fuel cell technologies;

8 (2) enhance the impact and advancement of the
9 hydrogen economy investments and contributions to
10 United States economic competitiveness and secu-
11 rity; and

12 (3) make available infrastructure, expertise, and
13 financial resources to the United States hydrogen
14 and fuel cell technologies scientific and engineering
15 research and education enterprise.

16 (d) INTERNATIONAL HYDROGEN ENERGY DEVELOP-
17 MENT.—In carrying out the program under section 3, the
18 Secretary, in coordination with the heads of other appro-
19 priate Federal and multilateral agencies (including the
20 United States Agency for International Development)
21 shall support collaborative efforts with international part-
22 ners to facilitate and accelerate the transition to clean and
23 efficient energy and mobility systems using fuel cells and
24 hydrogen technologies through research, development,
25 demonstration, and commercial application activities.

1 (e) COORDINATION.—To the maximum extent prac-
2 ticable, the Secretary shall carry out the program under
3 section 3 in coordination with other relevant programs and
4 capabilities of the Department and other Federal research
5 programs, including activities authorized in sections 803,
6 805, and 808 of the Energy Policy Act of 2005 (42 U.S.C.
7 16152, 16154, and 16157) and in subtitle B of title III
8 of division D of the Infrastructure Investment and Jobs
9 Act (PL 117–58).

10 **SEC. 9. AUTHORIZATION OF APPROPRIATIONS.**

11 There are authorized to be appropriated to the Sec-
12 retary for research, development, demonstration, and com-
13 mercial application of hydrogen and fuel cell energy sys-
14 tems, and other related technologies in the United States,
15 including to carry out this Act, the following:

- 16 (1) For fiscal year 2023, \$161,160,000.
17 (2) For fiscal year 2024, \$164,383,000.
18 (3) For fiscal year 2025, \$167,670,000.
19 (4) For fiscal year 2026, \$171,024,000.
20 (5) For fiscal year 2027, \$174,444,480.

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