

118TH CONGRESS
1ST SESSION

S. 1576

To provide for advancements in carbon removal research, quantification, and commercialization, including by harnessing natural processes, and for other purposes.

IN THE SENATE OF THE UNITED STATES

MAY 11, 2023

Ms. COLLINS (for herself, Ms. CANTWELL, Mr. CASSIDY, Mr. KING, and Mr. COONS) introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

A BILL

To provide for advancements in carbon removal research, quantification, and commercialization, including by harnessing natural processes, and for other purposes.

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

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

4 (a) SHORT TITLE.—This Act may be cited as the
5 “Carbon Removal and Emissions Storage Technologies
6 Act of 2023” or the “CREST Act of 2023”.

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

Sec. 1. Short title; table of contents.

Sec. 2. Definitions.

TITLE I—CARBON REMOVAL RESEARCH AND DEVELOPMENT

Subtitle A—Biomass Carbon Removal

Sec. 101. Biomass carbon removal programs.

Sec. 102. Biological carbon dioxide conversion programs.

Subtitle B—Geological Carbon Removal

Sec. 111. Carbon mineralization pilot projects.

Sec. 112. Carbon mineralization resource assessment.

Sec. 113. Tailings and waste mineralization program.

Subtitle C—Aquatic Carbon Removal

Sec. 121. Ocean carbon removal mission.

Sec. 122. Direct ocean capture assessment.

Sec. 123. Offshore carbon storage program and assessment.

Subtitle D—Atmospheric Carbon Removal

Sec. 131. Direct air capture technology manufacturing research program.

Subtitle E—Carbon Removal Quantification

Sec. 141. Carbon removal quantification.

TITLE II—CARBON REMOVAL PURCHASING PILOT PROGRAM

Sec. 201. Carbon removal purchasing pilot program.

1 SEC. 2. DEFINITIONS.

2 In this Act:

3 (1) CARBON REMOVAL.—The term “carbon re-
 4 moval” means the intentional removal, including by
 5 harnessing natural processes, of carbon dioxide di-
 6 rectly from the atmosphere or upper hydrosphere
 7 and subsequent storage of the carbon dioxide in geo-
 8 logical, biobased, or ocean reservoirs or in value-
 9 added products that results in a net removal of car-
 10 bon dioxide from the atmosphere, as measured on a
 11 lifecycle basis.

1 (2) CARBON REMOVAL TECHNOLOGY OR AP-
2 PROACH.—The term “carbon removal technology or
3 approach” includes—

4 (A) direct air capture with durable storage;

5 (B) soil carbon sequestration;

6 (C) biomass carbon removal and storage;

7 (D) enhanced mineralization;

8 (E) ocean-based carbon dioxide removal;

9 and

10 (F) afforestation or reforestation.

11 (3) SECRETARY.—The term “Secretary” means
12 the Secretary of Energy.

13 **TITLE I—CARBON REMOVAL**
14 **RESEARCH AND DEVELOPMENT**
15 **Subtitle A—Biomass Carbon**
16 **Removal**

17 **SEC. 101. BIOMASS CARBON REMOVAL PROGRAMS.**

18 (a) OFFICE OF SCIENCE.—Section 306 of the De-
19 partment of Energy Research and Innovation Act (42
20 U.S.C. 18644) is amended—

21 (1) by redesignating subsections (k) and (l) as
22 subsections (l) and (m), respectively; and

23 (2) by inserting after subsection (j) the fol-
24 lowing:

25 “(k) ALGAL BIOMASS CARBON REMOVAL.—

1 “(1) IN GENERAL.—The Director shall carry
 2 out a research and development program to gain un-
 3 derstanding of the underlying biology of algal bio-
 4 mass systems and the possible use of algal biomass
 5 systems as a means of carbon removal (as defined
 6 in section 2 of the Carbon Removal and Emissions
 7 Storage Technologies Act of 2023) from the air and
 8 aquatic sources.

9 “(2) REQUIREMENTS.—The program carried
 10 out under paragraph (1) shall—

11 “(A) support efforts to reduce long-term
 12 technical barriers for algal biomass with carbon
 13 capture; and

14 “(B) coordinate closely with the Bioenergy
 15 Technologies Office and the Office of Fossil En-
 16 ergy and Carbon Management.”.

17 (b) OFFICE OF ENERGY EFFICIENCY AND RENEW-
 18 ABLE ENERGY.—Section 932 of the Energy Policy Act of
 19 2005 (42 U.S.C. 16232) is amended—

20 (1) in subsection (b)—

21 (A) in paragraph (5), by striking “and”
 22 after the semicolon;

23 (B) in paragraph (6), by striking the pe-
 24 riod and inserting “; and”; and

25 (C) by adding at the end the following:

1 “(7) biological carbon removal (as defined in
2 section 2 of the Carbon Removal and Emissions
3 Storage Technologies Act of 2023).”; and

4 (2) by inserting after subsection (e) the fol-
5 lowing:

6 “(f) BIOLOGICAL CARBON REMOVAL.—

7 “(1) DEFINITION OF CARBON REMOVAL.—In
8 this subsection, the term ‘carbon removal’ has the
9 meaning given the term in section 2 of the Carbon
10 Removal and Emissions Storage Technologies Act of
11 2023.

12 “(2) GOALS.—The goals of the biological car-
13 bon removal program under subsection (b)(7) shall
14 be to develop and deploy, in partnership with indus-
15 try and institutions of higher education—

16 “(A) improved tools and understanding of
17 feedstocks, supplies, and logistics with respect
18 to carbon removal using biomass sources;

19 “(B) technologies for the optimized conver-
20 sion of aquatic and terrestrial biomass for car-
21 bon removal;

22 “(C) cost-competitive carbon capture tech-
23 nologies applied to bioenergy, including—

24 “(i) algal, terrestrial, and marine bio-
25 mass;

1 “(ii) biofuels; and

2 “(iii) bioproducts; and

3 “(D) applied research on best practices in
4 macroalgae cultivation and phenotype selection,
5 including by carrying out aquatic pilot projects.

6 “(3) COORDINATION.—Activities conducted
7 under this subsection shall be coordinated with the
8 relevant programs of the Office of Science, the Of-
9 fice of Fossil Energy and Carbon Management, and
10 the Department of Agriculture.”.

11 (c) OFFICE OF FOSSIL ENERGY AND CARBON MAN-
12 AGEMENT.—Section 962(b) of the Energy Policy Act of
13 2005 (42 U.S.C. 16292(b)) is amended—

14 (1) in paragraph (1), by striking “performance
15 of” and all that follows through the period at the
16 end and inserting the following: “performance of—

17 “(A) coal and natural gas use;

18 “(B) biomass with carbon capture for utili-
19 zation or permanent storage; and

20 “(C) manufacturing and industrial facili-
21 ties.”; and

22 (2) in paragraph (3)—

23 (A) in subparagraph (A)—

24 (i) in clause (v), by striking “and”
25 after the semicolon;

1 (ii) in clause (vi), by striking the pe-
2 riod at the end and inserting “; and”;

3 (iii) by adding at the end the fol-
4 lowing:

5 “(vii) developing advanced boilers to
6 enable net-negative lifecycle carbon emis-
7 sions through co-firing with biomass.”; and
8 (B) by adding at the end the following:

9 “(G) Developing carbon capture tech-
10 nologies applied to bioenergy systems that re-
11 sult in net-negative lifecycle carbon emissions,
12 including—

13 “(i) biofuels production;

14 “(ii) bioproducts;

15 “(iii) biomass used in power systems
16 and industrial applications; and

17 “(iv) fossil fuel power systems and in-
18 dustrial systems co-fired with biomass.”.

19 (d) OFFICE OF ENERGY EFFICIENCY AND RENEW-
20 ABLE ENERGY.—

21 (1) IN GENERAL.—The Energy Independence
22 and Security Act of 2007 (42 U.S.C. 17001 et seq.)
23 is amended by striking section 228 (121 Stat. 1535)
24 and inserting the following:

1 **“SEC. 228. AQUATIC BIOMASS.**

2 “(a) IN GENERAL.—The Director of the Bioenergy
3 Technologies Office shall carry out applied research on—

4 “(1) microalgae and macroalgae cultivation and
5 phenotype selection; and

6 “(2) optimization of aquatic biomass conversion
7 pathways.

8 “(b) REQUIREMENTS.—The research carried out
9 under subsection (a) shall support efforts—

10 “(1) to develop best practices in microalgae and
11 macroalgae cultivation and phenotype selection, in-
12 cluding by carrying out aquatic pilot projects—

13 “(A) on microalgae and macroalgae; and

14 “(B) in freshwater and seawater; and

15 “(2) to optimize aquatic biomass conversion
16 pathways that result in carbon removal (as defined
17 in section 2 of the Carbon Removal and Emissions
18 Storage Technologies Act of 2023) for biopower,
19 biofuels, and other uses.

20 “(c) FUNDING.—There are authorized to be appro-
21 priated to the Secretary to carry out this section—

22 “(1) \$3,000,000 for fiscal year 2024;

23 “(2) \$8,000,000 for fiscal year 2025; and

24 “(3) \$20,000,000 for each of fiscal years 2026
25 through 2028.”.

1 (2) CLERICAL AMENDMENT.—The table of con-
 2 tents for the Energy Independence and Security Act
 3 of 2007 (Public Law 110–140; 121 Stat. 1493) is
 4 amended by striking the item relating to section 228
 5 and inserting the following:

“Sec. 228. Aquatic biomass.”.

6 **SEC. 102. BIOLOGICAL CARBON DIOXIDE CONVERSION PRO-**
 7 **GRAMS.**

8 (a) IN GENERAL.—The Energy Policy Act of 2005
 9 is amended by inserting after section 977 (42 U.S.C.
 10 16317) the following:

11 **“SEC. 977A. BIOLOGICAL CARBON DIOXIDE CONVERSION**
 12 **PROGRAMS.**

13 “(a) GENETIC MODELING AND TOOLS;
 14 BIOPROSPECTING.—

15 “(1) IN GENERAL.—The Director of the Office
 16 of Science shall establish a program to improve ge-
 17 netic modeling and manipulation for carbon dioxide
 18 conversion.

19 “(2) METHODOLOGY.—The program established
 20 under paragraph (1) shall—

21 “(A) support efforts to improve carbon di-
 22 oxide uptake and conversion through genetic
 23 manipulation of crops and trees, including—

24 “(i) soil enhancements;

1 “(ii) enhanced photosynthesis, includ-
2 ing microbial soil amendments and
3 perennialization; and

4 “(iii) root growth; and

5 “(B) support efforts to bioprospect using
6 tools and high-throughput screening methods
7 for organisms with unique attributes related to
8 carbon dioxide conversion.

9 “(3) COORDINATION.—In carrying out the pro-
10 gram established under paragraph (1), the Director
11 of the Office of Science shall coordinate with the
12 National Science Foundation and the Agricultural
13 Research Service.

14 “(b) NEW MATERIALS DEVELOPMENT AND APPLICA-
15 TION.—

16 “(1) DEFINITION OF CARBON REMOVAL.—In
17 this subsection, the term ‘carbon removal’ has the
18 meaning given the term in section 2 of the Carbon
19 Removal and Emissions Storage Technologies Act of
20 2023.

21 “(2) PROGRAM.—The Assistant Secretary for
22 Energy Efficiency and Renewable Energy, in con-
23 sultation with the Secretary of Agriculture, shall es-
24 tablish a program to develop new biologically based

1 carbon dioxide utilization products and coproducts
2 that result in carbon removal.

3 “(3) METHODOLOGY.—The program established
4 under paragraph (2) shall—

5 “(A) support efforts to develop new carbon
6 dioxide utilization products that result in car-
7 bon removal;

8 “(B) prioritize products that have the po-
9 tential to be deployed at a large scale; and

10 “(C) support efforts to develop valorization
11 of coproducts for—

12 “(i) feed;

13 “(ii) fuel; and

14 “(iii) other uses.”.

15 (b) CLERICAL AMENDMENT.—The table of contents
16 for the Energy Policy Act of 2005 (Public Law 109–58;
17 119 Stat. 600) is amended by inserting after the item re-
18 lating to section 977 the following:

“Sec. 977A. Biological carbon dioxide conversion programs.”.

19 **Subtitle B—Geological Carbon**
20 **Removal**

21 **SEC. 111. CARBON MINERALIZATION PILOT PROJECTS.**

22 (a) IN GENERAL.—The Energy Policy Act of 2005
23 is amended by inserting after section 963 (42 U.S.C.
24 16293) the following:

1 **“SEC. 963A. CARBON MINERALIZATION PILOT PROJECTS.**

2 “(a) IN GENERAL.—The Secretary, in consultation
3 with the Administrator of the National Oceanic and At-
4 mospheric Administration and the Director of the United
5 States Geological Survey, shall conduct field experiments
6 of ex situ and in situ carbon mineralization approaches
7 for the purposes of advancing carbon removal technologies
8 or approaches (as defined in section 2 of the Carbon Re-
9 moval and Emissions Storage Technologies Act of 2023).

10 “(b) ACTIVITIES.—In carrying out subsection (a), the
11 Secretary shall—

12 “(1) conduct field experiments of ex situ carbon
13 mineralization—

14 “(A) using desalination brine treatment;
15 and

16 “(B) through the broadcast of reactive
17 minerals on—

18 “(i) soils;

19 “(ii) beaches; and

20 “(iii) shallow oceans; and

21 “(2) conduct field experiments of in situ carbon
22 mineralization, including through drilling and injec-
23 tion in reactive formations for—

24 “(A) mantle peridotite;

25 “(B) basalt; and

26 “(C) other relevant formations.

1 “(c) FIELD EXPERIMENT GOALS AND OBJEC-
 2 TIVES.—The Secretary shall develop goals and objectives
 3 for field experiments carried out under this section to de-
 4 crease the energy requirements and costs to produce the
 5 resulting mineralized carbon.

6 “(d) ENVIRONMENTAL IMPACT.—In carrying out
 7 field experiments under this section, the Secretary shall
 8 comply with all applicable environmental laws and regula-
 9 tions.

10 “(e) FUNDING.—There are authorized to be appro-
 11 priated to the Secretary to carry out this section—

12 “(1) \$4,000,000 for fiscal year 2024;

13 “(2) \$9,000,000 for fiscal year 2025;

14 “(3) \$18,000,000 for fiscal year 2026; and

15 “(4) \$30,000,000 for each of fiscal years 2027
 16 and 2028.”.

17 (b) CLERICAL AMENDMENT.—The table of contents
 18 for the Energy Policy Act of 2005 (Public Law 109–58;
 19 119 Stat. 600) is amended by inserting after the item re-
 20 lating to section 963 the following:

“Sec. 963A. Carbon mineralization pilot projects.”.

21 **SEC. 112. CARBON MINERALIZATION RESOURCE ASSESS-**
 22 **MENT.**

23 (a) IN GENERAL.—The Secretary of the Interior (re-
 24 ferred to in this section as the “Secretary”) shall complete
 25 a national assessment of the potential for using carbon

1 mineralization for carbon removal, in accordance with the
2 methodology developed under subsection (b).

3 (b) METHODOLOGY.—Not later than 2 years after
4 the date of enactment of this Act, the Secretary, acting
5 through the Director of the United States Geological Sur-
6 vey, shall develop a methodology to assess geological re-
7 sources, mine tailings, and other alkaline industrial wastes
8 to identify sustainable sources of reactive minerals suit-
9 able for carbon mineralization, while taking into consider-
10 ation minerals and mineral classes with high reactivity and
11 fast kinetics.

12 (c) COORDINATION.—

13 (1) FEDERAL COORDINATION.—To ensure the
14 maximum usefulness and success of the assessment
15 under subsection (a), the Secretary shall—

16 (A) consult with the Secretary of Energy
17 and the Administrator of the Environmental
18 Protection Agency on the format and content of
19 the assessment; and

20 (B) share relevant data with the Depart-
21 ment of Energy and the Environmental Protec-
22 tion Agency.

23 (2) STATE COORDINATION.—The Secretary
24 shall consult with State geological surveys and other
25 relevant entities to ensure, to the maximum extent

1 practicable, the usefulness and success of the assess-
2 ment under subsection (a).

3 (d) REPORT.—

4 (1) IN GENERAL.—Not later than 180 days
5 after the date on which the assessment under sub-
6 section (a) is completed, the Secretary shall submit
7 to the Committee on Energy and Natural Resources
8 of the Senate and the Committee on Natural Re-
9 sources of the House of Representatives a report de-
10 scribing the findings under the assessment, including
11 the locations and available quantities of suitable re-
12 active minerals.

13 (2) PUBLIC AVAILABILITY.—Not later than 30
14 days after the date on which the Secretary submits
15 the report under paragraph (1), the Secretary shall
16 make the report publicly available.

17 **SEC. 113. TAILINGS AND WASTE MINERALIZATION PRO-**
18 **GRAM.**

19 (a) TAILINGS AND WASTE MINERALIZATION PRO-
20 GRAM.—

21 (1) IN GENERAL.—The Secretary shall conduct
22 field experiments to examine the use of mine tailings
23 and industrial wastes for the purpose of carbon min-
24 eralization.

1 (2) ACTIVITIES.—The field experiments using
2 mine tailings and industrial wastes conducted under
3 paragraph (1) shall assess—

4 (A) the reusing of industrial slags and
5 mine tailings in manufacturing; and

6 (B) other industrial wastes that may have
7 carbon mineralization properties.

8 (b) STUDY ON ENVIRONMENTAL IMPACTS OF MIN-
9 ERALIZATION PRODUCTS.—

10 (1) IN GENERAL.—Not later than 3 years after
11 the date of enactment of this Act, the Secretary
12 shall conduct, and submit to Congress a report that
13 describes the results of, a study on the environ-
14 mental impacts of—

15 (A) broadcasting materials and distrib-
16 uting piles of mine tailings at various scales for
17 the purposes of enhanced carbon mineralization;
18 and

19 (B) additional mining for the purposes of
20 carbon mineralization.

21 (2) REQUIREMENTS.—The study under para-
22 graph (1) shall include an analysis of—

23 (A) the relative carbon removal potential
24 associated with various scales of carbon min-
25 eralization;

1 (B) the cost of environmental mitigation of
2 the environmental impacts identified under the
3 study; and

4 (C) opportunities—

5 (i) for remediation;

6 (ii) to co-extract reactive minerals
7 with conventional mining operations; and

8 (iii) for the use of reactive minerals in
9 mining remediation.

10 **Subtitle C—Aquatic Carbon** 11 **Removal**

12 **SEC. 121. OCEAN CARBON REMOVAL MISSION.**

13 Section 969D of the Energy Policy Act of 2005 (42
14 U.S.C. 16298d) is amended—

15 (1) in subsection (a) by inserting “and aquatic
16 sources” after “atmosphere”; and

17 (2) in subsection (c)—

18 (A) in paragraph (5), by striking “and”
19 after the semicolon;

20 (B) in paragraph (6), by striking the pe-
21 riod at the end and inserting a semicolon; and

22 (C) by adding at the end the following:

23 “(7) ocean carbon removal and strategies, such
24 as—

1 “(A) blue carbon, which is the manage-
2 ment of vegetated coastal habitats (including
3 mangroves, tidal marshes, seagrasses, kelp for-
4 ests, and other tidal, freshwater, or saltwater
5 wetlands) that sequester carbon (including
6 autochthonous carbon and allochthonous car-
7 bon) from the atmosphere, accumulate carbon
8 in biomass, and store the carbon in soils;

9 “(B) direct ocean capture (as described in
10 section 122(a) of the Carbon Removal and
11 Emissions Storage Technologies Act of 2023);

12 “(C) microalgae and macroalgae cultiva-
13 tion for—

14 “(i) biofuels;

15 “(ii) bioproducts; and

16 “(iii) carbon storage; and

17 “(D) ocean alkalinity enhancement; and

18 “(8) any combination of activities described in
19 paragraphs (1) through (7) that have the potential
20 for significant carbon removal (as defined in section
21 2 of the Carbon Removal and Emissions Storage
22 Technologies Act of 2023).”.

1 **SEC. 122. DIRECT OCEAN CAPTURE ASSESSMENT.**

2 (a) IN GENERAL.—The Secretary shall conduct a
3 comprehensive assessment of the potential for removing
4 carbon dioxide directly from the oceans.

5 (b) METHODOLOGY.—In conducting the assessment
6 under subsection (a), the Secretary shall consider the po-
7 tential and relative merits of—

8 (1) pathways, methods, and technologies that
9 are able to directly remove carbon dioxide from the
10 oceans through engineered or inorganic processes;
11 and

12 (2) technologies such as filters, membranes,
13 phase change systems, chemical conversion, or other
14 technological pathways.

15 (c) INCLUSION.—In conducting the assessment under
16 subsection (a), the Secretary shall incorporate any infor-
17 mation on the results of activities conducted under section
18 223 of the National Defense Authorization Act for Fiscal
19 Year 2020 (10 U.S.C. 4001 note; Public Law 116–92).

20 (d) REPORT.—Not later than 1 year after the date
21 of enactment of this Act, the Secretary, in consultation
22 with the Administrator of the National Oceanic and At-
23 mospheric Administration, shall submit to the Committees
24 on Energy and Natural Resources and Commerce,
25 Science, and Transportation of the Senate and the Com-
26 mittee on Energy and Commerce of the House of Rep-

1 representatives a report describing the results of the assess-
2 ment under subsection (a).

3 (e) AUTHORIZATION OF APPROPRIATIONS.—There
4 are authorized to be appropriated to the Secretary to carry
5 out this section—

6 (1) \$2,000,000 for fiscal year 2024;

7 (2) \$4,000,000 for fiscal year 2025; and

8 (3) \$8,000,000 for each of fiscal years 2026
9 through 2028.

10 **SEC. 123. OFFSHORE CARBON STORAGE PROGRAM AND AS-**
11 **SESSMENT.**

12 (a) CARBON DIOXIDE IMPACTS AND FATE IN THE
13 OCEAN.—

14 (1) IN GENERAL.—The Department of Energy
15 Carbon Capture and Sequestration Research, Devel-
16 opment, and Demonstration Act of 2007 (Public
17 Law 110–140; 121 Stat. 1704) is amended by add-
18 ing at the end the following:

19 **“SEC. 709. CARBON DIOXIDE IMPACTS AND FATE IN THE**
20 **OCEAN.**

21 “(a) IN GENERAL.—The Secretary shall establish a
22 program to monitor, research, and model the ecological
23 impacts of ocean carbon dioxide removal and storage tech-
24 niques.

1 “(b) COORDINATION.—In carrying out the program
2 established under subsection (a), the Secretary shall co-
3 ordinate with the Administrator of the National Oceanic
4 and Atmospheric Administration and the Administrator of
5 the National Aeronautics and Space Administration.

6 “(c) AUTHORIZATION OF APPROPRIATIONS.—There
7 are authorized to be appropriated to the Secretary to carry
8 out this section—

9 “(1) \$2,000,000 for fiscal year 2024; and

10 “(2) \$5,000,000 for each of fiscal years 2025
11 through 2028.”.

12 (2) CLERICAL AMENDMENT.—The table of con-
13 tents for the Energy Independence and Security Act
14 of 2007 (Public Law 110–140; 121 Stat. 1496) is
15 amended by inserting after the item relating to sec-
16 tion 708 the following:

“Sec. 709. Carbon dioxide impacts and fate in the ocean.”.

17 (b) OUTER CONTINENTAL SHELF RESOURCE AS-
18 SESSMENT.—

19 (1) IN GENERAL.—Not later than 1 year after
20 the date of enactment of this Act, the Secretary
21 shall—

22 (A) expand the CarbonSAFE Initiative of
23 the Department of Energy to complete a na-
24 tional carbon mineralization assessment that ex-
25 amines the full range of carbon mineralization

1 storage potential for the outer Continental
2 Shelf region; and

3 (B) submit to the Committees on Energy
4 and Natural Resources and Commerce, Science,
5 and Transportation of the Senate and the Com-
6 mittee on Energy and Commerce of the House
7 of Representatives a report describing the re-
8 sults of the assessment.

9 (2) AUTHORIZATION OF APPROPRIATIONS.—

10 There is authorized to be appropriated to the Sec-
11 retary to carry out this subsection \$5,000,000 for
12 each of fiscal years 2024 through 2028.

13 (c) ASSESSMENT TO DETERMINE THE POTENTIAL
14 FOR OFFSHORE CARBON STORAGE.—

15 (1) IN GENERAL.—The Secretary, in consulta-
16 tion with the Secretary of the Interior, the Adminis-
17 trator of the Environmental Protection Agency, and
18 the Administrator of the National Oceanic and At-
19 mospheric Administration, shall conduct a com-
20 prehensive assessment of the potential for offshore
21 carbon storage, including an assessment of—

22 (A) the potential for offshore carbon stor-
23 age—

24 (i) in deep offshore sub-seabed loca-
25 tions, such as in geological formations;

1 (ii) at the seabed, such as through
2 biomass sinking; and

3 (iii) within the oceans, such as liquid
4 carbon dioxide storage; and

5 (B) other relevant methods of offshore car-
6 bon storage.

7 (2) INCLUSION.—The assessment under para-
8 graph (1) shall include recommendations of meas-
9 ures that the Department of Energy may take to im-
10 prove the ease, safety, and security of offshore car-
11 bon dioxide storage.

12 (3) REPORTING.—Not later than 2 years after
13 the date of enactment of this Act, the Secretary
14 shall submit to the Committees on Energy and Nat-
15 ural Resources and Commerce, Science, and Trans-
16 portation of the Senate and the Committee on En-
17 ergy and Commerce of the House of Representatives
18 a report describing the results of the assessment
19 under paragraph (1).

20 **Subtitle D—Atmospheric Carbon**
21 **Removal**

22 **SEC. 131. DIRECT AIR CAPTURE TECHNOLOGY MANUFAC-**
23 **TURING RESEARCH PROGRAM.**

24 (a) INITIATIVE.—

1 (1) IN GENERAL.—The Secretary shall establish
2 a program for the research, development, and dem-
3 onstration of manufacturing techniques for direct air
4 capture technologies (referred to in this section as
5 the “program”).

6 (2) COORDINATION.—In carrying out the pro-
7 gram, the Secretary shall leverage expertise and re-
8 sources from—

9 (A) the Office of Science;

10 (B) the Office of Energy Efficiency and
11 Renewable Energy; and

12 (C) the Office of Fossil Energy and Car-
13 bon Management.

14 (b) CONTACTOR DESIGN.—

15 (1) IN GENERAL.—In carrying out the program,
16 the Secretary shall conduct research on applied tech-
17 nology development of air contactor design.

18 (2) REQUIREMENTS.—The research under para-
19 graph (1) shall support efforts to improve air
20 contactors with—

21 (A) low pressure drop;

22 (B) high surface area; and

23 (C) high longevity.

24 (c) MANUFACTURING IMPROVEMENT.—

1 (1) IN GENERAL.—In carrying out the program,
2 the Secretary shall conduct research scaling-up man-
3 ufacturing of direct air capture components.

4 (2) REQUIREMENTS.—The research under para-
5 graph (1) shall—

6 (A) support efforts to improve techniques
7 for low-cost manufacturing of direct air capture
8 components and materials; and

9 (B) be coordinated with private industry
10 and universities.

11 (d) AUTHORIZATION OF APPROPRIATIONS.—There
12 are authorized to be appropriated to the Secretary—

13 (1) to carry out subsection (b)—

14 (A) \$3,000,000 for fiscal year 2024;

15 (B) \$7,000,000 for fiscal year 2025; and

16 (C) \$10,000,000 for each of fiscal years
17 2026 through 2028; and

18 (2) to carry out subsection (c)—

19 (A) \$2,000,000 for fiscal year 2024;

20 (B) \$5,000,000 for fiscal year 2025; and

21 (C) \$10,000,000 for each of fiscal years
22 2026 through 2028.

1 **Subtitle E—Carbon Removal**
2 **Quantification**

3 **SEC. 141. CARBON REMOVAL QUANTIFICATION.**

4 (a) IN GENERAL.—Title V of the Energy Act of 2020
5 (42 U.S.C. 16298e et seq.) is amended by adding at the
6 end the following:

7 **“SEC. 5003. QUANTIFYING THE BENEFITS OF CARBON RE-**
8 **MOVAL.**

9 “(a) PURPOSES.—The purposes of this section are—

10 “(1) to quantify the net carbon removed
11 through atmospheric and aquatic carbon removal
12 pathways;

13 “(2) to determine the current and projected
14 carbon removal capacity of atmospheric and aquatic
15 carbon removal pathways;

16 “(3) to determine the current and likely future
17 technical readiness of carbon removal technologies or
18 approaches for large-scale carbon removal deploy-
19 ment; and

20 “(4) to aid in the commercialization of carbon
21 removal technologies or approaches.

22 “(b) DEFINITIONS.—In this section:

23 “(1) CARBON REMOVAL; CARBON REMOVAL
24 TECHNOLOGY OR APPROACH.—The terms ‘carbon re-
25 moval’ and ‘carbon removal technology or approach’

1 have the meanings given the terms in section 2 of
2 the Carbon Removal and Emissions Storage Tech-
3 nologies Act of 2023.

4 “(2) ELIGIBLE ENTITY.—The term ‘eligible en-
5 tity’ means any of the following entities:

6 “(A) An institution of higher education.

7 “(B) A National Laboratory.

8 “(C) A Federal research agency.

9 “(D) A State research agency.

10 “(E) A nonprofit research organization.

11 “(F) An industrial entity.

12 “(G) A consortium of 2 or more entities
13 described in subparagraphs (A) through (F).

14 “(3) SECRETARY.—The term ‘Secretary’ means
15 the Secretary of Energy.

16 “(c) CARBON REMOVAL FOOTPRINT PROGRAM.—

17 “(1) ESTABLISHMENT.—Not later than 1 year
18 after the date of enactment of this section, the Sec-
19 retary shall establish a program to carry out the
20 purposes described in subsection (a), including by
21 providing financial assistance to eligible entities to
22 examine the technological, economic, and environ-
23 mental impacts of carbon removal pathways and
24 technologies.

1 “(2) ELIGIBLE ACTIVITIES.—Activities eligible
2 to receive financial assistance under this section in-
3 clude—

4 “(A) assessments of technological or eco-
5 nomic barriers to the widescale deployment of
6 carbon removal pathways and technologies; and

7 “(B) lifecycle assessments for carbon re-
8 moval pathways and technologies, including
9 gathering data in partnership with a direct air
10 capture test center authorized under section
11 969D(f)(1) of the Energy Policy Act of 2005
12 (42 U.S.C. 16298d(f)(1)).

13 “(3) APPLICATIONS.—An eligible entity seeking
14 financial assistance under this section shall submit
15 to the Secretary an application that includes a de-
16 scription of—

17 “(A) the applicable project;

18 “(B) the software programs, consultants,
19 and general methodologies to be used to con-
20 duct the assessment;

21 “(C) the location of any applicable facility
22 or project;

23 “(D) expected feedstocks and other inputs;
24 and

25 “(E) the expected use of carbon removed.

1 “(4) PRIORITY.—In selecting eligible entities to
2 receive financial assistance under this section, the
3 Secretary shall give priority to eligible entities
4 that—

5 “(A) make the assessment publicly avail-
6 able, with confidential business information re-
7 dacted or removed; and

8 “(B) have not previously received financial
9 assistance under this section.”.

10 (b) CLERICAL AMENDMENT.—The table of contents
11 for the Energy Act of 2020 (Public Law 116–260; 134
12 Stat. 2419) is amended by inserting after the item relating
13 to section 5002 the following:

“Sec. 5003. Quantifying the benefits of carbon removal.”.

14 **TITLE II—CARBON REMOVAL**
15 **PURCHASING PILOT PROGRAM**

16 **SEC. 201. CARBON REMOVAL PURCHASING PILOT PRO-**
17 **GRAM.**

18 (a) IN GENERAL.—Subtitle F of title IX of the En-
19 ergy Policy Act of 2005 (42 U.S.C. 16291 et seq.) is
20 amended by adding at the end the following:

21 **“SEC. 969E. CARBON REMOVAL PURCHASING PILOT PRO-**
22 **GRAM.**

23 “(a) PURPOSES.—The purposes of this section are—

1 “(1) to accelerate the deployment and commer-
2 cialization of technologically diverse carbon removal
3 pathways and technologies;

4 “(2) to stimulate the development and commer-
5 cialization of low-carbon products made with carbon
6 dioxide removed from the atmosphere or oceans; and

7 “(3) to support the development and diversifica-
8 tion of technologies relating to carbon removal.

9 “(b) DEFINITIONS.—In this section:

10 “(1) ADDITIONAL.—The term ‘additional’, with
11 respect to carbon dioxide removed from the atmos-
12 phere or upper hydrosphere, means that carbon di-
13 oxide was removed pursuant to an intentional carbon
14 removal activity that delivers a net removal of car-
15 bon dioxide from the atmosphere, measured on a
16 lifecycle basis, that would not have occurred without
17 the carbon removal activity.

18 “(2) ALL-IN COST.—The term ‘all-in cost’
19 means the total cost of—

20 “(A) the capture, transport, and storage of
21 carbon dioxide; and

22 “(B) the measurement, reporting, and
23 verification of carbon dioxide removed on a net
24 ton carbon dioxide equivalent basis.

1 “(3) ELIGIBLE ENTITY.—The term ‘eligible en-
2 tity’ means a carbon removal facility that—

3 “(A) is located in the United States;

4 “(B) meets all applicable Federal and
5 State permitting requirements; and

6 “(C) meets financial, technical, and tech-
7 nological diversity criteria established by the
8 Secretary.

9 “(4) REMOVAL.—The term ‘removal’ means—

10 “(A) the capture of carbon dioxide from
11 the atmosphere or upper hydrosphere through a
12 chemical, physical, or other process; and

13 “(B) the subsequent permanent storage or
14 use of the carbon dioxide in a manner that en-
15 sures that the carbon dioxide does not reenter
16 the atmosphere or upper hydrosphere.

17 “(5) UPPER HYDROSPHERE.—The term ‘upper
18 hydrosphere’ means the total liquid water existing
19 on the surface level of the earth, including—

20 “(A) oceans;

21 “(B) lakes;

22 “(C) rivers; and

23 “(D) other surface bodies of water.

24 “(c) PROGRAM.—

1 “(1) ESTABLISHMENT.—The Secretary shall es-
2 tablish a competitive purchasing pilot program under
3 which the Secretary shall purchase from eligible en-
4 tities carbon dioxide removed from the atmosphere
5 or upper hydrosphere.

6 “(2) PURCHASE.—In carrying out the pilot pro-
7 gram under paragraph (1), the Secretary shall pur-
8 chase, subject to the availability of appropriations,
9 removed carbon dioxide from eligible entities—

10 “(A) until the date on which the first re-
11 verse auction is held under paragraph (3), by
12 making a payment per net ton carbon equiva-
13 lent basis to account for lifecycle greenhouse
14 gas inputs to carbon removal in an amount de-
15 termined by the Secretary; and

16 “(B) beginning with the first reverse auc-
17 tion held under paragraph (3), in accordance
18 with the reverse auction procedures described in
19 that paragraph.

20 “(3) REVERSE AUCTION PROCEDURES.—

21 “(A) IN GENERAL.—Not later than 2 years
22 after the date of enactment of this section, and
23 annually thereafter, the Secretary shall conduct
24 a reverse auction under which—

1 “(i) the Secretary shall solicit bids
2 from eligible entities in each tier described
3 in subparagraph (B)(ii) (referred to in this
4 section as a ‘permanence tier’); and

5 “(ii) eligible entities shall submit to
6 the Secretary sealed bids describing—

7 “(I) a desired price for the re-
8 moved carbon dioxide on a per net ton
9 carbon dioxide equivalent basis;

10 “(II) the estimated net ton car-
11 bon dioxide equivalent removed by the
12 eligible entity annually that the eligi-
13 ble entity desires the Secretary to
14 purchase at the desired price;

15 “(III) details of the permanence
16 of the removed carbon dioxide;

17 “(IV) details on the purity, loca-
18 tion, and transportation options for
19 the removed carbon dioxide to be pur-
20 chased by the Secretary for purposes
21 of the all-in costs;

22 “(V) a lifecycle assessment of the
23 operation to quantify the net carbon
24 dioxide removed, while accounting for
25 greenhouse gas emissions associated

1 with the production of the inputs nec-
2 essary for the carbon dioxide removal
3 and storage processes; and

4 “(VI) any other details the Sec-
5 retary may require.

6 “(B) SELECTION.—

7 “(i) IN GENERAL.—The Secretary
8 shall—

9 “(I) examine the bids submitted
10 under subparagraph (A)(ii) to deter-
11 mine which bids are acceptable under
12 the criteria established by the Sec-
13 retary for the applicable permanence
14 tier; and

15 “(II) of the bids determined to be
16 acceptable under subclause (I), iden-
17 tify a technologically diverse set of
18 carbon removal approaches, and for
19 each of those selected approaches, se-
20 lect the bids containing the lowest de-
21 sired price for carbon dioxide, subject
22 to clause (iv), until the amount of
23 funds available for the applicable per-
24 manence tier of the reverse auction is
25 obligated.

1 “(ii) PERMANENCE TIERS.—In select-
2 ing bids under clause (i), the Secretary
3 shall group the permanence of each carbon
4 removal bid into 1 of the following 2 tiers:

5 “(I) Medium-term tier for bids
6 providing for the removal of carbon
7 dioxide for at least 100 years, but
8 fewer than 1,000 years.

9 “(II) Long-term tier for bids pro-
10 viding for the removal of carbon diox-
11 ide for 1,000 years or more.

12 “(iii) PRIORITY.—In any case in
13 which the desired price in 2 or more bids
14 submitted under subparagraph (A)(ii) for
15 an applicable permanence tier is equal, the
16 Secretary shall give priority to eligible enti-
17 ties that demonstrate outstanding potential
18 for local and regional economic develop-
19 ment in carrying out projects to remove
20 carbon dioxide from ambient air or aquatic
21 sources.

22 “(iv) LIMITATION ON FUNDS RE-
23 CEIVED BY A SINGLE COMPANY.—To the
24 extent that there are sufficient bids accept-
25 able under clause (i)(I), the Secretary shall

1 ensure that one or more eligible entities
2 under common control does not receive
3 more than 15 percent of the amounts
4 made available for a fiscal year under this
5 section.

6 “(4) COST CAP.—

7 “(A) IN GENERAL.—Subject to subpara-
8 graph (B), for purposes of a reverse auction
9 under paragraph (3), the Secretary shall—

10 “(i) determine the current average
11 market price per net ton carbon dioxide
12 equivalent basis to account for lifecycle
13 greenhouse gas inputs of removed carbon
14 within each permanence tier; and

15 “(ii) set that price as the maximum
16 price per ton to be paid under the reverse
17 auction within each permanence tier.

18 “(B) INCREASED CAP.—In the case of an
19 eligible entity that uses a technology that has
20 the potential to eventually remove carbon diox-
21 ide at an all-in cost of less than \$100 per net
22 ton carbon dioxide equivalent, the Secretary
23 shall double the maximum price per net ton
24 carbon dioxide equivalent established under

1 subparagraph (A)(ii) with respect to the eligible
2 entity.

3 “(5) REQUIREMENT.—In purchasing removed
4 carbon dioxide under the program under paragraph
5 (1), the Secretary shall determine that the carbon
6 dioxide—

7 “(A) is additional;

8 “(B) shall be delivered not later than 5
9 years after the date of the purchase;

10 “(C) shall have a monitoring, reporting,
11 and verification plan approved by the Depart-
12 ment of Energy; and

13 “(D) has not less than a 99 percent likeli-
14 hood of being stored for not fewer than 100
15 years.

16 “(d) USE OF CARBON DIOXIDE.—Carbon dioxide
17 purchased under the pilot program under subsection (c),
18 at the discretion of the Secretary, may be used or stored
19 in any manner that ensures that the carbon dioxide does
20 not reenter the atmosphere or upper hydrosphere during
21 the time period associated with the applicable permanence
22 tier.

23 “(e) PILOT PROGRAM COORDINATION.—Amounts
24 made available under this section may be made available

1 to carry out pilot and demonstration projects described in
2 section 969D(f)(2)(B) and section 969D(g).

3 “(f) CONFIDENTIALITY.—The Secretary shall estab-
4 lish procedures to ensure that any confidential, private,
5 proprietary, or privileged information that is included in
6 a sealed bid submitted under this section is not publicly
7 disclosed or otherwise improperly used.

8 “(g) AUTHORIZATION OF APPROPRIATIONS.—

9 “(1) IN GENERAL.—There are authorized to be
10 appropriated to the Secretary to carry out this sec-
11 tion—

12 “(A) \$20,000,000 for fiscal year 2024;

13 “(B) \$30,000,000 for fiscal year 2025; and

14 “(C) \$60,000,000 for each of fiscal years
15 2026 through 2028.

16 “(2) ALLOCATION.—Amounts made available
17 under paragraph (1) for each fiscal year shall be al-
18 located between the permanence tiers as follows:

19 “(A) 70 percent shall be allocated for the
20 permanence tier described in subsection
21 (c)(3)(B)(ii)(II).

22 “(B) 30 percent shall be allocated for the
23 permanence tier described in subsection
24 (c)(3)(B)(ii)(I).”.

1 (b) CLERICAL AMENDMENT.—The table of contents
2 for the Energy Policy Act of 2005 (Public Law 109–59;
3 119 Stat. 600; 134 Stat. 2550) is amended by adding at
4 the end of the items relating to subtitle F of title IX the
5 following:

“Sec. 969E. Carbon removal purchasing pilot program.”.

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