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The Hydrogen Provisions of the Bi-Partisan Infrastructure Plan

*By Peter J. Connors**

In this article, the author discusses the key hydrogen-related provisions of the Infrastructure Investment and Jobs Act, including its definition of clean hydrogen.

Despite its known value as an alternative energy source, the United States has lacked a comprehensive national policy with respect to hydrogen. At the same time, hydrogen developers lack the tax incentives afforded to renewable energy such as biomass, wind, and solar. The infrastructure bill, formally, “The Infrastructure Investment and Jobs Act” (the “Bill”), addresses this, as it contains a number of provisions that will aid in the advancement of hydrogen as an alternative energy source. The Bill authorizes \$9.5 billion in appropriations for the development of hydrogen as a source of clean energy. These provisions are contained in Sections 40311 to 40318 of the Bill. The Bill authorizes \$9.5 billion in appropriations for the development of hydrogen as a source of clean energy, including \$8 billion for the establishment of at least four regional hydrogen hubs.

The Bill amends or adds to the existing provisions of the Energy Policy Act of 2005 (the “Energy Policy Act”). Section 40311 describes findings of Congress. Section 40312 contains definitions; Section 40313 establishes the Clean Hydrogen Research and Development Program; Section 40314 contains the heart of the legislation adding five new sections to the Energy Policy Act, including one devoted exclusively to electrolysis; and, finally, Section 40315 establishes the criteria for clean hydrogen production qualification.

While the Bill contains no tax incentives, other proposed legislation that will likely be incorporated in the reconciliation bill taken up in tandem in the House of Representatives contain numerous hydrogen-related tax incentives. One of the key features of the Bill is its definition of clean hydrogen.

SECTIONS 40311 AND 40312—CONGRESS’ FINDINGS; DEFINITIONS AND THE COLORS OF HYDROGEN

This section of the Bill states that Congress finds that:

- Hydrogen plays a critical part in the comprehensive energy portfolio of the United States;

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- The use of hydrogen resources of the United States promotes energy security and resilience and provides economic value and environmental benefits for diverse applications across multiple sectors of the economy; and
- Hydrogen can be produced from a variety of domestically available clean energy sources, including fossil fuels with carbon capture, utilization, and sequestration; hydrogen-carrier fuels (including ethanol and methanol); renewable energy resources, including biomass; nuclear power; and other methods determined by the Secretary of the Energy to be appropriate.

Section 803 of the Energy Policy Act is amended to add a definition of clean hydrogen and hydrogen. “Clean hydrogen” and “hydrogen” mean hydrogen produced in compliance with the greenhouse gas emissions standard established under Section 822(a) of the Energy Policy Act (as described below in “Clean Hydrogen Product Qualifications”), produced from any fuel source. Under that section, clean hydrogen is defined as hydrogen produced with a carbon intensity equal to or less than two kilograms of carbon-dioxide equivalent per kilogram of hydrogen produced. This seems to mean that only on-site (production related) emissions are included. One could argue that upstream emissions should also be included. The adoption of a quantitative measure is helpful.

The definition of clean hydrogen is consistent with what is generally thought to be both blue and green hydrogen. However, hydrogen produced with steam methane reformation, even with carbon capture and sequestration, may not always be clean hydrogen. The difference in results may turn on whether all the carbon dioxide is captured and sequestered or whether only a high percentage is. In this regard, the Biden administration’s proposal, which includes very generous tax credits for the production of low-carbon hydrogen states, “low-carbon hydrogen” refers to hydrogen produced using zero-carbon emissions electricity (renewables or nuclear) and water as a feedstock, or hydrogen produced using natural gas as a feedstock and with all carbon emitted in the production process captured and sequestered.¹

Steam methane reformation without carbon capture and storage (“CCS”) produces 9.3 kg CO₂/kg H₂ at the site from steam methane reforming without

¹ General Explanations of the Administration’s Fiscal Year 2022 Revenue Proposals, at page 49, available at <https://home.treasury.gov/system/files/131/General-Explanations-FY2022.pdf>.

CCS.² To reduce the carbon dioxide content so as to get it to the two-kilogram figure, approximately 78 percent of the carbon dioxide must be captured.³

The Colors of Hydrogen

People who discuss hydrogen as a renewable energy source, often color code the hydrogen, to show how my CO₂ is produced. Grey hydrogen is hydrogen from fossil fuels; blue hydrogen is hydrogen produced from natural gas, but carbon capture, utilization, and storage (“CCUS”) is used to remove substantially all the CO₂. Green hydrogen is hydrogen produced from electrolysis that in turn is powered with renewable energy. However, there is no formal designation of any of these terms.

As noted earlier, the Bill takes a quantitative approach to analyzing what is clean hydrogen. Using the colors of hydrogen would engender uncertainty.

SECTION 40313—ESTABLISHMENT OF THE CLEAN HYDROGEN RESEARCH AND DEVELOPMENT PROGRAM

This section establishes the Clean Hydrogen Research and Development Program. This is accomplished through an amendment to Section 805 of the Energy Policy Act. The goals of the program are to advance research and development and commercialize the use of clean hydrogen in the transportation, utility, industrial, commercial, and residential sectors, and to demonstrate a standard of clean hydrogen production in the transportation, utility, industrial, commercial, and residential sectors by 2040. Not later than 180 days after the enactment of the Bill, the Secretary of Energy is required to establish targets for the program to address near-term, mid-term, and long-term challenges to the advancement of clean hydrogen systems and technologies.

The section then details 12 sets of activities that the Secretary of Energy, in partnership with the private sector, is required to advance and support. These activities are as follows:

- (1) The establishment of a series of technology cost goals oriented toward achieving the standard of clean hydrogen production developed under Section 822 (as described below in “Clean Hydrogen Production Qualifications”);
- (2) The production of clean hydrogen from diverse energy sources, including fossil fuels with carbon capture, utilization, and sequestration; hydrogen-carrier fuels (including ethanol and methanol); re-

² See the H2A model at <https://www.nrel.gov/hydrogen/assets/docs/future-central-natural-gas-without-co2-sequestration-v3-2018.xlsm>.

³ $(9.3-2)/9.3*100\%=78\%$.

- newable energy resources, including biomass; nuclear energy; and any other methods the Secretary of Energy determines to be appropriate;
- (3) The use of clean hydrogen for commercial, industrial, and residential electric power generation;
 - (4) The use of clean hydrogen in the industrial applications, including steelmaking cement, chemical feedstocks, and process heat;
 - (5) The use of clean hydrogen for use as a fuel source for other residential and commercial comfort heating and hot water requirements;
 - (6) The sale and efficient delivery of hydrogen or hydrogen-carrier fuels;
 - (7) Advanced vehicle, locomotive, maritime vessel, or plane technologies;
 - (8) Storage of hydrogen or hydrogen-carrier fuels, including the development of materials for safe economic storage in gaseous, liquid, or solid form;
 - (9) The development of safe, durable, affordable, and efficient fuel cells, including fuel-flexible fuel cell power systems, improved manufacturing process, high-temperature membranes, cost-effective fuel process for natural gas, fuel cell stack and system reliability, low-temperature operation, and cost-start capability;
 - (10) The ability of domestic clean hydrogen equipment manufacturers to manufacture commercially available competitive technologies in the United States;
 - (11) The use of clean hydrogen in the transportation sectors, including in light-, medium-, and heavy-duty vehicles, rail transport, aviation, and maritime applications; and
 - (12) In coordination with relevant agencies, the development of appropriate uniform codes and standards for the sale and consistent deployment and commercialization of clean hydrogen production, processing, delivery, and end-use technologies.

SECTION 40314—ADDITIONAL CLEAN HYDROGEN PROGRAMS

Section 40314 adds five important provisions to the Energy Policy Act. These take the form of amendments to the Energy Policy Act.

Regional Hydrogen Hubs

Section 813 of the Energy Policy Act is amended. As amended, it provides for the creation of regional hydrogen hubs. This section requires the development of at least four regional clean hydrogen hubs that:

- Demonstrably aid the achievement of the clean hydrogen production standard;
- Demonstrate the production, processing, delivery, storage, and end-use of clean hydrogen; and
- Can be developed into a national clean hydrogen network to facilitate a clear hydrogen economy.

The Bill authorizes the appropriation of \$8,000,0000 for fiscal years 2022 through 2026; the Secretary of Energy may provide grants to each of the regional hydrogen hubs selected.

A National Energy Strategy for Hydrogen

Section 814 of the Energy Policy Act is amended. As amended, it requires the Secretary of Energy to develop a technological and economical national energy strategy and roadmap to facilitate widescale production, processing, delivery, storage, and use of clean hydrogen. Not later than 180 days after the date of enactment of the Bill, the Secretary of Energy is required to submit to Congress the clean hydrogen strategy and roadmap. The Secretary is required to submit updates to the clean hydrogen strategy and roadmap not less frequently than once every three years after the date of the initial submission of the report and roadmap.

Grants for Research and Development

Section 815 is amended. As amended, it provides the Secretary is required to award multiyear grants to, and enter into contracts, cooperative agreements, or any other agreements for research, development, and demonstration projects to advance new clean hydrogen production, processing, delivery, storage and the of-use equipment manufacturing technology and techniques. The Bill authorizes \$500,000,000 to be appropriated for fiscal years 2022 through 2026.

The Clean Energy Electrolysis Program

Section 816 is also amended. It establishes the “Clean Hydrogen Electrolysis Program.” Hydrogen produced through electrolysis using renewable electricity is an important source of clean hydrogen and its role is likely to increase as technological advancements are made.

Not later than 90 days after the date of enactment of the Bill, the Secretary of Energy is required to establish a research, development, demonstration, commercialization, and deployment program for purposes of commercialization to improve the efficiency, increase the durability, and reduce the cost of producing clean hydrogen using electrolyzers.

In carrying out the program, the Secretary of Energy shall award grants, on a competitive basis, to eligible entities for projects that the Secretary determines

would provide the greatest progress toward achieving the goals of the program. The goals of the program are to reduce the cost of hydrogen produced using electrolyzers to less than \$2 per kilogram of hydrogen by 2026, and any other goals the Secretary of Energy determines are appropriate. The Bill authorizes \$1 billion to be appropriated to carry out the program.

In carrying out the program, the Secretary of Energy shall fund demonstration projects to demonstrate technologies that produce clean hydrogen using electrolyzers, and to validate information on the cost, efficiency, durability, and feasibility of commercial deployment of the foregoing technologies. The program shall focus on:

- Low-cost electrolyzers;
- High-temperature electrolyzers;
- Advanced reversible fuel cells;
- New highly active, selective, and durable electrolyzer catalysts and electro-catalysts;
- Modular electrolyzers;
- Low-cost membranes or electrolytes and separation materials that are durable in the presence of impurities or seawater;
- Improved component design and material integration;
- Clean hydrogen storage technologies;
- Technologies that integrate hydrogen production, clean hydrogen compression, and drying technologies; clean hydrogen storage and transportation; or stationary systems; and
- Integrated systems that combine hydrogen production with renewable power or nuclear power generation technologies.

Coordination of the National Laboratories

As amended, Section 817 establishes a mechanism for the coordination of the work of the Office of Sciences laboratories that are part of National Laboratory system. These laboratories include the National Energy Technology Laboratory, commonly known as NETL, the Idaho National Laboratory, commonly known as INL, and the National Renewable Energy Laboratory, commonly known as NREL. Under this section, the NETL is required to coordinate with the aforementioned laboratories, institutions of higher education, research institutes, industrial researchers and international researchers and shall serve as a clearinghouse to collect information from, and distribute information to, the National Laboratories and other research organizations described above.

While the coordination requirement specifically refers to NETL, INL and NREL, other National Laboratories are also involved in hydrogen research. For example, Sandia National Laboratory and the Pacific Northwest National Laboratory are well-known for their research involving hydrogen. Presumably, these other laboratories are covered by the “research institute” category.

SECTION 40315—CLEAN HYDROGEN PRODUCTION QUALIFICATIONS

The Energy Policy Act is amended by adding a new section, Section 822, “Clean Hydrogen Production Qualifications.” Under this provision, clean hydrogen is defined as hydrogen produced with a carbon dioxide intensity equal or less than two kilogram per kilogram of hydrogen produced.

This provision requires that, not later than 180 days after the enactment of the Bill, the Secretary of Energy, in consultation with the Administrator of the EPA and after taking into account input from industry and other stakeholders, as determined by the Secretary, shall develop an initial standard for the carbon intensity of clean hydrogen production. The standard developed is required to support clean hydrogen production from each source identified in Section 805(e)(2) of the Energy Policy Act (fossil fuels with carbon capture, utilization, and sequestration; hydrogen-carrier fuels (including ethanol and methanol); renewable energy resources, including biomass; nuclear energy; and any other methods the Secretary of Energy determines to be appropriate) and take into consideration technological and economic feasibility.

No later than five years after the date under which the standard is developed, the Secretary, in consultation with the Administrator of the Environmental Protection Agency, is required to determine whether the definition of clean hydrogen should be adjusted and, if so, the Secretary shall carry out the adjustment.

CONCLUSION

The Bill makes a much-needed advancement in the development of a national hydrogen strategy. The reconciliation bill will add much needed tax incentives.