
**SENATE COMMITTEE ON ENERGY, UTILITIES AND
COMMUNICATIONS**
Senator Ben Hueso, Chair
2019 - 2020 Regular

Bill No: SB 662 **Hearing Date:** 4/10/2019
Author: Archuleta
Version: 2/22/2019 As Introduced
Urgency: No **Fiscal:** Yes
Consultant: Sarah Smith

SUBJECT: Green electrolytic hydrogen

DIGEST: This bill requires the California Public Utilities Commission (CPUC) to approve or amend investor-owned utility (IOU) applications for ratepayer-funded investments in green electrolytic hydrogen produce and infrastructure, and it incorporates green electrolytic hydrogen into various definitions of transportation electrification related to state agency duties to address greenhouse gas (GHG) emissions reduction goals.

ANALYSIS:

Existing law:

- 1) Defines transportation electrification as the use of electricity from external sources of electrical power, including the electrical grid, for all or part of vehicles, vessels, trains, boats, or other equipment that are mobile sources of air pollution and GHG and associated programs and charging and propulsion infrastructure to support this use of electricity. (Public Utilities Code §237.5)
- 2) Defines “green electrolytic hydrogen” as hydrogen gas produced through electrolysis and does not include hydrogen gas manufactured using steam reforming or any other conversion technology that produces hydrogen from a fossil fuel feedstock. (Public Utilities Code §400.2)
- 3) Requires the California Energy Commission (CEC) and CPUC to consider a number of factors in their duties to support the state’s clean energy and climate goals, including, but not limited to, authorizing the procurement of resources that minimize reliance on system power and fossil fuel resources and, where feasible, cost effective, and consistent with other state policy objectives, increasing energy storage with a variety of technologies, which may include green electrolytic hydrogen. (Public Utilities Code §400)

- 4) Requires the CPUC, CEC and California Air Resources Board (ARB) to consider green electrolytic hydrogen an eligible form of energy storage, and it requires them to consider other potential uses of green electrolytic hydrogen. (Public Utilities Code §400.3)
- 5) Defines the interests of ratepayers as short or long-term direct benefits specific to ratepayers that provide safer, more reliable, or less costly gas or electrical service and also support a number of resources, including increased use of alternative fuels. (Public Utilities Code §740.8)
- 6) Requires the CPUC to direct IOUs to file applications for investments to accelerate transportation electrification, reduce reliance on petroleum, and meet certain climate goals. Allows the CPUC to approve or amend applications for transportation electrification investments. IOUs are also authorized to recover reasonable costs for approved investments from ratepayers if they are consistent with certain requirements. (Public Utilities Code §740.12(b))
- 7) Requires the CPUC to review data related to current and future transportation electrification adoption and charging infrastructure prior to allowing an IOU to collect new program costs from ratepayers. (Public Utilities Code §740.12(c))

This bill:

- 1) Redefines transportation electrification to include green electrolytic hydrogen used as a transportation fuel.
- 2) Requires the CPUC to approve or amend applications for IOU hydrogen refueling infrastructure and green electrolytic hydrogen production as a transportation fuel. This bill authorizes IOUs to recover reasonable costs for approved investments from ratepayers.
- 3) Requires the CPUC and the CEC to consider opportunities to increase grid-responsive production of green electrolytic hydrogen for use in the transportation sector in their duties related to clean energy and climate goals.
- 4) Requires the CPUC, CEC, and ARB to consider green electrolytic hydrogen's use as an alternative transportation fuel. This bill specifies that grid-responsive production of green electrolytic hydrogen using excess or low-cost renewable generation and the use of that hydrogen as a mechanism of energy storage to displace the use of fossil fuels to generate electricity and as a transportation fuel are clean energy and pollution reduction objectives and technologies of this state.

- 5) Includes green electrolytic hydrogen for the transportation sector as a ratepayer interest.
- 6) Requires the CPUC to review data regarding electric transportation refueling infrastructure use prior to authorizing IOU transportation electrification investments.

Background

What is green electrolytic hydrogen? Existing law defines green electrolytic hydrogen as hydrogen gas produced from electrolysis and excludes other methane-based forms of producing hydrogen. Electrolysis uses electricity to split water into hydrogen and oxygen molecules through an electrolyzer. The hydrogen gas extracted from this process can be used to power hydrogen fuel cells, which can be used in a manner similar to batteries. As a result, hydrogen can be used as energy storage and as a fuel for hydrogen fuel cell vehicles. This bill redefines transportation electrification to specifically include green electrolytic hydrogen.

Existing investments in hydrogen development and fueling infrastructure. This bill expands requirements on the CPUC, CEC and ARB to consider green electrolytic hydrogen for use as a transportation fuel. The CEC is already making investments in renewable hydrogen production and fueling through its Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). As of March 1, 2019, ARFVTP has awarded over \$140 million for hydrogen refueling infrastructure, including 66 hydrogen refueling stations and fleets. The CEC has funded two projects related to green electrolytic hydrogen production; however, the CEC does not have any real cost data from these projects yet.

The lack of real cost data related to hydrogen production partly stems from the technology's lack of market readiness. Researchers are still developing mechanisms for lowering the costs and increasing the efficiency of hydrogen production to make costs-per-unit appropriate for ratepayers. While the CEC has funded 66 hydrogen stations using \$140 million, ARFVTP has also funded 9,655 electric charging connectors with approximately \$95 million. Without real cost data, the bill's ratepayer costs and benefits are unclear. This bill could potentially result in significant ratepayer costs while funding relatively few hydrogen fueling options. While this bill requires the CPUC to review transportation electrification fueling utilization data to assess market barriers that would result in stranded costs prior to authorizing ratepayer investments, it is not clear that sufficient data related to hydrogen production facility costs exist to ensure that the CPUC can account for the degree to which production costs would impact ratepayers.

The pros and cons of power-to-gas. In addition to authorizing additional investments in hydrogen refueling, this bill also aims to increase the amount of ratepayer investments in hydrogen fuel production. The process of converting electricity into a gas fuel is known as power-to-gas. Power-to-gas can encompass many different technologies, and green electrolytic hydrogen for transportation is a form of power-to-gas that uses excess renewable energy to power electrolyzers that extract hydrogen gas for fuel. Green electrolytic hydrogen has the capacity to help use excess renewable energy created by the electricity sector to help reduce tailpipe emissions associated with the transportation sector.

Despite these advantages, green electrolytic hydrogen can be associated with efficiency losses and may not provide emissions reduction benefits significantly beyond renewable electric energy. The emissions intensity of fuel from power-to-hydrogen is dependent upon the emissions intensity of the electricity used to perform electrolysis. If an electrolyzer is powered using electricity from the grid, its emissions intensity will only be as low as the emissions associated with the power supplied to the electrical grid at that time. Energy costs for electrolytic hydrogen production are also directly associated with electricity rates. While recent advances have been made to increase the energy efficiency of electrolyzers, studies indicate that most existing electrolyzers operate at approximately 70 percent efficiency. Efficiency losses can also occur in the process of cooling hydrogen molecules for storage and transport.

Associated infrastructure is an important cost consideration. Although solar power may provide low-cost, renewable power for hydrogen electrolysis, hydrogen fuel costs and are also influenced by the cost of infrastructure needed to store and transport hydrogen as a fuel. Since green electrolytic hydrogen systems are still undergoing research, limited information is available regarding real costs associated with hydrogen production, storage, and transportation.

According to research from the National Renewable Energy Laboratory (NREL), hydrogen systems that do not re-sell the hydrogen have higher costs and lower revenue than conventional storage technologies due to lower efficiency and higher capital costs for fuel cells. As a result, it is difficult for systems that solely generate hydrogen fuel for storage and use to economically compete against conventional technologies. Many projections regarding the cost-competitiveness of hydrogen assume that existing natural gas infrastructure can be re-purposed for hydrogen fuel storage and transportation or that hydrogen can be injected into natural gas pipelines alongside natural gas. However, it is not clear that California's existing natural gas infrastructure can safely transport large volumes of hydrogen (either alone or blended into natural gas) without significant upgrades.

Hydrogen can embrittle and crack certain metals, and it can increase the combustibility of gas leaks. While NREL found that using hydrogen blended natural gas under well-regulated circumstances should not increase the risk of explosions, the same study also noted that injecting up to 25 percent into natural gas increases explosion risks in confined areas and raises the probability of fires. Mitigating these risks would likely require additional investments in upgrading natural gas infrastructure to facilitate hydrogen transportation. These costs should also be considered when evaluating the cost-effectiveness of proposed ratepayer-funded green electrolytic hydrogen production facilities.

Are special considerations necessary? This bill adds green electrolytic hydrogen as a technology that must be specifically considered in various statutes related to meeting California climate goals. However, it is not clear that adding this specificity for the technology is needed. Prior legislation (SB 1369, Skinner, Chapter 567, Statutes of 2018) required the CPUC, ARB, and CEC to consider green electrolytic hydrogen as an eligible form of energy storage. The bill also required these entities to consider other potential uses of green electrolytic hydrogen. The use of green electrolytic hydrogen production and refueling for transportation is a potential use of the technology that these agencies may already be considering under existing law. The CEC is already considering these other uses in various funding opportunities.

Need for amendments. As currently drafted, this bill requires the CPUC to approve or amend an IOU's application to invest in green electrolytic hydrogen production and fueling infrastructure. At this time, insufficient information exists on the real costs associated with rate-basing green electrolytic hydrogen generation and associated infrastructure. While these costs may be just and reasonable under certain circumstances, other proposals may not be cost effective for ratepayers. The CEC is already funding hydrogen refueling infrastructure for transportation purposes. Allowing the CPUC to authorize ratepayer funding for hydrogen refueling infrastructure could lead to duplicative investments in fueling infrastructure that may not be cost-effective. *To ensure that the CPUC has sufficient information on which it can base cost effectiveness determinations for ratepayer investments, the author and the committee may wish to consider amending this bill to clarify that the CPUC has the authority to ensure that proposed investments in green electrolytic hydrogen are cost-effective for ratepayers, help meet California's climate goals and do not duplicate investments made by other agencies.*

Double referral. Should this bill be approved by this committee, it will be re-referred to the Senate Committees on Transportation for their consideration.

Prior/Related Legislation

SB 1369 (Skinner, Chapter 567, Statutes of 2018) required the CPUC, ARB, and CEC to consider green electrolytic hydrogen, as defined, an eligible form of energy storage, and consider other potential uses of green electrolytic hydrogen.

SB 433 (Mendoza, 2017) would have authorized the CPUC to allow a gas corporation to procure zero-carbon hydrogen and recover through rates the reasonable cost of pipeline infrastructure developed to transport the hydrogen to end users. The bill died in the Assembly.

SB 350 (De León, Chapter 547, Statutes of 2015) the Clean Energy and Pollution Reduction Act of 2015, established new clean energy, clean air and GHG reduction goals and established the IRP process through which IOUs file electricity sector procurements, including transportation electrification investments.

FISCAL EFFECT: Appropriation: No Fiscal Com.: Yes Local: Yes

SUPPORT:

Ballard Fuel Cell Systems (Sponsor)
Alaska Applied Sciences, Inc.
California Hydrogen Business Council
Center for Transportation and the Environment
Energy Independence Now
Golden Gate Zero Emission Marine
H2B2 USA LLC
H₂Safe, Inc.
Hitachi Zosen Inova
Hydrogenics USA
ITM Power
Johnson Matthey
Loop Energy Inc.
Millennium Reign Energy LLC
Nel Hydrogen
Nuvera Fuel Cells, LLC
Pacific Gas and Electric Company, if amended
PDC Machines, Inc.
Plug Power
Red and White Fleet
Solar Wind Storage, LLC
Southern California Gas Company, if amended

SunLine Transit Agency
T2M Global
US Hybrid Corp.
Vinjamuri Innovations LLC
Winkelmann Flowform Technology-Fuel Systems

OPPOSITION:

None received

ARGUMENTS IN SUPPORT: According to the Author:

“California has made great strides on moving the transportation sector to zero emission. However, the rest of the journey will require multiple technologies and innovative solutions to funding investment in those technologies. Electrolytic hydrogen is a 100 percent renewable, zero emission fuel and it has advantages that make it the only real solution to a number of settings where we as a state have prioritized moving to zero emission technology, including the heavy-duty sector where high power demands make many applications unsuitable for battery technology utilization. SB 662 will remove barriers to adopting hydrogen technology and help California achieve our emission reduction goals. Additionally, this bill will allow us to stop the counterproductive practice of curtailing solar production as electrolytic hydrogen can be produced using that renewable energy and that production can be concentrated during peak hours, allowing for the proliferation of even more solar energy production, rather than the curtailment of it.”

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