Date of Hearing: June 16, 2021

ASSEMBLY COMMITTEE ON UTILITIES AND ENERGY
Chris Holden, Chair
SB 18 (Skinner) – As Amended June 7, 2021

SENATE VOTE: 38-0

SUBJECT: Hydrogen: green hydrogen: emissions of greenhouse gases

SUMMARY: Requires the California Air Resources Board (CARB) to include a strategic plan for hydrogen as part of the Climate Change Scoping Plan, and requires other state agencies, as specified, to incorporate hydrogen into various planning and procurement considerations. Specifically, **this bill**:

1) Requires CARB, by December 31, 2022, to include as part of the Climate Change Scoping Plan a strategic plan for accelerating hydrogen's production and use, and an analysis, prepared in consultation with the California Independent System Operator (CAISO), of how curtailed power could be used for green hydrogen production. The strategic plan must include the following:
    a. A specific plan to accelerate production and use of green hydrogen, as an element of the overall plan for hydrogen.
    b. An assessment of difficult to decarbonize sectors of the economy where green hydrogen may be more feasible and cost-effective. This assessment shall include:
        i. An estimate of the amount of greenhouse gases (GHG) emissions reductions and air quality benefits that green hydrogen deployment could provide,
        ii. The costs of using green hydrogen, and
        iii. The associated health and environmental impacts of prioritizing various forms of hydrogen compared to other alternatives.
    c. A review of similar international efforts to deploy hydrogen.
    d. Recommendations to the Legislature for actions to implement the plan, including ways to overcome market barriers of green hydrogen.
    e. A plan for supporting hydrogen infrastructure and end uses in difficult to decarbonize sectors of the economy while supporting the employment of a skilled and trained workforce.
    f. The potential for other forms of hydrogen, outside of green hydrogen, to achieve emission reductions.

2) Defines "decarbonize" and "decarbonizing" as reducing or eliminating associated emissions of GHG.

3) Requires the California Energy Commission (CEC) to study and model, as part of the upcoming 2023 and 2025 integrated energy policy report (IEPR), the potential for hydrogen to decarbonize the electric and transportation sectors and support California's goal to procure 100 percent of its electricity from zero-carbon resources, among other goals. Repeals this IEPR requirement on January 1, 2030.

4) Requires the California Public Utilities Commission (CPUC) to incorporate green electrolytic hydrogen into resource adequacy requirements. Specifies the CPUC may make a finding that hydrogen cannot be considered for RA if sufficient information is absent.

5) Requires the CPUC to consider green electrolytic hydrogen as part of any rulemaking proceeding on energy storage begun after December 31, 2021.

6) Requires the CPUC, CARB, and CEC to consider green electrolytic hydrogen an eligible form of energy storage, and as part of the integrated resource plan (IRP) process and all decarbonization strategies.

7) Makes numerous findings and declarations relating to the promise of green hydrogen for advancing the state's climate and carbon neutrality goals while providing opportunities for a skilled and trained workforce.

EXISTING LAW:

1) 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)

2) Requires CARB to create a Climate Change Scoping Plan to achieve the maximum technologically feasible and cost-effective reductions in GHG emissions by 2020. CARB must update this Scoping Plan at least once every five years. (California Health and Safety Code § 38561)

3) Requires the CEC to adopt the IEPR every two years, which must contain an overview of major energy trends and issues facing the state, including, but not limited to, supply, demand, pricing, reliability, efficiency, and impacts on public health and safety, the economy, resources, and the environment. (Public Resources Code § 25302)

4) Requires the CPUC to work with CAISO to establish resource adequacy requirements for load serving entities (LSEs), i.e. electric corporations, community choice aggregators, and electric cooperatives. Existing law specifies the criteria the CPUC must consider when establishing resource adequacy requirements and specifies that an electrical corporation's reasonable costs for meeting resource adequacy requirements are recoverable from customers through non-bypassable charges. (Public Utilities Code § 380)

5) Requires the CPUC, CEC, and CARB to consider green electrolytic hydrogen an eligible form of energy storage and consider its potential uses. (Public Utilities Code § 400.3)

6) Establishes the IRP process for LSEs to file plans with the CPUC detailing the resources that the LSE will use to meet the state's climate goals while ensuring reliability at just and reasonable rates. (Public Utilities Code § 454.52)

7) Establishes a state goal of procuring 100 percent of electricity from eligible renewable energy resources and zero-carbon resources by December 31, 2045. (Public Utilities Code § 454.53)

FISCAL EFFECT: According to the Senate Committee on Appropriations, upfront and ongoing costs in the millions of dollars are estimated for CARB to prepare the green hydrogen strategic plan, and in the hundreds of thousands of dollars for the CPUC to incorporate green electrolytic hydrogen into its various proceedings.

BACKGROUND:

The Hydrogen Color Wheel – Current conversations around hydrogen (H_2) often confuse the various types of hydrogen production, mistakenly treating all hydrogen equally. The type of feedstock (what material is used to make the H_2) and the production method (what is done to break apart the feedstock into H_2) determines the type of hydrogen produced.

Some notable feedstocks of hydrogen include biomass, biomass-derived liquids like ethanol and bio-oil, biogas, coal, natural gas, and water. These feedstocks are then broken down through thermochemical processes to generate H_2. The thermochemical processes vary and can generate different amounts and types of particulate pollution and GHGs. In every process, energy is needed in order to generate H_2. Some processes rely on clean resources exclusively for their power, while others are less discriminating.

The various combinations of feedstocks and processes result in a multitude of hydrogen products. A simplified color spectrum has been adopted to describe these hydrogen products; however, the definitions of these colors are neither universally agreed upon nor rigorous.

- "Gray (or brown) hydrogen" is produced from a natural gas feedstock and whatever energy is cheapest, via natural gas steam methane reforming. The vast majority of H_2 currently used in the United States comes from this process. While cheap and efficient, it generates carbon dioxide and other pollutants, depending on the energy source used.
- "Blue hydrogen" employs the same process as gray hydrogen, but the carbon dioxide emitted from steam methane reforming is captured and stored, lessening the GHG impact of this process.
- "Turquoise hydrogen" uses a natural gas feedstock, which is passed through molten metal to split the natural gas into H_2 and solid carbon.
- "Green hydrogen" is produced using only renewable feedstock – such as biomass, renewable natural gas, or water – and typically (but not always) relies on renewable electricity to generate the hydrogen.
- "Green electrolytic hydrogen" is a specific type of green hydrogen which uses water as the feedstock and renewable electricity to split the water in order to generate H_2. Green electrolytic hydrogen is currently the only type of hydrogen defined in the Public Utilities Code (Public Utilities Code § 400.2). However, its statutory definition does not specify that renewable electricity must be used to split the water, meaning it need not be fully "green" in the traditional sense.
- "Pink hydrogen" refers to a specific type of green electrolytic hydrogen where only nuclear energy is used to split the water.
- "Yellow hydrogen" refers to a specific type of green electrolytic hydrogen where only solar energy is used to split the water.

As the Hydrogen Color Wheel indicates, any conversation about H_2 is heavily dependent upon the color and precise definition of that color being discussed. With so many colors with fairly loose definitions being considered, it is easy to misunderstand.

What Do We Do With All the H_2? Hydrogen has the potential to be used in a multitude of applications – from fuel cells in cars; to replacing natural gas in homes; to fuel replacement in aviation, shipping, and trucking industries; and to generate electricity. One, much discussed, potential application of H_2 is to firm our renewable energy grid. By using low-cost, abundant electricity from intermittent renewables during the day (i.e. solar and wind) to produce H_2, and then using that H_2 in fuel cells or injecting into a pipeline to provide power at other times, hydrogen can act as a form of storage. However, in practice, many of the technologies used to produce H_2 from renewables are still expensive and unable to economically cycle on and off in line with the availability of intermittent renewables. This example in the energy sector is characteristic of many other hydrogen applications – where the GHG footprint, cost, and availability of the hydrogen are uncertain or unclear – calling for a more thorough understanding of which hydrogen product is best suited to which application.

Moreover, certain uses for hydrogen will strongly depend on reliable methods for safely storing and transporting it in large quantities. It is not as simple as injecting hydrogen directly into the natural gas pipeline. Hydrogen can embrittle and crack gas pipeline materials.[1] As the percentage of hydrogen in the pipeline increases, the operating pressure of the pipeline may need adjustment,[2] potentially compromising older pipelines in the state. The CPUC currently has a $1.5 million contract with the University of California Riverside and the Gas Technology Institute to conduct experimental work on the safety and efficacy of injecting hydrogen into California's pipeline.[3]

COMMENTS:

1) *Author's Statement.* "The most basic element in the universe – hydrogen – may be poised to help California and the world move to a cleaner economy while protecting well-paying jobs for our workers. Green Hydrogen – which can be created through multiple clean pathways including splitting water using excess renewable electricity from solar and wind, steam reformation of biogas, and gasification of biomass – can be a game changer to decarbonize some of California's most difficult to decarbonize sectors: transportation, long haul trucking, ocean shipping, even air travel. It can also store renewable energy for later use, and power industry or the electrical grid. All while preserving well-paying jobs in traditional industries. Many countries around the world are accelerating their green hydrogen production capabilities with the explicit goal of becoming a major global exporter. California has an opportunity to also develop a global leadership position in green hydrogen.

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[1] Hafsi, Z., Mishra, M., and Elaoud, S., "Hydrogen embrittlement of steel pipelines during transients," *Procedia Structural Integrity,* Vol. 13, 2018, pg. 210-217.
[2] Penev, M., Zuboy, J., and Hunter, C.,"Economic analysis of a high-pressure urban pipeline concept (HyLine) for delivering hydrogen to retail fueling stations," *Transportation Research Part D: Transport and Environment,* Volume 77, 2019, pg. 92-105.
[3] UC Riverside Center for Environmental Research and Technology, "Hydrogen Impacts Study;" April 2020-September 2021. https://www.cert.ucr.edu/hydrogen-impacts-study

SB 18 advances green hydrogen by requiring the CA Air Resources Board (CARB) and other state agencies to start planning so our state can take full advantage of the decarbonization and job creation benefits associated with multi-sectoral green hydrogen production and use at scale."

2) *What's in a name – Hydrogen, Green Hydrogen, and Green Electrolytic Hydrogen?* Hydrogen is the through line in this bill, with every section including hydrogen in some form. However, the bill incorporates different "colors" of hydrogen throughout. The bill requires CARB to include a strategic plan for hydrogen (all colors) in the Climate Change Scoping Plan, with a specific plan for green hydrogen (undefined). The bill then requires the CEC to study and model the potential of hydrogen (all colors) as part of their 2023 and 2025 IEPRs. The bill also requires the CPUC to consider green electrolytic hydrogen (renewable in its feedstock, not necessarily in its electricity - per statute) as part of resource adequacy requirements, its IRP process, and part of encouraging a diverse portfolio of resources for future energy storage procurement. The bill further calls on the CPUC, CARB, and the CEC to consider green electrolytic hydrogen an eligible form of energy storage and in all decarbonization strategies.

   As noted above, the many colors of hydrogen represent not only technological possibility, but also the potential to confuse what is actually being discussed, made available, and best suited for each application. The advocates for this bill suggest the comprehensive approach proposed by the CARB strategic plan for hydrogen (all colors) should complement, not slow down, efforts to push green electrolytic hydrogen (renewable in its feedstock, not necessarily in its electricity - per statute) advancement in the electric sector. While previous legislation[4] called upon the energy agencies to consider green electrolytic hydrogen as a procurement resource and an eligible form of energy storage, it feels premature to advance green electrolytic hydrogen in the electric sector while a more comprehensive strategy to understand hydrogen's best use across all sectors of the economy is being contemplated.

3) *Plan First, Implement After.* Given the potential economy-wide applications of hydrogen, the various forms of hydrogen that may be generated from different feedstocks and processes, and the various prices and availabilities of these different types of hydrogen, it seems reasonable that a comprehensive approach to planning for hydrogen (all colors) across sectors is warranted. This bill seeks to achieve this by directing CARB to develop a strategic plan for hydrogen by December 31, 2022. Such a plan will presumably aid in identifying which types of hydrogen are best suited to which sectors, while maximizing environmental, economic, and reliability benefits.

   The main thrust of calling upon CARB to conduct such a strategic plan is that many uncertainties remain within the hydrogen market. The state should not commit to fully integrating hydrogen into its emission reduction and clean energy goals until a thorough understanding of suitability, availability, and costs are conducted for the various hydrogen types, and definitions of those various types of hydrogen are clearly articulated.

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[4] SB 1369 (Skinner, Chapter 567, Statutes of 2018)

Given that many hydrogen technologies are in their infancy, their emissions profiles are unknown, and their scalability and reliability remain uncertain, the committee may wish to remove the provisions of this bill that include green electrolytic hydrogen exclusively in the resource adequacy process, future energy storage procurement, and the IRP. Rather, these electric sector activities would benefit from the insight gained after incorporating hydrogen broadly into the economy-wide planning of CARB's Scoping Plan and the broad, electric-system planning of the CEC's IEPR.

4) *Related Legislation.*

SB 662 (Archuleta, 2021) requires the CPUC, in collaboration with CARB and the CEC, to initiate a proceeding to authorize gas corporations to file applications for investments in programs to accelerate zero-emission vehicle transportation, including battery and hydrogen fuel cell vehicles. Status: Held – Senate Committee on Appropriations.

SB 697 (Hueso, 2021) requires CARB to consider developing and implementing a Green Hydrogen Credit Program and determine whether or not such a program would be effective in incentivizing green hydrogen production. Status: Held – Senate Committee on Appropriations.

5) *Prior Legislation.*

SB 1122 (Skinner, 2020) would have required CARB to incorporate planning and recommendations for green electrolytic hydrogen into the Scoping Plan. The bill contained provisions substantially similar to those contained in this bill. Status: Died – Senate Energy, Utilities, and Communications Committee.

SB 662 (Archuleta, 2019) would have set targets for in-state production of renewable hydrogen for transportation and required the CPUC to allow gas utilities to file applications for investments to accelerate transportation electrification, including hydrogen and hydrogen-related pipelines. Status: Died – Assembly Utilities and Energy Committee.

SB 1369 (Skinner) established a definition of green electrolytic hydrogen, required the CEC and CPUC to incorporate green electrolytic hydrogen as a resource that may be considered for procurement to reach state clean energy goals, and required the CPUC, CEC, and CARB to consider green electrolytic hydrogen an eligible form of energy storage. Status: Chapter 567, Statutes of 2018.

SB 100 (De León) established a goal of procuring 100 percent of the state's electricity from zero-carbon resources by December 31, 2045. Status: Chapter 312, Statutes of 2018.

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. Status: Died – Assembly Utilities and Energy Committee.

REGISTERED SUPPORT / OPPOSITION:

Support

Alameda County Transportation Commission
Alameda-Contra Costa Transit District (AC Transit)
Aquahydrex
California Energy Storage Alliance
California Hydrogen Business Council
California Hydrogen Coalition
Center for Transportation and the Environment
Coalition for Renewable Natural Gas
Green Hydrogen Coalition
Independent Energy Producers Association
Marin Clean Energy (MCE)
Pacific Environment
Sempra Energy Utilities
State Building and Construction Trades Council of CA
Utility Workers Union of America, Local 132
Utility Workers Union of America, Local 483
Utility Workers Union of America, Local 522

Support If Amended

Bioenergy Association of California
Natural Resources Defense Council (NRDC)

Oppose Unless Amended

350 Humboldt: Grass Roots Climate Action

Other

The Utility Reform Network (TURN)

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