Date of Hearing: June 20, 2018

ASSEMBLY COMMITTEE ON UTILITIES AND ENERGY
Chris Holden, Chair
SB 1369 (Skinner) – As Amended June 13, 2018

SENATE VOTE: 28-10

SUBJECT: Energy: electrolytic hydrogen

SUMMARY: Requires the California Energy Commission (CEC) to conduct up to three pilot projects utilizing green electrolytic hydrogen and requires the use of the gas to be considered in integrated resource plans (IRPs). Specifically, **this bill:**

1) Defines green electrolytic hydrogen to mean hydrogen gas produced through electrolysis and does not include hydrogen gas manufactured using steam reforming or some other conversion technology that produces hydrogen from a fossil fuel feedstock.

2) Requires the CEC to deploy up to three pilot projects by January 1, 2021 to produce green electrolytic hydrogen that use no more than five megawatts and that does at least one of the following:

    a. Reduce greenhouse gas emissions; or

    b. Use electricity from zero-carbon electricity resources; or

    c. Use electricity for management of the grid to facilitate integration of renewable and zero-carbon.

3) Requires that the pilot projects:

    a. Use no more than five megawatts unless the CEC determines higher usage is appropriate;

    b. Be geographically diverse;

    c. Be distributed among various electric and gas corporations, community choice aggregators and energy service providers (LSEs or load serving entities);

    d. Facilitate reduction in GHG emissions and criteria air pollutants;

    e. Produce electrical system benefits and reduce fossil fuel derived natural gas use; and

    f. Be funded by moneys dedicated to research and development.

4) Requires the California Public Utilities Commission (CPUC), the CEC and the Air Resources Board (CARB), to consider the use of green electrolytic hydrogen when evaluating an IRP submitted by an LSE or a local publicly owned utility (POU) including procurement for storage and to displace fossil fuels.

5) Requires the CPUC, CEC and CARB to adopt policies and incentives to increase the deployment of green electrolytic hydrogen projects.

EXISTING LAW:

1) Requires the CEC to develop and implement the Electric Program Investment Charge (EPIC) program to overcome the barriers that prevent the achievement of the state's statutory energy goals. (Public Resources Code § 25710 et seq.)

2) Requires the Office of Environmental Health Hazard Assessment (OEHHA) to compile a list of constituents of concern that could pose risks to human health and that are found in biogas, at concentrations that significantly exceed the concentrations of those constituents in natural gas. (Health and Safety Code § 25421 [a])

3) Requires the CPUC to adopt standards for biomethane that specify the concentrations of constituents of concerns that are reasonably necessary to protect public health, ensure pipeline integrity and safety, and to adopt monitoring, testing, reporting and recordkeeping protocols. (Health and Safety Code § 25421 [c])

4) Requires the CPUC to adopt pipeline access rules that ensure that each gas corporation provides nondiscriminatory access to the gas pipeline system to any party for the purposes of physically interconnecting with the gas pipeline system and effectuating the delivery of gas. (Public Utilities Code § 784)

5) Requires the CPUC to adopt a process for each LSE to file an integrated resource plan (IRP) to ensure that LSEs meet the GHG emission reduction targets established by the CARB for the electricity sector, procure at least 50 percent eligible renewable energy resources by December 31, 2030, minimize impacts on ratepayers' bills, and meet other requirements. (Public Utilities Code § 454.52)

6) Requires that the governing board of a POU with an annual electrical demand exceeding 700 gigawatt hours adopt an IRP to ensure the utility achieves specified objectives and file that IRP with the CEC which provides recommendations to correct deficiencies, if any. (Public Utilities Code §§ 9621, 9622)

FISCAL EFFECT: According to the Senate Appropriations Committee:

- The CPUC indicates that it would incur costs of $445,000 (ratepayer funds) to support one new permanent position to (1) incorporate hydrogen gas potential into the integrated resource plan process, (2) coordinate with the CEC on pilot projects, and (3) update natural gas quality rules to incorporate hydrogen gas safely into the existing infrastructure. Of this amount, $250,000 would be one-time for a contract for a study

assessing hydrogen gas potential for electrification, pipeline injection, storage and low carbon fuel, and safety issues.

- The CEC indicates this bill would result in costs of $150,000 (special fund) to support 1.0 position to develop the solicitation for projects. Additionally, this bill would result in the use of up to $9 million to $15 million in Electric Program Investment Charge (EPIC) program funds for three projects. Absent this bill, such projects could receive EPIC funding through the existing program, or those funds could be allocated to other types of projects.

- The CARB indicates that its costs resulting from the bill would be minor and absorbable.

BACKGROUND:

Electrolytic Hydrogen Gas – According to the U.S. Department of Energy (DOE) hydrogen can be produced by splitting oxygen and hydrogen from water with the help of electricity. Water is not a good conductor of electricity so something like salt can be added to facilitate the process but does have adverse environmental impacts. A membrane can also be used. The DOE further reports that:

> Hydrogen produced via electrolysis can result in zero greenhouse gas emissions, *depending on the source of the electricity used.* The source of the required electricity – including its cost and efficiency, as well as emissions resulting from electricity generation – must be considered when evaluating the benefits and economic viability of hydrogen production via electrolysis. In many regions of the country, today's power grid is not ideal for providing the electricity required for electrolysis because of the greenhouse gases released and the amount of fuel required due to the low efficiency of the electricity generation process. Hydrogen production via electrolysis is being pursued for renewable (wind) and nuclear energy options. These pathways result in virtually zero greenhouse gas and criteria pollutant emissions.

CEC's 2017 Integrated Energy Policy Report (IEPR) – Considered hydrogen production from electrolysis of water as an opportunity to use excess energy. The CEC reported that:

> …a pathway for preserving the value of excess renewable electricity is to use it in the electrolysis of water. This involves the use of electricity to split water molecules into hydrogen and oxygen gases. The hydrogen can be stored more cheaply than electricity in a battery and can be used on demand in fuel cells. These fuel cells convert the hydrogen back into electricity, whether for stationary applications or for the powering of fuel cell electric vehicles.
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> Alternatively, the hydrogen produced from excess renewable electricity can be combined with waste or captured CO2 to create renewable methane for the direct displacement of fossil fuel natural gas. This renewable hydrogen or methane can be stored in tanks, used in fuel cell electric vehicles, or directly injected into natural gas or dedicated hydrogen pipelines. This strategy of transferring electrical energy into gaseous chemical energy for

> energy storage or other useful purposes is termed power-to-gas. Power-to-gas systems can provide long-term energy storage and be deployed in scales similar to pumped hydropower and compressed air, but are modular and flexible in siting. Compared to electric battery storage, while battery costs go up in proportion to the quantity of energy stored, power-to-gas costs are nearly independent of the quantity of energy stored when the existing gas grid is used as the storage medium. The University of California, Irvine, in partnership with SoCalGas, is demonstrating power-to-gas technology on the campus microgrid. Preliminary results of the demonstration using 0.24–0.78 percent of pipeline hydrogen have shown that power-to-gas technology can increase the use of intermittent renewable energy. The portion of renewable energy used in the campus microgrid could increase from 3.5 percent to 35 percent by implementing a power-to-gas strategy.
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> Energy + Environmental Economics (E3) performed a preliminary cost-effectiveness analysis of various strategies for CARB's 2017 Climate Change Scoping Plan Update and for the Energy Commission's scenario analysis of long-term energy strategies through 2050…Commenters [to the IEPR]suggested that power-to-gas and power-to hydrogen could be used in various applications including grid services, such as voltage and frequency regulation, demand response, ramping services, and avoiding curtailment or negative pricing of renewables.

The CEC further reported that the cost of electrolytic hydrogen is an issue. The capital cost of the electrolyzer unit is high and the conversion process is electricity intensive. They note the need for further research to improve energy efficiency for converting electricity to hydrogen and integrating compression into the electrolyzer to avoid the cost of a separate hydrogen compressor needed to increase pressure for hydrogen storage.

Renewables Portfolio Eligibility Guidebook – Developed by the CEC, the RPS Guidebook provides that:

> A facility converting hydrogen gas to electricity in a fuel cell may qualify for RPS certification if the hydrogen was derived from a non-fossil-based fuel or feedstock through a process powered using an eligible renewable energy resource. The electricity generated by a facility using this type of hydrogen gas is eligible for the RPS only if the electricity that was used to derive the hydrogen is not also counted toward an RPS compliance obligation or claimed for any other program as renewable generation.

COMMENTS:

1) Author's Statement. Clean energy from solar and wind can be stored by breaking apart water to make hydrogen gas and oxygen. SB 1369 defines this new form of storage – "green electrolytic hydrogen" – and directs the Energy Commission, in consultation with the PUC and Air Resources Board to deploy up to three pilot projects to demonstrate how green electrolytic hydrogen can help integrate renewable energy into the grid across the state, provide clean transportation fuel, and decarbonize the natural gas sector.

2) Pilots Purpose Unclear. A pilot project is usually a small scale preliminary study conducted in order to evaluate feasibility, time, cost, adverse events, and improve upon

the technology prior to implementation of a full-scale project. This bill does not have a clear purpose for the pilot. It specifies that a result, for example, is to reduce greenhouse gas emissions, but the bill lacks guiding principles, objectives, what is to be learned, and when and where the results of the work should be reported.

The CEC has done some research on electrolytic hydrogen the results of which show that the capital cost of the electrolyzer unit is high and the conversion process is electricity intensive. The CEC notes the need for further research to improve energy efficiency for converting electricity to hydrogen and integrating compression into the electrolyzer to avoid the cost of a separate hydrogen compressor needed to increase pressure for hydrogen storage. *The committee may wish to consider amending the bill to provide clarity to the pilots as indicated on the attached draft amendments*.

3) Funding Source Clarification. The bill requires the CEC to use funds dedicated to research. The primary funding source available to the CEC is the Electric Program Investment Charge (EPIC). *The committee may wish to clarify the funding source as reflected in the attached draft amendments.*

4) Use of Gas Revenues. The green electrolytic hydrogen gas appears to have a market value. It's the production of the gas which is costly and methods to reduce the costs of that production are being piloted. Since the gas produced may have a market value, the committee may wish to clarify that proceeds from the sale of any green electrolytic hydrogen be credited to the CEC's source of funds for research. *The committee may wish to clarify that revenues be credited to the EPIC as reflected in the attached draft amendments.*

5) Future Use. The bill calls for the use of green electrolytic hydrogen to be considered by LSEs and POUs when they file their integrated resource plans. The bill also broadly directs the CPUC, CEC, and ARB to adopt policies and incentives to increase the deployment of green electrolytic hydrogen. Is this too soon? Typically when a technology is being piloted, the use and/or benefits and effectiveness of the technology are still being assessed. Should mandated consideration of the product be included in the IRPs before the agencies can consider whether the investment is good for the grid and good for the ratepayers? *The committee may wish to consider delaying IRP consideration until 2021 and waiting to pursue these mandates as reflected in the attached amendments.*

6) Related Legislation. SB 433 (Mendoza) Permits the CPUC to authorize a gas corporation to procure zero-carbon or low-carbon hydrogen. Status: Assembly Utilities & Energy Committee.

REGISTERED SUPPORT / OPPOSITION:

Support

3m Company
Advanced Power And Energy Program

AquaHydrex
California Energy Storage Alliance
California Hydrogen Business Council
Coalition For Clean Air
ITM Power Inc.
Magnum Development
MHPS Americas
Palo Alto Research Center
The Utility Reform Network

Opposition

None on file.

Oppose Unless Amended

California Municipal Utilities Association

Analysis Prepared by: Kellie Smith / U. & E. /

Attachment
Proposed Amendments to SB 1369 (Skinner)

SEC. 2. Chapter 8.5 (commencing with Section 2847) is added to Part 2 of Division 1 of the Public Utilities Code, to read:

CHAPTER 8.5. Green Electrolytic Hydrogen

~~**Article 1.** Definitions~~

~~**2847.** For purposes of this chapter, the following terms have the following meanings:~~

~~(a) "Eligible renewable energy resource" means a source of electrical generation that is an eligible renewable energy resource pursuant to the California Renewables Portfolio Standard Program (Article 16 (commencing with Section 399.11) of Chapter 2.3 of Part 1).~~

~~(b) "Green electrolytic hydrogen" means hydrogen gas produced through electrolysis and does not include hydrogen gas manufactured using steam reforming or some other conversion technology that produces hydrogen from a fossil fuel feedstock. A project to produce "green electrolytic hydrogen" shall do at least one of the following:~~

~~(1) Reduce emissions of greenhouse gases.~~

~~(2) Utilize electricity from zero-carbon electricity resources.~~

~~(3) Utilize electricity generated for management of the electrical grid to facilitate integration of renewable and zero-carbon electricity.~~

~~(c) "Integrated resource plan" means an integrated resource plan filed by a load-serving entity for approval by the commission pursuant to Section 454.52 or an integrated resource plan adopted by a local publicly owned electric utility and filed with the Energy Commission pursuant to Section 9622.~~

~~(d) "ISO" means the Independent System Operator or a successor multistate independent system operator.~~

~~(e) "Load-serving entity" has the same meaning as defined in Section 380.~~

~~(f) "Renewable electricity" means electricity that is generated by an eligible renewable energy resource within the meaning of the California Renewables Portfolio Standard (Article 16 (commencing with Section 399.11) of Chapter 2.3 of Part 1).~~

~~(g) "State board" means the State Air Resources Board.~~

~~(h) "Zero-carbon electricity" means electricity that is generated in a manner that does not produce emissions of greenhouse gases.~~

~~**Article 2.**~~ Green Electrolytic Hydrogen Pilot Program

~~**2848.**~~ Public Resources Code Section XXXXX

(a) Green electrolytic hydrogen" means hydrogen gas produced through electrolysis and does not include hydrogen gas manufactured using steam reforming or some other conversion technology that produces hydrogen from a fossil fuel feedstock, and uses electricity from zero-carbon electricity resources in the its production.

(b) The Energy Commission, in consultation with the Public Utilities Commission and State Air Resources Board, shall develop up to three green electrolytic hydrogen pilot projects by January 1, 2021, to produce green electrolytic hydrogen and to evaluate methods for:

1) Reducing the costs of production of green electrolytic hydrogen; and

2) Reducing the energy intensity associated with the production of green electrolytic hydrogen;

~~(1) Reduce emissions of greenhouse gases.~~

~~(2) Utilize electricity from zero-carbon electricity resources.~~

~~(3) Utilize electricity generated for management of the electrical grid to facilitate integration of renewable and zero-carbon electricity.~~

(b) The pilot projects shall meet the following criteria:

(1) ~~Each shall use no more than~~ Have a capacity no greater than five megawatts, unless the commission determines that higher usage is appropriate;

(2) Utilize electricity from zero-carbon electricity resources;

~~(2) Together, they shall achieve reasonable geographic diversity~~.

(3~~) They shall be~~ Be distributed among various load-serving entities;

~~(4) They shall facilitate~~ (3) Facilitate reductions in emissions of greenhouse gases and criteria air pollutants; and

~~(5) They shall produce~~ (4) Produce electrical system benefits and reduce fossil fuel derived natural gas usage.

(c) The pilot projects shall only be funded from moneys that are dedicated for research and development ~~and shall not be recovered directly from ratepayers, except for moneys that the commission, prior to January 1, 2019, authorized to be recovered for the purpose of research and~~

~~development~~ pursuant to Chapter 8.1 (commencing with Section 25710) of Division 15 of the Public Resources Code.

Article 3. Integrated Resource Planning and Electrification

2849. The commission, the state board, and the Energy Commission shall do both of the following:

(a) Consider existing and potential uses for green electrolytic hydrogen in meeting the statewide greenhouse gas emissions limits approved by the state board when evaluating an integrated resource plan adopted by a load-serving entity or local publicly owned electric utility filed after January 1, ~~2019~~ 2021, including the procurement of green electrolytic hydrogen for energy storage and to displace the use of fossil fuels in the electrical industry.

~~(b) Adopt policies and incentives to increase the deployment of green electrolytic hydrogen projects, as appropriate.~~