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SoCalGas Comments on June 20th Workshop on Integrating Renewable Energy

Additional submitted attachment is included below.

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California Energy Commission
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Subject: Comments in response to the 2018 Integrated Energy Policy Report Update (IEPR Update) Workshop on Renewable Integration and Electric System Flexibility, 18-IEPR-06

Southern California Gas Company (SoCalGas) appreciates the opportunity to comment on the Renewable Integration and Electric System Flexibility workshop conducted by the California Energy Commission (CEC) and held on June 20, 2018 as part of the 2018 IEPR Update proceeding.

During the workshop, several presenters highlighted the need for creative solutions to integrate renewables, increase the electric system's flexibility, and maintain system reliability. Clyde Loutan from the California Independent System Operator (CAISO) showed the projected impacts of photovoltaic (PV) on net load (or the forecasted electric load minus the expected supply of solar) on its system through 2020. Mr. Loutan noted that they did not expect to see the "belly" of the duck curve sink as much in their forecast due to increased PV solar generation coming onto the system (overgeneration) or that there would be such a steep upward ramp (when the sun sets and solar generation ends) between 4-7pm (when solar generation ends and the production of natural gas-fired electric generation quickly ramps up to meet demand). He further noted that the ramps are increasing and "present a risk going forward if sufficient ramping capability does not exist."[1] Mr. Loutan later noted that storage, flexible resources, demand response, and other solutions will all be necessary to maintain system reliability.

The shift towards electrification of residential buildings could potentially exacerbate the ramping challenges experienced by CAISO as electric demand increases. This further accentuates the need of maintaining diverse and flexible resources to support the grid.

[1] Presentation by Clyde Loutan at the June 20, 2018 IEPR Workshop on Renewable Integration and Electric System Flexibility, Slide 13. Available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=223856.

The following comments are focused on how power-to-gas (P2G) technology can specifically help integrate renewables into the electric system, as well as provide long-term system reliability, energy storage, and a decarbonized natural gas supply.

I. *P2G Can Support the Integration of Renewable Electricity*

P2G prevents curtailment of high penetrations of variable renewable generation by making use of surplus renewable electricity, that would otherwise be wasted, by storing it for later use as needed in any of several applications. As California is faced with an increasingly urgent need to deploy utility-scale energy storage solutions to support intermittent renewable power generation, P2G should be evaluated rigorously by the CEC for its potential as a large-scale storage option.

Like batteries, P2G technologies have excellent load-following capabilities, which are necessary to manage the intermittency of solar and wind resources. Unlike battery storage, however, P2G can store utility-scale quantities of energy indefinitely, without self-discharge. For example, wind power generated in March can be delivered into the high-value energy markets of August and September. This can be effective in alleviating the ramping problem identified by CAISO during the afternoon and evening periods. Also, unlike batteries, P2G is always available and never fills up (batteries are unavailable during discharge periods or once storage limits are reached). These unique attributes have the potential to enable very high levels of renewable energy use while maximizing economic value.

II. P2G Can Increase Electricity System Flexibility & Energy Storage

Expanding energy portfolios increase system reliability in a cost-effective manner,[2] as an over-reliance on a single energy source can create avoidable and unnecessary risks for public safety and the economy.

P2G can increase electric system flexibility by providing grid-balancing services under a range of conditions and over a wide span of durations. In particular, P2G can complement shorter-term resources, like batteries, to provide seasonal and long-term storage. The dynamic responsiveness of electrolyzers enables them to absorb power generation spikes, and by switching on and off, the electrolyzer can flatten out an intermittent resource such as PV at times when generation is variable. The ability of electrolyzers to provide various ancillary services is significantly enhanced when connected to the gas grid and to generation resources that can be quickly dispatched. P2G's ability to provide longer-term grid storage, ranging from several hours to months, derives primarily from the gas grid's ability to receive, store, and distribute extremely large amounts of energy as hydrogen and methane.

The increasing role of variable, intermittent and off-peak electrical generation from solar and wind energy into California's electrical transmission and distribution grid is being impeded by a relative dearth of utility scale energy storage systems. California is on pace to curtail over 400

[2] United Nations Framework Convention on Climate Change, *Risk Management Approaches to Address Adverse effects of Climate Change*, Accessed from http://unfccc.int/cooperation_support/response_measures/items/5003.php.

GWh of wind and solar electricity in 2018. P2G can prevent renewables curtailment by providing a cost-effective, utility-scale energy storage outlet for wind and solar generators. P2G can thus, increase renewable energy deliveries overall, improve the economics of wind and solar projects, conserve renewable power production that would otherwise be curtailed, and deliver renewables into the highest and best end use energy markets.

P2G technology has the potential to provide a large-scale, cost-effective solution for storing excess energy produced from renewable sources. In the P2G process, excess renewable energy is used to electrolyze water to produce hydrogen gas. The hydrogen can be used in fuel cells for transportation or various power applications. It can also be directly injected in limited quantities into existing pipelines, or when co-located with a carbon dioxide source such as from dairy gas, it can be methanated and injected into the pipeline, decarbonizing the gas system and providing energy for later use anywhere over the vast pipeline network.

As a storage source, P2G is particularly flexible. It is uniquely able to scale from small, microgrid applications up to terawatt levels of energy storage at the utility scale. When connected to the gas network, P2G is also more geographically flexible than other bulk storage options, like pumped hydro or compressed air, because P2G modular and can be sited virtually anywhere on the grid. Additionally, at high capacity, P2G has a lower cost[3] and geographic footprint than batteries, which experience a significant increase in both cost and footprint as capacity scales up.[4]

III. P2G Can Decarbonize the Natural Gas Supply

An integrated energy grid, comprised of both electric and gas delivery systems that are increasingly renewable and lower carbon, can ensure reliability, and help society adapt and become more resilient to the impacts of climate change.

P2G advances deep energy decarbonization in multiple ways across the energy system. As mentioned above, decarbonized gas in the form of P2G can play an important role in integrating variable renewable generation by producing gas, and then storing it in the existing infrastructure for when it is needed to serve residential, commercial, and industrial customers, or for electricity generation. The hydrogen energy made during the P2G process can be returned to the grid when needed as carbon-free electricity via fuel cell. If large amounts of power are needed, the hydrogen can be synthesized into renewable methane and used to generate very low carbon electricity via peaker generators or gas combined cycle power plants. The renewable methane made by the P2G process can also be used to decarbonize traditional natural gas end-uses, like cooking and heating.

P2G can also can be used to decarbonize industrial refineries and hydrogen production,

[3] For durations over 6 to 8 hours, providing a potentially more cost-effective strategy for day-night, weekly, and seasonal electricity storage.
[4] California Hydrogen Business Council White Paper on Power-to-Gas

which, according to the California Air Resources Board (CARB), represent the state's largest individual industrial GHG source, contributing 31% of the sector's total emissions.[5] Additionally, the CO_2 used for methanating hydrogen can be supplied through carbon capture technologies at industrial plants, so that these GHGs, which would normally be released into the air, can be repurposed to form clean, renewable gas.

In the European Union, more than 35 P2G facilities are being planned, constructed, or operated.[6] These are referred to collectively as a "system solution" because of the added benefits of helping balance the grid and providing substantial energy storage capacity.

The global hydrogen market is gaining traction with significant investment potential for renewables integration. France recently announced a "hydrogen strategy" to utilize hydrogen across all sectors with a goal of 10% hydrogen penetration by 2023 and between 20% to 40% by 2028. The country has allocated 100 million Euros starting in 2019 as part of the strategy.[7]

Keele University in the U.K., is exploring hydrogen blending into its private gas network beginning 2019 to reduce carbon emissions from heating buildings. The HyDeploy Project, is currently performing a gas safety check in buildings within the trial area of up to 20% hydrogen blending content as part of their decarbonization efforts.[8]

The Australian Gas Infrastructure Group has announced plans to blend hydrogen into its natural gas supplies to take advantage of excess renewable generation. The utility announced plans for Australia's first P2G plant, worth $8.9 million, to be built in Adelaide, South Australia. The hydrogen produced will be injected into the local gas distribution network to provide low-carbon gas to homes and businesses.[9]

Dubai Electricity and Water Authority (DEWA) and Siemens AG signed a memorandum of understanding (MOU) in 2018 to kick off the region's first P2G electrolysis facility. The proposed project is aimed to be at "MW-Scale" and is part of DEWA's plan to convert PV

[5] California GHG Emission Inventory. 2016 Edition. *California Greenhouse Gas Emissions for 2000 to 2014- Trends of Emissions and Other Indicators.* Accessed from https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_trends_00-14_20160617.pdf.
[6] European Power to Gas Website. Accessed from http://www.europeanpowertogas.com.
[7] Electrive.com. June 2018. *France to utilise hydrogen across all sectors*. Accessed from https://www.electrive.com/2018/06/04/france-to-utilise-hydrogen-across-all-sectors/.
[8] Gas Power Heat Systems Network. February 2018. *Trial to explore blending of hydrogen into gas network.* Accessed from https://networks.online/gphsn/news/1000904/trial-explore-blending-hydrogen-gas-network.
[9] Green Tech Media. March 2018. *Australia Seeks Hydrogen to Soak Up Excess Renewable Energy Production.* Accessed from https://www.greentechmedia.com/articles/read/australia-looks-to-hydrogen-to-soak-up-excess-renewable-energy-production#gs.sb4MM1M.

electricity generated at its Solar Park project into hydrogen as part of a strategy to accelerate renewables integration and deployment in the region.[10]

In Germany, two major power and gas grid firms (Amprion and Open Grid Europe) recently unveiled plans to jointly build large P2G plants in the next decade to help store and transport renewable energy to meet Germany's tough climate protection goals.[11] The firms are looking at building 50 to 100 MW size P2G plants, which will help complement thousands of kilometers of new north to south power lines planned by Amprion and its peers to accompany the boom in green power production.

These are only some among the many projects being deployed around the world.

IV. Supporting Microgrids

P2G can support microgrids, which are improving the reliability and resiliency of the electric sector and decarbonizing building energy use. SoCalGas commissioned a demonstration project at the University of California, Irvine (UCI) to show the feasibility of P2G to capture and return excess renewable power to a microgrid. The UCI campus microgrid is comprised of PV, a thermal energy storage system with district heating and cooling, a natural gas combined cycle (NGCC) cogenerating plant, and a lithium ion battery energy storage system serving a community of more than 30,000 people and encompassing a wide array of building types, and transportation options. The newest addition to the UCI campus microgrid is a P2G system that uses a polymer electrolyte membrane electrolyzer to convert excess renewable power into hydrogen gas. The hydrogen gas is injected into the campus pipeline system where it is blended with natural gas. The hydrogen/natural gas blend is then used to power the onsite NGCC system.

The UCI system demonstrates several of the value propositions that P2G technology can provide for microgrids, including a dispatchable load, the capture of otherwise-curtailed intermittent renewable power, and using the natural gas system as a storage resource for excess renewable energy. The integration of the campus' electric microgrid and natural gas distribution system has allowed the campus to decarbonize the electricity and natural gas serving buildings on the campus. Dr. Jack Brouwer made a presentation during the 2017 IEPR Renewable Gas Workshop describing the increased utilization of the campus' solar grid by integrating P2G into their operations.[12]

V. Conclusion

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[10] Business Wire. February 2018. *DEWA Signs MoU with Expo 2020 Dubai and Siemens to Kick off Region's First Solar-Driven Hydrogen Electrolysis Facility.* Accessed from https://www.businesswire.com/news/home/20180212006494/en/DEWA-Signs-MoU-Expo-2020-Dubai-Siemens.

[11] Energyworld. June 2018. *German power, gas grids co-operate on storage plans up to 2030.* Accessed from https://energy.economictimes.indiatimes.com/news/power/german-power-gas-grids-co-operate-on-storage-plans-up-to-2030/64675933.

[12] Presentation by Jack Brouwer at June 26, 2017 IEPR workshop. Accessed from https://efiling.energy.ca.gov/GetDocument.aspx?tn=220149

P2G can help ensure system reliability through management of over-generation, providing flexible energy storage, resource adequacy and flexibility, and addressing regional reliability needs. Additionally, P2G largely relies on existing infrastructure, existing permits and existing rights-of-way.

For these reasons, we encourage CEC to consider natural gas storage and generation as well as P2G when deciding how best to strategically deploy energy storage.

Sincerely,

/s/ Tim Carmichael

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