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Office of Energy Efficiency and Renewable Energy
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Comments of Google LLC in response to the
Clean Hydrogen Production Standard Draft Guidance

November 4, 2022

Google LLC (Google) appreciates the opportunity to provide comments to the Department of Energy (DOE) regarding its draft guidance for a Clean Hydrogen Production Standard (CHPS) that is being developed to meet the requirements of the Infrastructure Investment and Jobs Act of 2021.

Google is an American technology company that focuses on search engine technology, online advertising, cloud computing, computer software, quantum computing, e-commerce, artificial intelligence, and consumer electronics. Google's mission is to organize the world's information and make it universally accessible and useful.

Google is dedicated to building a carbon-free future for all. In 2007, we became the first major company to be carbon neutral. In 2017, we became the first major company to match 100% of our annual electricity use with renewable energy and we are one of the largest purchasers of renewable energy in the world, with over 7 gigawatts (GW) of renewable energy projects under contract. In 2020, we committed to become the first major company to operate on 24/7 carbon-free energy by 2030. Last year, we announced a goal to achieve net zero emissions across our operations and value chain, including our consumer hardware products, by 2030

We believe that clean hydrogen is an important tool to enable deep decarbonization of our own operations and value chain, as well as the global economy. It is a potential decarbonization pathway for multiple sectors including industry, power, and transport and shipping. Through our own activities, we seek to support the commercialization of advanced clean energy technologies, including clean hydrogen solutions, and are working with partners to advance these solutions across the globe. We also advocate for policies to accelerate energy system decarbonization, and earlier this year published a global energy policy roadmap detailing the policies we believe are essential to enable 24/7 carbon-free energy for all.

Strong standards are essential to ensure the environmental integrity of clean hydrogen. Without such standards, hydrogen production could lead to significant increases in carbon dioxide emissions, undermining its effectiveness as a key decarbonization tool in the coming years. As a potential purchaser of clean hydrogen for our own operations, Google is also focused on ensuring that emissions associated with any hydrogen that we purchase and use in the future are minimized and can be accurately accounted for.

While each of the questions raised by DOE in the consultation are important for the development of a strong CHPS, we limit our comments to question 3(c), regarding the use of contractual instruments for verifying clean hydrogen produced from grid-based electricity:

> *Should renewable energy credits, power purchase agreements, or other market structures be allowable in characterizing the intensity of electricity emissions for hydrogen production? Should any requirements be placed on these instruments if they are allowed to be accounted for as a source of clean electricity (e.g. restrictions on time of generation, time of use, or regional considerations)? What are the pros and cons of allowing different schemes? How should these instruments be structured (e.g. time of generation, time of use, or regional considerations) if they are allowed for use?*

We believe that low-carbon hydrogen produced by grid-based electricity (in addition to behind-the-meter clean electricity generation) can enable the production of significant quantities of hydrogen to facilitate decarbonization in other sectors of the economy. However, it is critical to develop standards that ensure that such hydrogen production actually utilizes clean electricity at the time and place where such production occurs. Google's own experience as one of the largest purchasers of renewable energy has shown us that matching our annual electricity consumption with renewable energy production, while an important milestone, is not the same as operating around-the-clock on carbon-free electricity. Even though we fully match our electricity use with renewable energy on an *annual* basis, the underlying electricity that we rely on to power our operations is only 66% carbon-free when measured on a location-specific, hourly basis. As a result, we continue to rely on fossil fuels in certain places and at certain times, which results in carbon emissions associated with our operations.[1]

Research produced by Princeton University shows that deploying additional clean energy generation with granular geographic and temporal correlation to hydrogen production is critical to ensuring that grid-based hydrogen has sufficiently low embodied carbon emissions.[2] In their study, they show that even fully matching demand with clean electricity on an annual basis may not significantly reduce embodied emissions, since such goals are typically met with only one technology (e.g. solar power) and the average grid emissions are generally higher during times when hydrogen demand exceeds procured clean supply, and are already low when the clean supply is generating. Matching supply to demand on an hourly basis is thus key to ensuring low emissions during all times of operation. A recent study by the Florence School of Regulation demonstrates that the modest costs added by requiring hourly matching is more than offset by the environmental benefits.[3]

Fortunately, new tools are quickly becoming available to assess and verify the use of carbon-free electricity at an hourly level. Time-based energy attribute certificates (T-EACs) are instruments that, in addition to tracking how and where electricity is produced, also certify specifically when

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[1] As we note in our detailed 24/7 CFE methodology paper (page 21), current carbon accounting methodologies allow those matching annual electricity demand with renewable energy, via either PPAs or renewable energy credits, to claim zero emissions, even though actual emissions are not zero.

[2] Ricks, Wilson, Xu, Qingyu, & Jenkins, Jesse D. (2022). Enabling grid-based hydrogen production with low embodied emissions in the United States. Zenodo. https://doi.org/10.5281/zenodo.7183516

[3] Brauer, Johannes, Villavicenio, Manuel, and Truby, Johannes (2022). Green Hydrogen: How Grey Can It Be? Florence School of Regulation. https://fsr.eui.eu/publications/?handle=1814/74850

that electricity was produced. While traditional renewable energy certificates (RECs) may provide information on how much electricity a wind farm produces in a given month, T-EACs tell you the exact hour when it was produced. There is now an international standard for T-EACs, as well real-world experience in using the instrument. We worked with M-RETS, a REC registry in the United States, to complete the first-ever hourly certification of clean energy. Next year, we expect to retire EACs at an hourly level for over 10 TWh with multiple partners across the globe.

T-EACs can be used to verify that carbon-free electricity was purchased and used for the production of grid-based clean hydrogen on a location- and time-matched basis. T-EACs that are used to demonstrate hourly and geographic matching of electricity generation to load could be bundled (such as via a PPA or retail energy agreement) or unbundled (purchased separately from generation). In either case, the key is that the clean energy generating asset is on the same grid as the hydrogen electrolyzer and is matched at an hourly level to its consumption.

New contracting structures are also being developed to enable the sourcing of clean energy around the clock. To date, Google has signed energy supply agreements with three different partners across the globe - including in Virginia, California, and Germany - that ensure a minimum amount of hourly carbon-free energy matching.[4]

We therefore recommend that the CHPS include the following quality criteria for contractual instruments for grid-based electricity to be used for the production of low-carbon hydrogen:

- **Temporal correlation**: The CHPS should require hourly correlation of consumption with zero-carbon electricity generation, which is necessary to minimize the emissions associated with grid-based hydrogen production.
- **Geographic correlation**: To maintain the integrity of claims that zero-carbon electricity is used to power the production of grid-based hydrogen, hydrogen and clean electricity production should occur within the same geography. We recommend using the same balancing authority, or regional transmission organization (RTO) if it exists.
- **Additionality**: Large-scale deployment of grid-based hydrogen implies significant increases in electricity demand. It is imperative that this demand contributes to, and does not undermine, a rapid decarbonization of the power sector. Therefore, the CHPS should encourage the development of additional clean energy capacity on electricity grids. This could include the production of new assets, repowering of existing assets, or extending the lives of assets that would otherwise be retired.

These same three criteria have also been proposed by the European Commission as part of their own approach for defining the minimum requirements to demonstrate that renewable hydrogen from grid-based electricity is actually clean. At a minimum, we believe that it's important for DOE to ensure that the carbon impact of grid-based hydrogen is assessed at an hourly level,

[4] A detailed discussion of this new transaction model, which we call the "CFE Manager" can be found in our recent paper published on the topic.

based on where the consumption occurs. We recommend the use of attributional accounting methods to allocate carbon associated with hydrogen production.

We appreciate the opportunity to provide these comments to DOE, and are available to discuss further at your convenience.

Sincerely,

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