White Paper

Tracking Renewable Energy for the 45V Hydrogen Production Tax Credit Without Hourly Matching

A Response to IRS Notice 2022-58

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Introduction

Part of the US Inflation Reduction Act is provision for what is called the 45V Hydrogen Production Tax Credit. The Production Tax Credit provides up to a $3 credit per kg of hydrogen-produced for projects with lifecycle greenhouse gas emissions less than 0.45 kg CO2e per kg of hydrogen.

The US Department of the Treasury is now being asked to write guidance on how the tax credits will be implemented. At least three rules have been proposed which are sometimes referred to as "Three Pillars" consisting of:

- Hourly Matching – Which requires hydrogen producers to match their consumption of electricity from the grid with clean electricity production on an hourly basis
- Deliverability – That renewable electricity production must be nearby the hydrogen facility
- Additionality – Only using renewable electricity production that has been recently installed

This paper will demonstrate that *hourly matching is completely unnecessary to track renewable energy* between a source and hydrogen electrolysis generator (load) to achieve decarbonization.

Instead, this paper will show that by meeting the following Four Criteria, renewable energy for hydrogen generation can be assured in order to qualify for the 45V Production Tax Credit.

- An energy contract between renewable energy supplier and hydrogen generator
- Electric metering of both the renewable supplier and hydrogen generator
- A defined billing interval
- Connection to a common electrical grid

This is an extremely important concept because not only is hourly matching unnecessary, but it will also be difficult or impossible for most hydrogen generators to achieve.

If hourly matching is adopted, a majority of hydrogen generators will not be able to access the tax credit. Here's why. Most hydrogen generators will need to operate continuously in order to achieve an adequate Return on Investment in their costly capital equipment. However, renewable energy sources such as wind and solar will only produce energy intermittently. So even though the renewable source and hydrogen generator producing and using exactly the same amount of *energy* during a billing interval, it often won't be simultaneous.

This paper will show that the renewable energy generation and hydrogen use do not have to occur simultaneously in order to achieve decarbonization as long as the energy quantities reported during a billing interval match.

Energy Contracts

A renewable energy supplier (which is the source) and a hydrogen generator (which is the load) need to use the electrical grid to transfer energy, but the grid co-mingles energy from many sources and loads. Yet in order for energy to qualify for the tax credit, we need to be able to demonstrate that the Source energy-per-billing-interval and Load energy-per-billing-interval are matched. An *Energy Contract* can serve to legally attest that the electrical energy-per-billing-interval being supplied by the Source is not being sold or committed to any other user (Load). This source could be new renewable energy or renewable energy diverted from some previous use. The important point here is that the source and load are paired by the contract and measured with electric meters and accounted for during some billing interval – probably a month.

Various contract vehicles are available for this purpose such as Power Purchase Agreements (PPA) and Renewable Energy Contract (REC). The PPA or REC could be between the hydrogen generator and either a private renewable energy supplier or the utility if the utility has their own renewable sources.

Additionally, only the measured energy-per-billing-interval supplied by the Source that matches the measured energy-per-interval used by the Load qualifies for the production tax credit. If the Source supplies more energy-per-billing-interval than the Load uses, the excess energy does not qualify for the production tax credit. If the Load uses more energy-per-billing-interval than the Source supplied, the make-up energy also doesn't qualify for the credit. This accounts for issues such as renewable energy "curtailment" or surges in usage by the Load.

Please note a very important point here regarding time. The only time interval needed is the billing interval. The source does NOT have to generate energy simultaneously as the load is using the energy to achieve decarbonization. This is because *energy* already contains a time element as explained next.

Defining Energy

To understand how we can track energy through the electric grid which co-mingles energy from many sources, and also to understand why, to achieve decarbonization, renewable energy generation and use do NOT have to occur simultaneously (within a billing interval), it will be useful to review the nature of energy.

Electrical energy is defined as Power times Time. Power has the units of Watts, and time has the units of hours. Therefore, the unit of electrical energy is the Watt-Hour. For convenience, we often talk in terms of thousands, millions, or billions of Watt-hours. That is, kilowatt-hours (kWh), megawatt-hours (MWh) or gigawatt-hours (GWh) respectively.

It's extremely important we make the mental distinction between power and *energy*. Power is instantaneous, but energy is power over time. We're trying to track renewable energy, not power.

So energy already contains an element of time. But, for tracking and billing purposes we need to know the amount of energy per some second time interval – usually a month. In other

words, kWh per month, MWh per month or GWh per month. This energy is tracked and reported the use of electric meters.

So through metering, we have the means to track the quantity-per-billing-interval of renewable energy being put onto the grid by a renewable Source as well as the quantity-per-billing-interval of energy taken from the grid by a hydrogen generator Load. Of course, the quantity generated and quantity used must match in order to conclude that the quantity used applies for the production tax credit. However, what about *timing* of the energy generation versus the timing of the energy use during the billing interval? Does that matter? And what should our billing interval be?

Billing Interval

The purpose of the billing interval is accounting – to collect the energy quantity (that is Watt-hours) reported by the Source and Load. Only the matching energy quantity during the interval can claim the Production Tax Credit. At first, it may seem they need to match instantaneously. However, that's not the case since time is already accounted for in the units of energy, that is Energy = Power x Time. But having too long a measurement interval doesn't make sense either. The hydrogen producers won't want to collect data for years and consequently have to wait years to claim the 45V Production Tax Credit. So, what we have here is an accounting issue. How frequently should we tally the renewable energy generated by the Source and used by the Load? The interval is arbitrary, however electrical energy is commonly billed monthly and a month is an appropriate interval to use for 45V accounting.

Asynchronous Energy Generation and Usage

We've shown that by use of an energy contract and metering we can verify the matching of renewable energy generation and Load usage. But what if, during that billing interval, the energy from a renewable Source is generated at a time different than the Load uses it? As long as the generation and usage fall within our billing interval and quantities match, it doesn't matter and this is best illustrated with an example.

Let's say there are two businesses within some electrical grid and these two businesses want to attach to this grid to transfer electrical energy from a solar array to an electrolysis hydrogen fuel station. The two businesses execute a Power Purchase Agreement (PPA) to agree to transfer 1 GWh of renewable energy per month. In order to qualify for the 45V Production Tax Credit, the hydrogen generator cites the PPA to verify that the renewable energy from the solar array is only being sold to them. The quantity of renewable energy is verified by electrical metering at both businesses. Only the quantity of energy used by the hydrogen generator that is matched by solar array during that billing interval qualifies for the tax credit.

But what about the time of production and use? As long as the particular production and use applying for the tax credit falls within our billing interval (for example a month) timing doesn't matter, and here's why.

Let's consider a worst-case example and assume that for some reason, during a billing interval, some hydrogen generator never draws electrical energy at the same time that some solar array

is producing it. Assuming 1 GWh of energy is to be exchanged, when the solar array is producing their 1 GWh per month of renewable energy, the utility supplying this electrical grid needs to reduce the amount of non-renewable energy they supply to the grid by 1 GWh – thereby *decarbonizing 1 GWh of electricity*. Now at a different time during the month, when the hydrogen generator draws their 1 GWh, the utility needs to supply an additional 1 GWh of non-renewable energy. So during the month, the grid first reduced the amount of non-renewable energy by 1 GWh when the solar array produced 1 GWh, but then increased it by 1GWh when the hydrogen generator used 1 GWh. One minus one equals zero, so *the net result is that during that month, the utility supplied the same energy they would have if the solar array and the hydrogen generator were not connected to the grid, yet the solar business and the hydrogen business have used the grid to transfer their renewable energy even if it was not at the same time, and with no increase in non-renewable energy*. This is why "hourly matching" is not necessary. A renewable source and a hydrogen load don't need to supply and use energy simultaneously within a billing window to qualify for the tax credit. Time is already accounted for in the units of energy which is power times time.

Summary

This paper has shown that hourly matching is unnecessary and that the 45V Production Tax Credit can be properly applied with the use of Four Criteria:

1. An energy contract
    - Between renewable energy (Source) and hydrogen generator (Load)
    - Attests to unique pairing between Source and Load, that is, no double-selling of the energy
    - Specifies the quantity of renewable energy (Watt-hours) to be transferred
2. Metering
    - Assures quantity of energy claimed for the tax credit by hydrogen generator is matched by energy from a renewable source during the billing interval
3. Billing Interval
    - Defines the period over which the energy provided by Source and used by the Load are matched
4. Within the same electrical grid
    - To show that there is an electrical path to transfer energy between the renewable source and the hydrogen load

This paper also shows that the Four Criteria above meet the intentions of hourly matching to

- Avoid generation of new non-renewable energy
- Tracking energy from source to load
- Accurately reflects quantity of energy qualifying for the 45V Production Tax Credit

This paper also shows that the Four Criteria above avoids issues with hourly matching such as:

- Complicated and costly to track

- Hourly matching is difficult to implement for most hydrogen generators because hydrogen generators need to operate continuously but renewable sources are intermittent

A word about deliverability and Additionality

Deliverability

Deliverability is described as requiring that the Source of renewable energy and the hydrogen use or Load be located "nearby". The intent here is not to have renewable energy generation, for example, in Hawaii to be claimed for hydrogen generation in New York. The energy generator and the energy user should be connected to the same grid so there is an electrical path for the energy. This idea has merit but the current wording is vague and unclear. So the author recommends that the word "nearby" be changed to "connected to the same grid" or similar wording.

Additionality

Additionality is described as only renewable electricity production that has been "recently installed" should qualify for the tax credit. The intent here is to avoid diverting renewable energy already being supplied to the grid for general consumption over to hydrogen generation simply to qualify for the production tax credit. This seems out-of-scope for legislation that is only intended to provide a tax credit to hydrogen generation which uses renewable electricity – rather than to dictate to renewable energy suppliers who they can and can't sell their electricity to.

There are a lot of unintended consequences to requiring only new sources. For example, what if a solar array is supplying electricity to a hydrogen generator and that generator goes out of business? That solar array would then like to supply energy to a new hydrogen generator but would be prevented from doing so by this rule.

A second example is using a nuclear power plant to supply energy to a hydrogen generator. However, they would be prevented from doing so because the nuclear power plant is not a "new" source of energy.

For these reasons, the author recommends avoiding the Additionality criteria.

About the Author

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