How to Make Hourly Scope 2 Allocational Accounting Work

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Introduction

The Greenhouse Gas Protocol (the Protocol) was established as a global standard guiding consistent accounting and reporting of corporate greenhouse gas emissions. A central purpose of the Protocol's Scope 2 standard is to accurately **allocate** electricity-sector emissions from electricity generation to consumers of electricity. In an accurate and complete allocation of emissions, all emissions from electricity generation and transmission (scope 1) would be fully allocated to electricity consumers (scope 2). Those who are in the process of updating the Protocol's Scope 2 Market-Based Method (MBM) are considering a range of differing ideas and proposals to improve the current system and increase the accuracy of the allocation of electricity-sector emissions to individual companies.

One of the leading proposals for how to update the Protocol recommends matching clean energy attributes to electricity consumption on an hourly basis within a given market boundary –often referred to as 24/7 accounting. Proponents of this approach argue that a 24/7 framework more closely tracks the operation of the actual grid, which delivers power to consumers on a very granular time and location basis. However, to accurately and completely allocate electricity sector emissions, the 24/7 hourly matching framework needs to resolve several issues.

Criteria for Making 24/7 Work

1. Prevent Double Counting

In a proper allocational accounting system, total allocated scope 2 (indirect) emissions from electricity consumption should equal the corresponding scope 1 (direct) emissions from electricity generation. This cannot be done if there is "double counting" in the system - *e.g.,* when multiple entities claim credit for the same clean energy generation.

In current scope 2 market-based accounting, electricity users count the volume of megawatt hours (MWh) they consume, subtract their MWhs of clean energy purchases, and finally apply an emissions rate (tons of CO2/MWh) to any remaining (residual) load.

> Calculation: *Scope 2 market-based emissions = (MWh of consumed electricity - MWh of clean energy purchases) * emission rate*

The most readily available emissions rate in most markets around the world is an annual average emission rate[1] (AER). It is used in the majority of today's reporting and is calculated by dividing the total grid emissions by the total MWh in that grid, resulting in an average tons of CO2/MWh value. As a result of using AER, direct clean energy purchases by reporting entities (such as corporations) can get counted twice: once when companies subtract their clean energy purchases from their load, and again when they apply the AER, as the AER does not subtract the clean energy claimed by individual companies. The following example illustrates this point.

> *<u>Example 1</u>: Current Scope 2 Market-Based Method Using AER Double Counts Clean Power*

Consider a hypothetical power grid operating for one hour. This hypothetical grid consists of:

- An 800 MW gas plant emitting 0.5 tonnes of CO_2 per MWh
- Two 100 MW renewable energy plants with zero emissions from operations

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[1] An Average Emissions Rate (AER) is simply the total emission from a given grid divided by the total number of MWh in that grid, resulting in an average tons of CO2/MWh value.

- One plant is utility-owned
- The other is independently owned, with its energy and environmental attributes sold directly to a corporate buyer

Scope 1 Allocations:

Scope 1 carbon accounting calculates all system-wide direct emissions and allocates them to specific generators.

Table 1: Scope 1 Emissions

Generator	**Emission Rate (tons of CO2/MWh)**	**Total Generation (MWh)[2]**	**Total Allocated Emissions (tons C02)**
	a	*b*	*c = a x b*
Gas Generator	0.5	800	400
Clean Generator A (utility contracted)	0	100	0
Clean Generator B (corporate offtake)	0	100	0
Totals		**1,000 MWh**	**400 tons**

Total scope 1 emissions for this grid are 400 tons (800MWh x 0.5 tons/MWh), all of which are allocated to the gas generator as it is the only source of emissions.

Scope 2 Allocations:

Under the scope 2 Market-Based Method, companies first deduct their own clean energy purchases from their volume of consumed energy, then typically multiply their remaining load by the grid's AER. However, because the AER calculation (total tons divided by total MWhs) also includes the 100MWh of clean energy purchased by and accounted for by Company X, that 100MWh is counted twice. The resulting double counting is a failure to fully allocate system-wide emissions (scope 1) to consumers of electricity (scope 2). This double counting results in the 40 tons of unassigned emissions: total scope 1 (400 tons) less the assigned scope 2 (360 tons), as shown in Table 2 below[3].

[2] For purposes of this simplified example, the renewable plants are assumed to operate at 100% capacity factor.

[3] This is a well-known issue with the current market-based method of Scope 2 accounting and one that is exacerbated as clean energy penetration grows (only 20% in this example) resulting in a higher level of unassigned emissions.

Table 2: Scope 2 Emissions Allocations Under Current Market-Based Method

Units	Category	Definition	Company X	Rest of Grid	Totals
Volumes (MWh)	Consumed Electricity (Load)	Consumed MWh	200	800	1,000
	Direct Clean Energy Purchased	*MWh claimed through direct purchases*	*100*	*0*	*100*
	Residual Load	*Consumed MWh less direct purchases*	*100 (200 - 100)*	*800*	*900 (1000–100)*
Emissions	Average Emission Rate (AER) (tons/MWh)	Total Scope 1 grid emission divided by total grid MWh	0.4 (400 tons /1,000 MWh)		
	Scope 2 Assigned Emissions (tons)	Residual load x AER	40 (100 x 0.4)	320 (800 x 0.4)	360
	Total Scope 1 Emissions (tons)		.	.	400
	Unassigned Emissions	**Scope 1 - Scope 2**			**40**

Example 2: Hourly Matching Can Exacerbate Double-Counting

Whether hourly allocation (24/7) prevents or exacerbates double counting depends on the details of how it is implemented. Under some 24-7 methodology proposals[4], however, double counting is actually made worse.

1. Step 1: As in Table 2 above, under these 24/7 proposals companies first subtract directly purchased clean energy from their total volume of consumed energy, although now on an hourly basis (each hour matched with a Renewable Energy Certificate (REC). This is the first time clean energy is counted.

2. Step 2: Next, under the 24/7 methodology, companies want to account for the hourly clean energy supplied to them by the grid (above and beyond their contracted clean energy). They do this by applying a grid-wide clean energy percentage to their remaining volume of load. So, if the grid in question is – as in this example - powered by 20% clean energy, the company multiplies its remaining unmatched volume of consumption by that 20% – irrespective of the fact that half of that clean energy has already been counted. This is the second time clean energy is counted.[5]

3. Step 3: Lastly, having deducted direct clean energy purchases and then accounting (inaccurately) for the hourly clean MWh supplied by the grid, companies then apply an emission rate (tons of CO2/MWh) to any remaining (residual) load in order to calculate their remaining scope 2 carbon footprint. In practice, this emissions rate is oftentimes the AER. As in the first example, the AER again includes contracted/claimed clean energy purchases, so that clean energy is counted a third time.

The three steps result in even more unassigned scope 1 emissions, as shown in Table 3 below.

[4] For discussion on leading 24/7 methodologies, see https://www.sciencedirect.com/science/article/pii/S2211467X24001950

[5] In this simplified example, it is the company's own clean energy purchase that is counted twice. In real world example, the clean energy percentage on the grid might include clean energy claimed by many other companies.

Table 3: Emissions Allocations Under Potential 24/7 Market-Based Method

Units	Category	Definition	Company X	Rest of Grid	Totals
Volumes	Consumed Electricity	MWh consumed	200	800	1,000
	Direct Clean Energy Purchased	*MWh claimed through direct private purchases*	*100*	*0*	*100*
Step 1	*Residual Load*	*Consumed MWh less direct purchases*	*100 (200-100)*	*800*	*900 (1000-100)*
	Accounting for clean energy in the grid mix				
	Hourly matched clean energy from grid	% of grid-wide generation that's clean	20% (200 MWh / 1,000 MWh)		
Step 2	Clean energy claimed through grid mix to reduce residual load	MWh of residual load that is hourly matched w/clean energy from grid	20 (100 x 20%)	.	.
	Hourly matched residual load	MWh of residual load minus hourly clean energy from grid mix	80 (100 - 20)		.
Emissions	Average Emission Rate (AER)	Total Scope 1 divided by total MWh	0.4 (400 tons /1,000 MWh)		
Step 3	Scope 2 Assigned Emissions (tons)	Hourly residual load x AER	32 (80 x 0.4)	320 (800 x 0.4)	352
	Total Scope 1 Emissions (tons)		.	.	400
	Unassigned Emissions	**Scope 1 - Scope 2**			**48**[6]

The difference between Table 2 and Table 3 is that Company X further reduces its reported residual load from 100MWh in Table 2 to only 80MWh in Table 3 by counting the clean energy already on the grid. That reduction increases the amount of unallocated Scope 1 emissions from 40 tons to 48.

Possible Solutions

There are proposals for improving this inaccurate result. One is to improve on step 2 by using "Standard Supply Service" – i.e., only counting clean generation that is required by mandate (such as an RPS), clean generation subject to regulated cost recovery, and publicly-owned clean generation. Each reporting entity would claim their pro-rata share of that generation. This would hypothetically eliminate double counting from Step 2. In reality, this information is not widely available, so many companies would *not* have access to Standard Supply Service data for all of their operations.

In Step 3, the problem remains of what emissions factor to apply to the remaining load to calculate emissions. Another imperfect proposal is to use a fossil-only emissions rate. The fossil-only emission rate is *not* widely available today - - and certainly not on an hourly basis - but could theoretically be calculated by dividing all fossil generator emissions by fossil

[6] The difference between Table 2 and Table 3 is that Company X further reduces its reported residual load from 100MWh in Table 2 to only 80MWh in Table 3 by counting the clean energy already on the grid. That reduction increases the amount of unallocated Scope 1 emissions from 40 tons to 48.

generator MWh. While this would ensure no double counting of clean generation, it likely *under* counts clean generation and would then overstate emissions and thus fall short of an accurate allocational system.

The best – and perhaps only -- solution under hourly allocation would be to allocate remaining emissions using a granular (hourly and spatially aligned) residual mix factor.[7] A granular hourly residual mix factor is one in which all contracted or claimed clean energy has been removed from the. Unfortunately, the reality is that very few jurisdictions have developed residual mix emissions rates even on an annual basis, and virtually nowhere is it currently available on an hourly basis.[8]

While the use of Standard Supply Service, fossil-only emissions rates, or granular residual mix factors could theoretically improve emissions allocation (as illustrated in Table 3), these data sources are often unavailable in practice. This lack of data access will likely cause companies to default to using AERs (Average Emissions Rates), which should not be permitted under the revised Scope 2 standard.

2. Require a Demonstration of Deliverability

One of the theoretical merits of a 24/7 matching approach is the assumption of physical deliverability. By drawing narrower geographic boundaries within which generation and load are matched on an hourly basis, 24/7 assumes that a clean MWh purchased by a company can reach the load it is meant to serve. But common geography does not mean deliverability.

Leading 24/7 proposals use no test to confirm deliverability but instead assume that energy can flow unimpeded from areas of clean energy generation to areas of demand within the same "grid regions", thus canceling out a company's emissions.[9] That assumption, however, fails to account for the large and growing intra-regional transmission challenges faced by modern grids.[10]

For example, consider load based in Houston. A company trying to balance its Houston-based load might purchase plentiful new West Texas wind to help match on a 24/7 basis. However, the transmission lines between renewables-rich West and load in south Texas often become congested, like a highway at rush hour. Therefore, despite being in the same grid region, that wind power purchased by the company may not be physically deliverable to its load in Houston. Instead, its power demand will actually be served by local -- and likely fossil -- generation resources. You cannot, therefore, assume that a clean MWh generated in West Texas will have the same emissions impact as a MWh consumed near Houston.

Possible Solutions

A narrower and thus more accurate approach would be to use bidding zones, since they better reflect deliverability of generation to load.[11] But even within a bidding zone there can be congestion, which is often reflected in differences in locational marginal prices (LMPs). Differences between LMPs in different parts of the zone reflect transmission congestion (and to a lesser degree line losses). If the LMP at load is more than a little greater than LMP at the site of generation, that reflects the existence of congestion and a likely lack of deliverability[12].

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[7] One imperfect solution to the counting problem is to instead of using the average emissions factors that lead to double counting of clean energy one would instead apply a fossil emissions factor to remaining load. While this would ensure no double counting of clean generation, it would likely overstate emissions and thus fall short of an accurate allocational system.

[8] One proposal for increasing allocational accuracy is to identify "Standard Supply Service" – clean generation that is required by mandate (such as an RPS), clean generation subject to regulated cost recovery, and publicly-owned clean generation. Each reporting entity should be able to claim a pro-rata share of that generation. The residual mix, however, must account for contracted and claimed CFE above and beyond what's in standard supply service.

[9] Proposed regulations for implementing the Section 45V Production Tax Credit require that load from hydrogen electrolyzers be met by renewable generation that is hourly-matched to load within the same grid region – defined as deliverability regions. Department of the Treasury Internal Revenue Service. Credit for Production of Clean Hydrogen and Energy Credit, rule published January 10, 2025https://www.federalregister.gov/documents/2025/01/10/2024-31513/credit-for-production-of-clean-hydrogen-and-energy-credit. https://www.federalregister.gov/documents/2025/01/10/2024-31513/credit-for-production-of-clean-hydrogen-and-energy-credit

[10] See https://resurety.com/carbon-impact-of-intra-regional-transmission-congestion/

[11] "Bidding zone" is the U.S. term; "market load zone" is the EU term.

[12] One study suggests that average line losses tend to top out at around 3%, so any LMP differential greater than that implies transmission congestion and lack of deliverability. REsurety. *Ibid.*

If the goal is physical deliverability, accurate allocation of emissions and attributes under time and location granular accounting should require not just that there be *theoretical* physical transmission pathways between generation and load, but an *actual* pathway for deliverability – such as would be demonstrated by low LMP differentials -- that accounts for transmission constraints and congestion.[13]

Conclusion

For the Protocol revision process to succeed in its effort, the revised standard should be both more accurate and remain feasible for companies to implement. Unfortunately, one of the leading proposals for this update - 24/7 matching - runs the risk of reducing making Scope 2 less accurate.

- While the issues of double or triple counting outlined above could potentially be reduced with the use of Standard Service Supply data, fossil-specific emissions factors, or true hourly residual mix factors, these data sources are not widely available. It is likely, therefore, that reporting entities would revert to using annual average emissions factors, exacerbating double counting and further degrading the accuracy of Scope 2 accounting.
- Similarly, if the goal of tightened market boundaries is to achieve physical deliverability between load and clean energy generation, the grid regions proposal fails to deliver on this goal and allows companies to overstate the emissions reductions of their clean energy purchases.

Any revisions to the Protocol's Scope 2 Market-based method should carefully consider the practical realities of implementation. As it stands, the lack of data availability means reporting entities will likely be forced to default to an annual AER. This will result in a carbon accounting standard that is even less accurate than the current one. If the only data widely available is average emission factors, hourly matching should not be considered as a viable methodology.

[13] Again from the 45V hourly matching context: "We recommend a delivery requirement for grid-based hydrogen producers that allows procured clean generation to be counted toward clean hydrogen production in a given hour only if it can be proven that there is an uncongested transmission pathway between the point of generation and the point of offtake." Princeton ZERO Lab. https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/chps/princeton-zero-lab.pdf?sfvrsn=bba512a1_1