Integrated Corporate Carbon Accounting for Scope 2 Emissions

A Response to the GHG Protocol Scope 2 Public Consultation Survey

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In response to recent debates over how to assess the carbon emissions associated with a firm's electricity consumption, the GHG Protocol has launched a revision of its Scope 2 Guidance, along with public consultations on the proposed updates.

The thrust of our feedback on the proposed updates is that the task of assessing and reporting the carbon intensity of energy purchased by different customers on a grid during a particular time interval should be in the domain of the attendant "energy supplier".[1] Importantly, the energy supplier ought to determine the actual emissions embodied in delivered energy using primary data by allocating the emissions coming from different power generation sources to customers in a differentiated manner based on, what we call, a *structured market-based method*. This method builds on the market-based method (MBM) and the location-based method (LBM). It ensures that all generated emissions during a particular time interval are allocated, and it prevents suppliers from biasing the allocation. It also allows energy customers to take full credit for any renewable energy they procure and/or contract for. When combined with additional constraints, the method further aligns abatement incentives for different customers with the societal goal to decarbonize the overall energy supply.

Various analysts have argued that, when properly implemented, the LBM will capture the actual emissions embodied in consumed electricity. Yet, by always attributing the average emission intensity of the local grid, it inhibits the procurement of energy with low carbon intensity (Glenk, 2025). In contrast, the MBM provides incentives to procure renewable energy, yet it often understates the actual emissions embodied in consumed electricity (Bjørn et al., 2022). This issue arises because today's EACs are often from existing sources, prone to double-counting, and nonspecific about when and where the certified electricity was generated.

The fundamental challenge with procured electricity is that any greenhouse gas molecules emitted by power generators are inherently tied to the electrons generated at any point in time, yet electrons on a grid cannot be traced from a specific generator to a specific customer. The structured market-based approach we propose navigates this indeterminacy.

[1] Depending on the organization of electricity markets, the role of the energy supplier may comprise multiple parties (e.g., utilities, energy brokers, and grid operators). Carbon intensity levels must then be passed down the value chain, satisfying the guiding principles at each stage.

We propose three guiding principles for the *structured market-based method*. First, the energy supplier assesses the actual emissions embodied in delivered energy to individual customers using primary data. This enables energy customers to report the actual emissions embodied in consumed electricity and incentivizes renewable energy procurement, analogous to the sequential provision of cradle-to-gate product carbon footprints (Reichelstein, 2024). Second, the energy supplier allocates emissions in proportion to the kWh of energy generated and consumed. This neutrality requirement prevents the supplier from attributing emissions to customers in a biased manner. Third, in any given period, total emissions generated equal total emissions allocated to customers. This balancing requirement ensures that no emissions generated are omitted.

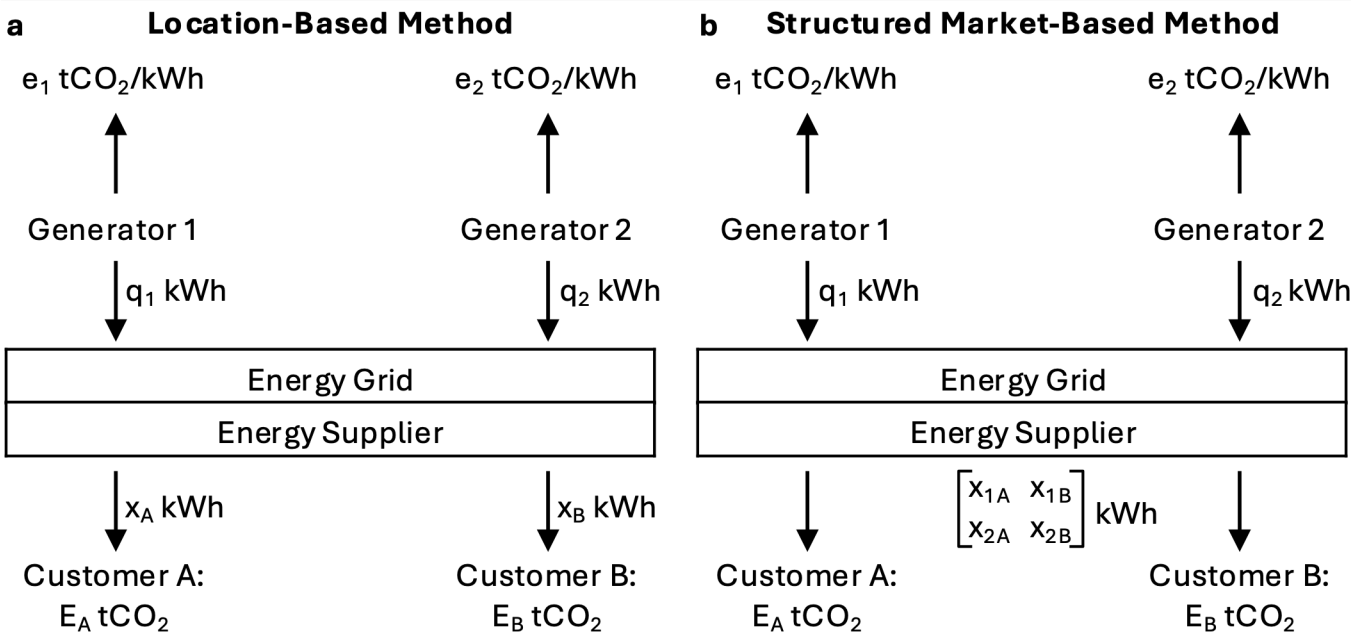

Figure 1. Accounting for emissions in delivered energy. This figure illustrates (**a**) the location-based method and (**b**) the structured market-based method for allocating actual emissions embodied in delivered energy.

To illustrate these principles, consider a stylized electricity system with two power generators (1 and 2), two energy customers (A and B), and one energy supplier operating the generators and delivering electricity to the customers, as shown in Figure 1. The balancing requirement states that, in any given period, the total emissions from generators 1 and 2 must equal the total emissions allocated to customers A and B, i.e., $E_A + E_B = e_1 \cdot q_1 + e_2 \cdot q_2$. Under the location-based method, the average carbon intensity of the grid is given by dividing the total emissions generated by the total electricity delivered, i.e., $\bar{e} = \frac{e_1 \cdot q_1 + e_2 \cdot q_2}{x_A + x_b}$. The energy supplier then attributes $E_A = x_A \cdot \bar{e}$ tons of carbon dioxide (tCO_2) to customer A and $E_B = x_B \cdot \bar{e}$ tCO_2 to customer B. This allocation is neutral and balanced by construction. Under a *structured market-based method*, the energy supplier prepares an assignment matrix that captures how much electricity generated by each generator is contractually delivered to each customer.[2] Based on this matrix, the energy supplier attributes $E_A =$

[2] For notational parsimony, suppose that transmission losses are negligible, i.e., $x_{1A} + x_{1B} = q_1$ and $x_{2A} + x_{2B} = q_2$.

$x_{1A} \cdot e_1 + x_{2A} \cdot e_2$ tCO_2 to customer A and $E_B = x_{1B} \cdot e_1 + x_{2B} \cdot e_2$ tCO_2 to customer B. This allocation is also neutral and balanced.

Through carbon accounting rules, regulators and standard setters aim to incentivize firms to decarbonize. The structured market-based method allows firms to take full credit for the renewable energy they procure and/or contract for. A requirement to match energy generation and consumption on an hourly basis further incentivizes firms to procure renewable energy in accordance with their real-time demand. An additionality requirement also incentivizes firms to procure renewable energy that is incremental to the existing generation capacity. The structured market-based method, in combination with hourly matching and additionality requirements, thus ensures alignment between abatement incentives for energy customers and the overall economic decarbonization goals.

Our guiding principles for the *structured market-based method* entail several implications for the recognition of market-based instruments. First, our focus is on measures of actual emissions incurred. These measures are conceptually distinct from measures of consequential emissions, including avoidance offsets that estimate potential emission reductions relative to counterfactual baselines. Second, the neutrality requirement implies that EACs must be bundled with the underlying energy. Otherwise, the energy supplier could bias the allocation of emissions, for example, by attributing disproportionately low emissions to select customers. Third, the balancing requirement implies that attributed energy must be deliverable to the customer. Attributing renewable energy generated in another, disconnected system to customers in the local system would cause those customers to underreport the total emissions generated in the local system.

The proposed update to the Scope 2 Guidance is generally consistent with our *structured market-based approach*. Specifically, the updates to the location-based and market-based methods effectively aim to approximate a neutral and balanced allocation of emissions and to strengthen the incentives for renewable energy procurement. However, a key difference is that energy customers are still expected to estimate the emissions embodied in consumed electricity. Placing the default responsibility with the energy supplier instead ensures that they determine the actual emissions from power generation using primary data and allocate them to customers in a neutral and balanced way. If at the outset energy suppliers do not provide carbon intensity metrics, customers can still resort to the estimation procedures described in the proposed update to the Scope 2 Guidance.

In closing, we note that our approach to accounting for Scope 2 emissions is consistent with the general principles of integrated corporate and product-level carbon accounting (Ernst et al., 2025). This is because our approach effectively reflects that power generation companies attribute their direct (Scope 1) emissions to their products, i.e., the electricity and heat delivered to the grid and subsequently to customers. This is in line with the stated objective of the GHG Protocol and ISO (at COP30 last year) to integrate and harmonize corporate and project-level accounting standards (GHG Protocol, 2025).

References

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