ACCOUNTING FOR IMPACT

Refocusing GHG Protocol Scope 2 methodology on 'impact accounting'

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INTRODUCTION

A growing number of institutions—including corporations, universities, and local governments—are making significant investments in renewable energy, largely to reduce their greenhouse gas (GHG) footprint. Many organizations began by purchasing green attributes via unbundled renewable energy certificates (RECs) and moved on to signing power purchase agreements (PPAs) for new renewable energy projects that met further criteria designed to maximize positive social and environmental impact.[1] This has led to record-breaking renewable energy purchasing by corporations and other large institutions.[2,3]

Some organizations have already reached initial targets and are now looking for even more ambitious goals to deepen their impact—such as 100% renewable energy, net-zero energy, and carbon neutrality targets. The GHG Protocol (GHGP) has been instrumental in catalyzing this corporate and institutional investment in renewable energy.

As the world's most widely used GHG accounting standard, GHGP will continue to be pivotal in the ongoing evolution of corporate sustainability efforts aimed at global decarbonization. That's in part because organizations are strongly incented to reduce those emissions that they can 'count' in their GHG reporting. By extension, accounting standards therefore orient decision-making. If traditional GHG accounting metrics and science-based decision-making tools differ, the accounting metrics tend to dominate sustainability strategies.

We thus see a ripe opportunity to better align traditional GHG accounting with science-based decision-making tools. Refocusing GHGP's Scope 2 methodology in ways that are consistent with the goal of decarbonization could guide institutions toward higher-impact choices and investments. This insight brief offers a proposed alternative or addition to current Scope 2 accounting methodologies to do precisely that.

We invite comments (and critiques!) to:

Henry Richardson, senior analyst, henry@watttime.org

[1] "The Role of RECs and Additionality in Green Power Markets." Smart Energy Decisions. April 2017.
[2] CEBA Deal Tracker. Clean Energy Buyers Association.
[3] "Corporate Clean Energy Buying Tops 30GW Mark in Record Year." BloombergNEF. 31 January 2022.

THE CHALLENGE

Current Scope 2 Methods Actually Match Megawatt-Hours, Not Emissions

Scope 2 emissions refer to an organization's indirect emissions associated with purchased energy such as electricity. For many institutions, electricity-related Scope 2 emissions are significant. Such emissions can be even higher when taking into account efforts to also decarbonize Scope 3 supply chain emissions.

Yet although Scope 2 accounting refers to emissions **in name**, current Scope 2 frameworks are actually rooted in counting and matching megawatt-hours (MWh) of electricity **in practice** as merely an indirect proxy for emissions. Organizations pursuing net-zero Scope 2 emissions are currently purchasing enough MWh of RECs to match what they consume. A more effective strategy would be measuring the real outcome (i.e., emissions) directly.[4] This would make accounting more consistent with decarbonization goals and ensure that accounting practices better enable measurable progress towards this objective.

Moreover, current Scope 2 accounting treats all renewable generation equally as zero-emissions resources. Yet there is growing acknowledgement that not all renewable energy projects provide the same emissions-reduction benefit, a dynamic that is not captured in the current GHGP Scope 2 calculations that focus on matching MWh of load with MWh of renewable energy.

The actual avoided emissions impact of new renewable energy varies widely between otherwise comparable projects based on **where** those projects are located and the generation profiles of those projects (i.e., **which** existing generation they displace or compete with for a place in the grid mix dispatch stack). For example, when one considers the actual emissions avoided, a new MWh of solar energy in California that simply displaces other solar is far less impactful than a new MWh of wind energy in Illinois that genuinely shuts down coal-fired generation.

Scope 2 of the GHGP currently includes two methods for calculating the emissions footprint of electricity consumption: location-based and market-based.

- The **location-based calculation** uses average emissions factors of the local grid to determine an emissions footprint based on facilities' MWh of electricity consumption.

- The **market-based calculation** allows organizations to match electricity consumption with contractual instruments for renewable energy on a per-MWh basis and count that electricity consumption as zero emissions, with the emissions of any remaining unmatched MWhs calculated using a residual mix factor.[5]

[4] A vision for how ambitious organizations can accurately measure electricity emissions to take genuine action. Tomorrow and WattTime. August 2021.

[5] If the residual mix emissions factor is not available, companies may use the average, location-based emission factors.

Both methods are ways of assigning a portion of estimated electricity-related system emissions to a specific organization's footprint based on MWh of electricity consumption and renewable generation. But these methods do little to directly calculate—or influence—whether an organization's actions and investments caused total real-world emissions to go up or down.

An organization reducing its own emissions on paper doesn't authentically make climate change any less likely if it simply leaves the remainder of emissions on everyone else's balance sheet. More-impactful Scope 2 emissions reductions need to reduce the size of the overall emissions pie, not merely adjust how we portion out slices of the pie to each actor in the system.

If required as a supplement to Scope 2's market- and location-based approaches, an emissions-focused approach to 'impact accounting' could incent actions that yield faster, greater emissions reductions, such as developing new renewable energy projects in grid regions with higher emissions—where those renewables result in greater reductions in real-world total emissions (since the current legacy approach treats all renewable energy projects equally as 'zero-emissions' generation).

Likewise, an emissions-centric 'impact accounting' approach provides greater incentive for using load flexibility and energy storage to shift demand away from times of dirtier electricity and toward times of cleaner electricity (since marginal emissions rates vary over time and by location, making some MWh of electricity consumption cleaner or dirtier than others).

A new approach to Scope 2 emissions accounting is needed to complement these legacy methods and catalyze a new wave of emissions reductions. Such an approach would target two crucial variables: 1) **what** we are measuring (e.g., MWh of electricity as a proxy vs. actual emissions), and 2) **how** we are measuring it (e.g., average emissions factors vs. marginal emissions rates).

Our proposed solution focuses on measuring actual emissions using marginal emissions rates to more effectively and consistently capture what GHG accounting ultimately should be about: measuring progress toward system-wide emissions reductions via the actions and investments of individual market participants.

Unlike current Scope 2 approaches that center on net-zero energy and carbon neutrality claims, this proposed approach opens the door for 'impact-neutral' and even 'impact-positive' ways of thinking about ambition.

THE PROPOSED SOLUTION

Use Marginal Emissions to Calculate Avoided and Induced Emissions

Our proposed solution aims to refocus on the emissions impact of actions, and would help serve a growing appetite for impact-driven procurement and accelerate the pace of decarbonization. This 'impact accounting' approach focuses on the **avoided emissions impact of renewable generation**, as well as a more novel idea: **the 'induced' emissions caused by electricity consumption**. Both induced and avoided emissions would be **calculated in a consistent, apples-to-apples manner, using marginal emissions rates** (see Figure 1).[6] Organizations whose induced and avoided emissions are equal could be said to have become **'impact neutral**,' while also opening up the possibility of rewarding further ambition by becoming **'impact positive'** through avoided emissions that exceed induced emissions.

This calculation methodology has been explored by organizations including Tabors Caramanis Rudkevich,[7] REsurety,[8] WattTime, and others. An avoided emissions approach has already been adopted as an additional criteria for renewable energy procurement by diverse organizations including Salesforce,[9] Nucor,[10] Boston University,[11] Clearloop,[12] Edison Energy,[13] and others.

FIGURE 1. Expanding Scope 2 accounting to include an impact-based approach

LOCATION-BASED	MARKET-BASED	IMPACT-BASED
Uses **average emissions factors** based on the generation mix for the local grid to calculate GHG footprint	Takes into account **green energy purchases**, such as purchased RECs/EACs on a MWh matching basis, to calculate GHG footprint	Uses **marginal emissions rates** to determine **induced emissions for load** and **avoided emissions for renewable generation** to understand how overall system emissions change through actions

The existing location-based and market-based approaches to Scope 2 accounting use either average emissions factors or MWh matching and residual grid mixes, respectively, to assign a GHG footprint to that electricity. Our proposed 'impact accounting' framework directly hones in on the emissions themselves, using marginal emissions to calculate the induced and avoided emissions associated with electricity consumption and generation, respectively. It can exist in parallel to—rather than as a pure replacement for—the location- and market-based approaches to provide a fuller picture.

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[6] Marginal emissions rates could take many forms, and we do not necessarily mean only short-term marginal operating emissions and may include other types of long-run marginal emissions data. Average emissions factors should not be assumed to be a good proxy for large, long-run marginal emissions. For the proposed framework, we are using short-run marginal emissions rates.

[7] "Marginal Emission Rate:" The Needed Metric of Carbon Displacement in an Increasingly Electrified World." Tabors Caramanis Rudkevich. July 2021.

[8] Locational Marginal Emissions: A Force Multiplier for the Carbon Impact of Clean Energy Programs. The Brattle Group and REsurety. March 2022.

[9] More Than a Megawatt: Embedding Social & Environmental Impact in the Renewable Energy Procurement Process. Salesforce. October 2020.

[10] "Nucor, Emissionality, and the Pursuit of Green Steel." WattTime. December 2020.

[11] "A Study in Emissionality: Why Boston University Looked Beyond New England for Its First Wind Power Purchase." Renewable Energy World. 14 January 2019.

[12] "Rivian and Clearloop Partner on Solar Project That Carves a New Path for More Impactful Corporate Renewable Procurement." Clearloop. 28 April 2022.

[13] "Edison Energy partners with WattTime to help corporate buyers maximize carbon emissions reductions." Edison Energy. 16 March 2022.

One of the primary advantages of this proposed methodology is that it reorients Scope 2 accounting toward decarbonization by focusing directly on the emissions impacts of electricity consumption and renewable generation. It also provides clear metrics to measure progress towards decarbonization goals. This is because it moves away from an emphasis on merely using a proxy—matching MWh of electricity—under the current market-based approach of Scope 2 accounting.

Furthermore, since metrics for accounting and decision making are consistent, inherent incentives are better aligned with decarbonization,[14] such as by giving credit for actions that reduce the greatest emissions, like shifting load to clean times and locations and building clean generation in the dirtiest grid regions where renewables displace more fossil-fueled generation.

For example, consider a 100% renewable energy procurement scenario. It turns out that MWh-based net-zero energy on paper doesn't necessarily equate to actual net-zero carbon emissions (see Figure 2).

Under the market-based approach of current Scope 2 accounting, an organization in this situation with 100,000 MWh of electricity load in California (CAISO) could procure either 100,000 MWh of solar energy in California or 100,000 MWh of wind energy in Illinois (MISO) to equally achieve net-zero energy (and therefore, **on paper** also achieve net-zero emissions under the market-based approach).

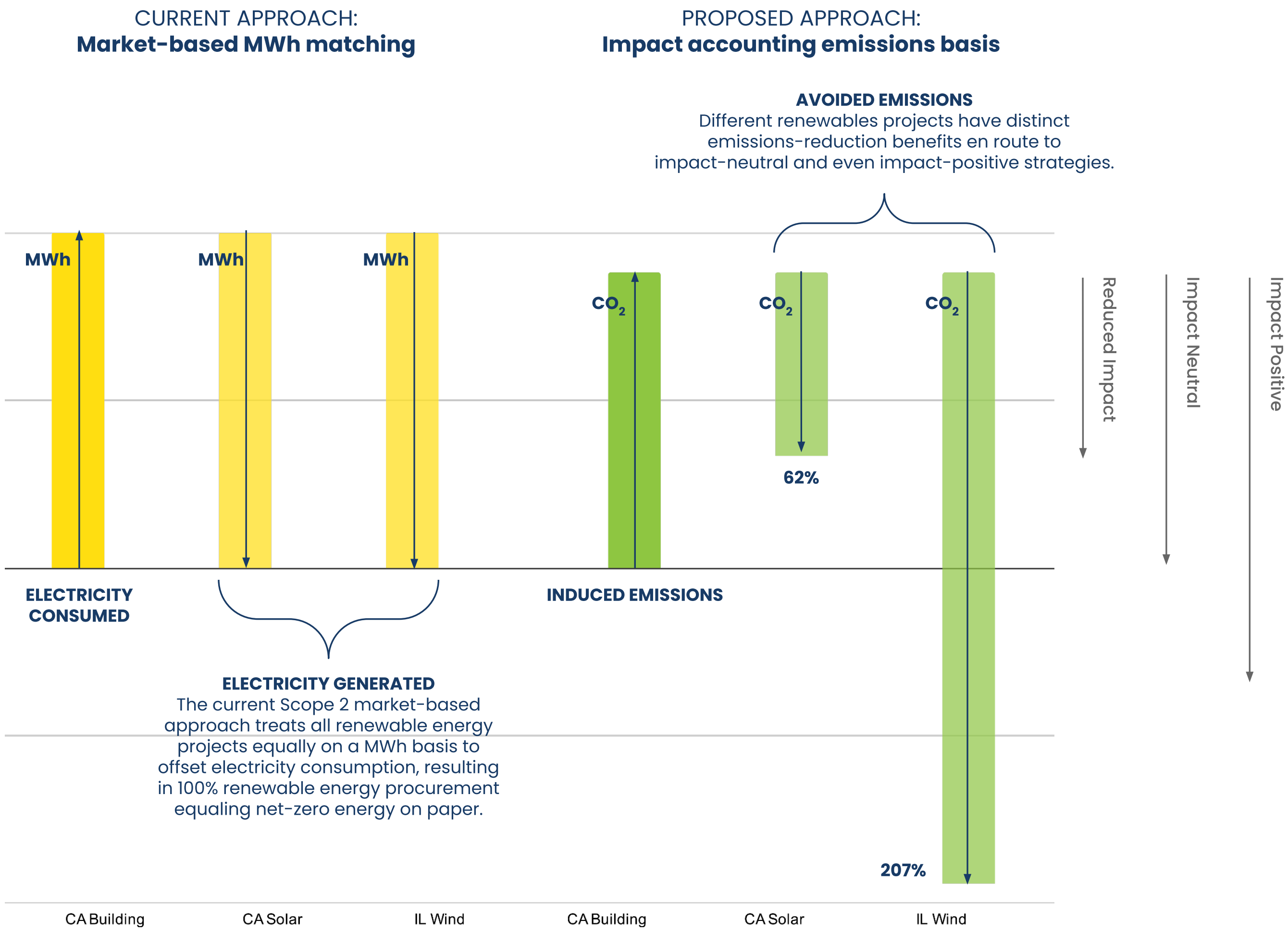
But under our proposed addition to Scope 2, the organization would instead calculate the actual induced and avoided emissions from their activities.

First, they would determine their induced emissions (by multiplying their load by the CAISO marginal emissions rate of 0.35 tonnes CO_2 per MWh, resulting in 35,000 tonnes CO_2 induced). Next, they would calculate the avoided emissions of potential renewable energy projects (0.22 tonnes CO_2 per MWh of solar in California and 0.73 tonnes CO_2 per MWh wind in Illinois, yielding 22,000 and 73,000 tonnes CO_2 avoided, respectively).

From this perspective, it becomes clear that Illinois wind results in 3x the avoided emissions per MWh that California solar does, providing the necessary insights for the organization to choose a Scope 2 strategy that achieves greater actual, **real-world** emissions reductions.

[14] We recognize that marginal emissions signals are unlikely to be the only signal on which organizations base their decarbonization strategies. Consistent with our experience working with partners, we often find co-optimization across two or more factors, such as economic and emissions signals.

FIGURE 2. Current and proposed approaches treat loads and renewable energy differently



The current market-based approach to Scope 2 emissions focuses on matching MWh of electricity, and therefore treats all renewable energy projects as equally 'good' (i.e., zero emissions) on a MWh basis to similarly offset MWh of electricity consumption, such as en route to net-zero energy targets. Our proposed approach focuses on marginal emissions—induced emissions for electricity consumption and avoided emissions based on the distinct benefits of various renewable energy projects. Organizations whose induced and avoided emissions are equal could be said to have become 'impact neutral,' while organizations that go even further with avoided emissions that exceed induced emissions would be considered 'impact positive.'

HOW IT WORKS

An Approach for Calculating Induced and Avoided Emissions

Under this proposed 'impact accounting' framework, all electricity consumers would have Scope 2 **induced emissions**. Specifically, an organization's induced emissions would be equal to their time-specific load multiplied by the time-specific marginal emissions rate at their location. This incentivizes consumers such as corporations and governments to move electricity load to low-emissions times and locations.

$$induced\ emissions = \sum_i \sum_t Load_i\,[t] \bullet MEF_i\,[t]$$

where

i is in the set of all locations that an entity consumes electricity
t is in the set of all time steps across a year considered in the calculation
$Load_i\,[t]$ = the entity's load at location i during time t
$MEF_i\,[t]$ = the marginal emissions factor at location i during time t

Similarly, under this proposed accounting framework, renewable energy generation has **avoided emissions**, calculated as their time-specific generation profile multiplied by the time-specific marginal emissions rate at their location. This incentivizes renewables developers to site and offtakers to preferentially select projects in locations with higher marginal emissions and target generation profiles to high-emissions periods when renewables can displace more fossil-fueled power plants (rather than oversaturating grids already rich in renewables and/or grids where renewable curtailment is becoming a growing challenge).

$$avoided\ emissions = \sum_i \sum_t - Generation_i\,[t] \bullet MEF_i\,[t]$$

where

i is in the set of all locations that an entity generates electricity
t is in the set of all time steps across a year considered in the calculation
$Generation_i\,[t]$ = The entity's generation at location i during time t
$MEF_i\,[t]$ = The marginal emissions factor at location i during time t

In this paper, we use a positive number to indicate induced emissions and a negative number to indicate avoided emissions.

DISCUSSION

This proposed accounting methodology has several features that will help accelerate decarbonization and make it easily implementable.

First, it shifts the focus from an accounting system that fundamentally focuses on MWh to one that fundamentally focuses on how an institution's actions affect climate change by causing total global emissions to go up or down.

By measuring the total impact actions cause on climate change, this framework incentivizes institutions to take the actions that will genuinely be most helpful for true decarbonization. The incentive to deploy solutions and strategies such as energy storage, load shifting, renewable development, consumption siting, and transmission development will be aligned with where and when they will have the most emissions reductions. Load will have greater emissions during dirtier periods and lower emissions during cleaner periods. This would also encourage siting of new energy-consuming facilities with significant Scope 2 electricity demand in cleaner regions. On the generation side, renewables will have greater Scope 2 avoided emissions in dirtier regions and at dirtier times, encouraging the development of renewables in places and with generation profiles that displace more dirtier generation.

Crucially, under this framework, consideration of emissions impact would be baked into required attributional accounting practices, thereby aligning the accounting metrics on which institutions are evaluated with the objective of global decarbonization. This shift is necessary because institutions will naturally calibrate decision-making with the metrics they are evaluated against. If optional reporting pathways for avoided emissions were sufficient to direct resources towards higher-impact strategies, the GHG Protocol for Project Accounting would have received far wider adoption.

Second, because this approach relies on the marginal emissions rate, it does not require complete market participation to determine the impact of actions, unlike residual mix calculations used in the market-based approach. Each participant can calculate their impact without relying on renewable claims information from other actors in the grid. By not relying on residual mix, this approach also does not shift emissions burden to other actors in the grid. This is crucial because we know that in the real world, not every company is equally motivated to drive impact. So, any serious decarbonization strategy must work, even without 100% participation from all electricity consumers.

Third, the approach articulated here can be calculated using different granularities (both spatial and temporal) of meter and grid data while still incentivizing carbon-reducing behavior. There is currently a widespread trend toward more granular emissions data.

Under the approach outlined here, greater granularity would better map to real-world total impacts. Thus, WattTime would recommend using the most granular temporal and spatial data that are practically available. Widely available data sources make it possible to implement this approach immediately. This methodology can be calculated with publicly available data sources that cover the globe including eGRID non-baseload factors, EPA's AVERT, and UNFCC's Harmonized IFI Default Grid Factors. The EIA is also in the process of releasing marginal emissions data, as required in Section 40412 of the 2021 U.S. Infrastructure Investment and Jobs Act.[15] Other sources of data are also available, including from WattTime.

A fourth advantage of this approach is that it dovetails nicely with the market-based methodology's practice whereby institutions can purchase both load or contractual emissions claims from renewable energy generators. This transfer would simply need to be done in avoided emissions, not MWh. One consideration is that the mechanism to transfer emissions-reduction claims from generators to consumers would have to carefully consider the renewable energy procurement mechanism and the degree to which it caused new renewable energy to be developed. Different mechanisms could fall on a spectrum of impact that would provide all parties with transparency into how value is allocated along such a spectrum. Care would also have to be taken to avoid double counting. Existing mechanisms like RECs could play a role in this.

The accounting logics of Scopes 1 and 2 require that they be theoretically equivalent. The total Scope 1 emissions of all electricity generation should equal the total Scope 2 emissions of all electricity consumption. The fifth and final advantage of this proposed approach that we have observed is that it adheres to this very useful convention.

Like the current Scope 2 emissions calculation, if applied to all participants in a market, this approach allocates total system emissions such that the sum of Scope 2 emissions across all parties (induced emissions for end users and avoided emissions for generators) equals total direct emissions (Scope 1) for the electricity sector. This approach, advanced by Rudkevich and Ruiz in a 2012 paper, carefully accounts for all emissions in the system.[16] We include a summary of the methodology in Appendix A.

Given these practical benefits, in principle this methodology could conceivably replace existing approaches to Scope 2. But existing approaches are widespread, and it is important not to disrupt the existing thriving decarbonization ecosystem that GHGP has already nurtured. We propose that a more practical near-term approach is to begin requiring reporting a third value in parallel with current Scope 2 methodologies to present a comprehensive view of an organization's electricity emissions. Note that, importantly, adding this new reporting approach would not introduce a significant new reporting burden, as it can be quickly and easily calculated from the existing data institutions **already** collect for current approaches.

[15] H.R.3684 - Infrastructure Investment and Jobs Act. 117th Congress, United States. 15 November 2021.

[16] "Locational Carbon Footprint of the Power Industry: Implications for Operations, Planning and Policy Making." Handbook of CO_2 in Power Systems. PP 131–165. March 2012.

CONCLUSION

WattTime recommends that the GHGP Scope 2 guidance adopt a marginal emissions 'impact accounting' methodology, along with the proposed approaches for calculating induced emissions for electricity load and avoided emissions for renewable generation. This methodology could either replace the existing approaches or become required reporting in parallel with the existing requirements.

We see this as a natural evolution, and one that enhances and evolves where GHGP Scope 2 accounting already is today. GHGP currently does allow for the use of marginal emissions rates in some cases. For example, GHGP permits voluntary reporting of the avoided emissions of renewable generation using marginal emissions rates. However, because this approach is not required it has received limited adoption to date. Further, in this paper's proposed approach we also extend the use of marginal emissions rates to make their application consistent across both electricity generation **and** electricity load.

This approach would realign participants' actions to greater emissions reductions, create the correct incentives for decarbonization throughout the electric grid, and do so without introducing significant new complexities or reporting burdens. We hope WRI and GHG Protocol stakeholders will consider adopting this approach for Scope 2.

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APPENDIX A: SYSTEM-WIDE EMISSIONS SCOPE 2 CALCULATION

This proposed emissions accounting framework is a different way of attributing emissions to all actors in the electric grid built on the framework advanced by Rudkevich and Ruiz. A key innovation in this accounting approach is that fossil generators are also responsible for some Scope 2 emissions (in addition to their Scope 1 direct emissions). This could be induced emissions if the generator is dirtier than the marginal resource or avoided emissions if the generator is cleaner than the marginal resource. This is a departure from traditional Scope 2 accounting, which only assigns Scope 2 emissions to load, but this solves a number of accounting problems and incentivizes generators to generate more if they would displace a dirtier resource and generate less if a cleaner resource would backfill. The Scope 2 emissions equation for fossil generators would be as follows:

$$fossil\ generator\ scope\ 2\ emissions = \sum_{t}(DirectEmissions[t] - (Generation[t] \bullet MEF[t]))$$

where

t is in the set of all time steps across a year considered in the calculation
$DirectEmissions[t]$ = The entity's direct stack emissions during time t
$Generation[t]$ = The entity's generation during time t
$MEF[t]$ = The marginal emissions factor during time t

Unlike the current Scope 2 approaches, some emissions will be allocated to generators and transmission under the proposed accounting scheme. This differs from current guidance where emissions are allocated only to consumers and reinforces incentives to reduce emissions for generators. For example, in a simplified situation where natural gas is the marginal resource, other gas resources will have no Scope 2 emissions because they have an equal emissions rate to the marginal resource. Coal generators will have positive Scope 2 emissions because they are dirtier than the marginal resource. This sends the signal that they should decrease generation, as it would be backfilled by the relatively cleaner marginal natural gas. If a natural gas generator is cleaner than the marginal resource, it will also have a negative Scope 2 emissions. While this is a departure from the current accounting scheme, this will incentivise cleaner fossil resources to increase generation, resulting in a reduction in overall emissions. This approach ensures that the accounting is aligned with the best actions that reduce overall global emissions for both generators and consumers.

This calculation methodology can be applied to all participants in the electric grid, which ensures that Scope 2 for all grid participants (generation and load) is equal to Scope 1. An implementation for a simple grid example can be found in Table 1. An implementation is available in a spreadsheet upon request.

TABLE 1. Sample calculation for induced and avoided emissions for generators and loads

Marginal Emissions Factor (MEF) = 0.45

		Energy (MWh)	**Direct Emissions Rate** (tonnes CO_2 per MWh)	**Scope 1 Direct Emissions** (tonnes CO_2)	**Scope 2 Indirect Emissions** (tonnes CO_2)
				= Energy Generation x Emissions Rate	= Scope 1 Direct Emissions – [Energy Generation x MEF]
GENERATION	Wind	800	0	0	-360
	Coal	500	0.98	490	265
	Nat Gas	900	0.45	405	0
				NA	= Energy Load x MEF
LOAD	Consumer 1	300	0	0	135
	Consumer 2	600	0	0	270
	Consumer 3	1,300	0	0	585
			Emissions Totals	**895**	**895**

Generators have Scope 1 emissions as a direct result of their MWh of generation. They also have Scope 2 avoided emissions as the difference between their direct emissions and the emissions benefit they provide. Thus in this example, wind has negative Scope 2 emissions since it's cleaner than the marginal resource (natural gas), coal has additional Scope 2 emissions on top of its Scope 1 emissions since it's dirtier than the marginal resource, and natural gas has no additional Scope 2 emissions since it is the marginal resource.

Consumers have no Scope 1 emissions since they comprise entirely load and no emissions-causing direct generation. They also have Scope 2 induced emissions as a result of their MWh of load and the grid's marginal emissions rate.

The grand total of overal Scope 1 direct emissions (generators + load) and Scope 2 indirect emissions (avoided emissions of generators and induced emissions of consumers) are exactly equal. This shows that shifting generators and consumers alike to Scope 2 calculations based on marginal emissions rates still apportions total system emissions, but it does so in a way that doesn't require perfect information about all other market participants and their claims, and it refocuses Scope 2 calculations on any individual actor's impact on total system emissions.