Modernizing GHG Accounting Rules and Climate Leadership Programs

How Attributional and Consequential Accounting Differ and Why Both are Essential to Measure and Incentivize Progress Towards GHG Reduction Goals

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Abstract

This paper explores how incumbent greenhouse gas (GHG) accounting rules, and the various leadership and target-setting programs that depend on them, could be improved to provide an accurate allocation of emissions to energy procurement and use ("Scope 2 Market-Based inventories" in "attributional accounting") and begin to estimate the real-world emissions marginal impacts of company actions ("consequential accounting"). These two types of measures differ, but both are necessary to provide a fuller picture of a company's GHG impacts while determining strategies that effectively contribute to achieving net zero climate goals.

In recent decades, electricity buyers have become a growing force in clean energy deployment. Thousands of companies have set voluntary renewable energy and/or GHG emission reduction goals. Almost universally, companies and leadership programs use established rules for calculating and reporting emissions arising indirectly from electricity use detailed in the GHG Protocol's *Corporate Standard and Scope 2 Guidance*. While these accounting and disclosure rules and practices were effective in supporting the deployment of renewable energy, they are manifestly ill-suited to maximizing the contributions that electricity buyers could make to achieving a fully decarbonized grid on a climate science-based timeline.

The current Scope 2 Market-Based method has three major limitations:

- It does not accurately measure the emissions associated with electricity use,
- It fails to recognize the value of firm carbon-free electricity (CFE) and flexible balancing resources (e.g., storage), and
- It was not designed to estimate and prioritize actions that actually reduce emissions.

Experts widely recognize these problems, but significant disagreements remain about what changes are needed to accounting metrics, methodologies, and procurement strategies. The urgency of the climate crisis requires that these differences be resolved, and new approaches be adopted as soon as possible.

This paper lays out a roadmap for change in GHG accounting and disclosures. The Market-Based method should be improved to enable companies to report accurate and credible claims about the emissions from supply serving their electricity use, while creating the demand to accelerate the growth of all CFE resources necessary to fully decarbonize electricity grids. And new and separate consequential disclosures should be added to estimate and prioritize real-world emissions impacts. Improved attributional and new consequential metrics would enhance the accuracy and climate relevance of GHG accounting and disclosures regardless of a company's electricity procurement strategy. They could be used to distinguish higher-impact from lower-impact procurement approaches and allow the most beneficial strategies to be recognized.

About the Authors

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Neil Fisher is a Partner at *The NorthBridge Group*, where he has over thirty years of experience providing economic and strategic consulting services to both regulated distribution and vertically-integrated electric utilities, competitive generators and energy suppliers, and other companies and policy organizations active in the energy space. Before and throughout the restructuring process of the U.S. electricity industry, Mr. Fisher has assisted clients with wholesale market design, competitive market analysis and strategy, regulated power supply procurement, and state regulatory initiatives and strategy. Using a combination of market insights, policy and regulatory expertise, perspectives on the energy transition, and rigorous analytic and economic skills, he has worked with clients to develop recommendations to modernize GHG accounting and reporting policies, assess risks for existing generation and new investments, evaluate emerging clean energy technologies, and achieve carbon-free procurement goals.

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The views expressed within this paper are solely the responsibility of the authors, although informed by extensive discussions with stakeholders involved with GHG accounting.

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SECTION I

Introduction

A. Across the globe, efforts are failing to develop the array of clean energy technologies and supporting policies to achieve net zero emissions by mid-century or earlier.

According to the October 2022 report by the United Nations (UN) Environment Programme, there exists today no credible pathway to the Paris Agreement goal of limiting global warming to 1.5 degrees Celsius.[i] Across the globe, we are failing to develop the array of clean energy technologies and supporting policies to achieve decarbonization at the rate needed. Carbon-free electricity (CFE) generation must increase at an unprecedented scale in both the United States and globally despite the absence of effective, systemic policies to incentivize power sector decarbonization. Expanding the supply of clean electricity while displacing fossil generation is a linchpin in achieving all net-zero paths.[ii] Decarbonization of the electricity sector must accelerate, not only to mitigate that major source of emissions, but to also facilitate decarbonization via electrification of other sectors, including transport, heating, and some industrial processes. Deeply decarbonizing the national economy is expected to require more than a doubling of electric generation, a tripling of electric capacity, and a doubling of the transmission grid by mid-century relative to today's levels, reflecting an unprecedented rate of investment and development multiple times higher than experienced over the last 30 years.[iii]

The decarbonization of the electric sector could follow several potential pathways. Substantial declines in the cost of wind and solar resources achieved in recent years point to those resources playing a significant role. But researchers have explored pathways that diverge in terms of how much they rely on variable renewable energy (VRE) with and without batteries versus a broader portfolio of carbon-free technologies to achieve deep decarbonization. While the deployment of new wind and solar capacity in the near term can help reduce carbon emissions, the hour-by-hour pattern of wind and solar output does not match the time profile of power consumption by end-users.[1] This mismatch leads to continued reliance on fossil fuel generation.[iv] Based on research assessing the potential costs and uncertainties associated with different energy transition pathways, there is broad agreement that a technology-inclusive carbon-free energy approach, including firm[2] and dispatchable carbon-free resources to complement variable renewable generation,[3] is likely to be a less risky and cost-effective pathway to deep decarbonization.[v]

> The predominant body of analysis on decarbonization of the electricity sector indicates that the fastest, most cost-effective, and reliable pathway to grid decarbonization is through a diverse portfolio of carbon-free technologies, including wind and solar, along with firm CFE and advanced storage technologies.

Unfortunately, according to a UN report, "national climate action plans remain insufficient to limit global temperature rise to 1.5 degrees Celsius and meet the goals of the Paris Agreement."[vi] While government and private pledges to cut emissions to nearly zero now cover more than 90% of the world's economy, emissions levels are still rising.[vii] Society cannot afford actions and expenditures to support claims of progress while not actually reducing real-world emissions. In this paper, we argue that reformed accounting methods for attributing GHG emissions to companies and estimating the consequences of company policies and investments aimed at reducing emissions are essential for effective progress to achieve our GHG goals.

B. Electricity buyers are a growing force in clean energy deployment.

In recent decades, electricity buyers have become a growing force in clean energy deployment.[viii] Thousands of companies have set voluntary renewable energy and/or emissions reduction goals. Many participate in third-party programs that recognize leadership in clean electricity procurement.[4] Electricity procurement programs of buyers have expanded, becoming more ambitious, complex, and diverse. Figure 1 traces the development of these programs over the last quarter century. The first generation of efforts started in the late 1990s when the purchase of renewable energy certificates (RECs)[5] allowed companies to claim their electricity use was supplied by renewable energy. The RE100 initiative[ix] launched in 2014 encouraged companies to match their annual electricity consumption with REC purchases.[6] Since the mid-2010s, long-term Power Purchase Agreements (PPAs) with corporate off-takers increasingly have helped wind and solar developers lock-in energy and REC prices for financing.

In September 2021, the UN launched the *24/7 Carbon-Free Energy Compact*.[x,xi,xii] Energy buyers and suppliers in the compact commit to move beyond 100% renewable energy annual matching goals by adopting, over time, around-the-clock CFE procurement approaches to match hourly electricity demand on local electricity grids where their consumption occurs (referred to as "24/7" or temporal or hourly energy matching). The goal of 24/7 is to create a credible claim that the clean energy procured satisfies the company's electricity consumption and to encourage the development of resources needed to achieve carbon-free hourly energy matching. Over 140 organizations have signed the UN 24/7 Carbon-Free Energy Compact. The U.S. Government and several cities also have

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1 A NorthBridge Group analysis reveals a significant shortfall between electricity demand and VRE supply even if both are in the same grid region. Companies that contract for 100% renewables (annual match) draw between 20% and 50% of their annual electricity from the local grid, including fossil generation, depending on the location, demand profile, and mix of contracted renewable supplies. (*Advancing Corporate Procurement of Zero Carbon Electricity in the United States: Moving from RE100 to ZC100*, at 7).

2 Firm CFE technologies can supply electricity on demand such as hydropower, geothermal, energy storage, nuclear, hydrogen, and fossil fuels with carbon capture and storage.

3 Maintaining and extending the operating lives of existing CFE resources, even if as a transition to new technology development, is also a vital component of meeting grid decarbonization goals.

4 Third party leadership and target-setting programs include CDP, RE100, SBTi, and the U.S. Environmental Protection Agency's Green Power Partnership.

5 A "REC" is a commodity instrument representing the environmental attributes associated with a megawatt-hour (MWh) of qualified renewable energy generation, such as from wind or solar. It is similar to a European Guarantee of Origin or GO and International I-REC.

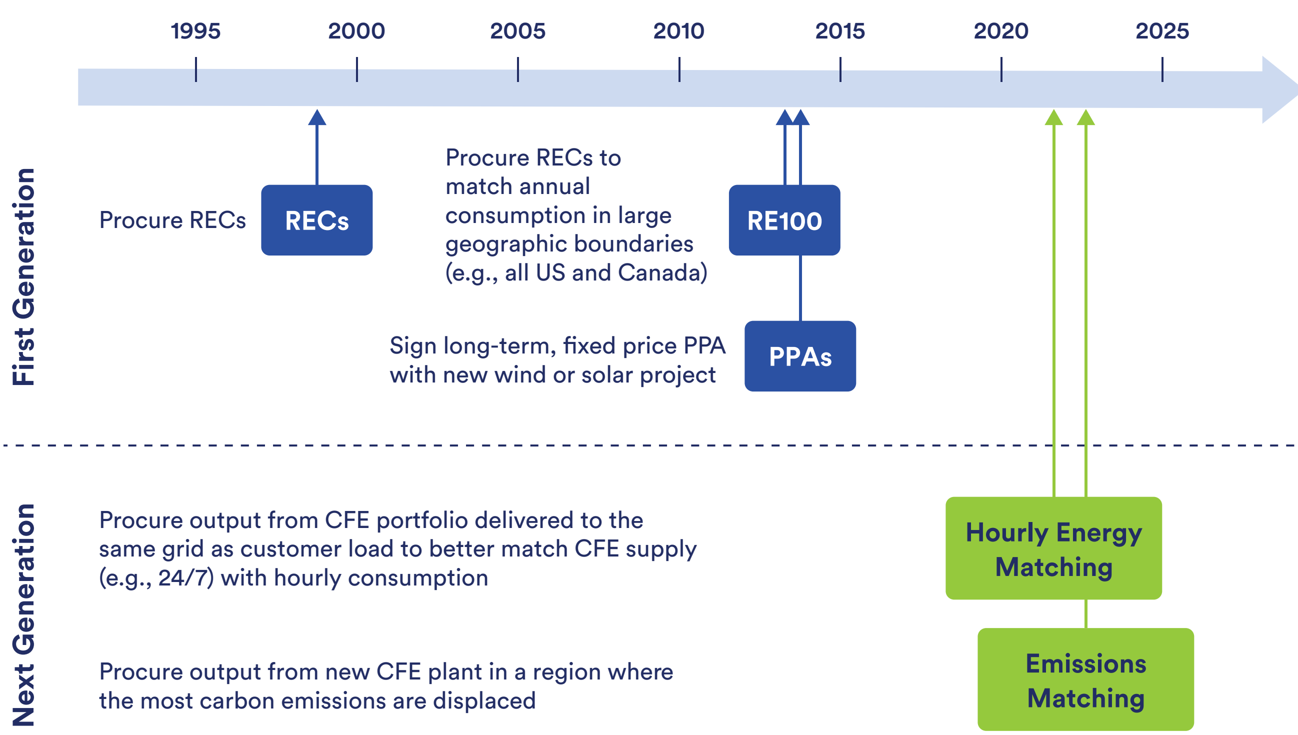
6 Today, over 400 companies "have made a commitment to go 100% renewable" in accordance with the RE100 technical criteria.

established similar goals to match CFE supply more closely with their consumption. In December 2022, a group of global companies and investors launched the *Emissions First Partnership* (EFP).[xiii] Many members support a shift in Market-Based accounting standards – moving away from current annual energy matching of clean energy attribute certificates (EACs)[7] and consumption (measured in megawatt-hours) towards emissions matching, which consists of the matching of emissions from consumption and those avoided through procurement actions (measured in tons). EFP members seek to make investments globally that prioritize actions where and when it matters most to displace the dirtiest fossil generation.

The latter "next generation" electricity procurement strategies, initiated by large buyers, seek to prioritize actions with greater climate benefit. However, both first and next generation electricity procurement transactions are in place today and are pursued for a variety of business reasons with varying climate benefits. The current GHG accounting and reporting system, and the leadership programs that depend on them, have not kept pace with these changes in procurement nor with increasing urgency of goals to achieve net-zero emissions by mid-century or earlier.

Figure 1: Electricity Procurement Goals Have Become More Ambitious, Complex, and Diverse

Source: The NorthBridge Group



First Generation Procurement Continues Today with Next Generation Options Added

[7] To simplify discussion, this paper refers to EACs associated with carbon-free electricity (CFE) as defined in the glossary.

C. The GHG Protocol is the world's most established and widely used accounting standards for how companies, cities, and countries measure, manage, and report GHG emissions.

Almost universally, companies and third-party leadership programs use established rules for calculating and reporting emissions arising indirectly from electricity use ("Scope 2" emissions) based on the GHG Protocol Corporate Accounting and Reporting Standard (*Corporate Standard*)[8] and amendment, known as the *Scope 2 Guidance*.[9]

> **The GHG Protocol Initiative** is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council on Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission was to develop internationally accepted GHG accounting and reporting standards for business and to promote their broad adoption.

For over two decades, the Protocol has played an important role in informing company actions and investments in climate mitigation. In many ways it has been a success, encouraging the development of wind and solar in the most economically viable locations. The Protocol has become the rulebook for carbon and clean energy disclosures, e.g., CDP, formerly known as the Carbon Disclosure Project, and leadership programs, e.g., Science Based Targets Initiative[10] or SBTi.[xiv] Nearly 19,000 companies, worth over half the global market capital, report to CDP using Protocol standards.[xv]

The Protocol "also forms the basis for mandatory corporate reporting programs in effect in the UK and those coming into effect in the EU,"[xvi] and also is the referenced format for new US Securities and Exchange Commission reporting requirements. For companies that aim to reduce their GHG footprints, the Protocol is an important consideration in procurement decisions and how to demonstrate reductions in attributional emissions inventories.

The *Corporate Standard* outlines the accounting and reporting rules for creating corporate inventories. It requires companies to quantify emissions from the generation of acquired and consumed electricity, steam, heat, or cooling (collectively referred to as "electricity").[xvii] To calculate Scope 2 emissions, the Corporate Standard recommends multiplying electricity consumption (in MWh) with certain emission factors to arrive at the total GHG emissions impact of electricity use.[xviii] Companies rely on these reported totals to set targets, track progress, and inform their stakeholders.[xix] Two methods are used to calculate Scope 2 emissions:

- **Location-Based Method** – The Location-Based inventory (LBI) reflects the average emissions intensity of grids on which energy consumption occurs based on grid average emission factor data, assuming a customer "consumes" the shared mix of generation on the local grid irrespective of their procurement actions.[xx]
- **Market-Based Method** – The Market-Based inventory (MBI) "reflects emissions from electricity that organizations have purposefully chosen" or receive through "their lack of choice."[xxi] It evaluates an organization's procurement actions by netting out purchases of EACs within a defined market boundary. When EACs are not available, emission factors are applied to the remaining consumption in accordance with a hierarchy described in Table 6.3 of the *Scope 2 Guidance*.

While *Scope 2 Guidance* requires dual reporting using both methods, companies have more control over their MBI and many companies opt to use the Market-Based method as the basis for target setting, measuring performance, and supporting claims associated with electricity use.[xxii] In theory, the MBI was designed to reflect the *location*[11] and *timing*[12] of purchased electricity

[8] The first version of the *Corporate Standard* was published in 2001.

[9] The *Scope 2 Guidance* was published in 2015.

[10] By the end of 2022, the cumulative total number of companies with validated science-based targets was 2,079 with another 2,151 companies with commitments to set targets, representing over a third of the global economy by market capitalization.

supply and/or EACs from *all sources*[13] of generation in relation to a company's consumption. According to *Scope 2 Guidance*, the use of an emission factor does not depend on whether the generation facility is existing or new, or why the generation has occurred.[xxiii] The Market-Based method is intended to be "policy-neutral" so that regardless of what causes a project to be built, the EAC still serves as the instrument conveying claims about the attributes of the underlying energy generation for consumers purchasing that generation.

The Market-Based method is meant to serve the goal of *allocating* emissions to electricity users. But the current method of calculating MBIs is based on a loose application of location-matching, time-matching, and attribute allocation, which is disconnected from the realities of supply procurement to serve electricity use and the changes required to decarbonize electricity grids.[14] In addition, as described later, attributional accounting is not well-suited nor designed to measure real-world emission consequences that flow from company actions.

D. The current GHG accounting rules and rewards ecosystem is out of sync with the actions required to actually achieve net-zero emissions.[15]

Current GHG accounting and reporting can result in a greatly reduced or even zero MBI on paper without reducing the actual GHG emissions associated with supply serving a company's electricity use; without developing the mix of resources needed to balance deliverable CFE supply with demand on the grid; and without reducing GHG emissions to the atmosphere. Customers can claim to consume 100% renewable energy when they purchase enough RECs to match their total annual electricity consumption. For instance, a company could purchase 100% of their supply from a nearby coal plant and entirely erase those emissions using unbundled RECs from a faraway wind farm that is disconnected from delivered electricity supply, but still claim to have achieved Scope 2 reductions. The associated production from that wind farm is not required to reflect supply that is deliverable to the location or timing of the buyer's consumption.

> In recent years there has been growing recognition that companies that *procure* 100% renewable energy nevertheless continue to *consume* electricity that is not carbon-free and continue to emit CO_2 and other GHGs.
>
> EPRI, *24/7 Carbon-Free Energy: Matching Carbon-Free Energy Procurement to Hourly Electric Load*, December 2022, pp. 9-10.

Matching RECs purchased anywhere in the United States with consumption on an annual basis enables companies to report a zero MBI with just solar or wind RECs with no firm or dispatchable CFE or batteries required. As a result, current Scope 2 accounting and disclosure practices are inadequate for driving deployment of the full suite of CFE resources necessary to support net-zero emission goals. Finally, current accounting rules do not require any estimates of the system-level emissions consequences of company actions.[16]

A company's report of a zero MBI can thus be easily misinterpreted by users of the Protocol. Often such reports are associated with a company's claims of using 100% renewable energy (use claims) and/or reducing

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11 Contractual instruments used in the Market-Based method are supposed to be "sourced from the same market" as operations and utility-specific emission factors are supposed to be calculated based on "delivered electricity." (*Scope 2 Guidance*, Table 7.1 Scope 2 Quality Criteria, 5 and 6.)

12 Contractual instruments used in the Market-Based method are supposed to be "issued and redeemed as close as possible to the period of energy consumption." (*Scope 2 Guidance*, Table 7.1 Scope 2 Quality Criteria 4.)

13 The Market-Based method was designed to account for all generation in a defined grid, not just low-carbon or renewable energy from projects supported by a specific company's financial support.

14 Since the Protocol's inception, climate goals, the Protocol's use, and technologies have changed dramatically. See the companion to this report, N. Fisher et al., *Modernizing GHG Accounting Rules and Climate Leadership Programs: When Should Companies be Able to Claim They Consume Carbon-Free Electricity?*, which focuses on recommendations to improve the Market-Based method.

15 The rules and rewards ecosystem is discussed in greater detail in *Modernizing How Electricity Buyers Account and are Recognized for Decarbonization Impact and Climate Leadership*, Green Strategies and The NorthBridge Group, August 2022.

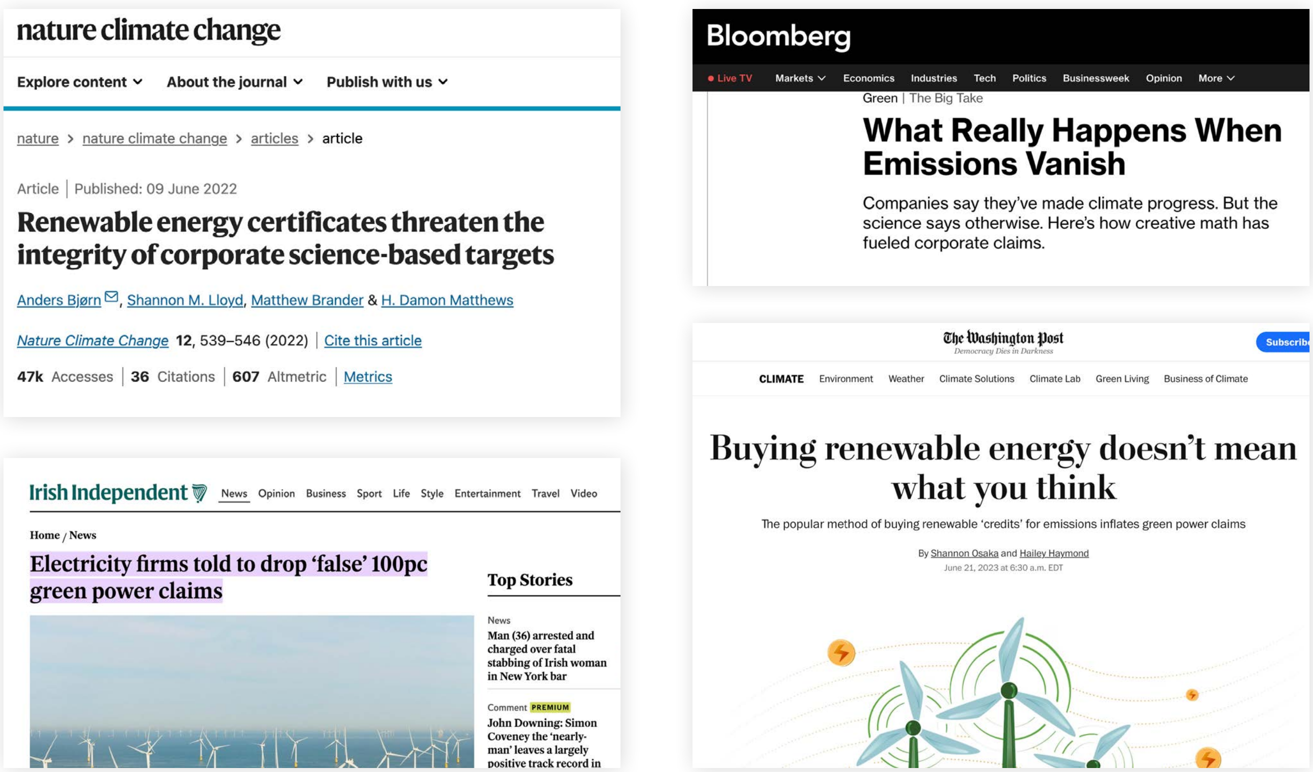
16 System-level impact refers to the overall effect on electricity grid emissions.

emissions to the atmosphere (impact claims). A zero MBI suggests that the company's environmental goals are met despite their continued reliance on fossil resources from their local electric grid. Recognition of the inaccuracy and misleading nature of such environmental claims has caused significant damage to the credibility of the GHG reporting system, and the actions of companies using them as justification, as evidenced in numerous public analysis and reports (Fig. 2).[xxiv]

Various problems with the Protocol are discussed at length elsewhere and are not repeated here.[17] Rather, this paper highlights three fundamental problems with the current Scope 2 Market-Based method, as shown in Fig. 3.[18]

Unless the current rules and rewards ecosystem is modernized, it cannot be used to identify actions that reduce emissions associated with purchased supply to serve electricity use, develop the resources needed for decarbonization, and/or reduce emissions to the atmosphere. It may instead misleadingly support actions that fail to accomplish any of these objectives. In particular, the current accounting system cannot distinguish between annual energy matching with EACs anywhere and whenever generated in the United States and hourly energy matching with supply that is actually deliverable to a customer's location. For instance, a company pursuing the former strategy and another

Figure 2: Example Criticisms of Today's GHG Accounting and Claims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Anders Bjørn, Shannon M. Lloyd, Matthew Brander & H. Damon Matthews

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Buying renewable energy doesn't mean what you think

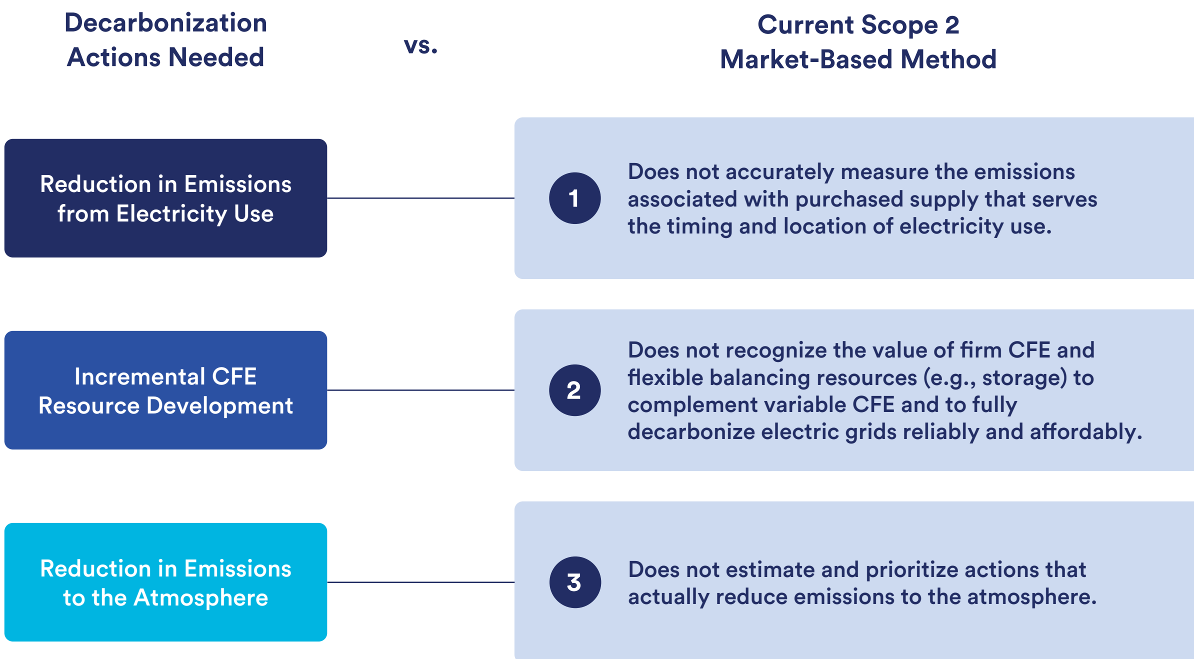
The popular method of buying renewable 'credits' for emissions inflates green power claims

By Shannon Osaka and Hailey Haymond
June 21, 2023 at 6:30 a.m. EDT

17 See endnotes xxiv and xxxi.

18 To be fair, when the Protocol and MBI were developed, it intentionally relied on the purchase of EACs that were disconnected from supply procurement to serve electricity use and the *Scope 2 Guidance* acknowledges that it was not designed or intended to support calculations of emissions avoided because of a buyer's energy transactions. As climate goals have evolved, it is fair and necessary to question whether these standards and accounting methods should be updated.

Figure 3: Existing GHG Disclosures and Climate Leadership Programs are Not Aligned with the Actions Needed to Achieve Net Zero Emissions



company pursuing the latter strategy could both report a zero MBI under the current rules. Further, the current system does not require or reward efforts to deploy the expanded suite of carbon-free technologies, including firm generation and advanced storage technologies, needed to achieve deep decarbonization of the electric grid. Finally, the current system does not attempt to distinguish higher-impact procurement and investment approaches from lower-impact approaches, which may or may not be directly linked to the location and timing of a company's consumption. The need to decarbonize the electricity sector more rapidly requires that the existing "rules and rewards" ecosystem be modernized to better measure and recognize the actions required to achieve net zero climate goals.

E. The GHG Protocol update process currently underway is the best opportunity to improve the Market-Based method to maximize the contributions that electricity buyers could make to achieving a fully decarbonized grid on a climate science-based timeline.

The problems identified above need to be addressed in the current GHG Protocol update process. WRI and WBCSD initiated a formal process in 2022 to update the Protocol involving over a thousand stakeholders. Experts widely recognize the current Market-Based method has major problems. At the same time, significant stakeholder disagreements over solutions have emerged related to accounting metrics, methodologies, and best procurement strategies.

Stakeholders Disagree on Whether and How to Reform Scope 2 Accounting

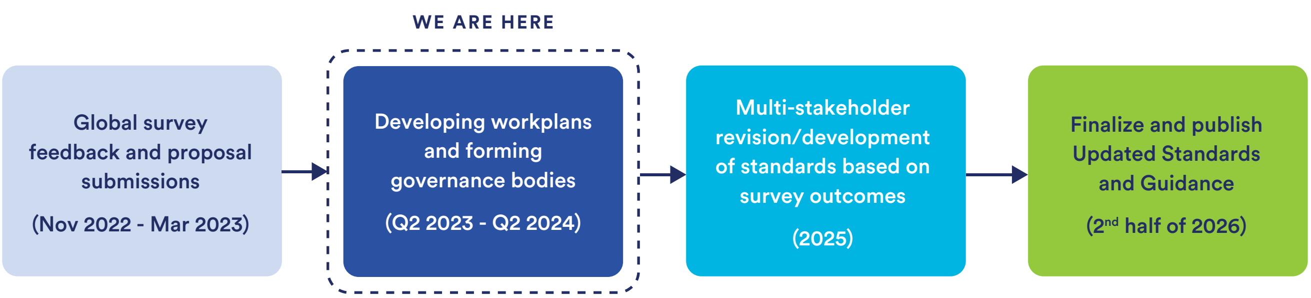
Some argue that we should be hesitant to make changes to the Protocol because it forms the basis for both voluntary and mandatory accounting and disclosure practices around the world. Some support retaining and improving MBI reporting by adding a preference or requirement for use of more granular data. Others support eliminating and replacing MBIs with consequential impact disclosures, while some support both improving MBIs and including new consequential impact disclosures. Others suggest that companies should be able to select and report whatever accounting method they prefer.

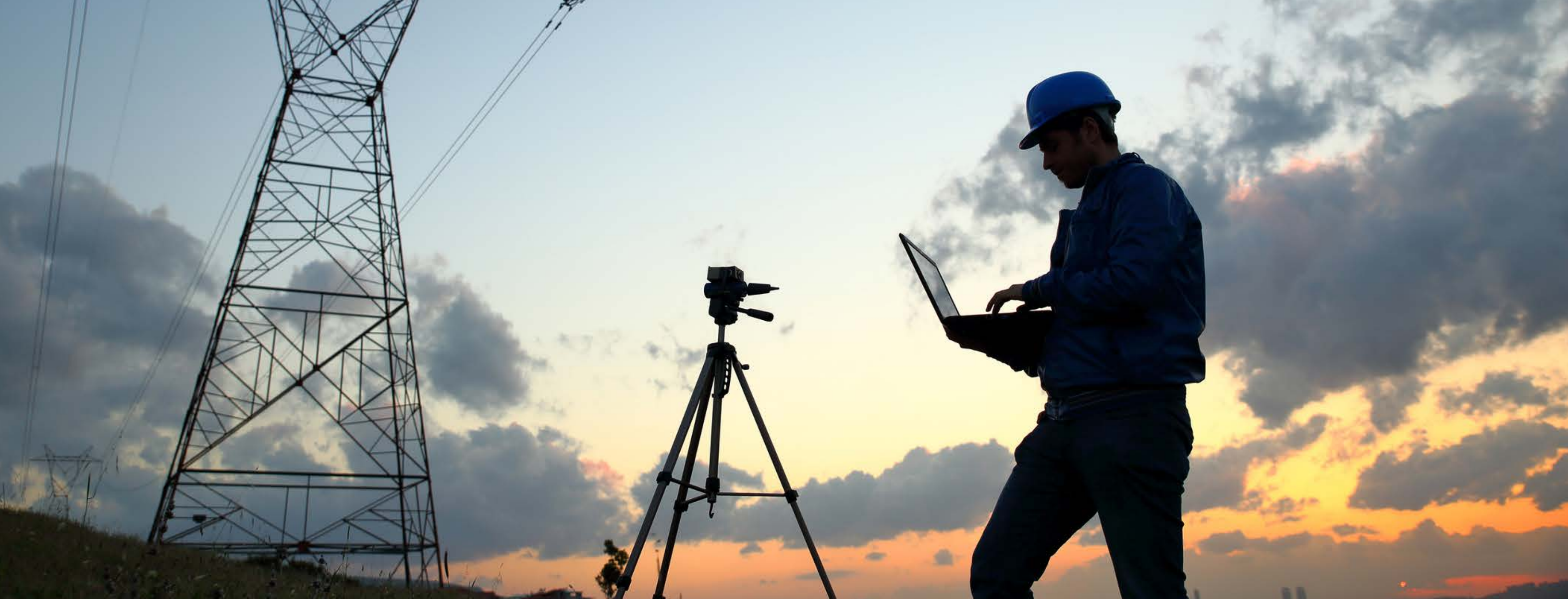
Numerous stakeholders are engaged in the protocol update process shown in Fig. 4, where they are presently hashing out those disagreements. As the figure shows, the current plan is to finalize and publish updated standards and guidance by the end of 2026. Now may be the last and best chance to improve the GHG accounting standards, and the leadership and target-setting programs that depend on them, to maximize the contributions that electricity buyers could make to achieving a fully decarbonized grid on a climate science-based timeline. More accurate and relevant GHG reporting is essential to accurately evaluate and recognize the climate impact of electricity procurement actions.

As we explain in the next section, we support parallel improvement of MBIs to make them more reflective of the resources needed to deliver CFE supply to the location and timing of consumption, and development of metrics describing consequential impacts so that company decision makers can get the most environmental improvement possible for the resources expended.

Figure 4: Now is a Critical Opportunity in the GHG Protocol Update Process to Improve the Metrics Used to Measure Progress in Achieving Climate Goals

Source: World Resources Institute, Webinar and Slides, October 3, 2023, slide 3. Updated April 30, 2024.





SECTION II

The Need for an Improved Market-Based Method

The Market-Based method should be improved to enable companies to report accurate and credible claims about the emissions from supply serving their electricity use, while creating demand to accelerate the growth of all carbon-free electricity (CFE) resources necessary to fully decarbonize electricity grids reliably and affordably.

Retaining and improving the Market-Based method is necessary to enable companies to accurately measure and support claims about the emissions associated with supply procurement to serve their electricity use. Making Market-Based inventories reflect supply that is deliverable to the location and timing of customer consumption also will create demand for the mix of CFE and balancing resources by signaling when and where CFE resources are needed to ensure reliable clean energy supply. However, the flaws associated with the current Market-Based method have led some to question whether it would be more productive to move away from the Market-Based method.

A. Some stakeholders question the value of the Market-Based method.

Three main arguments have emerged for either eliminating or not changing the Market-Based method.[xxv]

- First, despite frequent claims about companies "consuming" 100% renewable energy, it often is difficult to physically trace electricity flows from specific grid generating sources to a specific customer. Therefore, some stakeholders consider Location-Based Inventories (LBIs) a better representation of the emissions associated with the *physical* consumption of undifferentiated electricity on a shared electric grid.

- Second, some argue that the focus on attributing emissions from all generation resources (and the matching of EAC MWh with consumption) distracts from efforts to prioritize actions that reduce emissions to the atmosphere whose effectiveness must be based on consequential metrics.
- Third, some fear that tighter time and location energy matching requirements will limit participation and restrict market development and investment, making it tougher and more expensive to take climate-related actions.

Each of these concerns is discussed below in the context of why making improvements to the Market-Based method is important.

B. There are compelling reasons to retain and improve the Market-Based method.

LBIs measure the mix of generation on the local grid irrespective of a company's procurement actions (e.g., PPAs, green tariffs, supply contracts, REC purchases, 24/7 hourly energy matching, emissions matching, etc.). Companies have limited opportunity to reduce their LBIs,[19] and consequently, LBIs are not an effective tool for incentivizing and evaluating the impact of procurement actions.

Further, it is important to note that the challenges in physically tracing electricity from specific grid generating sources to specific end-users do not prevent the sale or purchase of electricity in wholesale and retail markets. Indeed, electricity typically is "delivered" to a certain location (e.g., load zone or market hub) in each hour. If tracking "delivered" supply to customers is possible in electricity markets and supply contracts, it should also be possible to improve how supply is matched with consumption in emissions accounting.

The second criticism, that reductions in MBIs do not necessarily result in actual emissions reductions, is valid. Despite how changes in MBIs are frequently interpreted by users of the Protocol, MBIs were not designed to measure actual marginal reductions in grid emissions.[20] *Scope 2 Guidance* instead offers an option for companies to estimate avoided emissions separately using another form of analysis, referred to as project level (or intervention) accounting.[xxvi] The Protocol already provides two different standards – one inventorying emissions (which is attributional) and another for project accounting (which is consequential). According to the *Guidance*, quantifying avoided emissions in project accounting can identify where low-carbon energy generation can have the biggest GHG impact. The problem is that project accounting is optional and rarely used by companies, and often ignored by leadership and recognition programs. Therefore, project accounting metrics to measure emission reductions are either absent or a low priority within target- and goal-setting programs and disclosures.

A growing body of research and analyses indicates that reductions in MBIs (attributional accounting) should not be confused with estimating system-level GHG reductions (consequential accounting).[xxvii] EACs represent attributes of one MWh of carbon-free electricity generation while offsets represent a metric ton of emissions avoided or reduced. As described by the EPA, EACs and offsets, however, are fundamentally different instruments with different impacts, representing different criteria for qualification and crediting in the context of inventories or emissions footprints.[xxviii] Attributional accounting was designed to allocate responsibility for emissions within specific boundaries, tied to a company's value chain. Consequential accounting was designed to assess whether actions taken and/or investments made by a company either reduce or increase system-wide emissions to the atmosphere, including impacts outside a company's defined boundaries. An MBI is based on the emissions of purchased supply and EACs, which may be very different from the marginal change in emissions of the entire power system that would result if the company altered the timing, amount, or source of its power purchases.[21] Another important difference is that changes in corporate procurement could set off a chain of adjustments in contracts and investments throughout the power system that in the long run alter the system's generation mix, with the resulting emissions change being very different than historical average emissions changes. Thus, basing going-forward decisions about procurement

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19 Companies can reduce LBIs by making energy efficiency improvements or supporting grid decarbonization efforts within their operating regions.

20 The *Corporate Standard* and *Scope 2 Guidance* (at 28) acknowledges that changes in Scope 2 inventories "may not always capture the actual emissions reduction accurately" and (at 7) "a single company's purchase [of a green power product] via a supplier or through a direct contract may not itself change overall grid emissions at the time of purchase."

21 For instance, according to Scope 2 Guidance, the use of an emission factor does not depend on whether the generation facility is existing or new, or why the generation has occurred. Thus, if a portfolio of decades-old hydro facilities and new gas-fired plants provide the power, marginal emissions from some corporate action would reflect only adjustments in the dispatch and even capacity of the new gas-fired source, but the average emissions would reflect a blend of rates of all sources regardless of whether incremental changes were made to the system.

on the historical averages embodied in MBI estimates could greatly distort estimates of the consequences of actual emissions changes for the power sector.

> Too often environmental professionals, policymakers, and standard-setters fail to distinguish between two major types of GHG accounting methods – which are appropriate for fundamentally different purposes. Using the wrong type of method can lead to bad decision-making. Often practitioners mistakenly assume that attributional is the only type of method and try to use such methods to answer questions that they cannot and should not be used to answer – like how much a mitigation action reduces emissions. A fundamentally different type of GHG accounting method is 'consequential', which aims to quantify the change in emissions caused by decisions or interventions. Another mistake that sometimes occurs is mixing elements of attributional and consequential approaches within a single method or analysis, such as including values for avoided emissions within what should be an attributional inventory. Importantly, both attributional and consequential methods are needed – with each used for their appropriate purposes.
>
> Matthew Brander, *The Most Important GHG Accounting Concept You May Not Have Heard of: the Attributional Consequential Distinction*, GHG Management Institute, March 2021, pp. 1-5.

Even if MBIs are modified to match deliverable CFE supply with the location and timing of consumption, companies could report an MBI of zero when actually they cause little change (or even increases[22]) in emissions. For example, a company could acquire RECs from projects where renewable energy production is already relatively abundant and the displacement of fossil energy is minimal or could acquire RECs from an existing resource whose emissions reduction potential has already mostly been achieved. And not all EACs, even if generated from new resources, have the same climate benefit. Analyses have demonstrated that an additional MWh of CFE can have widely different emission impacts depending on the timing and location of that CFE production, as the examples in Fig. 5 show.[xxix]

It will not surprise industry observers to see widely different emission impacts, since impacts depend largely on the fuel type and type of generation resource displaced (now and in the future). Unfortunately, the current accounting system cannot accurately recognize the difference in impact between adding a MWh of solar in California versus West Virginia. While not a requirement in Scope 2 accounting, many rely on the concept of "additionality" – whether a company's purchase led to installing more renewables – as a proxy for impact.[23] However, even installing new renewables does not always reduce grid emissions.[xxx] This is especially relevant in areas where increased renewable penetration displaces other CFE, is curtailed due to grid constraints, or requires fossil-fueled reserves to manage ramp-ups, ramp-downs, and volatility. So, additionality measured in terms of new CFE (in MWh) can be a poor proxy for estimating the emissions avoided (in tons). Therefore, as described in Section III, the authors recommend developing methodologies to directly estimate emission reductions.

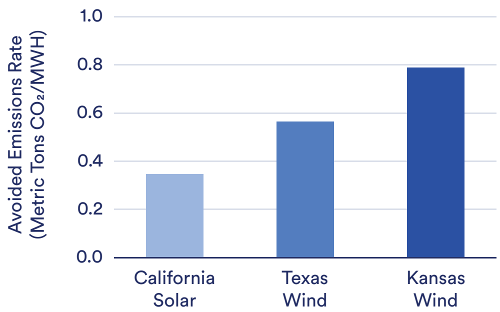
We now turn to the third criticism, which is the argument that it is too difficult for companies to a) balance deliverable CFE supply with consumption using stricter location and time matching requirements, and b) calculate an improved MBI without access to granular data. While considering deliverability and hourly (versus annual) calculations adds complexity, there is no escaping the need to wrestle with the significant complexities of grid decarbonization, and helpful tools are on the way. As noted at the outset of this paper, decarbonization of electric grids is not likely to be easy or inexpensive. Clearly, not all companies can be expected today to pursue a 24/7 procurement strategy or demonstrate direct emission impacts. But a company should not be able report a zero MBI and declare victory while not solving the fundamental problems of electric

22 This phenomenon has been recognized in the context of emissions attribution to power imports to regulated GHG markets, like California; so-called contract shuffling is then incentivized in which clean existing generation outside the regulated market is contracted as imports, replacing previous imports of high emissions generation from the unregulated market which is then diverted to consumers who are also in the unregulated market. (Chen, Y., Liu, A., and Hobbs, B.F., "*Economic and Emissions Implications of Load-Based, Source-Based, and First-Seller Emissions Trading Programs under California AB32*," Operations Research, 59(3), May-June 2011, pp. 696-712).

23 How "additionality" might be considered within Scope 2 inventory accounting principles often is not well-defined.

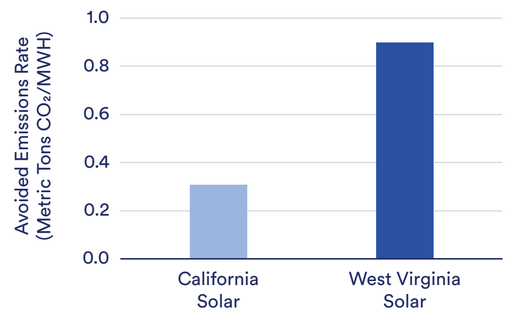
Figure 5: Not All EACs Have the Same Climate Benefit

WattTime: Kansas wind project has 2.3x the emissions impact as California solar project



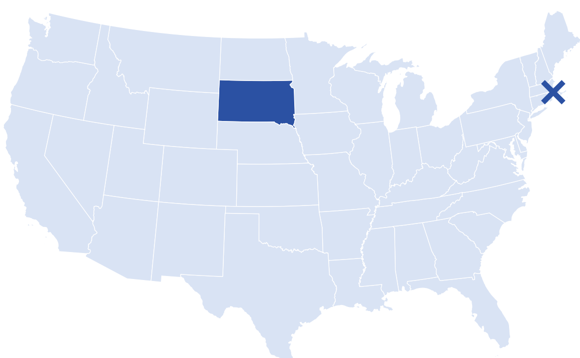
Source: WattTime – Richardson, H. and Evans, M. (2018). Avoided Emissions, Assessment of Three Renewable Energy Projects.

Salesforce: West Virginia solar project has almost 3x the emissions impact as California solar project



Source: Salesforce, More Than a Megawatt, p. 10.

Boston University: South Dakota wind project has 2-3 times the emissions impact as similar New England project



Source: www.bu.edu/sustainability/projects/bu-wind/

Microsoft: Explanimators, Decarbonization, (Episode 11), not all CFE has the same benefit

Source: www.youtube.com/watch?v=0LKa-KA93Kk

grid decarbonization. As discussed later, we must measure and disclose what matters – and then develop methodologies, data, and tools to measure progress toward achieving net zero goals. Simply reporting easy-to-accomplish progress irrespective of its relevance to attaining climate goals will waste resources and fail to achieve the needed transformation.

We offer two reasons for retaining and improving the Market-Based method that we believe are compelling.[24] The first reason is aligning the Market-Based method with physical deliverability of purchased electricity would enable companies to report accurate and credible claims about the emissions from supply serving their electricity use. Better estimates would result from an improved MBI that ties energy consumption patterns to

24 Stakeholders in the Protocol update process have stated other reasons to retain the Market-Based method, claiming it is the only way to track consumer choice in electricity supply; it is necessary to incentivize voluntary climate action; existing goals, targets and commitments are predicated on the Market-Based method; and the Market-Based method contributes to growth and development of renewable energy (*Detailed Summary of Survey Responses on Scope 2 Guidance*, WRI, November 2023, at 23-24).

the location and timing of supply and/or EAC purchases. We propose the following improvements for establishing a more accurate and credible MBI:

- Market-Based inventories should reflect supply that is deliverable to the location of customer consumption.
- Market-Based inventories should reflect supply that matches the timing of customer consumption.
- Customers should be able to count equally all EACs purchased and retired either directly or on their behalf by their load-serving entity (LSE).
- EACs should be used to substantiate claims of CFE use and their ownership rights should be fairly allocated[25] to customers who purchase them without double counting, double paying, or cost shifting.
- Required CFE purchases by customers, even if not claimed, should not be permitted to reduce the emissions attributed to other customers who have not purchased EACs. Without EAC purchases, fossil emission factors should be applied using the best available information.

These improvements are consistent with criteria already embedded within the *Scope 2 Guidance* and are discussed in greater detail in a companion paper, *Modernizing GHG Accounting Rules and Climate Leadership Programs: When Should Companies be Able to Claim They Consume Carbon-Free Electricity?* and in other documents.[xxxi]

To be clear, the purpose of these recommended improvements (related to attributional MBI accounting) is to assess the emissions and percentage of CFE associated with *purchased* supply that is *deliverable* to the location and time of company consumption. An improved MBI would focus attention on matching EACs (expressed in MWh) and the associated deliverable CFE with consumption (i.e., re-connecting attributes with generation that could serve electricity use).[26,27]

The second reason for retaining and improving the Market-Based method is matching deliverable CFE supply with consumption creates demand to accelerate the growth of *all* CFE resources necessary to fully decarbonize electricity grids reliably and affordably. An improved MBI would encourage companies and their suppliers to assemble the mix of resources needed to deliver CFE supply to the location and timing of consumption reliably and affordably, considering market conditions and the resources available.[28]

Today, U.S. grids rely on a diverse set of generation resources – baseload, intermediate/cycling, peaking, etc. – to match supply with customer consumption on a 24/7 basis, and unabated fossil resources are relied upon to supply much of the firm and dispatchable power when renewable generation is not available. These unabated resources currently represent about 60% of total U.S. generation.[xxxii] The key question is how to replace such resources with carbon-free alternatives. Increased deployments of wind, solar, energy storage, and regional transmission[29] are a large part of the answer, but a fully decarbonized grid will also require much more firm and dispatchable carbon-free generation.

Matching deliverable CFE supply with consumption will encourage the development of CFE generation and balancing resources that are needed to decarbonize electricity grids at all locations and times reliably and affordably, making the Protocol much more relevant to overall grid decarbonization initiatives. This could encourage a range of demand-side, supply-side, and grid investments, including combinations of advanced energy storage to balance VRE, firm CFE resources, demand response, and needed grid upgrades to enable growing shares of CFE to meet consumption on their local grid. The optimal mix of resources will

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25 "Fairly allocated" means that a customer should have the right to claim EACs that they purchase or their LSE purchases on their behalf, and similarly, not be able to claim EACs that they do not purchase.

26 EACs could still be unbundled from electricity supply, but now would be associated with generation that is deliverable to a company's electricity use.

27 The MBI provides a snapshot of emissions allocated to an end-user for a prior period. It does not reveal where the company started, what the company was required to do, what the company did voluntarily, or whether actions taken by the company had a direct consequential impact on overall system emissions (as described in the GHG Protocol for Project Accounting). More information is necessary to answer those questions.

28 As compared to annual energy matching, hourly energy matching requires a broader range of clean, flexible electricity supply and service options, and provides an incentive to procure more diverse, firm, and flexible CFE technologies to help ensure that the grid can integrate variable renewable generation. As discussed later, service ideally would be provided by utilities and suppliers on an aggregated customer basis and would consider generation and transmission resources available to deliver supply for electricity use.

29 Often wind and solar resources are most productive and economic in areas far from high electricity consumption. This requires the build-out of transmission within and between grid regions and countries to connect these resources with high-demand areas.

depend on many factors (economics, technology advancements, resource availability, etc.) and vary by geographic region. The accounting system should not pick technology winners and losers, but rather measure progress toward a desired end-state. To the extent more customers demand, and suppliers provide, hourly energy matching CFE supply, this will support investment in the broad set of resources required. This contrasts with the current reporting structure which drives demand for the lowest cost CFE, typically VRE in locations where it can be built and operated at the lowest cost, irrespective of the location and timing of consumption (and impact on emission reductions to the atmosphere). Detailed system analyses across various markets support the link between pursuing 24/7 procurement goals and the development of a diverse mix of CFE generation and balancing resources.[xxxiii] Recent market contracting experience also supports the connection between firm CFE and achieving high levels of hourly energy matching.[xxxiv]

In general, balancing electricity supply with consumption within an electric grid on an hourly (or sub-hourly) basis is not a new concept. Grid operators must match supply and customer load on a near instantaneous basis to provide reliable electricity service to all customers. Suppliers must balance supply and demand to maintain affordable and stable prices. When supplying or buying electricity, consideration of timing and deliverability are essential. CFE procurement on a 24/7 basis just adds a new dimension – reliance on carbon-free resources. Companies who do not incorporate time- or location-matching in their procurement goals rely on other customers, many of whom may be indifferent to their climate goals, to balance the grid.[30]

But EAC procurement and the accounting systems that support them need to accommodate contracting and EAC trading systems that take advantage of load and resource diversity over large regions, recognizing that such exchanges can drastically lower the capacity and operating costs of meeting load with predominantly CFE supply. If an accounting system instead encourages autarky[31] by requiring that small loads match their profiles with identified renewable, storage and firm clean resources, the cost of the energy transition will likely be greatly inflated. Encouraging individual customers to assemble the CFE resources necessary to match their individual loads on a stand-alone basis is likely to be difficult, expensive, and inefficient.[xxxv] The goal of 24/7 matching should not require every customer to be their own balancing authority, but to recognize the need to contribute to decarbonization of the broader grids where electricity is delivered. Importantly, customers do not need to and should not act alone. In wholesale electricity markets resources and loads are aggregated over tens of thousands, if not millions, of customers. System operators and suppliers balance supply resources with aggregated loads on a 24/7 basis; mainly, to ensure physical reliability and/or financial price affordability and stability. They must continue to balance supply and demand reliably and affordably but learn to do so with CFE resources.

Therefore, a challenge is to develop location- and time-matching accounting systems that can enable companies to substantiate credible CFE “use” claims, while also preserving incentives to take advantage of economies of scale and diversity across large regions. Utilities and competitive suppliers that are familiar with matching supply and consumption on an hourly basis can play a crucial role in assembling CFE resource portfolios to serve large groups of customers (e.g., as part of community choice aggregation, retail products, green tariff offerings or utility default service).[xxxvi] Highlighting the value of location and hourly energy matching in GHG accounting and reporting could help suppliers and other aggregators expand market access to smaller and mid-size customers.[32]

If more suppliers and customers pursue 24/7 procurement goals and have an opportunity to measure their progress in MBI reporting, this will facilitate market trading of granular certificates.[33] The data, certification mechanisms, and contractual structures needed to implement more granular temporal carbon accounting are scaling rapidly.[xxxvii] Hourly claims that match CFE production with electricity consumption within a

30 Providing “full requirements” service that balances CFE supply with consumption in all hours and locations typically is more difficult and expensive than providing “unit contingent” supply only when the sun is shining, or the wind is blowing, without requirements to match the timing and location of a customer’s consumption.

31 Autarky refers to a nation or entity that is self-sufficient, or an economic system of self-sufficiency and limited trade.

32 Companies like Flexidao, Granular Energy, ClearTrace, Powerledger, and others are already offering granular procurement and tracking services.

33 For example, the *Granular Certificate Trading Alliance* and Powerledger’s TraceX facilitate the trade of EACs by time and location.

defined market boundary are already possible in significant portions of the United States.[xxxviii] The *proposed regulations* to receive the 45V clean hydrogen production tax credit would require hourly matching of qualifying EACs beginning in January 2028.

The trading of time-based EACs can allow customers to pursue hourly matching in a more cost-effective manner, lowering the cost of hourly CFE procurement especially for buyers who have limited options for direct procurement from carbon-free generators.[xxxix] An hourly EAC market creates hourly price signals that can incentivize investment in clean technologies when the grid is dirtiest. If there is greater demand for EACs originating from specific locations or times of day, there will be greater incentive to develop resources providing these attributes. Hourly certificate trading allows customers to sell surplus or purchase deficit EACs in specific hours, which effectively allows for aggregation of generation resources and demand profiles.[xl] This is important, since matching CFE supply with aggregated system load, not an individual customer's load, is what matters, and is indeed essential to making the transition affordable. Grid decarbonization requires the development of resources to balance CFE supply with system load reliably and affordably by removing existing cost, technology, and data barriers to make time- and location-matching CFE available to all customers, while preserving and indeed expanding the benefits of interregional power trade.

SECTION III

Measuring Real Progress Toward Climate Goals

Improved Market-Based inventories and new impact accounting metrics and reporting disclosures are required to measure real progress toward climate goals.

Improved accounting metrics and reporting disclosures are needed to enhance the accuracy and relevance of environmental accounting. An improved MBI, with more granular time and location matching of EACs with consumption, while accounting for and encouraging beneficial interregional trading, can more accurately measure emissions associated with supply procurement to serve electricity use, while creating the demand to accelerate the growth of all CFE resources to fully decarbonize grids reliably and affordably. New impact disclosures can begin to estimate and prioritize procurement and consumption actions that reduce system-level emissions to the atmosphere.

As noted earlier, it is important to recognize that an MBI (as part of attributional accounting) and avoided emissions (as part of consequential accounting) are fundamentally different calculations. MBIs currently consider all procured supply – regardless of whether generation comes from existing or new facilities, why generation has occurred, or whether the purchased generation results in a change in system-level grid emissions. In contrast, consequential impacts are typically based on marginal emission factors considering incremental changes caused by a company's actions and the resulting effects on grid emissions. Each analysis answers different questions and each should ideally be measured separately and in parallel.

A company can use both GHG Protocol Initiative modules in combination to meet different purposes and objectives. Where a company is developing an inventory of its corporate-wide GHG emissions, the Corporate Accounting Standard can be used. If the same company develops a GHG project, then the Project Protocol can be used to quantify its project-based GHG reductions.

GHG Protocol for Project Accounting (p. 8)

Stakeholder feedback in the Protocol revision process highlighted that these two separate accounting methods are complementary and are viewed as essential in driving ambitious and meaningful decarbonization targets.[xli] Estimating avoided emissions, and as accurately as possible, will help prioritize procurement and investment decisions regardless of whether these reductions occur within the same market as a customer's consumption (and simultaneously reduce MBI) or occur outside the customer's market boundary (potentially not impacting MBI). Unlike MBI accounting, emission reductions to the atmosphere should not depend on *who* purchases an EAC or *how* a company chooses to use it.[34] The climate does not care which emissions are in whose inventory or who a company's supplier is. What matters is identifying incremental climate-benefitting actions and quantifying their impact over time as accurately as possible.

Since many large companies operate throughout the United States and globally, avoided emissions estimates can be used to identify which location to invest in first, and prioritize the staging of technology investments across and within market areas to achieve emission reductions at the lowest possible cost.[xlii] Prioritizing decisions that reduce actual emissions can be done in combination with hourly energy matching (24/7), as described in Google's paper "24/7 Carbon-Free Energy: Methodologies and Metrics,"[xliii] or independently, as suggested by some Emissions First Partnership members.[xliv] If such calculations are considered useful for corporate decision-making and goal setting, it follows that similar disclosures related to emission reductions could be useful, even if not precise, to users of the Protocol.

A. We need to accurately measure what we want to manage – emissions associated with supply serving electricity use, the development of incremental CFE resources needed to achieve grid decarbonization, and actual emission consequences of company actions.

Electric grid decarbonization is facilitated by 1) matching deliverable CFE supply with consumption in all locations and times, while recognizing the effects and benefits of trade across regions, 2) commercializing and deploying a diverse mix of CFE resources, and 3) prioritizing actions that cost-effectively induce large reductions in actual emissions to the atmosphere. These actions can be pursued in combination or independently. Therefore, the GHG accounting and reporting system should measure progress in pursuing each of these decarbonization actions as accurately as possible (see Fig. 6).

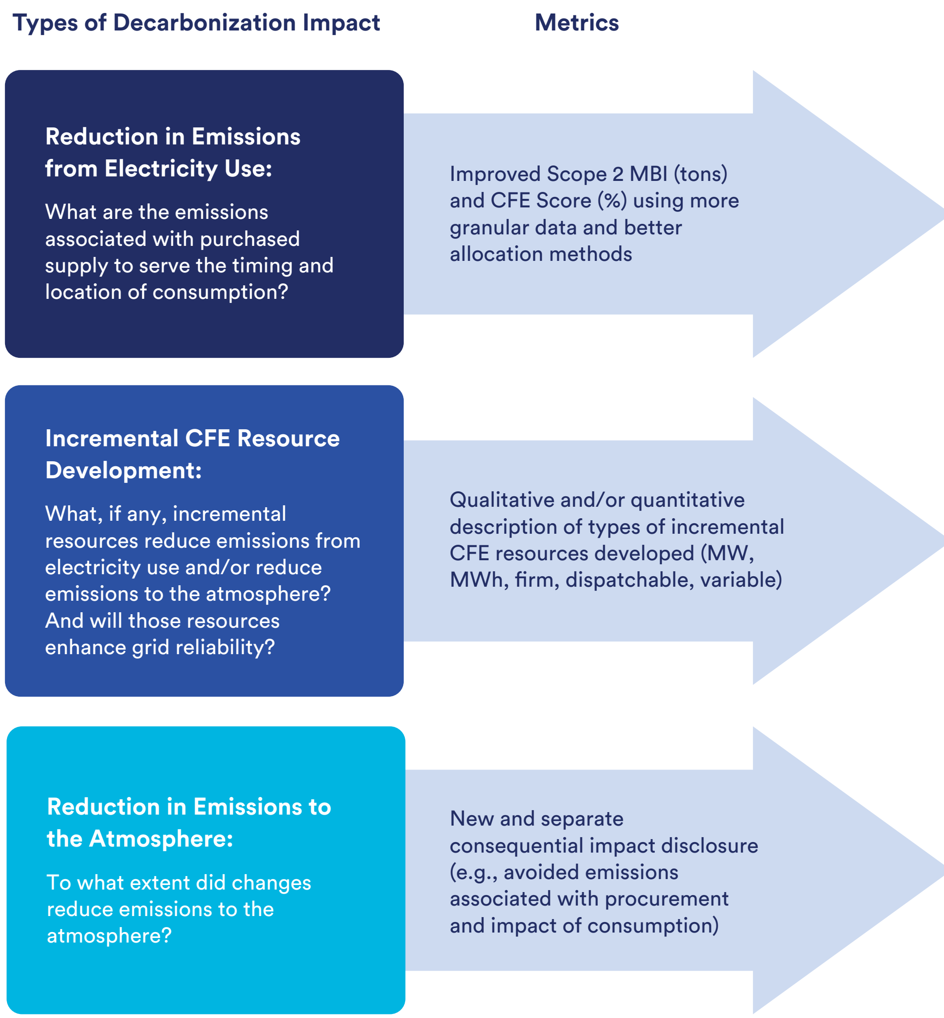
Many stakeholders are interested in having one magic number to measure environmental success. Countless studies have been commissioned to support either an hourly energy matching (24/7) or emission matching procurement approach, arguing that one approach is superior to the other and will put us on a better path toward decarbonization.

All these reform-minded stakeholders agree that status quo methods lead to misleading assessments of impacts and inefficient decisions and need to be fixed. In many instances, multiple electricity procurement objectives exist, and company decisions will involve trade-offs among economics, resource options, emission impacts, equity / community considerations, and other factors.[xlv] Emerging next generation procurement approaches, like suggested by the UN 24/7 Carbon-Free Energy Compact and Emissions First Partnership, seek to support electric sector decarbonization goals, and companies should have pathways to disclose the results of those interventions more clearly.

34 In the Market-Based method, the same EAC (MWh) is likely to result in a different level of MBI reduction (in tons) depending on who buys that EAC, since the MBI depends on the historical emission factors applicable to a *company's* procurement activities or grid location and how that company elects to apply that EAC to eliminate the emissions (on paper) associated with a MWh of consumption anywhere in the United States. The MBI reduction is disconnected with the timing and location of CFE production, does not reflect either short-run or long-run marginal system impacts, and may occur without any change in overall grid emissions.

Figure 6: Measuring Decarbonization Progress that Matters

Source: The NorthBridge Group



Energy customers should be empowered with a range of options to drive impact and accelerate grid decarbonization. While not all data is readily available, calculations are not automated and standardized, and corporate goals, abilities and access to markets differ, flexibility is needed in reporting. Superman and Batman have different strengths and weaknesses. We can argue about who is stronger, but we should recognize that both can help save the planet. An Electric Power Research Institute (EPRI) report explains:

"The debate between advocates for 24/7 CFE and those who favor emissionality is confusing in part because these two concepts are based on different GHG accounting methods (i.e., attributional versus consequential) that are used for different purposes. Attributional accounting seeks to allocate GHG emissions among the responsible emitters, while consequential accounting attempts to estimate the marginal GHG emissions impact of new investments.[xlvi]"

It is reasonable for corporate buyers to want to spend their climate-related investment dollars wisely and focus on actions that can maximize carbon emissions reductions per dollar spent. At the same time, we need to begin to develop, commercialize, and deploy a diverse mix of firm and load-following CFE resources, even if these technologies are more expensive today and even if the costs of decarbonization are relatively high in difficult-to-decarbonize market areas (e.g., New York city). Many years are typically needed to demonstrate, commercialize, and deploy new electric technologies at scale, especially for new technologies requiring large physical networks for production, transportation, and storage. Since emissions are cumulative, we not only have to succeed this year in reducing emissions, but also must start now to develop the resources to succeed fifteen years from now to achieve net zero climate goals. The actions and resources needed to succeed now and in the future may not be identical.

B. Improved accounting metrics and disclosures can be used to evaluate all types of procurement actions and can identify high-impact procurement approaches.

Improved metrics would enhance the accuracy, relevance, and transparency of information provided to potential users of the GHG Protocol (e.g., recognition programs, ESG rating companies, investors, consumers, etc.) regardless of a company's chosen electricity procurement strategy (Fig. 7).[35]

The accounting system should provide standards to report accurate and relevant information for all forms of electricity procurement. This would allow companies to disclose progress across one or more procurement goals – hourly energy matching, annual energy

Figure 7: Modernizing GHG Accounting and Recognition to Better Substantiate Environmental Claims and Incentivize Decarbonization Actions

Source: The NorthBridge Group

Current

Loose Market-Based Method

Annual purchases and emission factors across broad market boundary

- Anywhere in U.S.; annual matching
- No firm CFE or balancing resources required
- Agnostic about actual emissions impact to the atmosphere

Improved

Granular Market-Based Method

Measure emissions inventory to better reflect purchased supply/EACs that deliver to more granular market boundary with hourly matching

\+

Add Separate Consequential Accounting

Report incremental changes that displace fossil generation and calculate system-level emission impacts with no geographic limit

Benefit/Purpose

- Incentivize actions and support claims to lower emissions associated with purchased supply serving electricity use
- Accelerate development of mix of CFE resources needed to fully decarbonize grid

And

- Incentivize and reward actions that displace fossil generation and reduce emissions to the atmosphere

[35] The types of metrics and disclosures related to electricity procurement that are necessary to modernize the GHG Scope 2 Protocol are discussed in greater detail in proposals submitted to WRI and other reports. See endnote xxxi.

matching,[36] and emissions matching with resources that are in-market, out-of-market, existing and/or new. Several criteria could be used to evaluate procurement. For example, did a company's actions significantly lower their improved MBI, help develop incremental CFE (and if so, what kind), and/or significantly reduce real-world emissions on the grid? A company could perform well on all metrics, one metric or the other, or none of the metrics. An improved MBI, coupled with new and separate consequential impact disclosures, would more fully align the Protocol's reporting and accounting approaches with the actions needed to achieve decarbonization of the electric grid. Better accounting and reporting can distinguish higher-impact procurement approaches from lower-impact approaches, can allow the most impactful strategies to be recognized, and can help commercialize and deploy the expanded suite of carbon-free technologies needed to accelerate decarbonization of the electric grid.

C. Environmental claims should map to new and improved metrics that effectively identify and incentivize procurement actions with higher climate impact.

We need to map what is measured with the GHG emissions claims being made.[37] In attributional accounting, when companies (or their LSE) purchase and retire EACs associated with deliverable CFE matching their electricity consumption in each hour, using an improved MBI method, companies should be able to claim they are "using" CFE.[38] Similarly, consequential claims about emissions reductions to the atmosphere should be accompanied by a calculation of avoided emissions. Without such calculations, companies should disclose that either the emissions associated with purchased supply to serve their electricity use, or the climate impact related to their procurement have not been estimated and cannot be substantiated.
To measure progress toward the development of new CFE production, companies should identify and disclose the quantity of incremental CFE they currently support via contract and/or financing, inclusive of all forms of incremental carbon-free supply.[39] Such incremental CFE resources would then reduce a company's MBI (if time and location-matched with consumption) and/or result in a reporting of reduced emissions to the atmosphere (if fossil generation is displaced).

Requiring more precise language, metrics, and data can reduce the risk that consumers are misled by claims about the energy used to produce the goods and services they consume, avoid unwarranted and unjustified conclusions about the real benefit to the climate from company actions and help protect reporting companies from accusations of "greenwashing".

D. Further work is required to enable accurate measurement of emissions associated with electricity use and consequential impact disclosures.

Disagreements remain regarding how to calculate new and separate consequential impact disclosures.[xlvii] The methodologies are evolving and there is not yet consensus on an approach.[40] Some approaches are based on econometric system or engineering-economic system models and long-term forecasts that account for changes in capital stock (e.g., generating plant additions, retirements, and changes in the grid) in response to procurement. Others[xlviii] are based on historical short-run marginal emission factors and assume fixed capital stock. According to the GHG Protocol for Project Accounting,

[36] For example, companies could continue to pursue annual energy matching pursuant to the RE100 technical criteria. An improved MBI and consequential disclosures could still be used to measure emissions associated with electricity use and impact on system-level emissions, respectively. Companies calculating MBIs based on annual matching would not be directly comparable to MBIs based on hourly matching. To address this problem, when actual data is not available, annual MBIs could be converted to a corresponding estimated hourly MBI using standardized generation supply and customer load profiles.

[37] Better understanding and accurate interpretation of different measurements also is vital.

[38] Hourly matching claims should be substantiated with the use of hourly granular certificates.

[39] Incremental CFE could include new capacity, life extensions, repowering, uprates, etc.

[40] Guidelines are needed to define the methodology used for determining impact disclosures. Marginal emissions data may exist by node, region, or at national levels. Like when calculating an MBI, using granular data to calculate avoided emissions can improve accuracy. Avoided emissions can also be calculated with less granular publicly available data sources including eGRID non-baseload factors, EPA's AVERT, and UNFCCC's Harmonized IFI Default Grid Factors. (Henry Richardson, *Accounting for Impact, Refocusing GHG Protocol Scope 2 Methodology on 'Impact Accounting,'* WattTime, September 2022.)

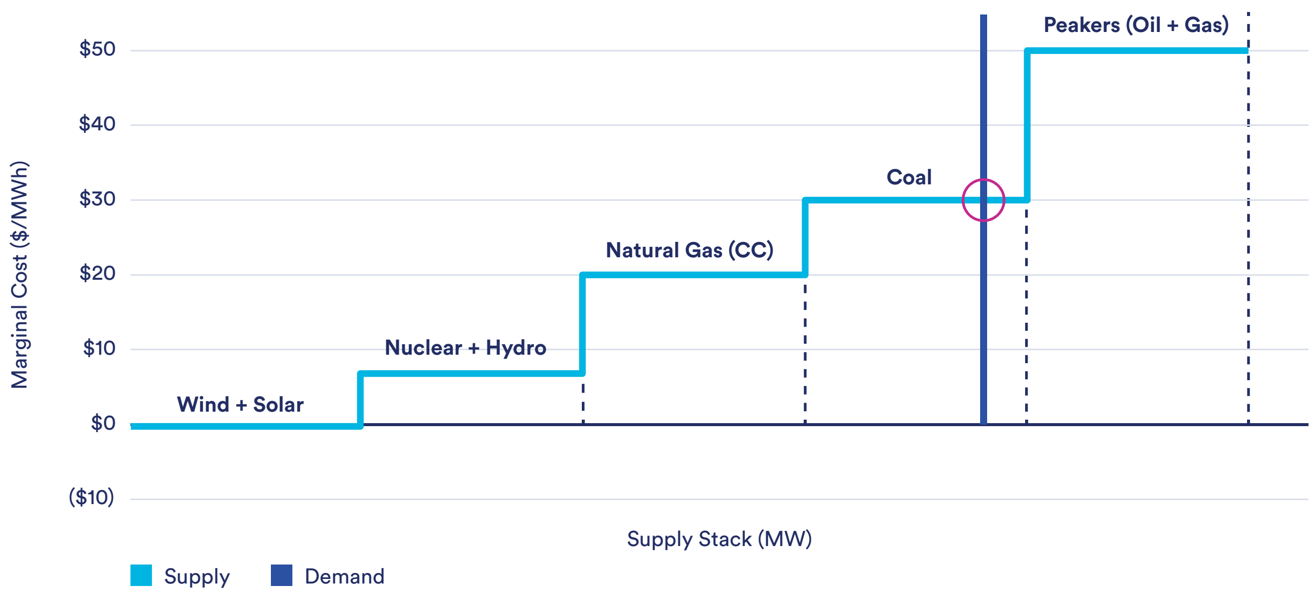
emission changes from projects should be measured relative to an estimated baseline scenario which represents a hypothetical description of what would have most likely occurred in the absence of any climate change mitigation.[xlix] Questions often raised include:

- What counts as a system change in emissions (e.g., emissions with and without a company action)?[41]
- What or who caused a change to occur?
- How to calculate the effect of a change over time?
- When and to what extent can companies claim credit for emission reductions?

Electricity-related GHG emissions at a given time depend on the demand and supply of resources operating on the grid. An illustrative supply curve used to dispatch electric generating resources in a regional electric grid is shown in Fig. 8. The supply curve shows the order in which the available generating units are dispatched to satisfy customer demand at any given time. As seen in the figure, generating resources are dispatched typically based on the lowest marginal cost (e.g., wind and solar generation with their $0/MWh marginal cost), followed by other zero-carbon generating resources (in this example, hydroelectric and nuclear), and then by carbon-emitting natural gas and coal,[42] and finally by higher-cost fossil-fueled peaking plants, which typically only operate a small number of hours in the year.[43]

Figure 8: Illustrative Electric System Supply Curve – Emission Impacts on Grid Driven Largely by Changes in Supply and Demand Over Time

Source: The NorthBridge Group, example and description included in Advancing Corporate Procurement of Zero Carbon Electricity in the United States: Moving from RE100 to ZC100, December 2021.



[41] Defining system changes can be complicated by the presence of an emissions cap and trading system (GHG Protocol for Project Accounting, at 19), as well as the particular rules (and politics) governing the definition of caps and how they are adjusted over time (Severin Borenstein, *Carbon Neutrality for Sale*, Haas Energy Institute Blog, University of California, January 2024).

[42] Marginal costs are based on representative fuel and variable operating costs. Coal plants may have lower marginal costs than natural gas plants depending on the region and the plant characteristics.

[43] Economic dispatch is subject to transmission and plant operating constraints associated with moving electricity from generators on the grid to end-use customers. This process in also used to establish locational marginal prices (LMPs) in electricity markets. The LMP represents the cost of generating the next increment of electricity at the location.

In this example, the coal plant is the marginal generator. A small increase or decrease in demand will change the generation needed from the coal plant. Similarly, adding more wind and solar generation on the left side of the figure would move the supply curve to the right, and given the same level of demand, less generation from the coal plant and lower emissions from the system would result. The amount of emission reductions driven by new CFE depends on the type of generation that it displaces (e.g., another CFE resource, natural gas combined cycle, oil or gas combustion turbine, or coal resource). This value varies largely between fuel types and the emission factors of the marginal generator(s) and varies regionally and over time as demand and resources on the grid change (e.g., plant additions, retirements, transmission improvements, etc.).

Emission impacts are driven by changes in demand and supply relative to a baseline level of emissions.[44] Defining a baseline level of emissions by location and over time to assess when incremental changes occur and quantify their impact is important and subject to debate.[45]

Nonetheless, attempting to measure decarbonization impact, even if imperfectly, is vital for improved environmental reporting and increasing the climate value of procurement and investment decisions.

Even among stakeholders who recognize the need to add new and separate consequential impact disclosures, parties disagree on *where* such impact disclosures should be reported. On the one hand, some argue that consequential impact disclosures do not belong in Scope 2 accounting since estimating marginal emission impacts associated with specific actions is fundamentally different than allocating all emissions to end-users. On the other hand, some argue that consequential accounting should fall within the *Scope 2 Guidance* (or the *Corporate Standard*) since users of the Protocol, and regulations and laws based on the Protocol, currently rely on Scope 1, Scope 2, and Scope 3 inventories. If not contained within the scopes, they fear that consequential accounting will not be on equal footing with an MBI. Reaching agreement on this issue will likely require changes in how the Protocol is used by third parties, including governments.

44 Additionality is incorporated as an implicit part of the procedures used to estimate baseline emissions in the *GHG Protocol for Project Accounting* (at 8).

45 Marginal emission rates are relatively easy to identify in particular hours based on which generators are on the margin and network relationships. However, it is more challenging to forecast how system loads, renewable output, and other system conditions will change over time.

SECTION IV

Conclusion

We recognize that important issues remain regarding *how and when* given the available data we can accurately measure emissions associated with supply procurement to serve electricity use[46] and emissions impacts to the atmosphere. While it is reasonable and constructive to debate how best to calculate these measures, we should agree that both attributional and consequential measures are vital to understanding decarbonization impacts and what actions will cost-effectively achieve our GHG goals. In a *joint letter* to WRI and WBCSD, seventeen stakeholders called for critical updates to the Protocol that encompass both types of measures.[li] Certainly, ongoing work will need to address a range of questions and details as to the timing for imposing new requirements, the burden of completing enhanced disclosures, and the availability of necessary data. While resolving these issues will be difficult, we strongly believe that building the reform process around these metrics will ensure that the Protocol continues to be a critical agent for reaching climate ambition. It is time to stop playing checkers when the climate requires chess. An improved MBI, coupled with new and separate consequential impact disclosures, would measure and report climate progress using more relevant, complete, consistent, transparent, and accurate information.[47]

46 Key issues and recommendations to calculate an improved MBI are discussed in more detail in a companion paper, N. Fisher et al., *Modernizing GHG Accounting Rules and Climate Leadership Programs: When Should Companies be Able to Claim They Consume Carbon-Free Electricity?*

47 The *Scope 2 Guidance* (at 21-23) describes these five principles – relevance, completeness, consistency, transparency, and accuracy – to develop fair and true inventories.

SECTION V

Glossary and Acronyms

Additionality	A criterion often applied to GHG project activities, where additionality denotes that the outcome of an intervention "would not have happened anyway"—i.e., that the project activity (or the same technologies or practices that it employs) would not have been implemented in the absence of that intervention (or Baseline Scenario).
Allocation	The process of assigning responsibility for GHG emissions from a specific generating unit among its various users of electricity.
Attribute	Descriptive or performance characteristics of a particular generation resource. For Scope 2 GHG accounting, the GHG emission rate attribute of the energy generation is required to be included in a contractual instrument in order to make a claim.
Attributional accounting	Attributional accounting is designed to allocate responsibility for emissions within specific boundaries, tied to a company's value chain.
Avoided emissions	An assessment of emissions reduced or avoided compared to a reference case or baseline scenario. Typically, avoided emissions represent the total carbon emissions, estimated in tCO_2e, from grid electricity that are displaced by the addition of a new CFE generation project to the same grid.
Balancing area	Balancing authorities are a functional role defined by the North American Electric Reliability Corporation and are primarily responsible for balancing electricity supply, demand, and interchange on their electric systems in real time. This balance is needed to maintain the safe and reliable operation of the power system and includes managing transfers of electricity with other balancing authorities. There are 66 balancing authorities in the United States.
Balancing resources	In this paper, balancing resources refer to non-generation resources that can help balance CFE supply with demand, such as energy storage, load-management, and transmission.
Baseline scenario	A hypothetical description of what would have most likely occurred in the absence of any considerations about climate change mitigation.

Baseload	A type of power plant that operates continuously (or nearly continuously) to meet base levels of power demand that can be expected regardless of the time of day or year.
Bidding zone or market load zone or market hub	A bidding zone in Europe is the largest geographical area in which bids and offers from market participants can be matched in which a single wholesale electricity market price applies without the need to attribute cross-zonal capacity. Currently, bidding zones in Europe are mostly defined by national borders. In the United States, market load zones are used for wholesale energy market settlement where the locational marginal price is the same (e.g., New England is divided into eight electric load zones.) A market hub is a collection of locations intended to represent an uncongested price for electric energy, facilitate electric energy trading, and enhance transparency and liquidity in the marketplace.
Bundled	An energy attribute certificate or other instrument that is traded with the underlying energy produced.
Carbon-free electricity (CFE)	CFE is electrical energy produced from resources that generate no carbon emissions, including marine energy, solar, wind, hydrokinetic (including tidal, wave, current, and thermal), geothermal, hydroelectric, nuclear, renewably sourced hydrogen, and electrical energy generation from fossil resources to the extent there is active capture and storage of carbon emissions that meets the EPA's requirements.
CFE score	The percentage of load that is matched with CFE within or deliverable to a defined market boundary. It can be measured by hour or annually. If measured hourly, purchased CFE in excess of load in one hour cannot be used in another hour unless stored.
Company	The term company is used in this paper as shorthand to refer to the entity developing a GHG inventory, which may include any organization or institution, either public or private, such as businesses, corporations, government agencies, nonprofit organizations, assurers and verifiers, universities, etc.
Consequential accounting	Consequential accounting is designed to assess whether actions taken and/or investments made by a company either reduce or increase system-wide emissions to the atmosphere, including impacts outside a company's defined boundaries.
Cost shifting	In this paper, cost shifting refers to companies being able to claim CFE/EACs they do not purchase and/or are supported by other customers.
Double counting	No double counting means that no certificate should be double issued, duplicated during transfer, double registered, double canceled, or used more than once.
Double paying	In this paper, "double paying" refers to companies unable to claim CFE they already purchase and then having to purchase additional CFE or EACs to reduce their Market-Based inventory.

eGRID	U.S. Environmental Protection Agency's *Emissions & Generation Resource Integrated Database* is a globally recognized source of emissions data for the electric power generated in the United States. Data in eGRID are displayed at the plant level and are also aggregated to state, electric generating company, power control area, eGRID subregion, NERC region, and the U.S. total levels.
eGRID fossil fuel output emission rate	eGRID fossil fuel output emission rates are calculated based on plants whose primary fuel is coal, oil, gas, or other fossil fuel.
eGRID non-baseload emission rate	eGRID defines non-baseload emission rates as the output emission rates for plants that combust fuel and have capacity factors less than 0.8, weighted by generation and a percent of generation determined by capacity factor.
eGRID total output emission rate (or system average emission rate)	The eGRID annual total output emission rate is the measure of the emissions as it relates to the net generation output. It is calculated as the emissions mass divided by the generation MWh multiplied by a unit conversion factor. Units are in lb/MWh for CO_2. Average emission factors represent all generation occurring within a defined region and should reflect net physical energy imports/exports across the grid boundary.
Emissions	The release of greenhouse gases into the atmosphere.
Emission factor	A factor that converts activity data into GHG emissions data.
Energy attribute certificate (EAC)	A category of contractual instruments used in the energy sector to convey information about energy generation to other entities involved in the sale, distribution, consumption, or regulation of electricity. This category includes instruments that may go by several different names, including certificates, tags, credits, etc. (EACs can apply to all types of generation, but to simplify discussion, this paper refers to EACs associated with carbon-free electricity.)
Fair share allocation	In this paper, a "fair share" allocation means that a customer should have the "right" to claim EACs that they purchase or their LSE purchases on their behalf, and similarly, not be able to claim EACs that they do not purchase.
Firm CFE	Firm CFE technologies can generate electricity on demand such as hydropower, geothermal, energy storage, nuclear, hydrogen, and fossil fuels with carbon capture and storage.
Granular certificate (GC)	Certificate relating to the characteristics of energy produced during a period of one hour or less. GCs are commonly referred to as time-based EACs.

Greenhouse gases (GHG)	GHGs are the seven gases covered by the UNFCCC: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF_6), and nitrogen triflouride (NF_3).
Grid or regional grid	A system of power transmission and distribution (T&D) lines under the control of a coordinating entity or "grid operator," which transfers electrical energy generated by power plants to energy users—also called a "power grid." The boundaries of a power grid are determined by technical, economic, and regulatory-jurisdictional factors. A regional grid corresponds to the area over which a single entity manages the operation of the electric power system and ensures that demand and supply are balanced. In the United States, this generally refers to one of seven RTOs or ISOs (California ISO, Electric Reliability of Council of Texas, Midcontinent ISO, New England ISO, New York ISO, PJM, Southwest Power Pool). These regional grids cover about half of the states and roughly two-thirds of total U.S. annual electricity demand.
Grid or system operator	The entity responsible for implementing procedures to dispatch a set of power plants in a given area to meet demand for electricity in real time.
Inventory or market boundary	An imaginary line that encompasses the direct and indirect emissions included in the inventory. It results from the chosen organizational and operational boundaries.
Location-based method (Scope 2)	A method that reflects the average emissions intensity of grids on which energy consumption occurs based on grid average emission factor data, assuming a customer consumes the shared mix of generation on the local grid irrespective of their procurement actions. Average energy generation emission factors are for defined locations, including local, subnational, or national boundaries.
Locational marginal price (LMP)	LMP is a way for wholesale electric energy prices to reflect the value of electric energy at different locations, accounting for the patterns of load, generation, and the physical limits of the transmission system. LMP is defined as the marginal price for energy at the location where the energy is delivered or received and is based on forecasted system conditions and the latest approved real-time security constrained economic dispatch program solution. LMP is expressed in $/MWh. LMP is a pricing approach that addresses transmission system congestion and loss costs, as well as energy costs. LMPs can be calculated in both the real-time energy market and day-ahead energy market. The LMP calculation calculates the full marginal cost of serving an increment of load.

Marginal emissions rate or factor	Short-run or operating marginal emission rates (sometimes referred to as SRMER, LMER, LME, or MER) represents the emissions per unit change in electricity consumption or injection of generation, considering changes in power plant production levels from one moment to the next assuming no structural changes in the grid, such as plant retirements or additions. Long-run or build marginal emission rates (sometimes referred to as LRMER) represents the emissions per unit change in electricity consumption or injection of generation, considering both operational (short-run) and long-term structural changes in the grid (e.g., the building and retirement of capital assets, such as generators). A buyer action can affect grid emissions across one or more timeframes and could have multiple marginal impacts.
Marginal generator or unit	Marginal generator(s) or unit(s) are the units "out on the edge of the supply stack" that would increase or decrease output in response to an increase or decrease in demand. In general, there is always one marginal unit representing the system energy price in a competitive market or system lambda (i.e., the cost of the next kWh that can be produced by an electricity supply system's generating units) in a regulated market. When there is congestion on the system, there will be one additional marginal unit for each constrained transmission line on the system.
Market-based method (Scope 2)	A method that reflects emissions from electricity that companies have purposefully chosen (e.g., through contracts) or receive through their lack of choice.
Megawatt (MW)	A unit of electrical power. One megawatt of power output is equivalent to the transfer of one million joules of electrical energy per second to the grid.
Megawatt-hour (MWh)	A unit of electrical energy equal to 3.6 billion joules; the amount of energy produced over one hour by a power plant with an output of 1 MW.
Power purchase agreement (PPA)	A type of contract that allows a consumer, typically large industrial or commercial entities, to form an agreement with a specific energy generating unit. The contract itself specifies the commercial terms including delivery, price, payment, etc. In many markets, these contracts secure a long-term stream of revenue for an energy project. In order for the consumer to say they are buying the electricity of the specific generator, attributes shall be contractually transferred to the consumer with the electricity.
Regional Transmission Organization (RTO) / Independent System Operator (ISO)	An RTO is an electric power transmission system operator that coordinates, controls, and monitors a multi-state electric grid. The purpose of the RTO is to promote economic efficiency, reliability, and non-discriminatory practices while reducing government oversight. An independent system operator (ISO) is an organization that coordinates, controls, and monitors the operation of the electrical power system within a single U.S. state, but sometimes encompasses multiple states.

Renewable energy	Energy taken from sources that are inexhaustible, e.g. wind, water, solar, geothermal energy, and biofuels.
Renewable energy certificate (REC)	A type of energy attribute certificate, used in the U.S. and Australia. In the U.S., a REC is defined as representing the property rights to the generation, environmental, social, and other non-power attributes of renewable electricity generation. It is a commodity instrument representing the environmental attributes associated with a megawatt-hour (MWh) of qualified renewable energy generation, such as from wind or solar. A REC is like a European Guarantee of Origin or GO or International I-REC.
Renewable portfolio standards (RPS)	A state- or national-level policy that requires that a minimum amount (usually a percentage) of electricity supply provided by each supply company is to come from renewable energy.
Residual mix	The "residual mix" refers to untracked or unclaimed energy and emissions if a company does not have other contractual information that meets the Scope 2 Quality Criteria (e.g., the emissions rate left after the other contractual information – energy attribute certificates, direct contracts, supplier-specific emission rates – are removed from the system). It is used when calculating the emissions from unspecified purchased or acquired electricity where more-accurate information about the resources and emissions associated with electricity use is not available from the user's state, region, or electricity supplier.
Scope 2 emissions	Indirect emissions from the generation of purchased or acquired electricity, steam, heat or cooling consumed by the reporting company.
Supplier-specific emission factor	An emission rate provided by an electricity supplier to its customers, reflecting the emissions associated with the energy it provides. Suppliers offering differentiated products (e.g. a renewable energy product) should provide specific emission rates for each product and ensure they are not double counted with standard power offers.
Tracking system	A database or registry that helps execute energy attribute certificate issuance and cancellation/retirement/claims between account holders in the system. It can track information on certificates or generation occurring throughout the defined system. They are typically tied to geopolitical or grid operational boundaries.
Unbundled	An energy attribute certificate or other instrument that is separate, and may be traded separately, from the underlying energy produced.

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