NARUC
National Association of Regulatory Utility Commissioners

Regulators' Financial Toolbox: Keeping Track of Clean Energy

The National Association of Regulatory Utility Commissioners (NARUC) Center for Partnership and Innovation (CPI) Regulators' Financial Toolbox series explores the types of financial tools utility regulators can use to support integration of electricity system technologies that benefit the public interest. This brief was prepared by Jamie Scripps of Hunterston Consulting LLC and is based upon work supported[1] by the Department of Energy under Award Number DE-OE0000925. The speakers' presentations can be found here.

On February 26, 2024, NARUC's Committee on Energy Resources and the Environment hosted a panel discussion titled "Keeping Track of Clean Energy Part III: Economy Wide Consistency" at the 2024 NARUC Winter Policy Summit. The panel was moderated by Hon. Abigail Anthony, Rhode Island Public Utilities Commission, and featured remarks by Wenbo Shi, PhD-Founder/CEO, Singularity Energy; Todd Jones, Principal, US Markets, Center for Resource Solutions (CRS); and Tory Clark, Partner, Energy + Environmental Economics.

The panel and this accompanying brief address:

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Overview of GHG Accounting Frameworks

Greenhouse gas (GHG) accounting frameworks are methodologies designed to quantify and assess the emissions of GHGs produced by human activities. Commonly employed frameworks include the GHG Protocol, established by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), which provides comprehensive guidelines for both corporate and governmental GHG accounting.[2] Additionally, internationally recognized standards like the ISO 14064 series offer a structured approach to GHG accounting, focusing on organizational-level reporting and verification.[3]

GHG accounting frameworks typically consider direct emissions from activities like fuel combustion and industrial processes (Scope 1), indirect emissions from purchased electricity and heat (Scope 2), and other indirect emissions associated with the organization's activities (Scope 3).[4]

There are two main categories of GHG accounting frameworks: attributional and consequential. Each approach provides a unique perspective on power generation, purchases, and interventions, with specific emphasis on the types of emissions factors used (e.g., grid average, market-based, residual mix). The primary differences between attributional and consequential GHG accounting lie in the scope of their analysis and the factors they consider. Attributional GHG accounting focuses on direct emissions associated with specific activities, while consequential GHG accounting considers the broader systemic impacts and indirect emissions resulting from changes induced by those activities.[5]

Attributional GHG accounting focuses on attributing emissions directly to the entity responsible for their generation, generally without considering the broader system-wide effects or changes in emissions resulting from the activity. Attributional GHG accounting provides a snapshot of emissions at a particular point in time and is often used for GHG inventories and reporting. Attributional GHG accounting is widely employed in corporate sustainability reporting, product life cycle assessments, and regulatory compliance to track and manage emissions from various sources within an organization’s operations or supply chain.[6]

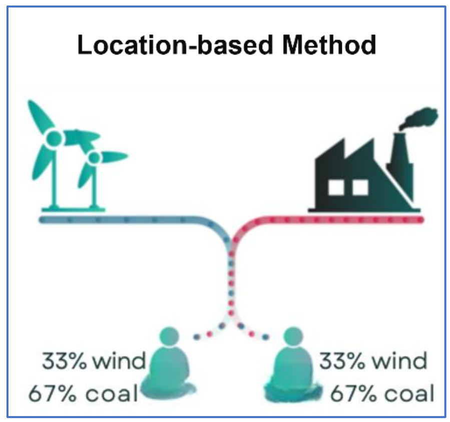

Figure 1: Wenbo Shi, slide 2 (adapted).

Attributional GHG accounting can be either location-based or market-based. Figure 1 above provides an illustration of the location-based method of GHG accounting. In location-based accounting, emissions are attributed directly to the location where the activity occurs, without considering the specific sources

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[2] See *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*. Available at https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf.

[3] See ISO 14064-1:2018 - Greenhouse gases. Available at https://www.iso.org/standard/66453.html.

[4] See *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*. Available at https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf, at page 25.

[5] See “Keeping Track of Clean Energy Part III: Economy Wide Consistency,” 2024 NARUC Winter Policy Summit, Presentation by Wenbo Shi, PhD-Founder/CEO, Singularity Energy, at slide 3 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

[6] Ibid.

of energy or the emissions intensity of that energy. This means that emissions are calculated based on average emission factors for the region, rather than the actual emissions associated with the energy sources used.[7] Location-based accounting is commonly used to assess emissions at a particular geographic scale, such as city-level or national-level emissions inventories.[8]

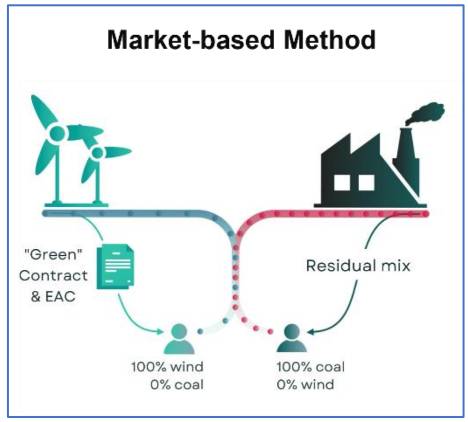

Figure 2: Wenbo Shi, slide 2 (adapted).

In contrast to location-based accounting, which relies on average emission factors for a given geographical area, market-based accounting considers the specific sources of energy and their emissions profiles. Figure 2 provides an illustration of the market-based method of GHG accounting. For example, market-based accounting considers the use of Energy Attribute Certificates (EACs) or renewable energy certificates (RECs), carbon offsets, or emissions trading schemes, and enables entities to account for emissions reductions achieved through purchasing renewable energy or investing in emission reduction projects.[9]

Consequential GHG accounting is a methodology used to evaluate the broader systemic impacts of activities, policies, or decisions on GHG emissions. Unlike attributional accounting, which focuses on quantifying direct emissions associated with specific activities or processes, consequential accounting also considers the indirect effects that result from changes in behavior or market dynamics induced by the activity being assessed.[10]

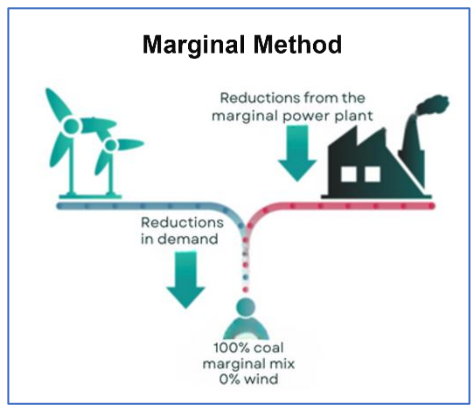

Figure 3: Wenbo Shi, slide 2 (adapted).

Marginal GHG accounting is an example of consequential GHG accounting and focuses on the additional emissions resulting from a specific change or action. Figure 3 provides an illustration of the marginal method of GHG accounting. This approach can be particularly useful for evaluating the emissions impact of policy interventions, technological innovations, or changes in behavior. There is a growing focus on locational marginal emissions, similar to location-based accounting but operating at a more detailed level. This approach holds promise for real-time decision-making applications like electric vehicle charging and human response. While organizations like PJM already release locational marginal emissions data,[11] technical refinement is still necessary to ensure its suitability for specific use cases. Long-run marginal emissions are also gaining traction. Unlike locational marginal emissions, which focus on operational decisions, long-run emissions consider structural changes within the system, such as the implementation

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[7] See "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Wenbo Shi, PhD-Founder/CEO, Singularity Energy, at slide 4 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.
[8] Ibid.
[9] Ibid.
[10] Ibid.
[11] See PJM, Markets & Operations, Emissions. Available at https://www.pjm.com/markets-and-operations/m/emissions.

of new data centers or renewable projects. These changes not only impact operating margins but also influence future infrastructure development.[12]

GHG Accounting and the Electricity System

The use of Energy Attribute Certificates (EACs) in the context of the Inflation Reduction Act, Section 45V Clean Hydrogen Production Tax Credit is an informative example that links GHG emissions tracking and accounting for electricity, hydrogen, and natural gas. Under the Inflation Reduction Act, Section 45V offers a credit of up to $3.00 per kilogram of "qualified clean hydrogen," which refers to hydrogen with a lifecycle GHG emissions rate of 4 kilograms of CO_2 equivalent or lower per kilogram of hydrogen.[13] The proposed requirements for the tax credit focus on hydrogen produced using electricity. As a result, the tax credit has the potential to add significant new load for electrolytic hydrogen production, and the clean energy procurement and development for that load has the potential to significantly transform clean energy markets. In December 2023, the U.S. Department of Treasury proposed regulations interpreting the 45V tax credit, including regarding the calculation of lifecycle GHG emissions from hydrogen production methods and validating the use of electricity from renewable or zero-emission origins for producing qualified clean hydrogen.[14]

The Section 45V framework is an example of attributional GHG accounting that takes into account 1) GHG emissions from specific sources within the electric sector that emit greenhouse gases and 2) emissions associated with the procurement of electricity, taking into account the GHG emissions generated not only by the operation of power plants but also by the entire lifecycle of the electricity generation process, including fuel extraction, processing, transportation, and waste disposal. The Section 45V framework also includes consequential GHG accounting, which takes into account the change in grid emissions from incremental load (see Figure 4 below).[15]

[12] See "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Wenbo Shi, PhD-Founder/CEO, Singularity Energy, at slide 7 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.
[13] See 26 USC § 45V(c)(2)(A).
[14] See 88 FR 89220. Available at https://www.federalregister.gov/d/2023-28359.
[15] See "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Todd Jones, Principal, US Markets, Center for Resource Solutions (CRS), at slide 17 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

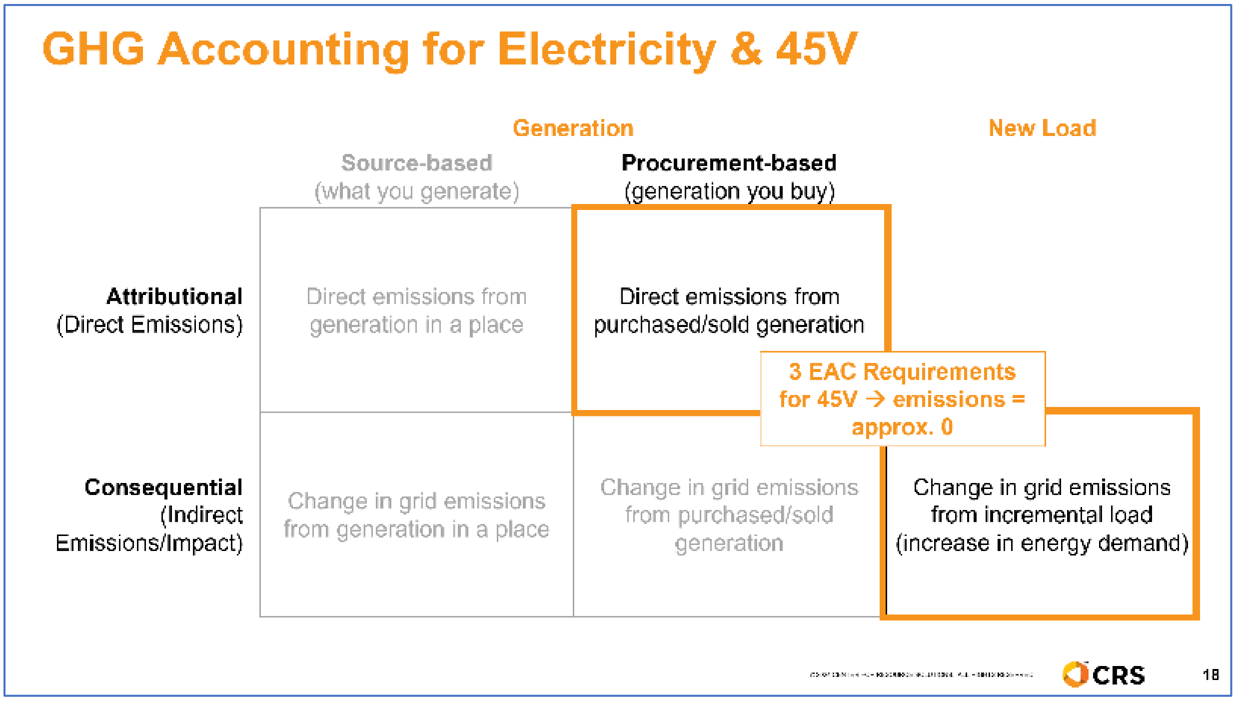

Figure 4: Jones, Slide 7

Section 45V requires the use of the Argonne National Laboratory's GREET Model[16] to calculate the lifecycle emissions where electricity is used as the fuel for hydrogen production. The amount of credit is based on the lifecycle emissions—the lower the emissions, the higher the credit. EACs are used to account for both the purchased electricity inputs and tracking emissions from specified generation to hydrogen load, and to account for the emissions impacts of the electricity used in the production of hydrogen to ensure that the incremental load from hydrogen production can reasonably be met with the purchased generation.[17]

EACs are legal instruments representing a claim to the specific attributes of a unit of energy produced, typically focusing on the source's renewable aspects.[18] These certificates play a critical role in substantiating the renewable or low-carbon credentials of electricity used in various processes, including hydrogen production. They ensure that the environmental benefits claimed, such as reduced GHG emissions, are backed by verifiable generation data, helping to maintain transparency and integrity in the market.[19]

Within the Section 45V framework, there are three requirements for EACs: 1) incrementality, meaning the EAC generator has to have started commercial operations no more than three years before the

[16] See U.S. Department of Energy, GREET. Available at https://www.energy.gov/eere/greet.
[17] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Todd Jones, Principal, US Markets, Center for Resource Solutions (CRS), at slide 17 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.
[18] "Assessing Lifecycle Greenhouse Gas Emissions Associated with Electricity Use for the Section 45V Clean Hydrogen Production Tax Credit." U.S. Department of Energy, 2023. Available at https://www.energy.gov/articles/clean-hydrogen-production-tax-credit-45v-resources.
[19] Ibid.

hydrogen facility that's using the EACs was placed into service; 2) temporal matching, which requires that EACs represent electricity produced in the same hour in which the hydrogen production facility consumes electricity; and 3) deliverability, meaning that EACs must represent electricity from a generator located in the same region as the hydrogen production facility.[20]

Overall, market-based GHG accounting and tracking, along with EACs, are essential to qualifying for the Section 45V tax credit. Energy users or hydrogen producers must have the capability to select the required low-emission power to fulfill the credit's requirements. Other state regulatory programs and incentives for load or LSE-based emissions reductions are similar. The lesson is that EACs are a credible mechanism for GHG accounting in the electric sector, and for achieving other goals for that power related to the impact of either generation or new load.[21]

GHG Accounting and the Natural Gas System

The natural gas system is responsible for approximately one-third of total U.S. GHG emissions, diversified across core sectors typically considered in GHG accounting. This includes CO2 emissions from natural gas combustion, such as natural gas use in electric power or direct use in buildings such as space heating and water heating, use in industrial applications, and on-site use for oil and gas production. This also includes methane leakage across the natural gas lifecycle.[22] Figure 5 provides an illustration of natural gas system GHG emissions.

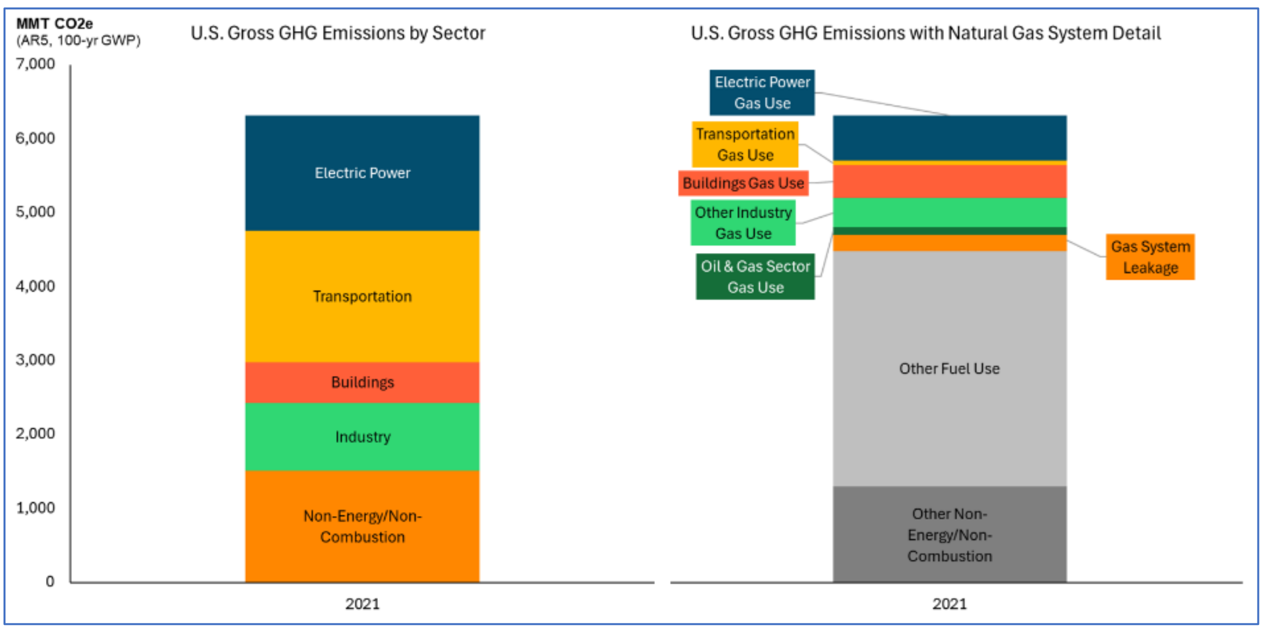

Figure 5: Natural Gas System Emissions. Clark, Slide 2.

[20] See "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Todd Jones, Principal, US Markets, Center for Resource Solutions (CRS), at slide 20 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

[21] Ibid.

[22] See "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Tory Clark, Partner, Energy + Environmental Economics, at slide 24 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

As policy-makers in some jurisdictions strive to decarbonize various sectors of the economy, potential changes in GHG accounting for the natural gas sector may be on the horizon. There are three primary types of fuels that are positioned to decarbonize our natural gas system: 1) green hydrogen; 2) biogas; and 3) synthetic natural gas. From a GHG accounting perspective, there are key differences among these types of fuels.[23]

Hydrogen emits no GHG emissions when combusted, regardless of how it was produced, though it may result in NOx emissions and some air quality effects. However, from a GHG accounting standpoint, its combustion is considered clean. The production of green hydrogen has minimal lifecycle emissions, the extent of which varies based on calculation methods and emission factors incorporated into models, such as the GREET Model. While challenges exist regarding the integration of hydrogen into the natural gas infrastructure, particularly concerning the compatibility with existing equipment such as pipelines, its benefits in terms of GHG accounting are significant.[24]

Both biogas and synthetic natural gas produce GHG emissions when combusted because methane is converted into CO_2 during combustion, just as with the combustion of fossil gas. However, they may also have reduced emissions associated with the feedstocks used in their production. With biomass, CO_2 is absorbed during the growth of the biomass. With synthetic natural gas, there is a biogenic form of carbon, or direct air capture is used to remove carbon from the atmosphere. This results in reduced emissions associated with the source. However, when combusted, positive emissions are generated. According to the U.S. EPA and many state accounting frameworks, these are counted as net zero emissions.[25]

The complexity of GHG accounting increases significantly when examining specific states or utility service territories. This is true in both the natural gas and electricity sectors. In most cases, state GHG inventories initially prioritize a location-based approach, focusing on the combustion that occurs within the state's boundaries. This approach aligns with regulators' control over activities within their jurisdiction. However, it may not fully address consequential emissions questions that are crucial for understanding energy usage and informing future energy and climate policies.[26]

For instance, states such as New Mexico, which is a net exporter of natural gas, may have a higher proportion of upstream emissions compared to their in-state fuel consumption. However, modeling can mitigate this discrepancy. For example, in Rhode Island, despite not being a major oil and gas producer, there is significant natural gas consumption. Modeling can align with GHG inventories, running scenarios incorporating lifecycle emission factors that encompass emissions from the well to the burner-tip. This

[23] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Tory Clark, Partner, Energy + Environmental Economics, at slide 24 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.
[24] Ibid.
[25] See, e.g., U.S. EPA, Sources of Greenhouse Gas Emissions. Available at https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
[26] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Tory Clark, Partner, Energy + Environmental Economics, at slide 24 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

approach enables assessment of potential impacts on modeling outcomes within regulatory proceedings.[27]

There are also challenges related to emissions sinks, particularly concerning biomass or potential direct air capture of CO_2, which could play a significant role in advancing renewable fuels. These sources are often concentrated in specific regions, such as agricultural centers and states with extensive forestry industries, where resources and potential for renewable natural gas (RNG) production are abundant. These regions may not necessarily coincide with areas of highest RNG consumption. In contrast, direct air capture facilities are likely to be located where existing CO_2 pipeline and storage infrastructure exists, allowing for easy interconnection for new large-scale CO_2 removal operations. Additionally, low electricity prices may influence the selection of sites for such facilities.[28]

Several states are making efforts to incorporate this consideration into their GHG inventories. For example, New York includes upstream emissions from fossil fuels in its calculations. Policy design also plays an important role. Initiatives such as clean heat standards have the capacity to extend beyond state boundaries, addressing the lifecycle emissions of fuels utilized in the heating sector, including natural gas. These policies can incorporate mechanisms such as offsets or certified gas that also extend beyond state borders, further complicating the accounting.[29]

Overall, there are various ways to approach GHG accounting for the natural gas sector. As in the electric sector, it will be important to exercise caution when considering different accounting frameworks to avoid double-counting emissions reductions. Double-counting occurs when two parties claim the same reduction in emissions in their GHG accounting. A risk of double-counting arises when a party sells its emissions reductions as carbon offsets or credits. There is also a risk of double counting when GHG accounting mechanisms involve multiple states or countries. While it may not be logical for one state to take full credit for another state's gas sector emissions reduction, it could be relevant within the context of energy and climate policy for a state to consider the GHG emissions of a neighboring state.[30]

What's Next?

Trends in location-based accounting for GHG emissions include the emergence of hourly and zonal/nodal tracking of the electricity generation mix and GHG emissions. The need for hourly tracking is clear since annual accounting could misestimate emissions by up to 35%. The EIA and some ISOs already publish hourly carbon data on the balancing authority level.[31] Recently, the Midcontinent Independent System Operator (MISO) worked with Singularity to explore nodal-level carbon tracking for the first time.[32] Remaining open issues include inconsistent data (annual vs. hourly, EIA vs. ISO vs. EPA,

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[27] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Tory Clark, Partner, Energy + Environmental Economics, at slide 24 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

[28] Ibid.

[29] Ibid.

[30] Ibid. at slide 23.

[31] See EIA, Hourly Electric Grid Monitor. Available at https://www.eia.gov/electricity/gridmonitor/about.

[32] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Wenbo Shi, PhD-Founder/CEO, Singularity Energy, at slide 8 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

import/export) and the potential for double counting clean energy for which an entity has already sold the associated EACs/RECs.[33]

Trends in market-based accounting include the emergence of 24/7 carbon free energy (CFE). There is a trend away from annual accounting toward hourly matching, with hourly RECs/EACs emerging to support the implementation of 24/7 CFE. Some registries (M-RETs, PJM-GATS) already support hourly retirement of RECs/EACs. Remaining open issues include boundaries and deliverability, along with the challenges of moving from tracking only renewable generation to all generation and moving from tracking only generation to both generation and consumption.[34]

Trends in consequential accounting include the emergence of locational marginal emissions accounting, which, as discussed above, is similar to location-based accounting but operates at a more detailed level. This approach holds potential for real-time decision-making applications like electric vehicle charging and human response. Long-run marginal emissions are also gaining attention. Unlike locational marginal emissions, which focus on operational decisions, long-run emissions consider broader structural changes within the system, such as the establishment of new data centers or renewable energy projects. These changes have implications not only for operating margins but also for project development and implementation.[35]

Remaining open issues include the fact that consequential accounting involves a counterfactual analysis,[36] which can lead to different models producing varied and sometimes contradictory results. Additionally, there may be a risk of entities misusing consequential accounting results as offsets. This could involve manipulating avoided emissions or induced emissions to conflict with established scope attribution frameworks. Finally, there are proposals to expand GHG accounting to include a Scope 4 alongside the existing Scopes 1, 2, and 3. This new scope would involve reporting avoided emissions, sometimes referred to as impact accounting.[37]

[33] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Wenbo Shi, PhD-Founder/CEO, Singularity Energy, at slide 8 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.
[34] Ibid. at slide 9.
[35] Ibid.
[36] A counterfactual analysis considers what might have been the result if events had happened in a different way.
[37] "Keeping Track of Clean Energy Part III: Economy Wide Consistency," 2024 NARUC Winter Policy Summit, Presentation by Wenbo Shi, PhD-Founder/CEO, Singularity Energy, at slide 9 (February 26, 2024). Available at https://pubs.naruc.org/pub/A3DA74D0-B1A8-9A0C-94A7-6030A31DFD07.

Resources for More Detailed Information

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Summary of Q&A

Commissioner Anthony: One thing I really love about your presentation is the clarity of the location-based accounting method, the transition from monetary base to market-based accounting method, and the consequential approach. Could you elaborate a bit more on the challenges of the consequential approach? What criticisms are typically raised, and why?

Wenbo Shi: So, I believe there are several challenges with consequential accounting, from various perspectives. Firstly, there's a technical challenge. As mentioned, it involves counterfactual analysis, comparing a scenario where an action didn't occur. This inherently introduces uncertainty, as it entails comparing two scenarios: one without the action and another with the action. The process involves comparing emissions in the first scenario and subtracting them from the second scenario. That's the theoretical approach, at least.

The reality is that conducting consequential accounting can be extremely costly, and obtaining all the necessary data can be challenging. As a result, it becomes technically difficult to provide a robust answer to the question at hand. Approximations are often made, and various models are utilized, along with sensitivity analyses, to provide directional answers. While this is a solvable problem, it's crucial to acknowledge the uncertainty inherent in the numbers. Even in an ideal scenario where all data is available and credible claims or calculations can be made regarding avoided or induced emissions, new questions arise regarding who should be credited for these outcomes. As mentioned in my presentation, there are instances where individuals may misuse this information to claim ownership of avoided emissions due to their actions. Therefore, there's a need for careful consideration and clarity regarding the allocation of such emissions credits.

Using consequential accounting as offsets or to create a new offsets market can be problematic because it only reveals what will change without determining who will own those changes. To illustrate this complex issue, consider the example of an airplane. Suppose there's a requirement for a minimum number of passengers, let's say 10, for the plane to take off. If nine tickets have already been sold and the 10th person decides not to purchase a ticket, the consequential emissions would be zero because the plane wouldn't fly without that passenger. However, if the 10th person decides to buy the last ticket, suddenly the consequential emissions encompass the emissions of the entire plane.

So my action leads to the increase of emissions of the whole airplane. But does that mean I should take ownership? Should I be responsible for all the emissions? The answer is no. Are you going to say that everybody else on the plane has zero emissions and only one person should take responsibility for all the consequential emissions? Probably not. So this highlights the difference between the attribution framework and the consequential framework I was talking about. Consequential accounting is useful to inform decisions, but it doesn't necessarily assign individual responsibility for all consequential emissions.

When making claims about those emissions, it's important to revert to the attribution framework. For instance, in the airplane example, you might still use the average approach where everybody shares the total emissions because it's about attributing the emissions plausibly to everyone. Consequential accounting, on the other hand, only assesses the system change and how it may impact others. So it's not about attribution; it's more about understanding change. However, you need to develop a different attribution framework for that. That's where the distinction lies between market-based and location-based accounting. Whether averaging it out makes sense is a separate conversation from understanding the change itself.

Todd Jones: Certainly, consequential accounting can be applied to carbon offsets, particularly in the carbon offset market where it calculates the emissions associated with various activities. The key difference here lies in the additionality tests. Additionality testing aims to establish the causal link between the activity (such as renewable energy generation or energy efficiency initiatives) and the avoided emissions that occur on the grid. Without passing this additionality test, you have a quantity of avoided emissions on the grid attributed to the generation or energy efficiency efforts but lacking a direct causal link to the purchaser or the entity implementing the energy efficiency measures.

Therefore, the presence of additionality testing ensures that there's a clear connection between the quantity of avoided emissions and the actions taken by the purchaser or the entity. Without additionality testing, the consequential accounting merely serves as a decision-making tool, as Wenbo mentioned. In the context of Section 45 V, the consequential number derived from such accounting enables the establishment of requirements to mitigate induced emissions through procurement.

Commissioner Anthony: You mentioned that Section 45 V is aimed at ensuring location matching incrementality and timing matching. What developments are you observing in the industry to facilitate this?

Todd Jones: Currently, there exists a voluntary market for renewable energy alongside state Renewable Portfolio Standards (RPS) markets. Each compliance and voluntary market has its own eligibility criteria for Renewable Energy Credits (RECs) or Energy Attribute Certificates (EACs). Therefore, the market caters to various preferences concerning market boundaries and procurement criteria, including vintage, which pertains to time matching. As it stands, the current system accommodates at least two of these three aspects.

Currently, the location information of the generation is embedded in or discoverable through the Energy Attribute Certificate (EAC). Each EAC is linked to a specific generator in a particular location. As a buyer in the market, you have the flexibility to choose EACs from generators that are close to your region, on-site, or even from generators across the country. Therefore, narrowing the boundary for 45 V to ensure location matching is feasible with the existing market infrastructure. This aligns with the deliverability requirement of the credit.

For the incrementality requirement, the information about the project's start date is currently embedded in or discoverable through the EAC. This allows for setting specific preferences and eligibility requirements based on the facility's age. For instance, in the Green-e certification program for the voluntary market, there is a 15-year new date requirement. However, for the 45 V credit, there is a three-year operational new date requirement. The time matching aspect is relatively new. Currently, Renewable Energy Certificates (RECs) are issued in different systems on a monthly or quarterly basis.

Regarding vintage information on the RECs indicating when the generation occurred, typically, this is provided on a monthly or quarterly basis. However, for specific hour-level time matching, more detailed information is needed. Progress is underway to enhance the granularity of generation tracking in EAC tracking systems, aiming to include features like hourly RECs. Presently, even without hourly RECs, hourly time matching is feasible by aligning hourly generation data with monthly RECs to avoid double counting. However, integrating such detailed data into tracking systems will likely be necessary for full implementation of 45 V and for meeting hourly requirements set by other companies and federal agencies. Thus, achieving hourly tracking capability, alongside comprehensive generation tracking, is a key target for these systems.

Commissioner Anthony: Tory, can you please explain some of the differences in how gas system modeling is different from electric system modeling?

Tory Clark: My expertise lies in economy-wide models, which allow tracking energy dynamics across entire states, regions, or the entire US. This comprehensive approach enables deep dives into specific sectors, facilitating a nuanced understanding of energy trends. While tracking emissions in the electricity sector is relatively straightforward, as trends are discernible despite complexities, monitoring fuel combustion for conventional generators utilizing gas and coal provides a clear point source of emissions. It's worth noting that while transmission and distribution entail losses, these pertain to electricity rather than emissions.

While we may not have precise figures for electricity losses over transmission lines, significant greenhouse gas emission categories are not overlooked. However, within the gas sector, methane leaks significantly alter our understanding of the environmental footprint of this fuel. This issue has sparked extensive discussion among environmental advocates, particularly concerning the implications of natural gas, hydrogen, and electrification in the context of energy decarbonization. Enhancing monitoring, verification, leak detection, and leak mitigation efforts becomes paramount. Moreover, transitioning pipeline molecules to renewable natural gas may not eliminate leakage concerns, depending on the composition of these molecules. I think that's one significant distinction.

Another difference lies in how we traditionally conduct greenhouse gas inventories. Currently, we typically account for the imported emissions linked to power consumption. Many state inventories include a line item for in-state generation as well as imported electricity. However, this is usually not done on a highly detailed, location-specific, hourly basis. Instead, there's an attempt to estimate the impact of the electricity consumed in the state as a whole. Electricity differs from natural gas, but perhaps the closest comparison would be the upstream emissions associated with natural gas that are not currently tracked in our conventional greenhouse gas accounting. Typically, modeling approaches involve utilizing the best available data on energy consumption and determining appropriate emission factors for the state. So from that perspective, the modeling is quite similar, but the nature of the industry and greenhouse gas emissions, as well as their timing, present different challenges.

<u>Questions from the audience:</u>

I was contemplating Todd's remarks about the voluntary compliance market for RECs. Over the past decade, I've observed a conflict, particularly in RPS deregulated states, concerning the ability of end-use customers to assert climate benefits from procuring renewable electricity. Many of these states mandate utilities to procure and supply a percentage of their service load from renewable sources. However, in deregulated states, utilities do not own generation assets and must procure them from the wholesale market. Consequently, utilities claim emissions benefits as part of Public Utility Commission compliance. Yet, customers who choose to procure a portion of their electricity from renewable sources through a third-party entity, typically the utility, also seek to claim these benefits

for market goodwill and shareholder compliance. I'm curious to hear from the panel if you've encountered this dynamic and your thoughts on addressing the dissonance between the load-serving entity and the end-use customer.

In New York state, where I reside, there has been a renewable portfolio standard in effect for some time. This dynamic is also evident in community solar programs across the country. On a smaller scale, the utility sponsors the community solar program and claims emissions benefits. However, as a residential customer participating in the program, I would like to assert that I power my house with solar electricity, despite not having panels on my roof.

Todd Jones: It boils down to using consistent frameworks for attributing generation to load and for making claims about what you're using and delivering to customers. Most Renewable Portfolio Standards (RPS) in the country use Renewable Energy Certificates (RECs) as the compliance instrument. This demonstrates that a certain portion of sales are met with renewable energy or specified generation. When RECs are retired for RPS compliance in most states, it means that those resources can be collectively claimed by the pool of utility customers. This allows all utility customers served by a compliant utility to claim a share of those renewables. For example, if the RPS requirement is 50%, all utility customers served by a compliant utility can claim their electricity is 50% renewable.

Currently, the Renewable Portfolio Standard (RPS) pool of renewables isn't disaggregated, meaning individual customers can't pick and choose generation from within that pool. Instead, everyone gets the same pool. However, if the pool consists entirely of renewable sources, then customers can claim their electricity is sourced 50% from renewables, even if there are emissions associated with some of the resources, such as biogas. Wind and solar, being zero-emission sources, can be claimed the same way as if customers were to purchase Renewable Energy Certificates (RECs) on their own.

There's ongoing discussion about ensuring utility customers can claim the emissions benefits associated with RPS-mandated renewables, which are substantiated with REC retirements in their inventories. This avoids over-procurement if utilities voluntarily achieve 100% renewable energy. These discussions also address the impact of voluntary activities or procurement on the grid. Overall, the idea behind RPS is to enable customers to claim they receive renewable energy and its associated emissions benefits. Does that address your question?

Wenbo Shi: One quick comment on that: This highlights precisely the issue I mentioned earlier regarding the market-based approach. In today's system, it's designed to track attributes primarily on the generation side. However, if you aim to match those same attributes with your consumption, there's a missing link. Ideally, with an all-encompassing generation and consumption tracking system, there would be a one-to-one mapping between generation certificates and your load. This would enable precise identification of the source of each megawatt-hour consumed.

With systems like RPS or community solar, or any specific program, as long as you comprehend all the contractual relationships and agreements, you should be ethically able to map all generation to consumption. Imagine every customer having an account, akin to current utility bills, detailing their monthly consumption in kilowatt-hours. With such models, you can precisely determine the source of those kilowatt-hours. Ultimately, generation equals consumption. Therefore, with complete end-to-end traceability, this problem can be resolved.

Currently, this is not the case, as it involves complex data encompassing market transactions, RPS, and bilateral contracts such as PPAs. This complexity can lead to confusion. However, in certain areas, like vertically integrated utility territories, this is feasible. These utilities have a comprehensive understanding and control over everything, simplifying the mapping of specific program details or tariff-specific contractual arrangements with consumption and generation. Thus, they possess a full picture of the situation.

Todd Jones: But this practice is becoming increasingly common, either through consumers conducting their own inventories, or through state initiatives such as power source disclosure. With all-generation tracking, a residual mix can be assigned to all unfulfilled loads, and each consumer receives a label detailing what they're receiving, with unspecified power assigned the residual mix. While some states and customers are implementing this, it's not universal or consistent. Therefore, what's needed is comprehensive all-generation tracking and verification of all transactions or power source disclosure across the board.

Wenbo Shi: In an ideal scenario, everything would be clear-cut and up-to-date with existing mechanisms.