THE CLIMATE REGISTRY
Credible Carbon Reporting

eco engineers

Guidance for Developing Carbon Disclosure Legislation

How to Address Supply Chain and Data Quality Challenges

About Us

The Climate Registry (TCR)

The Climate Registry (TCR) is a non-profit organization that empowers organizations to be climate leaders by providing best-in-class programs and services for measuring, verifying, and disclosing greenhouse gas (GHG) emissions. Since 2007, TCR's innovative initiatives and events have brought together a bipartisan coalition of governments, businesses, academia and NGOs to drive climate ambition and action on the road to net zero.

TCR grew out of the California Climate Action Registry (CCAR), expanding its GHG reporting program to other jurisdictions across North America. Backed by an advisory body consisting of states, provincial, and tribal jurisdictions TCR continues to maintain high-quality GHG reporting programs, protocols, and thought leadership for its members.

For more information about TCR, visit www.theclimateregistry.org.

EcoEngineers

EcoEngineers is a consulting, auditing, and advisory firm with an exclusive focus on the energy transition. From innovation to impact, Eco helps its clients navigate the disruption caused by carbon emissions and climate change. Eco helps organizations stay informed, measure emissions, make investment decisions, maintain compliance, and manage data through the lens of carbon accounting. Its team of engineers, scientists, auditors, consultants, and researchers live and work at the intersection of low-carbon fuel policy, innovative technologies, and the carbon marketplace.

Eco was established in 2009. Today, Eco's global team is shaping the response to climate change by advising businesses across the energy transition, and has developed industry-wide solutions for Scope 3 reporting.

Visit www.ecoengineers.us for more information.

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We welcome your feedback. If you would like to share your comments regarding this white paper, please contact info@theclimateregistry.org.

Foreword

We are all on the front lines of climate change: floods, fires, drought, and deadly heat are becoming the norm for many of us around the world. The good news is that we still have time to act. What we do in the next decade will determine the kind of future we pass on to our children and grandchildren.

As a former state legislator and chair of the Washington State Senate Environment, Energy & Technology Committee, I have seen firsthand the impact of effective climate policies and programs at the state, provisional, and local levels worldwide. I had the privilege of working with Governor Inslee and the House on meaningful and historic climate legislation, such as the Climate Commitment Act, a Clean Fuel Standard, clean buildings legislation, and environmental justice measures. It was tremendously gratifying to see the results of this legislation: not just reduced emissions but jobs, growth opportunities, and greater equity.

As legislators in a state with binding, enforceable commitments to the Paris Agreement, we recognized early on the accuracy of the adage that "you can't manage what you don't measure." In fact, measuring climate impact is a critical building block for the policies that follow. This paper is part of a bold conversation that state legislators and regulators must have about transparent, accurate, and credible carbon reporting.

There is great value to be found in learning from the public policy experience of others nationally and globally. This includes learning from other experts – such as EcoEngineers and The Climate Registry, the authors of this paper – who have been in the trenches measuring, disclosing, and managing greenhouse gas (GHG) emissions. The information and learnings they have captured in this guide will be invaluable to state legislators and regulators across the country who are thinking about or are in the process of designing climate policy.

We have risen to meet the moment of historic alignment for action before. We can do so for the climate. I encourage you to use this guide as a starting point for taking your next big step forward.

Hon. Reuven Carlyle (Ret.)
Founder, Earth Finance
Washington State Legislator (2009-2023)
Chair, State Senate Energy, Environment & Technology Committee (2017-2023)

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1. Introduction: Who Should Use This Guide and Why

This guide encapsulates The Climate Registry (TCR) and EcoEngineers' learnings over the past two decades and is intended to help policymakers draft and implement climate disclosure legislation that (1) reduces complexity and cost for corporations subject to the legislation, (2) drives greenhouse gas (GHG) reductions and helps organizations achieve their net-zero goals, and (3) garners industry and public support. We also hope that it will help organizations that are subject to disclosure regulations understand the complexity and purpose of these policies.

As the climate crisis intensifies, so does the pressure on governments and businesses to do something about it. This has resulted in a proliferation of net-zero targets and commitments as well as demands for greater transparency. In turn, the increased scrutiny of emissions has led to a rise in GHG reporting standards and frameworks and a shift of focus from voluntary to mandatory reporting regimes. For example, in May 2023, the European Carbon Border Adjustment Mechanism (CBAM) officially entered into force, and with it, a new set of mandatory GHG reporting requirements for Scope 1 and 2 emissions. Scope 3 extension to the legislation is currently being considered. In a similar move, California Senate Bill (SB) 253 and SB 261, collectively known as the "California Climate Accountability Package," were signed into law in October 2023.

Jurisdictions that are implementing or considering implementing regulations that would require corporations to disclose their GHG emissions are grappling with several key challenges:

1. **Addressing supply chain embedded (Scope 3) emissions:** Most reporting regulations consider only Scope 1 and 2 emissions. However, these emissions may only be the tip of the spear. **Scope 3 emissions are estimated to account for more than 75% of a business' total carbon emissions on average and can be as close to 100% in industries such as financial services and 89% for oil and gas.**[1] If we are going to achieve our climate goals, addressing Scope 3 emissions is essential. The challenge is that emissions associated with companies' supply (or value) chains are typically the most difficult to manage and measure. Addressing the complexities and potential costs of measuring these emissions has challenged legislators and bodies like the U.S. Securities and Exchange Commission (SEC).
2. **Ensuring accuracy and credibility of GHG data:** Accurate and credible data empowers companies to identify emission-reduction opportunities, underpins consumer confidence, and ensures that key stakeholders (e.g., policymakers, rating agencies, and financial institutions) can make informed decisions about the organization. It also protects corporations from greenwashing accusations and/or liability associated with greenwashing legislation, such as California's Voluntary Carbon Market Disclosures Act.

Verification and assurance conducted by a third party underpins data credibility and accuracy. As climate risks are increasingly seen as material, verification and assurance processes are increasingly considered the equivalent of the auditing process in annual financial reporting.

[1] *World Resources Institute: https://www.wri.org/update/trends-show-companies-are-ready-scope-3-reporting-us-climate-disclosure-rule*

However, navigating the cost of this process and the complexity frequently associated with assuring supply chain emissions has been a challenge for the industry.

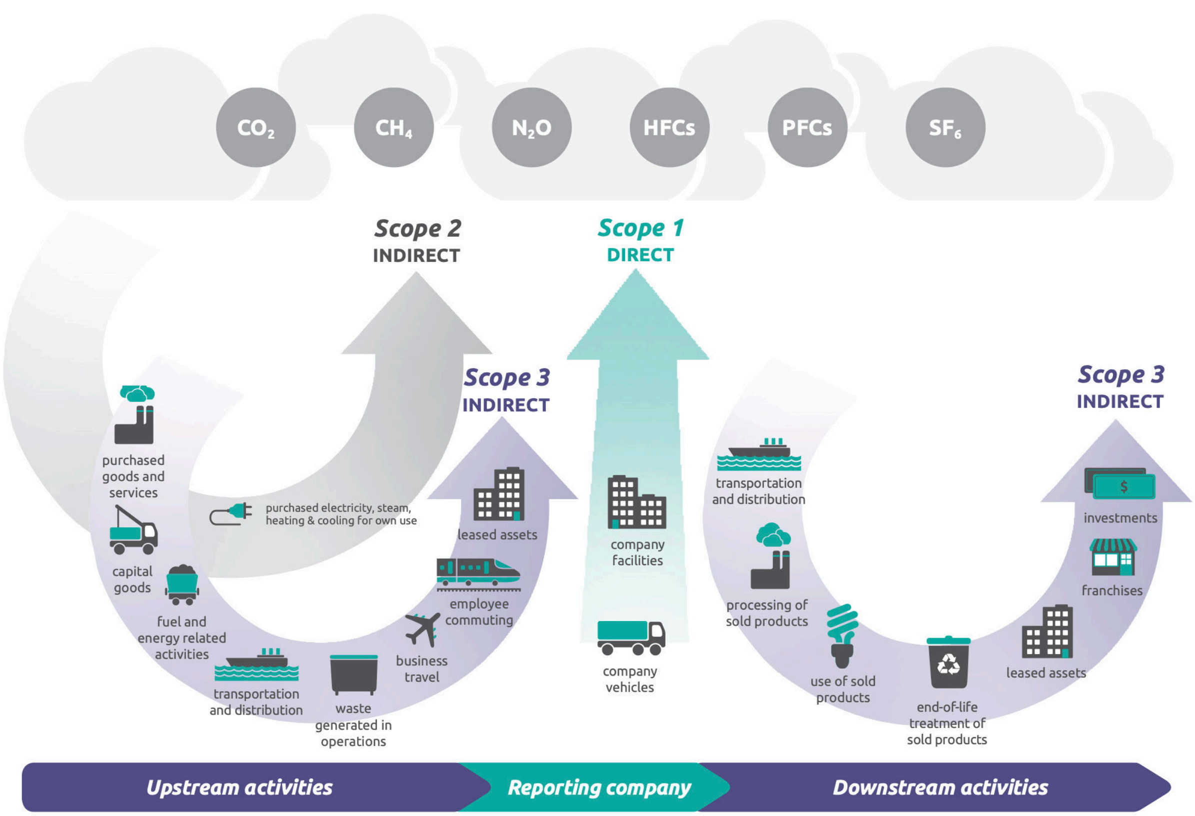
Considering the challenges and potential solutions outlined in this guide – particularly those associated with measuring and reporting Scope 3 emissions – fulsome, repeatable, and standardized GHG disclosures can be made a realistic first step towards reducing emissions and mitigating climate change.

2. Background: Key Concepts in Carbon Disclosure

Categories of GHG Emissions

The World Resources Institute (WRI)'s Greenhouse Gas Protocol Corporate Standard (GHG Protocol) – the world's most widely used GHG accounting standard for companies – classifies GHG emissions into three categories: Scope 1, 2, and 3. There is one category for direct emissions (Scope 1) and two categories for indirect emissions (Scopes 2 and 3).

Biogenic emissions are classified as non-Kyoto Protocol GHG emissions and fall outside the scopes. The GHG Protocol requires that carbon dioxide (CO2) emissions from biomass combustion be tracked separately from CO2 emissions associated with fossil fuels.



Source - Greenhouse Gas Protocol: Corporate Value Chain (Scope 3) Accounting and Reporting Standard.

In addition to all the potential benefits of reporting Scope 3 data, **emerging regulations are driving the need for detailed emissions reporting**. These include the European Union's (EU's) Non-Financial Reporting Directive (NFR), the Corporate Sustainability Reporting Directive (CSRD), and the Carbon Border Adjustment Mechanism (CBAM). These require varying degrees of tracking, measuring, verifying, and disclosing Scope 3 emissions. In the U.S., the Securities and Exchange Commission (SEC) requires greater disclosure of financial risks to businesses from climate change, and California SB 253 requires Scope 3 reporting.

Scope 1: Scope 1 emissions are direct anthropogenic (i.e., caused by human activities) emissions from sources owned or controlled by the company. These generally result from burning fossil fuels (e.g., boilers, turbines, process heat) during manufacturing and/or fleet operation.

There are four categories of Scope 1 emissions: stationary combustion, mobile combustion, physical and chemical processes, and fugitive sources.

Scope 2: Scope 2 emissions are indirect anthropogenic emissions associated with purchased energy, such as electricity, steam, heating, and cooling.

Scope 3: Scope 3 emissions are all other indirect anthropogenic GHG emissions in the supply or value chain. Examples include emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting organization, use of sold products and services, outsourced activities, recycling of used products, and waste disposal. Specific Scope 3 emission categories[2] identified by WRI's Greenhouse Gas Protocol are:

1. Purchased Goods and Services
2. Capital Goods
3. Fuel- and Energy-related Activities not Included in Scopes 1 or 2
4. Upstream Transportation and Distribution
5. Waste Generated in Operations
6. Business Travel
7. Employee Commuting
8. Upstream Leased Assets
9. Downstream Transportation and Distribution
10. Processing of Sold Products
11. Use of Sold Products
12. End-of-Life Treatment of Sold Products
13. Downstream Leased Assets

As organizations have varying control over activities in their supply chain, it can be much harder to collect data on Scope 3 emissions. In addition, the embedded nature of product emissions within areas like manufacturing inputs, leased assets, or financial products makes them much more complex than Scope 1 and 2 emissions. There is also the risk of double counting emissions, resulting from the nature of supply chains being long and typically opaque; indirect and embedded emissions are at risk of being counted inconsistently during reporting exercises.

[2] *Greenhouse Gas Protocol: Calculation Guidance: https://ghgprotocol.org/sites/default/files/standards/Scope3_Calculation_Guidance_0.pdf*

Emissions double-counting is often viewed as essential or reflecting best practice. After all, the Scope 1 and 2 emissions of upstream actors in a supply chain contribute to the embedded emissions of a product moving through that value chain and are therefore counted as part of Scope 3. In practice, important impediments arise for industry (and therefore for regulators) when applying frameworks for beneficial double counting, typically leading to data that boosts the variability and inaccuracy of Scope 3 accounting. Here are three important examples for consideration:

1. **The temporal nature of Scope 3 accruals:** Embedded emissions are accrued over time. For instance, while Category 4 Distribution may be easy to quantify in a reporting year, Category 2 might represent a multi-year loan, Category 8 a 10-year land lease, and Category 1 might involve an assembly that includes a range of component ages. However, Scope 1 and 2 disclosures (typically produced annually) covering a one-year period are usually always released alongside a Scope 3 disclosure built from multi-year emissions accrual. This can accentuate the proportion of Scope 3 emission contributions and make it harder to perform standardized accounting across all scopes.
2. **Category variability:** Category variability occurs often, for instance, when companies are involved in multiple retail areas and assign emissions to different categories. A supermarket that retails gasoline might account for this as Category 11 Use of Sold Products or Category 3 Fuel- and Energy-Related. The issue here is not that counting duplication may occur; it is that there is typically insufficient information within a supply chain to understand how others built up their Scope 3 calculations, and that makes it hard to define what categories of Scope 3 emissions are material to that industry or company – making it harder to focus on what is important.
3. **Accommodative discretion for calculation or estimating methods:** Currently, discretion is provided to choose between supplier-provided data or to use proxy data such as procurement information or publicly available schedules of emission factors to develop Scope 3 disclosure. This accommodative stance typically generates calculations that are reused elsewhere in the supply chain but have insufficient calculation method consistency to drive the standardization and low variance necessary for confidence in results.

The supply chains of recycled material are a good example of how double counting can skew GHG data. Recycled material percentages are often unknown and, therefore, counted as primary virgin materials, which boosts carbon intensity reporting. When double counting is identified and eliminated, it looks erroneously like an emissions reduction.

Types of Quantification

Carbon accounting has two ways to quantify emissions: the bottom-up approach, which we refer to as a facility-based approach, and the top-down approach, which is the organizational-based approach.

The Bottom-Up Approach

This approach is commonly deployed by organizations with capital-intensive operational activities, such as manufacturing supply chains, where collecting emissions data associated with an activity tends to be inherently measurable and where data can be used as a baseline to identify and measure improvements over time. The table below describes the bottom-up approach.

About	Pros	Cons
• Involves measuring and reporting emissions from **individual sources** within an entity • Typically focuses on direct emissions • Often used by organizations that have a higher degree of emissions measurability	• More precise and accurate as it measures emissions from individual sources and can measure/show emissions reductions over time	• Can be resource-intensive, time-consuming, and costly to implement • Requires protocols to govern the standardization and harmonization of measurement processes

The Top-Down Approach

This approach is often used for enterprise-level environmental, social, and governance (ESG) reporting and compliance reporting where calculation guidance is provided. The table below describes the top-down approach.

About	Pros	Cons
• Focuses on the **overall emissions** of an organization • Includes emissions from direct and indirect sources, such as those from the production of purchased goods and services • Often used by organizations that have a lower degree of control over their emissions sources and are unable to measure them accurately	• Allows organizations to identify the highest-emitting areas of their operations • Less resource-intensive, quicker, and less costly to implement • Allows for estimates where data gaps exist	• Plenty of discretion in selecting data sources and calculation methods • High variability based on the calculation method selected • Less granular data: often does not allow for operational improvements to show how reductions are directly linked to operational practices

Emissions Verification and Assurance

Verification and assurance practices are critical to ensuring data quality and integrity, which underpin informed decision-making by various stakeholders. Among the most prominent regulatory regimes mandating verification and assurance are the European Union's Corporate Sustainability Reporting Directive (CSRD), California's Climate Corporate Accountability Data Act (SB 253), and the SEC Climate Rule. In addition, Illinois and New York have introduced legislation that mirrors California's.

Verification includes a rigorous assessment of the data, systems, processes, and methodologies associated with a GHG inventory. Note that verification applies to GHG emissions measured and disclosed within the context of carbon neutrality claims, carbon offset programs, product footprinting, and/or organizational inventory accounting.

Assurance is more closely associated with evaluating sustainability performance and impact disclosed through corporate ESG reports and assertions. External assurance may cover an organization's environmental performance as well as its social and governance metrics. Typically, assurance conveys that ESG and climate disclosures are held to the same standard as financial disclosure.

Both verification and assurance services are provided by independent third parties, which ensures objectivity, lends credibility to the process, and ensures that consumers and all key stakeholders can trust and make informed decisions about the data.

In addition, both verification and assurance processes are carried out in accordance with and governed by specific criteria established through globally recognized frameworks or standards. These frameworks and standards dictate the requirements, processes, and principles by which third parties must conduct their assessments and evaluations. See Resources for links to verification and assurance standards.

Types of GHG Calculations, Level of Accuracy, and Operational Readiness

There are varying levels of accuracy around GHG data depending on how data is collected and measured. However, utilizing a type and method of measurement that achieves higher accuracy is not always a viable option given that individual facilities and sectors do not always have the funding, technologies, or protocols in place to achieve this outcome consistently, or simply where there has been no call to action to develop such a protocol. Thus, there are many concerns to consider when determining how to best collect GHG data, and it is often a journey that begins with a high level of operational readiness but not necessarily a high level of accuracy. This is described in the following table.

Collecting real-world operational data is the most optimal approach to calculating GHG emissions. Emission factors or estimates, while useful to satisfy compliance and conformity requirements, cannot show unexpected variations such as seasonal, weather, or unplanned operational situations, and they are not as effective as direct measurements that can show, or form a basis for, operational improvement over time.

Types of GHG Calculations, Level of Accuracy, and Operational Readiness

Level of Accuracy \ Current Operational Readiness	Low	Medium	High
High	Direct measurements, such as through the use of a Continuous Emissions Monitoring System (CEMS) at a fuel source. • Data sources: asset-level measurement. • Measurements are collected from operating assets through metering, and requirements are set out in defined measurement, reporting, and verification plans.		
Medium		Combination of activity data (such as consumption data) and emissions factor(s). • Data source: organizational-level, public emissions factors. • Emissions factors are developed through scientific methods of inquiry, adopted by regulators, and provided to reporting entities who perform desktop calculations based on organizational data.	
Low			Combination of activity estimation (e.g., estimating electricity use by comparing the organization's square footage and occupancy with the total square footage of the building and occupancy) and emissions factor(s). • Data source: organizational-level, external emissions guidance. • Enterprise-level operating data is calculated using techniques such as extrapolation, norms, and values or ratios, and subsequently calculated using emissions factors.

What Could Regulators Do to Bring Clarity to Scope 3 Disclosure?

In recognition of the current state of reporting complexity, the variability already endemic in existing Scope 3 quantification efforts, and the magnitude of Scope 3 significance to the total share of GHG emissions, regulators would be wise to define the goal and set out a phased pathway towards accomplishment. Such a phased plan could:

- Require disclosure based on the materiality of Scope 3 emissions. The Science Based Target Initiative (SBTi) defines this as 40% or more of total Scope 1, 2, and 3 emissions.
- Set out guidance on what source data and calculation methods are acceptable.
- Require openness regarding how those calculations are performed ("show your work" principle).
- Specify a data repository or technology to act as a ledger for those historical calculations.
- Call for independent third-party verification from accredited bodies.
- Set a vision and timeline to move from initial voluntary disclosure towards mandatory disclosure, ultimately setting a future date where non-conformity penalties will take effect.

3. Addressing Scope 3 Emissions in Climate Disclosure Regulation: Challenges and Potential Solutions

The Challenges

As mentioned in Section 2, Scope 3 emissions are more complex than Scopes 1 and 2 from a monitoring, reporting, and verification perspective. It can be very challenging for companies to have visibility of (and control over) emissions associated with upstream or downstream supply chain activities. Among the most salient challenges is the availability and quality of Scope 3 data, which can be difficult to collect. In turn, reporters often must rely on emission factors, estimates, and normative data tables when measuring these emissions.

Specifically, Scope 3 reporting challenges that have so far proven intractable are as follows:

1. **Persistent and compounding errors:** Organizations in the supply chain often make quantification errors or omissions, at times based on a desire to preserve intellectual property (IP) or confidential information, providing inaccurate data to their downstream customer(s). Any error will persist to (re)create inaccuracy across the entire downstream supply chain, and the error will compound in any areas where the data is used as an input to a percentage calculation, common in transport costs.
2. **Double counting:** Supply chains are rarely linear, so instances of double-counted emissions (i.e., when two or more reporters in the same value chain report the same GHG emissions in the same scope) can happen. Vendors may lack the visibility and detail to identify and avoid counting duplicate emissions.
3. **Comprehensive lack of standardization:** In the absence of legislation, companies have developed or selected their reporting protocols and procedures in their supply chain

1. environments. This has created variances in reported data and high compliance costs for organizations in more than one supply chain.
2. **Impaired ability to conduct independent third-party verification:** The challenges associated with external assurance of Scope 3 emissions mirror those associated with reporting them. Because these emissions are outside an organization's control and lack standardization in reporting protocols, assurance providers are limited in their ability to properly assess the full supply chain robustness of the data provided and/or the accuracy of the methodologies and calculations. This challenge is intensified for Scope 3 emission categories with more complex calculation methodologies and/or as data is sourced deeper within the value chain.

The good news is that as requirements for Scope 3 emissions become more widespread and calculation methodologies and data-gathering practices become more accurate and standardized, the cost, complexity, and results variance of Scope 3 reporting can be reduced significantly.

Potential Solutions

Reducing cost and complexity in Scope 3 reporting while also ensuring data accuracy and credibility requires solving the following:

1. Information disclosure and confidentiality needs;
2. Methods that reduce variation and complexity; and
3. Technology that supports measurement and verification across the supply chain.

Below, we describe how developing standardized methodologies, leveraging distributed ledger platforms, and ensuring interoperability will address these challenges.

Standardizing Industry-Developed Protocols: Solving for Cost

Supply chains differ, often vastly, within and between industries. They are also often quite complex – even for seemingly simple products. A normative top-down emissions factor approach to embedded emissions accounting will likely produce generalized and inaccurate results in the context of this variation. A purely bottom-up approach, with each organization independently defining how all vendors in the chain should gather and report data, will drive even more variance – and ultimately, there will not be enough verification capacity to service such a volume of diverse reports for many years to come.

Instead, the optimal solution would be to:

- Begin with an initial "grace" period within which the industry is authorized to use normative emissions factors to calculate their Scope 3 disclosures, much like organizations currently do on a voluntary basis.
- During the grace period, call for industry groups to come together, likely under the auspices of a recognized industry body, to build Scope 3 measurement protocols aligned to the requirements of an accepted standard such as GHG Protocol or

- International Financial Reporting Standards (IFRS).
- Recognize the protocol within the regulatory environment, much like Underwriters Laboratory (UL) standards for industrial safety products and practices are referenced by regulatory bodies such as the Occupational Safety and Health Administration (OSHA).
- Set a future date for regulatory Scope 3 disclosures moving from normative emissions factor-based to being based on actual, operational measurements – per the industry protocols in place. Regulators would ultimately use the operational, facility-based emissions data generated per industry protocols as a baseline to define measurement or protocol-specific improvements.

By adopting the industry-developed protocols designed to span entire supply chains, companies operating within that community of practice would measure their GHGs in a format that makes the most sense in the context of their operations, significantly reducing cost and complexity. A shared industry protocol provides a standardized approach in which the protocol itself can be validated by an independent third party against an agreed reporting standard in a consistent and repeatable way. This is much more efficient than developing custom audit plans for various highly varied individual company protocols.

Developing protocols that reduce compliance costs creates better and more dependable data and gives agency and equity to those to whom the burden of reporting accrues is not entirely novel. Calling on industry to develop its standards has worked in the U.S. for many decades, and a network of independent verification bodies has grown up to service these requirements. Calling on the industry to develop its own standardized measurement, verification, and reporting practices will lead to more buy-in, efficient implementation, and accurate data, and retaining the ownership of these protocols in the industry will ensure they keep pace with the production process and technology development over time.

Codifying the Adoption of Effective Technologies: Solving for Accuracy, Complexity, and Confidentiality

Supply chains are inherently complex, often international and opaque, so an efficient reporting platform can potentially be a game changer.

A potential solution is a contemporary distributed ledger (blockchain) technology: web3 architecture.[3] In a web3 environment, data storage and provenance are decentralized. This environment ensures the integrity of a single source of truth, such as a bill of materials. It provides a historical record of the product that cannot be changed or altered, in which the data is also more accurate because it comes directly from the operational environment. It allows information to be distributed to selected parties within and outside the supply chain as required. Each supplier within the chain has custody and full control of their own data, which they can share fully or partially with others within a chain or publicly. This approach lowers data-storage costs, addresses commercial confidentiality concerns, and is the basis for interoperability between the parties.

[3] *Web3 is a term used to describe a new version of the internet, built on blockchain technology and controlled communally by participants. While web3 hasn't yet arrived on a broad scale, some sectors, in particular financial services, have been using web3 technologies such as smart contracts and digital assets and tokens. See https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-web3 for a high-level discussion.*

By loading protocols into the ledger platform, ultimately, this type of technology allows supply chain participants to "show their work." In Scope 3 disclosures, this is imperative: without full calculation and data interpretation transparency, all issues with double-counting, temporal emissions accrual challenges, calculation methodology variance, and other challenges discussed in this paper will persist, preventing communities of practice from harmonizing around reporting standards or protocols, and limiting the extent to which verifiers could provide reasonable assurance of results.

Note:
Commercial confidentiality within supply chains is typically achieved through the many commercial contracts between the parties. Obligations to disclose Scope 3 emissions information within supply chains could generate important and conflicting variance to the existing/typical contractual confidentiality obligations in place. The magnitude of this challenge could be extremely significant.

Distributed ledger environments can establish "smart contracts" between the parties. Such smart contracts could be configured for Scope 3 disclosure and regulatory compliance, set up opportunities for insetting, and operate adjunct to conventional commercial contracts. Smart contracts allow for a high degree of flexibility and allow emitters to retain disclosure control to the extent that the confidentiality risks and conflicts with existing contracts are beneficially mitigated.

In summary, a) supply chains are often quite complex for seemingly simple products, and b) there are so many supply chain steps and so much going on in any given product that a normative top-down approach to embedded emissions accounting will produce inaccurate results due to activity variances, supply chain step omissions, or data gaps. Most importantly, a normative top-down approach may fail to deliver a reliable baseline to measure and further improve ongoing supply chain activity.

Interoperability Reporting and Verification Solutions: Solving for Cost

Regulators in the U.S. considering Scope 3 reporting have an opportunity to go further by enabling interoperability between supply chains. The web3 architecture model can be scaled across many thousands of supply chains, enabling Scope 3 reporting across an economy and driving down reporting costs even further.

Once a reporting protocol has been developed and validated for an industry group, it can be embedded into the web3 distributed ledger. Perhaps the most significant cost savings in this approach is driven by "on-chain verification." Discrete calculations based on data relating to production activity would be uploaded to the ledger in a standardized format that aligns with the protocol requirements. This allows a verifier to make one site visit to that production facility to audit for conformity to the protocol. Subsequent production data could be verified remotely so long as the producer continues to operate in conformity with the protocol.

In a Scope 3 emissions environment in which verified data is critical and the supply of verification service capacity and knowledge limited, industry protocols in combination with web3 distributed ledger platforms can deliver scale, reduce compliance costs, and ensure data integrity.

Example: Complexities Within Supply Chains
Glass used in television manufacturing illustrates how complexity within a supply chain can be found when an expectation for a simpler chain could easily be justified. For example, glass for TV manufacturing is composed of several minerals, each with its supply chain and, in some cases, complex ones. See the table below for more detials.

Mineral Components Commonly Used in Glass	
Mineral	**Use in Glassmaking**
Silica	Primary ingredient of glass, influences transparency, color, and mechanical properties.
Sodium Carbonate	Lowers melting point of silica, removes impurities, promotes strength and durability.
Potassium Carbonate	Enhances durability, enhances clarity, lowers melting point of silica.
Sodium Sulfate	Creates a smooth finish, influences color.
Sodium Nitrate	Enhances clarity, influences color.
Calcium Carbonate	Stabilizer, improves chemical durability, lowers melting temperature, removes air bubbles.
Calcium Oxide	Enhances workability, contributes to transparency.
Borax	Fluxing agent, lowers melting point, enhances chemical durability, enhances transparency and transmittance.
Magnesium Oxide	Increases strength, enhances workability.

4. Recommendations

In addition to the preliminary recommendations set out in Section 2, we believe that a strong case can be made for both a phased approach to goal accomplishment for full material Scope 3 disclosure and the maximization of data integrity and confidence that will result from the "show your work" principle, and a move towards reliance on facility-level bottom-up operational data rather than estimates or factors.

Regulators and standard setters must be mindful that Scope 3 emissions data, along with protocols for data gathering, agreement on calculation methods, and verifiability of results, is still in its development phase. This highlights that a phased, sequential move towards harmonized disclosure practices that can produce dependable data upon which to base emissions reduction activity will likely pay dividends to success.

An actionable sequential pathway toward Scope 3 disclosure is essential. Regulatory conformity in response to mandatory disclosure requirements is the means to an end. The end goal should be to develop trusted data – demonstrating minimal calculation or interpretation variability – that can serve as the basis for beginning the operational and industrial work necessary to drive measurable embedded emissions reductions.

The sequence could, therefore, be configured as follows:

- Mandate disclosure based on the materiality of Scope 3 emissions.
- Set out guidance on which source data and calculation methods are acceptable.

- Require openness regarding how those calculations are performed.
- Specify a data repository or technology to act as a ledger for those historical calculations.
- Call for independent third-party verification from accredited bodies.
- Set a vision and timeline to move from initial voluntary disclosure towards mandatory disclosure, ultimately setting future data in which non-conformity penalties will take effect.
- Use early disclosures to develop a Scope 3 baseline.
- Set targets for subsequent emissions intensity reductions.
- Call for industry groups to develop shared bottom-up facility-level reporting protocols.
- Reduce verification requirements for industries that move to facility-level data-driven disclosure.
- Mandate a future goal year for 100% adoption of facility-based bottom-up reporting.

5. Conclusion

The call to action on climate change is abundantly and alarmingly clear. Our planet is already about 1.1°C warmer than in the late 1800s, and emissions continue rising. To keep global warming to no more than 1.5°C – as called for in the Paris Agreement – emissions need to be reduced by 45% by 2030 and reach net zero by 2050.

The striking simplicity of the math magnifies the importance of cutting embedded emissions. If the global community must cut emissions by 45% by the end of the decade, involving private industry on the journey is a non-negotiable aspect of delivering on our decarbonization commitments.

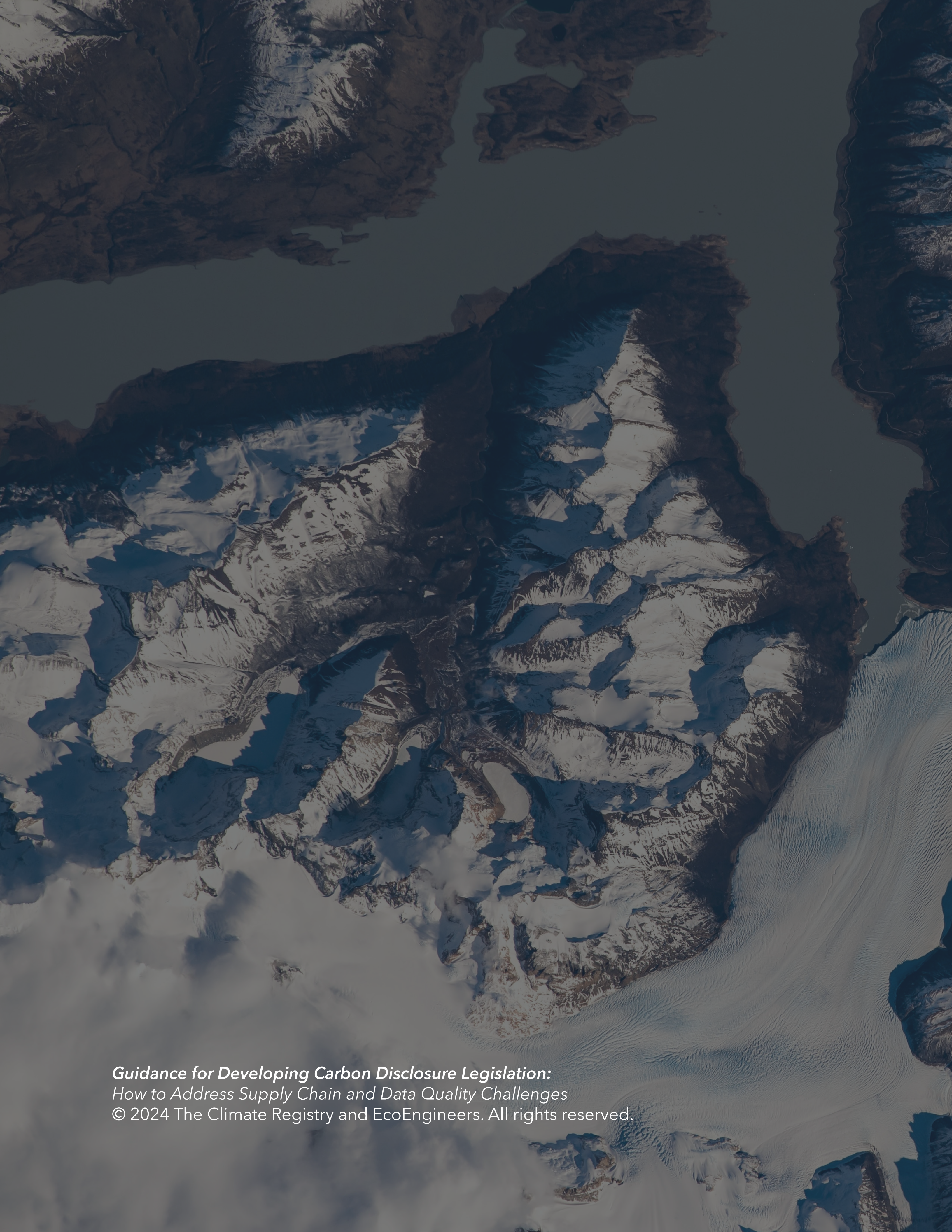
Only 20% of industry emissions are currently being measured and addressed. Enabling Scope 3 embedded emissions reporting will be the game changer that achieves these goals. Still, it is imperative that we set up a system that can generate dependable emission baselines, guiding a pathway toward measurable improvements.

There are many ways to approach GHG reporting programs, especially in light of a dynamic and evolving global landscape. This paper outlines key considerations for legislators and regulators to consider when designing and mandating GHG disclosure programs. It also offers potential solutions to the challenges associated with Scope 3 reporting, including cost, complexity, and significant data variability. Based on our experience and learnings, we believe that success will result from inviting the industry to standardize data collection procedures that make sense to them and foster commitment, setting up transparent and efficient data systems, and integrating assurance processes that can drive trust.

If we get this right, we can turn the tide in the fight against climate change. By demonstrating leadership through a more sophisticated and intentional regulatory approach, we can also reduce the compliance cost and complexity that others who execute less thoughtfully will incur and deliver a lasting competitive advantage to your jurisdiction.

Resources

1. California Senate Bill 253 (Climate Corporate Data Accountability Act): https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB253
2. Corporate Sustainability Reporting Directive (CSRD): https://info.anthesisgroup.com/hubfs/A%20Brief%20Guide%20to%20the%20CSRD-1.pdf
3. SEC Climate Rule: https://www.sec.gov/files/33-11275-fact-sheet.pdf
4. Verification and Assurance Standards:
    a. International Standard on Assurance Engagements - ISAE 3000 (Revised), Assurance Engagements Other than Audits or Reviews of Historical Financial Information (2013): https://www.iaasb.org/publications/international-standard-assurance-engagements-isae-3000-revised-assurance-engagements-other-audits-or
    b. ISO 14064-3:2019: https://www.iso.org/standard/66455.html
    c. AccountAbility's AA1000 Assurance Standard v3 2020: https://www.accountability.org/standards/aa1000-assurance-standard/
    d. American Institute of Certified Public Accountants (AICPA): AT-C 105: https://www.aicpa-cima.com/resources/download/exposure-draft-proposed-ssae-qm-supp-file-atc-105
    e. American Institute of Certified Public Accountants (AICPA): AT-C 205: https://us.aicpa.org/content/dam/aicpa/research/standards/auditattest/downloadabledocuments/at-c-00205.pdf
    f. American Institute of Certified Public Accountants (AICPA): AT-C 210: https://us.aicpa.org/content/dam/aicpa/research/standards/auditattest/downloadabledocuments/at-c-00210.pdf
    g. ISSA 5000: https://www.iaasb.org/publications/proposed-international-standard-sustainability-assurance-5000-general-requirements-sustainability



Guidance for Developing Carbon Disclosure Legislation:
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