World Business Council for Sustainable Development

CCICED Council Member Study Report on

International Best Practices in Corporate Carbon Accounting:

Considerations for Interoperability with China

(Draft)

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Foreword

Climate change poses severe threats to human survival and development, with excessive GHG emissions triggering extreme weather, ecosystem collapse, and economic systemic risks. Achieving carbon neutrality is an imperative for global sustainable development. As a responsible major power, China has committed to peaking CO_2 emissions by 2030 and achieving carbon neutrality by 2060, demonstrating its resolve in climate action.

The EU Carbon Border Adjustment Mechanism (CBAM) signifies the integration of climate governance with international trade. Followed by similar policies in the UK and Japan, it forms a unilateral ‘climate club’ system. As the world's largest carbon emitter and trading nation, China faces severe carbon barriers and industrial transition pressures. Against the backdrop of global efforts to address the climate crisis and reshape economic rules, reliable carbon accounting and climate-related disclosures have become the "new universal language" for transitioning toward a green future. Establishing an internationally comparable and mutually recognized standard system is of core strategic importance for China. It is crucial for leveraging climate finance, leading industrial transformation, and securing a leading role in global climate governance. This is especially urgent with the advent of global carbon border adjustment mechanisms, which necessitate a global common language to underpin these systems. The benefit of such a language is that it makes it easier for businesses to address the requirements of different approaches, thereby reducing their burden and compliance costs

Currently, international standards are rapidly converging around the International Sustainability Standards Board (ISSB) and the Greenhouse Gas Protocol (GHG Protocol) referenced by it. However, genuine integration goes beyond mere adoption—it hinges on achieving deep interoperability: ensuring that data under different standard systems can interact, be compared, and mutually recognized, thereby enabling seamless flow within global value chains. In this context, interoperability in corporate carbon accounting standards becomes crucial. A unified system can resolve CBAM disputes (e.g., differing definitions of indirect emissions between China and the EU), reduce exporters' compliance costs, enhance data credibility globally, and empower China to shape fair carbon neutrality rules.

This study aims to directly address this central challenge. By analyzing the critical challenges and strategic pathways for achieving interoperability between China's corporate carbon accounting system and leading international standards, with a focus on mitigating trade risks and enhancing global climate governance influence, which will enhance China's voice in global climate governance, address international carbon barriers, and facilitate corporate green transition.

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Executive Summary

This report provides a comprehensive analysis of the imperative for international interoperability in corporate carbon accounting systems, with a focused exploration of strategic pathways for aligning China's national framework with leading global standards. Against the backdrop of evolving global climate governance and the emergence of green trade barriers, the establishment of a comparable and mutually recognized carbon accounting system has become a critical prerequisite for enhancing China's influence in climate negotiations, countering international carbon-related trade barriers, and facilitating a smooth transition towards green industrialization.

The report offers an in-depth examination of the structure of major international standards such as the GHG Protocol, ISO 14064, and sector-specific frameworks, elucidating their distinct features as well as ongoing convergence efforts. It also details the composition and progress of China's existing three-tier carbon accounting system, while candidly identifying significant challenges it faces. These include fragmentation of standards, a severe lack of coverage for Scope 3 value chain emissions, substantial capacity shortfalls in carbon accounting among small and medium-sized enterprises (SMEs), definitional asymmetries with key trading partners on critical concepts such as indirect emissions, and lagging development of a localized, high-quality emission factor database that commands international trust.

In response to these multifaceted challenges, the report puts forward a series of strategic and systematic policy recommendations aimed at bridging existing gaps. The proposed measures emphasize the need to enhance China's corporate carbon accounting standards in a phased manner, gradually incorporating international best practices—particularly in value chain accounting. It strongly advocates for China's deeper and more proactive engagement in international standard-setting processes to ensure its national circumstances and practical experiences are reflected in global norms. Other key recommendations include prioritizing the international alignment of core methodologies such as electricity emission factors, launching robust capacity-building initiatives to uplift SMEs, and strategically considering the adoption of globally benchmarked disclosure frameworks. Furthermore, the report proposes establishing an advisory group comprising leading enterprises to provide practical, frontline insights for policy formulation.

Ultimately, achieving interoperability is positioned as a cornerstone for global climate action, equitable carbon pricing mechanisms, and the future interconnection of carbon markets. For China, the systematic implementation of these recommendations is essential to constructing a carbon accounting system that is both tailored to national conditions and internationally credible. This will not only strengthen China's influence in global climate governance but also provide solid support for

the green transformation of domestic industries, safeguard its economic interests amid evolving trade rules, and contribute an effective "Chinese solution" to global carbon neutrality efforts—ensuring a win-win outcome for both the environment and the economy.

1. International Context: An overview of Global GHG accounting frameworks

Carbon accounting frameworks and protocols take several principal forms which often have different rules governing considerations such as boundaries, timeframes, types of greenhouse gases (GHG) included, verification, and treatment of removals and offsets:

1) National GHG inventories.
2) Organisational (Corporate) GHG accounting.
3) Sector-specific organizational accounting, including for the financial sector and financed emissions.
4) Product-level GHG accounting (LCA).
5) Carbon crediting and offset standards and registries.
6) Avoided Emission

1.1 National GHG Inventories

The IPCC's 2006 Guidelines and 2019 Refinement are the authoritative methodological basis for national greenhouse-gas inventories submitted under UNFCCC. They set sectoral methods (energy, IPPU, AFOLU, waste), default emission factors, tiered methods (higher tiers = more detailed), and rules for uncertainty and reporting. These are the reference for country-level accounting and for many policy instruments. Countries are encouraged to use the most accurate data available, often moving from simple default emission factors to more detailed country-specific measurements as their technical capacity improves. This tiered approach balances scientific rigor with practical feasibility.

Central to the accounting process are emission inventories, which provide systematic records of annual emissions and removals. Inventories must adhere to the principles of transparency, accuracy, consistency, comparability, and completeness (TACCC). This ensures that reported numbers are both reliable and suitable for international review. Developed countries are required to submit detailed annual inventories, while developing countries may submit them less frequently, though capacity-building efforts are underway to improve global coverage and quality.

Verification and reporting are also key components of national GHG accounting. Under the United Nations Framework Convention on Climate Change (UNFCCC), countries submit their inventories for review by expert teams, who assess methodological soundness and data quality. This process builds trust among nations by ensuring accountability and reducing the risk of misreporting.

Increasingly, countries are also incorporating independent monitoring tools such as satellite-based measurements and remote sensing to enhance accuracy and detect discrepancies in land use or energy-related emissions data.

Finally, national GHG accounting plays a crucial role in policymaking, finance, and international cooperation. Reliable accounting allows governments to design targeted emissions reduction policies, evaluate their effectiveness, and make adjustments as needed. It also underpins carbon markets and climate finance mechanisms, where accurate reporting is essential for ensuring environmental integrity. By providing a clear picture of where emissions originate and how they change over time, national GHG accounting strengthens both domestic climate strategies and global collective action.

Relationship between national and corporate/organizational GHG accounting

The UNFCCC framework for national greenhouse gas (GHG) accounting and corporate or organizational GHG accounting frameworks share a common purpose: to measure, report, and manage emissions consistently and transparently. However, they operate at different scales and serve different policy and management objectives. National accounting, developed under the UNFCCC and guided by IPCC methodologies, exists to track countries' progress against international climate commitments and to ensure comparability of emissions data between states. Corporate accounting, by contrast, is designed primarily to inform management decisions, investor disclosures, and stakeholder communication. While both aim for accuracy and transparency, national frameworks emphasize comprehensive coverage of territorial emissions, whereas corporate frameworks prioritize organizational boundaries and decision-usefulness for business strategy.

A major discontinuity lies in how the two systems define boundaries for emissions measurement. National inventories are geographically based: they account for all emissions and removals within a country's borders, regardless of ownership or control. Corporate frameworks, such as the Greenhouse Gas Protocol, rely on organizational boundaries defined by operational or financial control and use the scope system (scope 1, 2, and 3) to capture direct and indirect emissions. This creates mismatches—for instance, emissions from an international airline may be attributed partly to a country under national rules, but to the airline itself under corporate rules, complicating alignment between the two levels.

Another difference arises in methodological detail and flexibility. National inventories are standardized through IPCC guidelines, which prescribe sector-specific methodologies and tiers of accuracy. These are designed to maximize comparability and ensure compliance with UNFCCC

reporting requirements. Corporate frameworks, while aligned conceptually, allow greater flexibility in methods and data sources, particularly for scope 3 emissions where companies often rely on estimates or industry averages. This flexibility makes corporate accounting more adaptable to varied organizational contexts but introduces inconsistency across firms, limiting comparability and complicating aggregation into national totals.

The two systems also diverge in verification and reporting practices. National inventories are subject to international expert review under the UNFCCC, which ensures methodological rigor and reduces misreporting risks. Corporate disclosures, on the other hand, are often voluntary or subject to varied regulatory requirements, with verification depending on investor pressure, market standards, or legal mandates. As a result, corporate data quality is more uneven, especially in supply-chain emissions reporting. This discontinuity highlights a key challenge: while corporate data is increasingly important for national inventories and global tracking, differences in boundary definitions, methodological choices, and verification rigor limit seamless integration of the two frameworks

Finally, the interplay between national and corporate frameworks is becoming more significant in the transition to a low-carbon economy. Corporate data provides a bottom-up input into national inventories, particularly in energy and industrial sectors, while national targets and policies shape the reporting requirements and reduction strategies of organizations. This bidirectional relationship ensures that climate action is aligned across scales: countries can meet their international commitments, and businesses can demonstrate accountability and contribute meaningfully to national and global goals. Over time, greater harmonization between the two levels of accounting is expected to improve accuracy, reduce reporting burdens, and support more effective climate action.

1.2 Organisational (Corporate) GHG Accounting

The Greenhouse Gas (GHG) Protocol corporate standards and the ISO 14064 standards are the two most widely used frameworks for corporate greenhouse gas accounting and reporting. Both serve to guide organizations in measuring, managing, and disclosing their emissions, but they evolved from different institutional contexts and embody distinct approaches. The GHG Protocol, developed in the late 1990s by the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), is designed to be a practical, user-friendly and flexible tool for businesses, focusing on corporate responsibility and consistency in detailed disclosures. ISO 14064, developed by the International Organization for Standardization, is part of the broader ISO 14000 family of environmental management standards and provides more prescriptive requirements that align with ISO’s tradition of standardization across industries and geographies.

1.2.1. GHG Protocol

The Greenhouse Gas (GHG) Protocol is the most widely used framework globally for measuring and reporting greenhouse gas emissions. It was launched in 2001 as a collaboration between WRI and the WBCSD, with the goal of creating a standardized and practical approach to corporate and organizational emissions accounting. Since then, it has become the foundation for nearly all voluntary and regulatory reporting initiatives, including the International Sustainabilty Standards Board, providing a common language that enables organizations to disclose their climate impacts in a consistent and transparent way.

At the core of the GHG Protocol is the Corporate Accounting and Reporting Standard, which establishes the principles, definitions, and methods companies should use to measure their emissions. This standard is built around five key principles—relevance, completeness, consistency, transparency, and accuracy—which ensure that reported emissions are useful, comparable, and trustworthy. By applying these principles, organizations can balance flexibility with rigor, allowing adaptation to diverse business models while ensuring credibility of disclosures.

One of the Protocol's most influential contributions is the introduction of emissions scopes, which categorize emissions into three groups. Scope 1 covers direct emissions from owned or controlled sources, such as company vehicles or onsite fuel combustion. Scope 2 accounts for indirect emissions from purchased electricity, heat, or steam. Scope 3, the most complex category, covers all other indirect emissions in the value chain, from supplier activities to customer use of products. This structure has become a global norm for describing organizational emissions and is now embedded in corporate reporting regulations and climate disclosure platforms.

The GHG Protocol is not a single document but rather a suite of standards that extend beyond the Corporate Standard. For example, the Scope 3 Standard provides detailed methods for calculating value chain emissions, helping companies address often-overlooked categories that typically account for the majority of their carbon footprint. The Project Protocol guides accounting for emission reduction projects, while the Product and Value Chain Standards address lifecycle emissions of products and supply chains. There are also protocols for governments, cities, and policies, reflecting the framework's versatility and global reach.

Nevertheless, the Protocol faces certain implementation challenges, particularly in relation to Scope 3 emissions. Collecting reliable data from across value chains is often difficult, leading many organizations to rely on estimates or industry averages. This can create variability in reporting quality, making it harder to compare performance across companies. The Protocol provides detailed

guidance and calculation tools to improve consistency, and ongoing updates seek to strengthen methodologies in areas of high uncertainty.

In practice, the Protocol plays a crucial role in corporate climate management. By identifying and quantifying emissions across scopes, organizations can better understand where their climate risks and opportunities lie. This information supports decision-making on energy efficiency, supply chain engagement, product innovation, and investment strategies. For many businesses, reporting under the GHG Protocol has also become a reputational and strategic necessity, as investors, customers, and regulators increasingly demand transparency on climate performance.

In particular, national regulatory frameworks and international accounting rules are increasingly relying upon or referring to the Greenhouse Gas (GHG) Protocol as the de facto global standard for corporate emissions accounting. Because of its wide adoption, clear categorization of scope 1, 2, and 3 emissions, and principle-based guidance, the Protocol has served as the methodological foundation for many governments developing mandatory disclosure requirements. For instance, the European Union's Corporate Sustainability Reporting Directive (CSRD) and its associated European Sustainability Reporting Standards (ESRS) reference the GHG Protocol's concepts and categories to ensure consistency in how companies measure and disclose emissions across scopes. Similarly, the United States Securities and Exchange Commission (SEC) drew heavily on the Protocol's framework in its proposed climate disclosure rules, particularly in its treatment of scope 1, 2, and 3 reporting.

Beyond national regulations, the GHG Protocol also plays a central role in international climate initiatives. The Task Force on Climate-related Financial Disclosures (TCFD), now being integrated into global standards through the International Sustainability Standards Board (ISSB), aligns its guidance with the GHG Protocol's accounting rules for emissions measurement. The ISSB's IFRS S2 Climate Standard, released in 2023, explicitly requires companies to measure and disclose emissions in accordance with the GHG Protocol, underscoring its authority as the global benchmark. This ensures that climate-related financial disclosures are consistent across jurisdictions and comparable across companies, reducing the risk of fragmented approaches to emissions reporting.

Several national GHG reporting programs have also drawn upon the Protocol for methodological consistency. The UK's Streamlined Energy and Carbon Reporting (SECR) requirements, Australia's National Greenhouse and Energy Reporting (NGER) scheme, and Japan's mandatory GHG reporting rules all use accounting principles and boundary-setting approaches that mirror or directly reference the GHG Protocol. While these regulatory systems may include country-specific calculation methods or reporting templates, they rely on the Protocol's foundational structure to

categorize emissions and guide organizational boundary choices. This harmonization is critical to ensuring that corporate-level disclosures can align with national inventories and international obligations under the Paris Agreement.

Finally, the GHG Protocol's influence is evident in carbon markets and voluntary disclosure systems that interface with regulatory frameworks. Platforms like the Carbon Disclosure Project (CDP), which governments and investors increasingly rely on for climate risk assessments, are directly based on the GHG Protocol. In addition, many emissions trading schemes and offset certification programs reference the Protocol to establish baseline accounting standards. As national regulations converge with international accounting rules, the GHG Protocol provides the backbone for alignment, helping to bridge voluntary disclosure, financial reporting, and compliance systems. Its role ensures that emissions data are produced consistently across scales, enabling integration into both regulatory oversight and global climate governance. This includes its Lifecycle Assessment Standard, which is relevant to carbon border adjustment mechanisms as it focuses on product level emissions. GHG P and ISO are starting a joint working group to update and align their standards in this increasingly important respect.

In sum, the GHG Protocol has become the cornerstone of corporate GHG accounting, shaping how emissions are measured, reported, and managed worldwide. Its emphasis on principles, its structured approach through scopes, and its wide suite of standards allow it to serve as both a practical toolkit and a global benchmark. By establishing comparability across organizations and enabling integration with policy and market systems, the Protocol continues to play a vital role in advancing corporate accountability and supporting the transition to a low-carbon economy.

1.2.2. ISO 14064

The ISO 14064 standard is an internationally recognized framework for quantifying, monitoring, reporting, and verifying greenhouse gas (GHG) emissions and removals. Developed by the International Organization for Standardization (ISO), which is made up of numerous members from national standard setting organizations, it is part of the broader ISO 14000 family of environmental management standards and provides organizations with a structured, auditable approach to climate accounting. First published in 2006 and revised in 2018, ISO 14064 was designed to bring rigor and consistency to corporate and project-level GHG reporting, supporting both voluntary initiatives and compliance with regulatory or contractual requirements.

ISO 14064 is divided into three parts, each with a distinct focus. ISO 14064-1 sets out principles and requirements for organizational-level GHG inventories, guiding companies on how to quantify and report their direct and indirect emissions. ISO 14064-2 applies to specific projects and activities,

providing methods for quantifying emission reductions or enhanced removals from mitigation initiatives such as renewable energy or reforestation. ISO 14064-3 establishes requirements for independent validation and verification of GHG assertions, ensuring that reported emissions or reductions are credible and can withstand external scrutiny. Together, these parts form a comprehensive framework that spans measurement, reporting, and assurance.

A defining feature of ISO 14064 is its emphasis on verification and assurance. Unlike some reporting frameworks, ISO embeds validation and verification requirements directly into its structure. This allows organizations to have their emissions data and reduction claims independently certified, which is especially valuable in contexts such as carbon markets, regulatory compliance, or contractual agreements where credibility and accuracy are paramount. This focus on verification makes ISO 14064 distinctively suited for organizations seeking auditable, certification-ready systems rather than purely disclosure-oriented reporting.

Another key strength of ISO 14064 is its alignment with ISO management standards, such as ISO 14001 for environmental management systems. This alignment makes it easier for organizations already working within ISO frameworks to integrate GHG accounting into their broader sustainability and quality management practices. As a result, ISO 14064 is often used by industries and organizations that require high levels of standardization, documentation, and certification, such as manufacturing, energy, and heavy industry.

In terms of scope and boundary setting, ISO 14064-1 requires organizations to define and justify their chosen approach for consolidating emissions, whether by operational control, financial control, or equity share. While this is conceptually similar to the Greenhouse Gas Protocol, ISO places greater emphasis on documentation, traceability, and transparency in boundary-setting decisions to ensure they can be independently verified. However, ISO 14064 offers less detailed guidance on value chain emissions than the GHG Protocol, meaning organizations often combine the two standards for comprehensive reporting.

The revision of 2018 significantly updated ISO 14064, bringing it closer in line with evolving climate disclosure needs and international practices. The updates clarified principles, strengthened requirements for organizational boundaries, and expanded guidance on indirect emissions. They also improved consistency between ISO 14064 and other ISO climate standards, such as ISO 14065 (requirements for GHG validation and verification bodies) and ISO 14067 (carbon footprint of products). These revisions helped the standard remain relevant in a rapidly evolving landscape of climate reporting expectations.

Overall, ISO 14064 provides a robust, auditable framework that emphasizes rigor, verification, and integration with broader management systems. While it is less widely used for public disclosure than the GHG Protocol, it is highly valued in contexts where assurance and certification are essential, such as emissions trading schemes, regulatory compliance, and project-based carbon reduction initiatives. In practice, many organizations adopt ISO 14064 alongside the GHG Protocol.

1.2.3. Key differences between and complementarities of the GHG Protocol and ISO 14064

The GHG Protocol was designed primarily for companies seeking to disclose emissions publicly and communicate transparently with stakeholders. It is a reporting-oriented standard, providing businesses with tools to structure disclosures in ways that are comparable across sectors. Highly respected and based in science, it accounts for about 80% of the market. ISO 14064 emphasizes compliance, assurance, and verification. It is less about stakeholder communication and use in multiple corporate contexts and more about supporting verifiable, auditable records that can be helpful in the context of regulatory or contractual scrutiny.

Another important difference lies in the degree of prescription. The GHG Protocol provides principles, guidance, and calculation tools, but leaves room for flexibility in data sources, estimation techniques, and boundary-setting choices. This flexibility has helped its widespread adoption but can result in variability in reporting quality between organizations. ISO 14064, by contrast, is far more prescriptive, specifying exact requirements for quantification, documentation, and verification. Its rigor makes it especially suitable for contexts where emissions reporting is tied to compliance o certificartion.

The treatment of verification also reflects a certain divergence of approach. Under the GHG Protocol, verification is encouraged but not embedded into the standard itself; third-party assurance is optional and often driven by stakeholder demands or regulatory requirements. In ISO 14064, however, verification is central: Part 3 of the standard explicitly details requirements for independent validation and verification, including competence of verifiers and processes for conducting assurance. This reflects ISO’s orientation toward producing standards that can underpin certification systems.

In terms of boundary definitions, both frameworks recognize organizational and operational boundaries but apply them differently. The GHG Protocol popularized the choice between the equity share and control approaches for consolidating organizational emissions, offering companies flexibility in determining which assets to include. ISO 14064 requires organizations to clearly state and justify their boundary-setting approach but prescribes more stringent documentation of these decisions, emphasizing transparency for verification purposes. While both systems acknowledge

value chain emissions, the GHG Protocol provides far more detailed guidance on scope 3, whereas ISO 14064 offers less explicit direction.

When considering integration into broader systems, the GHG Protocol has become the de facto global norm for voluntary reporting and has influenced many mandatory schemes, such as the EU Emissions Trading System's corporate reporting practices and U.S. EPA GHG reporting rules. ISO 14064, meanwhile, aligns closely with ISO's family of management standards (such as ISO 14001 on environmental management systems), making it a natural fit for organizations already adopting ISO frameworks for quality or environmental performance. This integration creates coherence for firms seeking a unified management and certification approach across sustainability domains.

The major points of difference can therefore be summarized along three lines: (1) flexibility vs. prescription, with the GHG Protocol offering more adaptable, principle-based guidance and ISO providing more rigid, auditable requirements; (2) emphasis on communication vs. compliance, with the GHG Protocol designed for broad corporate disclosure and ISO designed for certification and assurance; and (3) verification, with ISO embedding assurance requirements while the GHG Protocol leaves it optional. These differences mean that while both standards aim to improve emissions reporting, they serve complementary but distinct roles in practice.

In practice, many companies use the two frameworks in combination. The GHG Protocol often serves as the basis for data collection, categorization, and disclosure, while ISO 14064 provides the framework for verifying and certifying those disclosures. This hybrid approach allows organizations to benefit from the GHG Protocol's flexibility and global acceptance while leveraging ISO's credibility and rigor in assurance. As corporate climate reporting becomes increasingly regulated and subject to investor scrutiny, the complementarity between these frameworks may strengthen, with ISO offering verification infrastructure and the GHG Protocol continuing to shape the global language of corporate GHG accounting.

1.2.4. Ongoing process of refinement of and alignment between GHG Protocol and ISO 14064

Recognizing the risks of duplication and fragmentation, the two initiatives have engaged in efforts to build cooperation and ensure convergence, with the goal of reducing reporting burdens on organizations while maintaining credibility and comparability. A primary driver of convergence has been the globalization of climate disclosure requirements. Regulatory initiatives such as the EU's Corporate Sustainability Reporting Directive (CSRD) and IOSCO's backing of the creation of the International Sustainability Standards Board (ISSB) and the subsequent adoption its S2 climate standard by a growing number of jurisdictions all build on the GHG Protocol's scope structure and boundary-setting principles. At the same time, ISO 14064 is valued in regulatory and market

contexts for its auditable requirements and third-party assurance processes. This overlap has created pressure to align methodologies so that organizations can report once and satisfy both disclosure- and assurance-oriented requirements, reducing duplication and inconsistencies.

One of the central areas of convergence has been the conceptual framework. The GHG Protocol's innovations, such as the division of emissions into scope 1, scope 2, and scope 3, have been widely adopted across corporate and regulatory reporting systems. ISO 14064 has incorporated similar categorizations, ensuring that organizations using ISO's standards can align their disclosures with GHG Protocol-based frameworks like CDP, the Science Based Targets initiative, and regulatory reporting rules that explicitly reference the Protocol. This alignment ensures that companies do not face conflicting definitions when reporting under different schemes.

Another important dimension of cooperation lies in the principles guiding emissions accounting. Both the GHG Protocol and ISO 14064 emphasize relevance, completeness, consistency, transparency, and accuracy. While ISO 14064 codifies these principles into auditable requirements, and the GHG Protocol frames them as flexible guidance, their shared foundation makes it possible for organizations to use one system as the basis for reporting and the other as the framework for verification. This complementary structure helps companies that disclose using the GHG Protocol to also seek ISO-certified assurance without having to reframe their emissions data entirely.

The programs have also worked toward methodological consistency. One key area of methodological convergence has been the treatment of organizational boundaries. The GHG Protocol allows companies to choose between equity share and control (financial or operational) approaches when consolidating emissions. ISO 14064-1 recognizes these approaches but requires organizations to document their choices and provide clear justification, enabling verifiability. Recent cooperation has focused on clarifying how these approaches can be consistently applied across both frameworks, ensuring that data collected under the GHG Protocol can be directly validated under ISO 14064 without methodological conflicts.

Another area of focus is the categorization of emissions. The GHG Protocol's introduction of scopes 1, 2, and 3 has become the global norm for corporate reporting, adopted by regulators, voluntary disclosure platforms, and investors. ISO 14064 now incorporates this categorization to maintain compatibility. Efforts are ongoing to refine guidance on scope 2 reporting (especially market-based versus location-based electricity accounting) and scope 3 emissions, which present the greatest methodological challenges. Aligning calculation approaches for upstream and downstream emissions is critical, as value chain emissions typically account for the majority of corporate footprints.

Convergence efforts also address quantification methods and emission factors. The GHG Protocol provides calculation tools and guidance, often allowing flexibility in data sources, while ISO 14064 emphasizes rigor, traceability, and documentation of methods used. Work is being done to harmonize tiers of accuracy, encouraging companies to improve data quality over time without creating conflicting requirements. The aim is to ensure that emissions estimates developed under the GHG Protocol are both decision-useful for disclosure and robust enough to be verified under ISO standards.

Verification and assurance represent a particularly important dimension of convergence. The GHG Protocol itself does not prescribe verification but encourages organizations to seek third-party assurance. ISO 14064-3, by contrast, provides detailed requirements for validation and verification processes. Ongoing convergence discussions focus on bridging disclosure and assurance, making it easier for companies to report using the GHG Protocol and then use ISO 14064 as the framework for verification. This interoperability reduces transaction costs and ensures that disclosures carry credibility with regulators, investors, and carbon market participants.

The 2018 revision of ISO 14064 marked a significant step toward convergence. It clarified principles, strengthened boundary-setting rules, and expanded coverage of indirect emissions in ways that more closely align with the GHG Protocol. Since then, further collaboration has been encouraged by international bodies such as the UNFCCC, ISSB, and various industry groups, which seek to harmonize corporate accounting standards to avoid fragmentation. Updates to the GHG Protocol currently under consultation are expected to reflect these convergence efforts, particularly in scope 2 and 3 methodologies.

Practical convergence is also being promoted through capacity-building and guidance initiatives. Joint training programs, cross-references in reporting guidance, and shared terminology are being developed to help practitioners navigate both frameworks. Organizations such as CDP, SBTi, and regulatory authorities often reference both the GHG Protocol and ISO 14064 in their guidance, reinforcing alignment in practice. This ecosystem-level cooperation helps ensure that companies can rely on consistent methods across disclosure, target-setting, and verification processes.

Despite significant progress, some challenges remain. The GHG Protocol’s flexibility, which makes it accessible and widely adopted, can sometimes lead to variability in reporting quality. ISO 14064’s prescriptive requirements, while ensuring rigor, can be resource-intensive and less adaptable for smaller organizations. Achieving full methodological convergence requires balancing these differences—maintaining accessibility while ensuring robustness. Ongoing stakeholder consultations are working to reconcile these tensions, particularly in the treatment of value chain emissions and in setting minimum requirements for data quality.

In sum, the ongoing efforts to improve methodological consistency and convergence between the GHG Protocol and ISO 14064 reflect the growing demand for a coherent global system of GHG accounting and recognition that the two frameworks serve fundamentally complementary roles. The GHG Protocol provides the most widely accepted language and structure for emissions disclosure, while ISO 14064 delivers the rigor and certification infrastructure needed for assurance, compliance, and market participation.

As climate disclosure becomes increasingly mandatory and interconnected with financial reporting, alignment between disclosure-oriented and assurance-oriented frameworks is critical. By harmonizing principles, methodologies, and verification pathways, the two systems together create a foundation that supports transparency, comparability, and credibility in emissions reporting worldwide. This convergence not only reduces burdens for reporting organizations but also strengthens the integrity of climate data, helping policymakers, investors, and other stakeholders make informed decisions in the transition to a low-carbon economy. It reduces duplication, increases interoperability, and strengthens trust in reported emissions data, helping organizations to navigate voluntary and mandatory reporting environments more efficiently and coherently both within and across national borders.

In early September 2025, a ground-breaking partnership between GHG Protocol and the International Standards Organization (ISO), aimed at reducing fragmentation in the GHG accounting landscape, was announced. This new partnership drives forward an ambition of harmonisation and co-development, resulting in a more common global language for emissions measurement and reporting and thus simplifying the task at hand for companies, consultants, verifiers, auditors, conformity assessment bodies, and other third parties (e.g., trainers and software companies). It also aligns with growing calls for harmonisation, including most recently by the B7 community (tasked with consolidating the interests of the business community and developing concrete and actionable recommendations to the G7 leadership).

Going forward, GHG P and ISO will collaborate in the development of co-branded GHG standards, with experts from both organizations contributing their knowledge while continuing to engage respective governance systems and procedures. The work will cover corporate, product, project accounting and verification standards, and build on on-going standards revision and development activities as well as kick-off work on the development of an updated product carbon footprint standard (which inter alia leverages existing efforts by PCT accounting initiatives, such as PACT and others). The latter addresses rising demand for more accurate data from across supply chains and will support implementation of Carbon Border Adjustment Mechanisms which are on the rise globally through an aligned methodology.

Due to the interdependencies between corporate, product and project-based accounting, continuing to deliver a harmonised set of standards which “come from the same hand” remains critical. This partnership aims to deliver on that.

1.3 Sector-specific Organizational Accounting

1.3.1. Industrial

The global system of greenhouse gas (GHG) accounting has evolved beyond general standards like the Grenhouse Gas Protocol and ISO 14064 to include sector- and industry-specific frameworks. These tailored methodologies reflect the unique emissions profiles, boundary issues, and reduction opportunities found across different sectors of the economy. By providing specialized guidance, they improve both the accuracy of emissions measurement and the credibility of disclosures, while ensuring alignment with the general accounting principles of relevance, completeness, transparency, consistency, and accuracy.

One of the earliest and most important examples is in the agricultural sector. The GHG Protocol Agricultural Guidance, which provides sector-specific rules for agriculture, forestry, and land use. Agriculture is challenging because it involves non-CO_2 gases such as methane from livestock and nitrous oxide from soils, as well as potential carbon sequestration in biomass and soils. The framework helps companies and governments account for emissions from enteric fermentation, manure management, fertilizer application, rice cultivation, and land-use change. This has been critical in improving agricultural reporting under both voluntary disclosures and national inventories. GHG P’s Land Sector Guidance is in the process of being updated.

In the oil and gas industry, emissions are dominated by methane releases, flaring, and energy use in extraction and refining. The Oil and Gas Methane Partnership (OGMP) 2.0, convened by the UN Environment Programme and the Climate and Clean Air Coalition, sets detailed standards for reporting methane emissions at both source- and site-levels. In parallel, the International Petroleum Industry Environmental Conservation Association (IPIECA), in collaboration with the GHG Protocol, has developed reporting guidance that helps companies account for both operational emissions and downstream combustion of sold fuels. These frameworks respond to increasing scrutiny of oil and gas methane leakage, which has outsized climate impacts.

The electric power sector has its own specialized guidance in the form of the GHG Protocol Guidance for the Electric Power Sector. This framework addresses issues such as how utilities should account for emissions from power plants, grid-purchased electricity, and renewable energy procurement. It also clarifies accounting for market-based and location-based methods in scope 2 reporting, as well as treatment of renewable energy certificates (RECs) and power purchase

agreements. Because electricity underpins decarbonization in many sectors, having robust methodologies for utilities is critical to ensuring transparency and comparability in emissions reporting.

Heavy industry is another area where specialized frameworks have emerged, particularly in cement, steel, and chemicals production. The Cement Sustainability Initiative (CSI) Protocol, developed by WBCSD and now managed by the Global Cement and Concrete Association (GCCA), provides detailed guidance on accounting for emissions from clinker production, the most carbon-intensive stage of cement making. The World Steel Association runs a CO_2 Data Collection Program that helps steel companies calculate and benchmark their direct and indirect emissions. Similarly, the chemical sector has guidance through organizations like the International Council of Chemical Associations (ICCA). These frameworks are crucial because process emissions, rather than just energy use, dominate industrial GHG profiles.

The transport sector has multiple industry-specific frameworks due to its international nature and need for specific data sets. The Catena-X initiative is developing a standardized rulebook for calculating the Product Carbon Footprint (PCF) in the automotive industry. This framework enables accurate, comparable collection of real CO_2 emissions data across the entire value chain. Data recorded according to these standards can then be exchanged with partners using Catena-X certified solutions. This allows all participants in the value chain to assess their carbon footprint and implement targeted reduction measures. The result is a dependable foundation for strategic decision-making and regulatory reporting. The International Civil Aviation Organization (ICAO) has developed emissions methodologies and calculators that underpin the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). For maritime transport, the International Maritime Organization (IMO) has introduced a mandatory Data Collection System (DCS) that requires large ships to monitor and report annual fuel consumption and CO_2 emissions. For land freight and logistics, the Global Logistics Emissions Council (GLEC) Framework provides harmonized methodologies to calculate supply chain transport emissions across modes. Together, these frameworks help address the complexity of cross-border transport emissions.

For the real estate and built environment sector, accounting frameworks address emissions from building operations and embodied carbon in materials. The GHG Protocol for Cities extends corporate-level methods to urban systems, helping local governments account for emissions from energy, buildings, transport, and waste. Meanwhile, the Carbon Risk Real Estate Monitor (CRREM) provides science-based decarbonization pathways and tools for property investors and managers to assess stranded asset risks. These frameworks reflect the sector’s large share of global energy demand and its potential for efficiency-driven reductions.

The information and communications technology (ICT) sector has also developed specialized methodologies. The ICT Sector Guidance built on the GHG Protocol, developed jointly by the Global e-Sustainability Initiative (GeSI), the International Telecommunication Union (ITU), and the GSMA, provides methods for calculating emissions from telecom networks, data centers, and end-user devices. Importantly, it also considers the “enablement effect” of ICT—where digital solutions can reduce emissions in other sectors (for example, through teleconferencing or smart logistics). This dual perspective makes it unique among sectoral frameworks.

In the mining and metals sector, organizations such as the International Council on Mining and Metals (ICMM) provide sustainability and climate reporting guidance aligned with the GHG Protocol. Mining presents distinct challenges, including fugitive methane from coal operations, energy-intensive ore processing, and long supply chains for metals like copper and aluminum. Sector-specific methodologies help ensure that emissions are consistently calculated across companies, enabling investors and regulators to benchmark climate performance.

The food and beverage industry has adopted GHG accounting frameworks that combine agricultural guidance with product-level methodologies. For example, the Food and Beverage Sector Guidance of the GHG Protocol provides methods to account for scope 3 impacts such as agricultural sourcing, processing, packaging, and distribution. These frameworks are especially important given consumer and retailer demand for product-level carbon footprints and the sector’s reliance on complex global supply chains.

Another significant area is the waste and recycling sector, where specialized accounting approaches address emissions from landfills, incineration, recycling, and composting. The Solid Waste Emissions Estimation Tool (SWEET) and IPCC-aligned methodologies are often used by municipalities and companies. Sectoral guidance helps clarify accounting for avoided emissions (such as from recycling replacing virgin material use), which are often reported inconsistently in general frameworks.

Emerging frameworks are also being developed for emissions-intensive emerging technologies, such as hydrogen, carbon capture and storage (CCS), and bioenergy. For example, ISO and industry groups are working on methodologies for tracking emissions intensity of hydrogen production pathways. These are critical to ensuring that “low-carbon” technologies deliver genuine climate benefits and are not undermined by inconsistent or opaque accounting.

Taken together, sectoral or industry-specific GHG accounting frameworks form the second layer of the global climate accountability system. While general frameworks like the GHG Protocol and ISO 14064 establish overarching rules, sectoral methodologies translate these rules into operational

practice within industries. This ensures that emissions are measured consistently where technical details differ, and it supports comparability across companies and nations. As the pressure to decarbonize intensifies, sector-specific frameworks will continue to expand, providing the detail and rigor needed to achieve net-zero pathways.

1.3.2. Financial sector

The financial sector's approach to greenhouse gas (GHG) accounting has developed rapidly in recent years, as banks, insurers, pension funds, and asset managers recognize their central role in enabling or constraining the transition to a low-carbon economy. Unlike most industries, the sector's direct, operational emissions (scope 1 and scope 2) are relatively small. The overwhelming majority of its climate impact arises from financed emissions—the emissions linked to the activities and companies that financial institutions invest in, lend to, or underwrite. As a result, the sector has adopted specialized frameworks and methodologies to account for these indirect impacts, with growing regulatory and stakeholder pressure to disclose them transparently.

At the heart of this evolution is the Partnership for Carbon Accounting Financials (PCAF), which has emerged as the principal global standard for measuring financed emissions. PCAF provides a Global GHG Accounting and Reporting Standard for the Financial Industry, offering detailed methodologies for a wide range of asset classes, including listed equity, corporate bonds, business loans, project finance, mortgages, commercial real estate, and motor vehicle loans. By attributing portions of a borrower's or investee's emissions to the financial institution based on its proportional exposure, PCAF gives the sector a consistent approach to quantifying indirect climate impacts.

The concept of financed emissions attribution is central. Under PCAF, financial institutions allocate emissions proportionally, typically by dividing the value of their investment or loan by the total value of the borrower or project. For example, if a bank provides 10% of the financing for a company, it is responsible for 10% of that company's emissions. This proportional method ensures that emissions responsibility is shared across all financiers, while avoiding double counting at the sectoral level. It also creates a clear link between portfolio composition and climate impacts, enabling institutions to identify carbon-intensive exposures.

Importantly, financed emissions accounting aligns with broader climate disclosure initiatives. The Greenhouse Gas Protocol's Corporate Value Chain (Scope 3) Standard requires companies, including financial institutions, to report on the climate impacts of their investments. PCAF builds on this by offering granular methodologies specifically for the financial industry. Likewise, disclosure systems such as CDP (formerly Carbon Disclosure Project) and frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) expect financial institutions to measure and report

their portfolio-level emissions. In this way, PCAF operationalizes scope 3 requirements for a sector that might otherwise struggle to apply general GHG Protocol guidance.

The growing importance of financed emissions is also tied to net-zero commitments. Initiatives such as the Net-Zero Banking Alliance (NZBA), the Net-Zero Asset Managers Initiative (NZAMI), and the Net-Zero Insurance Alliance (NZIA) require signatories to align their portfolios with 1.5°C climate pathways. To demonstrate progress, institutions must measure financed emissions as a baseline, set interim targets for reducing portfolio carbon intensity, and report annually on progress. Without robust accounting standards, these commitments would lack credibility. Thus, PCAF has become a cornerstone of financial sector climate accountability.

One methodological challenge is data availability and quality. In many cases, investees or borrowers do not report their own emissions, particularly small and medium-sized enterprises. PCAF addresses this by introducing a data quality scoring system, allowing financial institutions to use estimated data when necessary, but with transparency about the reliability of those estimates. Over time, this encourages better disclosure by investees while giving institutions a pathway to improve portfolio coverage and accuracy.

Another challenge lies in boundary setting and alignment with other standards. For instance, double counting remains a risk when multiple institutions finance the same company or project, though PCAF's proportional attribution mitigates this. Similarly, consistency with regulatory frameworks such as the EU Sustainable Finance Disclosure Regulation (SFDR) and the EU Taxonomy requires ongoing refinement. Financial institutions must reconcile financed emissions accounting with broader environmental, social, and governance (ESG) reporting rules, as well as prudential regulations that increasingly incorporate climate risk considerations.

Beyond accounting, financed emissions frameworks help financial institutions manage transition risks and opportunities. High levels of financed emissions can indicate exposure to sectors vulnerable to regulatory tightening, carbon pricing, or market shifts. By identifying hotspots, institutions can reallocate capital towards low-carbon solutions, develop green financial products, and engage with clients on decarbonization strategies. In this way, GHG accounting is not just a reporting exercise but a tool for strategic portfolio management and risk mitigation.

There is also increasing focus on the role of financial sector GHG accounting in driving real-world emissions reductions. Critics warn that portfolio alignment strategies may sometimes prioritize divestment over engagement, shifting emissions rather than reducing them. To address this, frameworks emphasize that financed emissions disclosures should be linked to science-based targets, client engagement strategies, and investments in transition finance. This ensures that

financial institutions contribute to systemic decarbonization rather than merely optimizing their reported numbers.

In summary, the financial sector's approach to GHG accounting has matured from limited operational reporting to a sophisticated system centered on financed emissions. Through frameworks like PCAF, aligned with the GHG Protocol and integrated into disclosure regimes like TCFD, financial institutions can measure, attribute, and disclose their portfolio emissions consistently. This provides the foundation for credible net-zero commitments, regulatory compliance, and strategic risk management. As data quality improves and standards converge internationally, financed emissions accounting will remain a cornerstone of the sector's role in advancing the global low-carbon transition.

1.4 Product-level GHG accounting (LCA)

Product-level greenhouse gas (GHG) accounting frameworks are designed to quantify the emissions associated with the life cycle of specific products and services, from raw material extraction through production, distribution, use, and end-of-life. Unlike corporate or national GHG inventories, which focus on organizational or territorial boundaries, product-level accounting takes a life cycle perspective and assigns emissions to an individual good or service. This approach allows businesses, regulators, and consumers to understand the climate impacts of products, compare alternatives, and drive demand for lower-carbon solutions. Essentially, this allows for more targted decarbonization action. It also provides a foundation for eco-labels, carbon footprint disclosures, and product differentiation in competitive markets.

One of the most widely used frameworks is the GHG Protocol Product Life Cycle Accounting and Reporting Standard (often called the GHG Protocol Product Standard). This framework provides a structured methodology for companies to calculate the GHG emissions of individual products across their entire life cycle. It requires clear boundary setting (cradle-to-grave, cradle-to-gate, or partial life cycles), transparent assumptions, and consistent treatment of multifunctional processes. The Product Standard integrates with the GHG Protocol's corporate-level guidance, ensuring that product footprints are consistent with broader corporate inventories and scope 3 accounting.

Another influential framework is ISO 14067: Carbon footprint of products, part of the broader ISO 14060 family of GHG standards. ISO 14067 specifies principles, requirements, and guidelines for quantifying and reporting product carbon footprints, grounded in the life cycle assessment (LCA) methodology of ISO 14040 and ISO 14044. This standard provides detailed guidance on system boundaries, allocation rules, and data quality requirements, making it compatible with international

LCA practices. ISO 14067 is widely used in global supply chains because of its credibility and alignment with other ISO standards for environmental management.

The Life Cycle Assessment (LCA) methodology, as codified in ISO 14040/44, underpins both the GHG Protocol Product Standard and ISO 14067. LCA evaluates environmental impacts across the full product life cycle, including climate change, water use, and resource depletion. When applied specifically to GHG emissions, it provides a "carbon footprint of products." By following LCA principles, product-level accounting avoids burden shifting (reducing emissions in one stage but increasing them in another) and enables comprehensive comparisons between products with similar functions.

In Europe, the Product Environmental Footprint (PEF) initiative, led by the European Commission, extends product-level GHG accounting into a broader environmental assessment tool. Planned for publication in 2026, the PEF method is intended to harmonize product footprinting across EU markets, reducing the proliferation of inconsistent methodologies. While it covers multiple environmental impacts, GHG emissions are a central metric. The PEF framework has been tested across various product categories (e.g., apparel, food, packaging), and is intended to be linked to EU regulatory initiatives, including sustainable product policy and labeling schemes.

The PAS 2050:2011 Standard, developed by the British Standards Institution (BSI), is another important product-level framework. It provides a method for assessing the life cycle GHG emissions of goods and services, with specific rules for biogenic carbon, delayed emissions, and agricultural products. PAS 2050 has been used widely in the food, beverage, and consumer goods industries, and it has influenced both ISO 14067 and the GHG Protocol Product Standard. It remains a widely referenced benchmark, particularly in the UK and Europe, where companies use it for carbon labeling and consumer communication.

Product-level accounting frameworks must also contend with sector-specific Product Category Rules (PCRs). PCRs provide detailed instructions for calculating emissions of specific product types (e.g., cement, textiles, electronics). They ensure consistency by setting standardized functional units, system boundaries, and calculation methods tailored to each category. PCRs are often developed within the Environmental Product Declaration (EPD) system, a standardized reporting mechanism under ISO 14025. By aligning with EPDs, product-level GHG accounting facilitates credible third-party verified disclosures.

The food and agriculture sector has seen particularly active development of product-level accounting frameworks. Given the importance of land-use change, methane, and nitrous oxide in agricultural supply chains, specialized rules are required. The Cool Farm Tool, the FAO's EX-ACT

Tool, and the Product Environmental Footprint Category Rules for food products all provide tailored methodologies. These frameworks help companies calculate the climate impact of agricultural commodities, food products, and diets, which are key areas for consumer-facing carbon footprint labels.

In the construction and materials sector, product-level GHG accounting is increasingly tied to embodied carbon reporting. EPDs are widely used to disclose the life cycle emissions of cement, steel, glass, and other building materials. Frameworks such as the Cement Sustainability Initiative's CO_2 Protocol and PCRs for construction products guide these disclosures. They provide data for building-level carbon assessments, green building certifications (like LEED and BREEAM), and regulatory initiatives that require low-carbon material procurement.

The apparel and textile sector has also adopted product-level carbon footprinting frameworks to address consumer demand for transparency. Initiatives such as the Higg Index Product Tools, developed by the Sustainable Apparel Coalition, allow companies to measure the cradle-to-grave emissions of garments and footwear. These frameworks integrate LCA principles while addressing sector-specific challenges like fiber production, dyeing, and end-of-life scenarios. By providing product-level data, they support labelling schemes and brand-level climate targets.

Product-level GHG accounting is closely linked to carbon labelling and consumer communication. Initiatives like Carbon Trust labelling in the UK and similar schemes in Japan and France use product-level accounting to display carbon footprints on packaging. These labels allow consumers to compare products on the basis of climate impact, though challenges remain in ensuring clarity and avoiding confusion. Accurate and standardized product-level methodologies are critical to avoid greenwashing and build trust in such claims.

Methodological challenges persist in product-level GHG accounting. These include handling biogenic carbon and delayed emissions (e.g., in wood products), dealing with end-of-life scenarios (e.g., recycling vs. landfill), and ensuring data quality across global supply chains. Allocation in multi-output processes (e.g., dairy products yielding both milk and meat) remains contentious, with different frameworks allowing different approaches. Ongoing efforts to harmonize methodologies—particularly between ISO 14067, the GHG Protocol, and PEF—aim to reduce inconsistency and increase comparability.

Another area of focus is the integration of digital tools and databases to support product-level accounting. Databases like ecoinvent and the US LCI Database provide life cycle inventory data that can be used for carbon footprint calculations. Digital platforms are increasingly offering automated product-level accounting, enabling companies to scale up carbon footprinting across

large product portfolios. This digitalization trend may help overcome barriers related to data collection and consistency.

The strategic importance of product-level frameworks lies in their ability to link corporate emissions with consumer behavior. Corporate GHG inventories capture overall impacts, but product-level footprints provide the granularity needed to redesign products, optimize supply chains, and influence consumer choices. They also play a role in policy, as governments increasingly consider mandatory product carbon disclosure and labeling schemes to drive demand-side decarbonization. In this way, product-level accounting bridges corporate sustainability reporting and consumer-driven climate action.

In conclusion, product-level GHG accounting frameworks provide essential tools for measuring and communicating the climate impacts of goods and services. From the GHG Protocol Product Standard and ISO 14067 to sector-specific PCRs, PAS 2050, and the EU PEF method, these frameworks establish a global architecture for credible, consistent, and comparable carbon footprinting. While methodological challenges remain, ongoing convergence and the rise of digital solutions promise to strengthen their reliability and scalability. Ultimately, product-level accounting enables more informed choices by companies, consumers, and policymakers, supporting the transition to a low-carbon economy.

Consistency and interoperability – Partnership for Carbon Transparency (PACT)

The Partnership for Carbon Transparency (PACT), convened by WBCSD, has created a standardized framework to enable the transparent exchange of product-level greenhouse gas (GHG) emissions data across global value chains. Known as the PACT Standard and Technical Specifications, the framework is designed to bring consistency, comparability, and interoperability to how companies calculate and share PCFs. Its core objective is to make Scope 3 emissions—those embedded in supply chains—more measurable and actionable.

The PACT Framework builds on international accounting rules like the Greenhouse Gas Protocol and ISO standards, but it narrows the focus to product-level footprints and the mechanisms for exchanging data between supply chain actors. By harmonizing calculation approaches and technical protocols, PACT addresses the fragmentation that has long characterized corporate emissions reporting, where inconsistent assumptions and boundaries hinder comparability.

At the heart of PACT lies the Pathfinder Framework, which sets out methodological guidance for calculating PCFs. It establishes boundaries (cradle-to-gate or cradle-to-grave), defines rules for allocation and treatment of co-products, and sets minimum data quality thresholds. The framework

provides decision trees to ensure that companies use consistent logic when selecting methods, reducing subjectivity and enabling fairer comparisons across products and industries.

Alongside the methodological rules, PACT provides technical specifications that define how product carbon data is structured and exchanged. This includes a standardized data model, common file formats, metadata requirements, and interfaces that allow interoperability between different software systems. These specifications are crucial because they ensure that emissions data can flow seamlessly between diverse digital tools and enterprise systems, reducing the burden on suppliers and buyers alike.

The framework incorporates a multi-level data quality rating system to account for differences in the accuracy and specificity of emissions data. This allows companies to disclose whether a PCF is based on primary supplier data, industry averages, or modelled assumptions. Assurance requirements are also built into the framework, with a roadmap for scaling up third-party verification of both methodologies and data exchange systems, improving trust and credibility over time.

One of the refinements of the framework is its guidance on electricity and energy accounting. It specifies how companies should treat contractual instruments such as Renewable Energy Certificates (RECs) and Guarantees of Origin (GOs), ensuring consistent reporting of electricity-related emissions. This is particularly important in supply chains where purchased energy is a significant contributor to product footprints.

The PACT framework also integrates accounting for biogenic carbon and land-sector emissions, aligning with ongoing developments in the Greenhouse Gas Protocol Land Sector and Removals Guidance. This inclusion ensures that companies in agriculture, forestry, and bio-based industries can capture the unique carbon dynamics of their products, such as sequestration, delayed emissions, or end-of-life decomposition.

Recognizing emerging technologies, PACT provides methodological guidance for carbon capture, utilization, and storage (CCUS) as well as nature-based removals like reforestation. By offering clarity on how to account for these interventions, the framework reduces uncertainty and positions itself for relevance in future low-carbon supply chains that increasingly integrate negative-emissions solutions.

While initially focused on physical products, the PACT framework now also provides guidance for service-based carbon footprints, such as IT, consulting, or logistics services. This broadens its scope and ensures that value chain transparency is not limited to goods alone but extends to service industries that form a significant share of global Scope 3 emissions.

The framework has been stress-tested through Implementation Programs involving dozens of multinational companies across sectors such as chemicals, consumer goods, transport, and energy. These pilots have validated the feasibility of cross-platform data exchange and refined the methodology in practice. By exchanging hundreds of verified PCFs, companies have demonstrated how the framework can scale across real-world supply chains.

The PACT framework has deliberately aligned itself with sector-specific programs and consortia such as Catena-X (automotive), Together for Sustainability (chemicals), and the Global Battery Alliance. This harmonization ensures that industries do not reinvent separate, incompatible standards but instead build on a common foundation, fostering convergence across markets and reducing supplier burden.

In sum, the PACT framework represents a breakthrough in global GHG transparency. By combining robust methodological rules with interoperable technical specifications, it creates a trusted infrastructure for exchanging product-level carbon data. It helps companies move from reliance on averages and proxies toward verified, supplier-specific data, ultimately enabling more accurate Scope 3 reporting and actionable decarbonization. As regulations and market expectations increase, PACT's framework offers businesses a scalable solution for embedding carbon intelligence into supply chains.

1.5 Carbon Crediting and Offset Standards and Registries

Carbon crediting standards and registries form the institutional backbone of global carbon markets. They determine the rules for quantifying greenhouse gas (GHG) reductions and removals, certify projects that produce credits, and maintain the records of credit issuance, transfer, and retirement. At their core, these systems aim to transform climate mitigation activities into fungible financial instruments that can be traded or used to meet compliance or voluntary targets. The credibility of carbon markets therefore depends directly on the robustness, transparency, and governance of crediting standards and registries.

Various carbon crediting standards provide methodologies for quantifying GHG reductions and removals. These methodologies set rules for baseline determination, additionality testing, leakage assessment, and monitoring. Crediting standards also define procedures for validation (assessment of project design) and verification (assessment of actual outcomes), which are usually carried out by accredited third-party auditors. Registries, in turn, serve as the infrastructure that tracks credits throughout their lifecycle. Each credit is issued with a unique serial number, and registries publicly record the issuance, transfer, and retirement of credits. This prevents double counting and supports

transparency. In addition, registries act as centralized data sources for market participants, regulators, and researchers.

Prominent carbon credit standards and registries include:

UNFCCC

The Clean Development Mechanism (CDM), created under the Kyoto Protocol, was the first global carbon offset mechanism. It enabled developed countries to finance emission reduction projects in developing countries, generating Certified Emission Reductions (CERs) that could be used to meet Kyoto targets. The CDM catalyzed billions of dollars of investment in renewable energy, energy efficiency, and industrial abatement projects. Nevertheless, the CDM has been criticized for weak additionality testing, geographic concentration in a handful of countries, and limited contributions to sustainable development. As a result, many CERs lost value in voluntary markets. Despite these shortcomings, the CDM provided valuable institutional experience and a repository of methodologies that continue to inform new standards.

Under the Paris Agreement, the CDM is being replaced by the Article 6.4 mechanism. This framework aims to improve environmental integrity by strengthening additionality criteria, requiring corresponding adjustments to national inventories, and promoting sustainable development. If implemented effectively, Article 6.4 could provide a credible supply of internationally transferable credits, linking voluntary and compliance markets under a unified governance structure.

Yet the Article 6.4 mechanism faces political challenges. Negotiations continue on issues such as double counting, treatment of legacy CDM credits, and governance of removals. Until these are resolved, voluntary standards remain the dominant players in the carbon market.

Private sector and civil society

The Verified Carbon Standard (VCS), administered by Verra, is the largest voluntary carbon crediting program worldwide. It covers a broad portfolio of project types, including renewable energy, industrial gas destruction, improved forest management, REDD+ (avoided deforestation), and agricultural interventions. VCS methodologies are often flexible and can be adapted to emerging technologies or practices. Critically, VCS has played a leading role in scaling REDD+ projects, introducing jurisdictional approaches to address leakage and permanence risks. However, Verra has also been the target of criticism. Investigations have alleged over-crediting, particularly in forest-based projects, raising concerns that credits may not represent genuine emission reductions. Verra has responded by overhauling its REDD+ methodologies and increasing reliance on satellite

monitoring and standardized baselines. These reforms signal an effort to restore credibility, but they also highlight the vulnerability of large-scale voluntary programs to reputational risks.

The Gold Standard for the Global Goals (GSRGG) was established by WWF and other NGOs to ensure that carbon projects deliver robust climate benefits while also advancing sustainable development. Gold Standard projects must demonstrate contributions to at least three Sustainable Development Goals (SDGs) and involve strong stakeholder engagement processes. This dual emphasis on carbon and co-benefits distinguishes Gold Standard from VCS. Renewable energy projects, clean cooking technologies, water filtration, and small-scale forestry initiatives are common project types. The standard is recognized for its credibility and is often preferred by buyers seeking high-quality credits that provide measurable social and environmental co-benefits. Yet Gold Standard faces challenges in scale and cost. Its methodologies are narrower, and the rigorous co-benefit requirements often increase transaction costs for project developers. This can limit its competitiveness relative to VCS, which provides broader methodological coverage. Nonetheless, the Gold Standard's premium reputation means its credits often trade at higher prices, reflecting their perceived integrity.

The American Carbon Registry (ACR), managed by Winrock International, is one of the oldest voluntary carbon standards. It has pioneered methodologies in forestry, agriculture, and carbon capture and storage (CCS), and its credits are eligible in certain compliance markets such as California's cap-and-trade system. ACR has also been proactive in aligning with the Paris Agreement's Article 6 framework, designing protocols for corresponding adjustments to ensure credits are not double counted against national inventories. The ACR's strength lies in its technical rigor and early adoption of innovative methodologies. However, its scale is smaller than VCS, and its market visibility is lower outside of North America. As voluntary and compliance markets converge, ACR's focus on alignment with international accounting rules may become an important competitive advantage.

The Climate Action Reserve (CAR) was originally established in California to develop standardized protocols for North American compliance markets. Its methodologies focus on landfill gas, livestock methane, and forestry. CAR's participatory protocol development process is highly transparent and science-driven, providing strong credibility within compliance-oriented contexts. CAR's focus, however, is largely regional, limiting its applicability in global voluntary markets. Its strength lies in providing high-assurance credits for compliance purposes, but it has not sought to dominate the global voluntary crediting space like Verra or Gold Standard.

The Plan Vivo Standard specializes in community-based forestry and land-use projects. Its model requires long-term land management plans and emphasizes direct benefit-sharing with local

communities. Revenues from credit sales are returned to participants, ensuring tangible local development impacts. While Plan Vivo is relatively small in scale compared to other standards, it enjoys a strong reputation for ethical governance, community empowerment, and sustainable livelihoods. Its credits often command a premium among buyers seeking socially responsible investments. However, Plan Vivo's limited methodological scope and small-scale operations constrain its ability to deliver large volumes of credits.

ART-TREES (Architecture for REDD+ Transactions) is a specialized standard designed for jurisdictional REDD+ programs. It certifies emissions reductions from avoided deforestation at the national or subnational level, addressing leakage and permanence risks by operating at larger geographic scales. The LEAF Coalition, a public-private finance initiative, relies on ART-TREES to channel funding to tropical forest countries. ART-TREES is significant because it moves beyond project-level REDD+ to jurisdictional approaches, potentially scaling forest protection efforts. However, jurisdictional REDD+ faces challenges in measurement, benefit sharing, and political will within host countries. Its long-term success will depend on robust MRV systems and alignment with national climate strategies.

Cross-Cutting Integrity Challenges

Across all standards, common integrity challenges persist. Additionality—whether a project would have occurred without carbon finance—remains a central concern. Weak or subjective additionality tests can lead to credits that do not represent real emissions reductions. Permanence is another challenge, especially for forestry projects vulnerable to fire, pests, or policy reversals. Buffer pools and risk-sharing mechanisms mitigate this but cannot eliminate the risk entirely.

Leakage—emissions shifting from one area to another—also undermines integrity, particularly in land-use projects. Moreover, measurement uncertainty persists, with different methodologies producing divergent results. These issues collectively fuel skepticism about the true climate value of many credits.

To address these concerns, the Integrity Council for the Voluntary Carbon Market (IC-VCM) emerged in 2021 after the Taskforce on Scaling the Voluntary Carbon Markets (TSVCM) received backing from more than 250 global organisations. It has since introduced the Core Carbon Principles (CCPs), a set of minimum quality criteria covering additionality, permanence, robust quantification, and sustainable development. Carbon crediting programs are undergoing assessment against CCPs, which may serve as a quality filter across markets.

This initiative represents a major step toward harmonizing integrity standards and restoring trust in carbon credits; however, the CCPs are not a panacea. Their effectiveness depends on adoption by major crediting standards and demand from buyers and regulators. Without strong enforcement mechanisms, CCPs risk becoming aspirational rather than transformative.

The future of carbon crediting is also increasingly tied to digital monitoring, reporting, and verification (MRV). Advances in remote sensing, satellite imagery, blockchain, and artificial intelligence offer opportunities to improve accuracy, reduce costs, and increase transparency. Verra, Gold Standard, and ART-TREES are piloting digital MRV systems, which may address long-standing criticisms of unreliable data and opaque verification processes. At the same time, digitization raises questions of data privacy, equity, and governance. Ensuring that local communities retain agency in technology-driven MRV systems will be critical to maintaining trust and legitimacy.

In sum, carbon crediting standards and registries are indispensable to the functioning of carbon markets, both voluntary and compliance. They have evolved from the foundational but flawed CDM to a diverse ecosystem of voluntary programs, each with unique strengths and weaknesses. Verra's VCS dominates in scale, Gold Standard emphasizes sustainable development, ACR and CAR provide rigor and compliance alignment, Plan Vivo offers community credibility, and ART-TREES pioneers jurisdictional approaches. Yet critical challenges remain. Questions of additionality, permanence, and over-crediting undermine confidence in carbon markets. Integrity initiatives like the IC-VCM and innovations such as digital MRV offer pathways to improvement, but their success depends on robust governance, market acceptance, and alignment with international climate rules under Article 6.

Ultimately, carbon crediting standards and registries must balance scalability with integrity. Without trust, carbon markets risk becoming symbolic exercises in greenwashing. With credible standards, however, they have the potential to mobilize billions of dollars for meaningful climate action, channeling finance toward mitigation and sustainable development at a scale that is urgently needed.

1.6 Avoided Emission

WBCSD released the Guidance on Avoided Emissions in time for the 2023 G7 Climate, Energy and Environment Ministers meeting. The guidance was presented by WBCSD at the Sapporo G7 Ministers Meeting in April 2023, and was endorsed in the 2023 G7 Climate, Energy and Environment Ministers' final communiqué. A refined version of the Guidance on Avoided Emissions v2.0 was released in 2025 after a 2-year structured testing program with WBCSD member

companies and a separate 60-day open consultation. Over 100 multinational companies and expert organizations contributed to the updated WBCSD Guidance on Avoided Emissions.

With G7 endorsement of WBCSD's Guidance on Avoided Emissions, stakeholder interest increased, and the relationship with companies across key sectors (see AE Implementation Hub), financial institutions (e.g., GFANZ, PCAF, Project Frame, ICF), standard setters (e.g., ISO, GHG P, IEC) and policy actors (e.g., METI, European Commission) deepened. Collectively, we progress the methodological landscape, harmonize frameworks, provide open-access practitioner tools, as well as sector-specific guidance and tools. This includes creating engagement opportunities between finance and industry and the provision of guides to converge real economy, policy and finance approaches (e.g., at COPs and Climate Weeks).

We expect that the topics of avoided emissions and intervention-based GHG accounting will further progress towards global standardization. The GHG Protocol will address this in their upcoming Actions and Market Instruments Standard (AMI, expected in 2028) as per the latest AMI development plan, while the latest draft/proposed amendment of the 14064-1 ISO standard (GHG reporting on the organizational level) includes guidance related to avoided emissions (expected in 2026/7)."

Towards a Globally Coherent System of Carbon Accounting

It is particularly important to emphasize the strategic significance of adopting the GHG Protocol. This standard has gained widespread global recognition: the International Sustainability Standards Board (ISSB) officially references the GHG Protocol in its IFRS S2 Climate-related Disclosures Standard.

The design of the ISSB Standards inherently embodies the principle of interoperability. These standards aim to establish a "global baseline" for sustainability disclosures and have established mechanisms such as the Jurisdictional Working Group (JWG) and the Sustainability Standards Advisory Forum (SSAF) to enhance coordination with other jurisdictions, ensuring a high degree of interoperability with standards like the European Sustainability Reporting Standards (ESRS) and the U.S. Securities and Exchange Commission (SEC) proposals. China can undoubtedly play a greater role within this global framework. By sharing case studies from leading Chinese companies, China can not only provide "Chinese experience" to inform the refinement of the ISSB Standards but also significantly enhance the comparability of global sustainability disclosures.

This analysis has highlighted three principal challenges to the international coherence, consistency and comparability of carbon accounting. First, there are certain discontinuities between official national GHG accounting under the UNFCCC and disaggregated or “bottom-up” GHG accounting at

the organizational and product levels. Second, considerable fragmentation persists among countries with respect to organization and product GHG accounting and reporting due to the differing state and nature of regulation therein. Finally, fragmentation often also exists within industries and organizations—including those within the same country—due to the multitude of voluntary frameworks and nascent degree of national regulation thereof.

The growing market dominance of the GHG Protocol and ISO standards as well as their ongoing refinement and convergence are slowly helping to render the system more internationally aligned and interoperable. However, there is a long way to go. Perhaps the most promising recent step in this direction is the creation of the International Sustainability Standards Board by the International Financial Reporting Standards Foundation. The ISSB has taken convergence a step further by explicitly linking corporate disclosure to climate goals:

- IFRS S2, the climate-specific disclosure standard, requires companies to disclose GHG emissions (Scopes 1, 2, and 3) in accordance with the GHG Protocol. This harmonization ensures that reported corporate emissions can be reconciled with the same categories used in national inventories.

- The ISSB standards also require disclosure of climate-related risks and transition plans, directly connecting corporate disclosures with national Nationally Determined Contributions (NDCs) under the Paris Agreement.

- Importantly, ISSB embeds scenario analysis and Paris-aligned pathways into its reporting requirements. This means companies must disclose how their emissions trajectories and strategies align (or misalign) with a 1.5–2°C pathway, reinforcing consistency with Paris Agreement objectives.

By adopting ISSB standards, companies produce data that is not only consistent with the GHG Protocol's technical foundation but also explicitly aligned with Paris Agreement policy goals. And by adopting the ISSB standards in national regulation, countries scale such behavior throughout their economies and, over time, across a large proportion of the global economy. As of mid-2025, 36 jurisdictions have either adopted or are actively introducing ISSB Standards into their regulatory frameworks. Among these, 17 jurisdictions have finalized their approach—meaning their sustainability disclosure regime is formally aligned with ISSB Standards.

The jurisdictions that have completed the adoption process include:

- Australia
- Bangladesh

- Brazil
- Chile
- Ghana
- Hong Kong SAR
- Jordan
- Kenya
- Malaysia
- Mexico
- Nigeria
- Pakistan
- Sri Lanka
- Chinese Taipei
- Tanzania
- Türkiye
- Zambia

Of these, 14 target full adoption, 2 include climate-related requirements only, and 1 partially incorporates ISSB Standards. Another 16 jurisdictions are preparing or proposing frameworks that either fully align with ISSB Standards or aim for functional equivalence. Some jurisdictions are still consulting or planning their approach. Canada, Japan, Singapore and others are actively consulting on incorporating ISSB Standards. The UK aims to adopt ISSB-based Sustainability Disclosure Standards (SRS) by Q1 2025 and mandate their use for listed companies.

S&P Global Given its outsized importance in the world economy, how China proceeds in this regard could have a major influence on the pace of progress toward a globally coherent system of carbon accounting, affecting each of the three current dimensions of international discontinuity cited above. The next section examines the current state of and future prospects for carbon accounting in China.

2. China Context: An overview of China GHG Accounting Framework

China initiated the development of its carbon accounting system as early as 2011. The "*12th Five-Year Work Plan for Greenhouse Gas Emission Control*" (2011) marked the first policy document proposing the establishment of a statistical accounting system for greenhouse gas emissions, explicitly outlining a three-tier framework encompassing national, regional, and enterprise-level GHG emission statistics and accounting. China's carbon accounting system adheres to the overarching framework of the IPCC Inventory Guidelines while developing tailored GHG accounting methodologies and guidelines for various regions and sectors based on national conditions.

2.1 Corporate Levels

At the sectoral and enterprise levels, the National Development and Reform Commission (NDRC), in collaboration with the State Administration for Market Regulation (SAMR) and the Standardization Administration of China (SAC), promulgated the national standard "*General Guidelines for Greenhouse Gas Emissions Accounting and Reporting of Industrial Enterprises*" (GB/T 32150) in 2015. The GB/T 32150 series standards adopt accounting methodologies fundamentally consistent with the international standard ISO 14064-1 (2006 edition). Subsequently, from 2013 to 2015, the GB/T 32151 series standards were developed, covering 12 key sectors including power generation, grid operations, steel, chemicals, electrolytic aluminum, magnesium smelting, flat glass, cement, ceramics, civil aviation, coal, and textiles. (Bian Shaoqing, et al., 2024)

To further enhance the national carbon accounting system, the NDRC, National Bureau of Statistics, and Ministry of Ecology and Environment (MEE) jointly issued the "*Implementation Plan for Accelerating the Establishment of a Unified and Standardized Carbon Emission Statistical Accounting System*" in April 2022. This plan emphasizes the systematic development of statistical and accounting methodologies at all levels and categories. It establishes phased objectives and tasks for building the carbon emission system, including targets at the sectoral, enterprise, and key product levels, thereby expanding China's carbon accounting framework to encompass at least national, regional, sectoral/enterprise, and product dimensions.

By April 2025, an additional 18 national standards for enterprise greenhouse gas emission accounting are scheduled to come into effect. These standards cover multiple vital industries within the national economy. To date, China has cumulatively released 46 national standards for enterprise carbon emission accounting and reporting. These encompass key sectors such as power generation enterprises, grid enterprises, steel producers, mining enterprises, electronic equipment

manufacturers, and land transportation enterprises, achieving essentially comprehensive coverage of major industries.

In summary, China has largely completed the construction of a three-tier (national, regional, and enterprise) GHG statistical accounting framework. However, the foundational work for accounting at the product level remains relatively underdeveloped.

2.2 Product Level

China has implemented multiple initiatives in product carbon footprint standardization. Life cycle assessment (LCA) serves as the fundamental method for evaluating product carbon footprints. The national standards GB/T 24040—2008 (Environmental Management — Life Cycle Assessment — Principles and Framework) and GB/T 24044—2008 (Environmental Management — Life Cycle Assessment — Requirements and Guidelines) provide normative support for related accounting practices. In August 2024, the newly issued GB/T 24067—2024 (Greenhouse Gases — Product Carbon Footprint — Quantification Requirements and Guidelines) became the foundational standard for product carbon footprint accounting. Drawing on internationally accepted LCA methodologies, this standard specifies the principles, requirements, and implementation guidelines for quantifying greenhouse gas emissions and removals throughout the life cycle of goods and services. It also offers methodological guidance for quantifying partial carbon footprints of products [2], establishing a methodological basis for assessing the carbon footprint of individual products.

Concurrently, industry authorities such as the Ministry of Industry and Information Technology (MIIT) have actively promoted the development of carbon footprint accounting rule standards for key products in collaboration with industry associations and leading enterprises. In December 2024, MIIT released a recommended list of 15 group standards for industrial product carbon footprint accounting, including Quantification Methods and Requirements for Greenhouse Gas Product Carbon Footprint — Blast Furnace-Basic Oxygen Furnace Long-Process Steel Products. These standards accommodate the characteristics and needs of different industries, enhancing the specificity and practicality of carbon footprint accounting and providing standardized support for precise industry management.

According to incomplete statistics, as of December 31, 2024, China had released 460 carbon footprint-related standards at various levels, including national, industry, local, and group standards. Structurally, group standards dominate, with 389 standards accounting for 84.6% of the total, while government-led standards (national, industry, and local standards) comprise only 71 standards, representing a relatively small share. However, with the deepening of the national "Dual Carbon" strategy, national and industry standards are actively expanding their coverage. Statistics indicate

that 12 national carbon footprint standards are currently under development, with an additional 61 having been announced for project establishment. In terms of categories, existing carbon footprint standards primarily include: general principles for product carbon footprint accounting, accounting rules for key products, product carbon footprint labeling and certification, and accounting and reporting specifications. Among these, accounting rules for key products constitute the largest category, with 440 standards accounting for 95.6% of the total, covering sectors such as electronics and electrical appliances, agri-food, chemicals, and light industry. (Liu Chun-xia, et al., 2025.)

In the process of building the product carbon footprint standard system, inconsistency in standards has emerged as a significant challenge. At the international level, carbon footprint accounting standards adopted by different countries and regions exhibit notable differences. For instance, ISO 14067, PAS 2050, and the GHG Protocol each have distinct focuses and requirements, varying in aspects such as covered gas types and specific accounting rules. Domestically, although some regions and industry organizations have attempted to develop a series of carbon footprint quantification standards, considerable inconsistencies remain in product category rules (PCRs), system boundaries, inventory data quality, and cut-off criteria. This lack of uniformity leaves enterprises without consistent assessment benchmarks, hindering fair competition within industries and impeding the low-carbon transition of the entire industrial chain.

On another front, China faces weak data foundations in the implementation of carbon footprint accounting standards. Firstly, the lack of emission factor data is a widespread issue. Emission factors are core parameters for calculating product carbon footprints, and their accuracy directly determines the reliability of the results. However, data accumulation for factors related to raw materials and energy consumption remains insufficient in many industries, making it difficult to support refined carbon footprint calculations. Secondly, the development of localized life cycle unit process databases is relatively lagging. A comprehensive and authoritative localized life cycle database is crucial for accurate and holistic product carbon footprint accounting, as it should cover data for the entire chain from raw material extraction, production, and transportation to distribution, use, and end-of-life treatment. Yet, China still lacks a carbon footprint background database that is widely recognized internationally. Existing databases suffer from limitations in data coverage and quality, making it challenging for enterprises to access comprehensive and reliable data support when applying carbon footprint accounting standards, thereby compromising the accuracy of the accounting results.

3. Identifying the Issues

Within the construction of corporate carbon accounting standard systems, the lack of standardization presents a significant contemporary challenge. In practice, China's carbon emission accounting faces practical issues such as differences in statistical accounting boundaries, weak foundational development of emission factors, and a lack of uniform statistical calibers for greenhouse gases. These issues objectively constrain the execution of carbon emission reduction efforts and impact China's international discourse power in the realm of climate governance.

From an international perspective, standards such as ISO 14067 and the GHG Protocol possess distinct focuses and accounting requirements, exhibiting differences in aspects like the types of greenhouse gases covered and specific accounting rules. This leads to a lack of comparability in carbon emission data compiled under different frameworks. Furthermore, inconsistencies in the mandatory disclosure requirements across these standards further create a risk of misalignment between the emission reduction plans disclosed by companies and their actual mitigation outcomes.

Currently, green trade mechanisms implemented by some countries and regions have become "carbon barriers" that Chinese product exports inevitably encounter, primarily exerting influence through economic and regulatory channels. Economically, mechanisms like the EU's CBAM or international climate clubs impose tariffs on trade goods with high carbon emission intensity via border tax adjustments. Regulatorily, measures such as the EU's enacted New Battery Regulation impose mandatory constraints on exporting enterprises to reduce carbon footprints. Both approaches impose stringent carbon accounting requirements on Chinese exporters. (Bian Shaoqing, et al. 2024)

1) The Need for Extending Accounting Boundaries to the Entire Industrial Chain

China's current carbon market mechanism centers on the "reporting entity" and does not mandatorily require tracing carbon emission data beyond the entity to upstream suppliers. However, when companies procure precursor materials subject to the EU's Carbon Border Adjustment Mechanism (CBAM), they may face a lack of carbon emission information from their suppliers. This is particularly challenging for battery exporters, whose data tracking requirements must cover a broader value chain, extending not only upstream but also including downstream phases such as product use and end-of-life treatment.

This systemic gap is compounded by the absence of mandatory Scope 3 accounting requirements in domestic standards. While international frameworks like the GHG Protocol provide detailed guidance on value chain emissions, China's GB/T 32150 series focuses primarily on direct

emissions and selected indirect sources. This misalignment forces exporters to rely on estimates or industry averages for upstream data, resulting in significantly different carbon footprint calculations compared to international methodologies. For instance, the EU's Product Environmental Footprint (PEF) method requires specific product category rules with detailed allocation methods, while China's general principles lack such sector-specific granularity, creating non-comparable data and substantial compliance risks.

2) Carbon Accounting Capability Challenges for Exporters

China's carbon market sets an inclusion threshold (annual emissions ≥ 26,000 tons of CO_2 equivalent), based on which provincial ecological and environmental authorities dynamically manage a list of enterprises that meet the threshold and fall within covered sectors. In contrast, the EU CBAM and the New Battery Regulation define their scope of application based solely on sector classification without setting a lower emission limit. Consequently, even Chinese enterprises with relatively low emissions or smaller operational scales must comply with data reporting obligations if involved in exports to the EU, posing a practical test to the foundational carbon accounting capabilities of some firms.

Research indicates that over 60% of Chinese SMEs in export-oriented sectors lack dedicated sustainability personnel, and fewer than 20% have implemented digital carbon management systems. These enterprises often lack basic energy monitoring systems, understanding of emission factors, and experience with third-party verification. This widespread capacity deficit at the supplier level directly threatens the ability of larger Chinese exporters to assemble the accurate, verifiable value-chain data required by international markets. The problem is particularly acute in complex supply chains such as electric vehicles, where batteries alone can constitute 40-60% of the total carbon footprint, making comprehensive data collection from numerous small suppliers essential yet extremely challenging.

3) Carbon Price Recognition Issues Stemming from Differences in Indirect Emission Definitions

China and the EU hold divergent definitions of indirect emissions. Under the CBAM framework, indirect emissions specifically refer to emissions from purchased electricity, excluding those from purchased heat or steam. Conversely, China's carbon market rules classify both purchased electricity and purchased heat as indirect emission sources. This definitional discrepancy directly leads to potential inconsistencies in recognizing the "carbon price already paid" for exported products during accounting. (Bian Shaoqing, et al. 2024)

This technical discrepancy has significant financial implications. For energy-intensive industries like chemicals and steel that rely heavily on industrial heat, this definitional asymmetry could lead to millions of dollars in uncredited carbon costs annually. A Chinese exporter may have incurred real costs through the national ETS or CCER purchases to mitigate its steam-related emissions, but these investments may not be recognized under CBAM's accounting mechanism. This represents a potential double taxation scenario and fundamental unfairness in carbon cost treatment across jurisdictions. The issue underscores the urgent need for deep technical alignment in accounting rules to ensure climate policies are trade-neutral and fair, particularly for industries where thermal energy constitutes a substantial portion of their carbon footprint.

4) Lagging Development of China's Emission Factor Database Affects Recognition of Localized Data

The progress in developing China's emission factor database falls behind that of the EU, impacting the international acceptance of localized data. Significant differences exist between Chinese and international standards for calculating emission factors. For instance, the EU emphasizes life-cycle accounting, while China's current focus remains predominantly on CO2, with accounting boundaries and methodologies yet to be unified. Therefore, it is imperative to establish a standard framework that accommodates both international norms and national circumstances, promote the development of sector-specific accounting standards, strengthen the construction of energy consumption statistical databases, and enhance data credibility.

The absence of an authoritative, government-backed, and internationally reconciled life-cycle inventory (LCI) database is a critical infrastructure gap. Many Chinese emission factors are based on national averages that mask regional variations in grid cleanliness or industrial efficiency. For example, China's official grid emission factor (0.6101 $kgCO_2e/kWh$) differs significantly from the ISCC default value (0.94 $kgCO_2e/kWh$) used in international certifications, creating a 34% discrepancy in electricity-related emissions calculations. Furthermore, there's a notable lack of transparent, localized LCI data for key materials like specific grades of steel, plastics, and chemicals. This forces companies to choose between using less accurate domestic factors (risking international rejection) or international databases that may not reflect China's specific industrial context (potentially creating competitive disadvantages). The challenge is compounded by inconsistent data quality requirements, where international standards demand precise monitoring while China's system allows higher error tolerance for SMEs.

4. Policy Recommendations

Amid escalating global green trade barriers and the proliferation of carbon pricing mechanisms, enhancing the international interoperability of carbon accounting systems has become an urgent priority for Chinese enterprises. The development of China's carbon accounting system is not merely a technical issue but a strategic imperative. It is closely tied to China's influence in global climate governance and directly impacts the international competitiveness of its manufacturing sector. By establishing a high-quality carbon accounting system, China can contribute a Chinese solution to the global transition toward carbon neutrality while providing robust support for the green transformation of domestic industries, ultimately achieving a win-win outcome for both environmental and economic benefits.

By promoting standards alignment, strengthening data infrastructure development, establishing an internationally recognized verification system, advancing sector-specific pilot demonstrations, and enhancing international cooperation, China can progressively narrow the gap with advanced global standards and develop a carbon accounting system that aligns with national conditions while gaining international recognition.

4.1 General Recommendation to Systemically Enhance the International Interoperability

1) Improve the corporate carbon accounting standard system in a phased manner. In the short term, China's corporate greenhouse gas (GHG) accounting and reporting standards should fully consider the existing operational foundations, with a focus on enhancing applicability and practicality to better serve the needs of the national carbon market. In the long run, it is essential to draw on international standard frameworks to gradually incorporate requirements for value chain (Scope 3) indirect emission accounting and develop methodologies and standards for corporate value chain GHG emissions accounting, thereby establishing a more comprehensive carbon management system. China should also accelerate the development of Corporate Carbon Management System guidelines to help enterprises establish internal monitoring, reporting, and verification (MRV) mechanisms that are interoperable with international norms. This will not only ease compliance with mechanisms like the EU CBAM but also enhance the credibility and comparability of Chinese carbon data in international markets.

2) Deep engagement in international standard-setting. Active participation in key international dialogues, such as the revision of the *Scope 2 Guidance* led by WBCSD and WRI, should be prioritized. China should also strengthen technical collaboration with the International Sustainability Standards Board (ISSB)—especially around the implementation of IFRS S2—and contribute to the development of the ISO 14060 series. By systematically sharing China's practical experience in

carbon emission inventory research, Nationally Determined Contributions (NDCs), and the operation of the world's largest carbon market, China can inject a "Chinese Solution" into the refinement of international standards. This will facilitate mutual recognition of accounting outcomes, ease non-tariff trade barriers, and strengthen China's influence in bodies such as the UNFCCC and ISO, turning home-grown experience into global best practice.

3) Foster comprehensive participation in international standard coordination. Incentive mechanisms should be established to encourage and support experts from various sectors—including enterprises, industry associations, and academia—to deeply engage in the standard-setting activities of international organizations such as ISO and ISSB. This should include funding participation in technical committees, facilitating public-private partnerships for drafting technical comments, and establishing a national expert pool for sustained international engagement. Such efforts are essential to narrow technical discrepancies—for instance, in definitions of "indirect emissions" and carbon credit accounting—between Chinese and international standards. Only with a thorough understanding of international standards and rich domestic practical experience can China effectively shape international rules and ensure they accommodate national circumstances, thereby reducing future compliance costs for Chinese enterprises.

4) Enhance international alignment of electricity emission factor accounting. As a core element of the carbon accounting system, electricity emission factors urgently require the establishment of accounting standards that are aligned with international norms and a mechanism for timely updates. Clear statistical rules must be formulated to address the issue of double-counting between renewable energy environmental attributes and physical electricity quantities. China should develop a transparent, dynamic grid emission factor database that supports both location-based and market-based accounting methods, in line with the GHG Protocol Scope 2 Guidance. Furthermore, application scenarios for different emission factors should be clarified, allowing companies to flexibly use instruments such as green electricity procurement, renewable energy certificates (RECs), and Chinese Certified Emission Reductions (CCERs) to mitigate carbon costs. The active participation of the State Grid Corporation of China in the GHG Protocol's Scope 2 Technical Working Group (TWG) offers an operational model that should be scaled to other sectors.

5) Strengthen corporate carbon accounting capacity building. Relevant institutions and industry leaders should be encouraged to collaborate in providing targeted support to small and medium-sized enterprises (SMEs) within their supply chains where capabilities are weakest. Given that many SMEs are exposed to EU-style carbon regulations regardless of their size, support should include detailed guidance on establishing carbon management organizations, professional training on GHG accounting software and tools, third-party verification services, and design support for energy-

saving retrofits. Sector-specific capacity-building programs—especially in high-risk export industries such as batteries, textiles, and chemicals—should be rolled out with explicit alignment to international standards like GHG Protocol and ISO 14064. Moreover, a national platform for sharing best practices and common emission factors should be established to improve data availability and reduce reporting burden, particularly for SMEs with limited resources.

Through the systematic advancement of the aforementioned measures, China can gradually narrow the gap with international advanced levels and build a carbon accounting system that is both aligned with national conditions and internationally recognized. This is not merely a technical issue but also pertains to China's discourse power in global climate governance and the international competitiveness of its manufacturing sector. By constructing a high-quality carbon accounting system, China can provide a Chinese solution for the global transition to carbon neutrality, offer reliable support for the green transformation of domestic industries, and ultimately achieve a win-win outcome for both environmental and economic benefits.

4.2 Establishment of an Advisory Group for Corporate Carbon Accounting Interoperability

Listening to the practical insights of businesses is more critical than ever. Companies are on the front line of dealing with these challenges, and their practical experience is key to bridging standard differences and building workable solutions. An advisory group could usefully be established to pool the wisdom and practical experience of leading Chinese and international companies to:

1) Provide Insights: Deepen the understanding of the practical challenges, best practices, and solutions encountered by companies when applying international and domestic carbon accounting systems (e.g., GHG Protocol, ISO 14064, GB/T 32150 series).

2) Generate Recommendations: Offer concrete and actionable policy and technical recommendations for building better aligned and mutually recognized carbon accounting systems both within China and internationally, to drive both business efficacy and emissions impact.

3) Inform Policy: Provide practical, front-line market input to CCICED and relevant ministries (e.g., MEE, MIIT, MOF) to support the development of a carbon accounting system that aligns with national conditions and gains international recognition.

The group's dialogue could focus on the following key business perspectives:

- Alignment with GHG Protocol and related updates: Discuss the opportunities and challenges of fully adopting the GHG Protocol (including the Scope 3 Standard) and its specific impact on Chinese companies.

- Alignment of GHG Protocol with ISO: Explore how to leverage the flexibility of the GHG Protocol and the certification rigor of ISO 14064 to provide companies with a clear path that balances disclosure and assurance.
- Application of Product Carbon Footprint (PCF): Address practical difficulties in implementing PCF accounting in China, including data collection, allocation rules, and alignment with international methods to respond to CBAM and the Battery Regulation.
- Application of Avoided Emissions Standardized Guidance: Explore how to scientifically quantify the avoided emissions benefits of low-carbon technologies and solutions to inform climate finance and green technology investment.

Advisory Group Composition

- Leading Chinese Companies: Industry leaders operating in domestic and international markets that are already facing carbon accounting and disclosure pressures (e.g., in new energy batteries, steel, chemicals, electrical equipment, consumer goods manufacturing).
- Leading International Companies: Multinational corporations with extensive operations in China, rich experience in carbon management, and a deep understanding of international standards and regulations.
- Technical Carbon Accounting Specialists: Senior experts from research institutions, verification bodies, and professional service firms to provide technical expertise.

Convenor

The World Business Council for Sustainable Development (WBCSD) offers to build and curate this advisory group. WBCSD would leverage its global corporate network and expertise in sustainability standards to ensure the group's efficiency and professionalism.

Partnership

WBCSD proposes to establish a partnership with a leading Chinese institution (e.g., ISSB Beijing Office, China National Institute of Standardization (CNIS) or another suitable leading organization) to co-lead this initiative. The group would operate throughout 2026 and potentially beyond as a structured dialogue process, delving into core topics through regular workshops, closed-door meetings, and enterprise surveys.

Expected Impact and Value

- Provide deeper, practical business input for CCICED: The group's discussions and outputs will be based on real-world business challenges and perspectives, providing CCICED's policy research with valuable, first-hand practical insights, making policy recommendations more actionable and implementable.

- Support the domestic ISSB alignment process: The group's outputs can serve as a useful informal business instrument to support, feed into, and complement China's process of developing a national sustainability disclosure framework aligned with ISSB during 2026-2027. Corporate-level practical experience is critical to ensuring the feasibility of the national framework.

- Enhance global comparability: By sharing Chinese cases and experiences, it can not only inform the refinement of international standards but also significantly enhance the comparability of global sustainability disclosures, strengthening China's voice in global climate governance.

- Tangibly reduce corporate compliance costs: By promoting the mutual recognition of domestic and international standards, it can effectively reduce the burden of multiple standards and duplicate accounting for companies, providing clear and consistent guidance for their green transition.

5. Conclusion

International alignment of carbon accounting standards is foundational for achieving global carbon neutrality and climate action. It serves as a prerequisite for interlinking carbon markets and ensuring equitable implementation of carbon tariffs (e.g., EU CBAM). For China, interoperability strengthens its voice in global climate governance, enhances international credibility of carbon data to counter trade barriers, and leverages advanced global practices to refine domestic systems—laying the groundwork for carbon market internationalization. For enterprises, unified standards eliminate duplicate accounting, slash compliance costs; meet transnational supply chain requirements, boost ESG competitiveness, and secure global recognition of emission reduction achievements, accelerating green transition.

Establishing a unified carbon emission standards framework is a core component of global climate governance. This framework not only enables countries to collaboratively address climate change and achieve global temperature control targets but also empowers nations to enhance their international competitiveness during the low-carbon economic transition, attracting low-carbon technologies and green capital. By promoting international mutual recognition and cooperation of standards, coordination among countries in carbon emission monitoring, accounting, and reporting

can be strengthened, accelerating the global transition to a low-carbon economy. Furthermore, the development of this system deeply aligns with the concept of ecological civilization, providing support for the comprehensive green transformation of the economy and society and advancing the vision of harmonious coexistence between humans and nature.

Aligning carbon accounting methodologies with international standards is of strategic necessity. We believe the establishment of the proposed advisory group would be a critical and practical step towards aligning China's carbon accounting system with international standards, addressing international green trade barriers, and empowering companies to successfully achieve their green transition. We look forward to advancing this important initiative with CCICED and our Chinese partners.

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