

Carbon Management Guidelines for

EU Carbon Border Adjustment Mechanism (CBAM) Compliance

Strategic Toolkits for Hong Kong-invested Manufacturing
Enterprises with Asia-Pacific Operations

August 2025 Edition

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Forewords

At this pivotal moment in the global industrial restructuring, carbon management has transformed from an optional choice to a mandatory requirement for businesses. The emergence of carbon trading markets across the Asia-Pacific, alongside international green investment trends, is profoundly reshaping the competitive landscape for manufacturing. With decades of industrial development and innovation capabilities across the Asia-Pacific, Hong Kong manufacturers are positioned to lead this transformative wave.

The Federation of Hong Kong Industries (FHKI) has played a leading role in enabling SMEs to navigate environmental challenges. Since 2015, we have organised the annual BOCHK Corporate Low-Carbon Environmental Leadership Awards, recognising enterprises with outstanding sustainability performance. The program's steadily growing participation underscores the rising priority that industry now places on environmental issues and sustainable growth. In 2021, we established the Environmental, Social and Governance (ESG) Committee to further consolidate resources and strengthen industry engagement through seminars, workshops, and industry surveys, enhancing members' understanding of carbon mitigation policies and strategies. Last year, through the Hong Kong Q-Mark Council, we launched the Hong Kong Q-Carbon Certification Scheme and Hong Kong Q-ESG Certification Scheme, providing professional accreditation services to assist SMEs in establishing robust carbon and ESG management systems.

Hong Kong's manufacturers have built a comprehensive supply chain centred on Mainland China and extending across ASEAN. In this context, carbon management serves as a strategic opportunity to enhance corporate competitiveness in global markets. As a leading international financial and professional services centre, Hong Kong possesses a distinctive advantage in connecting global capital markets with green finance, providing comprehensive support for the green transformation of manufacturing. Through the synergy of finance, technology, and manufacturing, Hong Kong is poised to become a regional hub for green economic development, driving carbon neutrality across the Asia-Pacific.

We recognise that SMEs often face difficulties in understanding and complying with complex carbon regulations, particularly when engaging with diverse international markets and rules. The two volumes of *Carbon Management Guidelines* seek to bridge that gap. By integrating international standards, CBAM regulations of EU, and the practical needs of Hong Kong manufacturers, these guides unpack complex requirements into clear, actionable steps,

supplemented with case studies and industry insights. The guidelines provide SMEs with the knowledge and tools required to transition seamlessly to low-carbon operations, while maintaining operational efficiency and market competitiveness. We firmly believe that, in the context of the regional green transformation, establishing scientific and systematic carbon management practices early will gain a strategic advantage, reinforcing Hong Kong manufacturing's position in the global value chains.

FHKI remains steadfast in our commitment to walk alongside with industry, guiding manufacturers to navigate the challenges and capitalise on the opportunities of green transformation. Through these two *Carbon Management Guidelines*, we deliver decisive, actionable roadmap to Hong Kong manufacturers to not merely adapt, but thrive in the carbon-neutral era—powering forward our national carbon peaking and carbon neutrality ambitions, and driving transformative progress in global sustainable development.

Anthony Lam
FHKI Chairman

August 2025

In the face of escalating climatic challenges, Environmental, Social and Governance (ESG) issues are garnering unprecedented attention. Regulatory pressure on ESG is accelerating worldwide, particularly with the European Union's (EU) recent implementation of the Carbon Border Adjustment Mechanism (CBAM) and the imposition of carbon tariffs. As a highly open and export-oriented economy, Hong Kong manufacturers will inevitably face carbon regulatory challenges, implying that carbon management must become an integral part of corporate decision-making and daily operations for SMEs.

The Federation of Hong Kong Industries (FHKI) established the ESG Committee in 2021, dedicated to promoting industrial participation in achieving Hong Kong's goal of carbon neutrality by 2050. Through capacity building, knowledge exchange and ESG talent development, the Committee supports the industry sector in implementing effective ESG management. To strengthen the carbon management capabilities across the industry, and with the funding support from the Trade and Industry Department's Trade and Industrial Organisation Support Fund (TSF), we commissioned the Institute of Climate and Carbon Neutrality at the University of Hong Kong to launch the Project, "Facilitating ESG compliance in supply chain management for Hong Kong-invested manufacturing enterprises (HKMEs)". The Project includes hosting the APAC ESG Summit for SMEs, compiling two *Carbon Management Guidelines*, and developing an online carbon management platform to help businesses take practical actions in response to increasingly stringent regulatory requirements.

The two *Carbon Management Guidelines* are designed specifically for Hong Kong-funded manufacturing enterprises with production lines and supply chains operating across the Asia-Pacific region. Targeting the decision-makers, operational departments and green professionals, the *Guidelines* emphasise operability and practical application, providing the industry with step-by-step guidance. The *Carbon Management Guidelines for Carbon Neutrality and Sustainable Development Targets of Hong Kong and Mainland China* ("General Carbon Management Guidebook") focus on internal corporate management, introducing international standards and systems, and detailing how to establish and optimise carbon management systems, accurately capture carbon data, and implement emission reduction actions. The *Carbon Management Guidelines for EU Carbon Border Adjustment Mechanism (CBAM) Compliance* ("EU CBAM Guidebook"), on the other hand, focuses on analysing compliance and practices for the two major CBAM in-scope industries, iron and steel, and aluminium, addressing emissions calculation, data collection, reporting, and verification processes, illustrated with case studies. These complementary guides—the former emphasising internal capacity building and long-term transformation, the latter providing specialised analysis and strategies for CBAM—offer a systematic blueprint and action plan for the Hong Kong

manufacturers to establish comprehensive ESG management systems under the increasingly stringent international environmental requirements.

While tightening international carbon management trends present significant challenges for the manufacturing industry, early preparation for relevant regulations can transform these challenges into a competitive advantage. With these two *Carbon Management Guidelines*, FHKI aims to heighten industry vigilance toward international carbon regulations, empower enterprises to build robust carbon management systems ahead of competitors, transform regulatory challenges into strategic advantages and forge greener, more resilient supply chains—ultimately reinforcing Hong Kong manufacturing’s competitive edge in global markets.

Clara Chan

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Chairman, Steering Committee — Facilitating ESG Compliance in Supply
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August 2025

Chapter 1: Introduction

1.1. Purposes of this Guidebook: Providing a Practical and Actionable Roadmap

As the world accelerates its transition towards a low-carbon economy, regulatory mechanisms such as the European Union's Carbon Border Adjustment Mechanism (CBAM) are reshaping global trade dynamics. CBAM serves as a tool to prevent carbon leakage by imposing a carbon price on imported goods equivalent to the cost borne by EU producers under the Emissions Trading System (ETS). This policy has significant implications for international supply chains, particularly for economies with high trade exposure to the EU. Companies with carbon-intensive products face increased compliance costs, which may require them to either adopt greener production methods.

For Hong Kong Manufacturing Enterprises (HKMEs), especially small and medium-sized enterprises (SMEs), this guidebook serves as a practical resource to navigate CBAM requirements, offering insights, step-by-step guidance, and strategies to ensure a smooth transition into this new regulatory landscape.

The guidebook is designed to achieve the following objectives:

- **Support HKMEs in EU CBAM Compliance:** The guidebook provides practical guidance to assist HKMEs in meeting the EU CBAM requirements. It addresses the necessary steps for compliance, such as calculating embedded carbon emissions, collecting accurate data, and adhering to reporting and verification standards. This will ensure HKMEs can continue exporting to the EU without disruption.
- **Facilitate Carbon Management:** Beyond compliance, the guidebook encourages HKMEs to establish or enhance their carbon management systems. These systems will enable companies to monitor, report, and reduce emissions effectively, aligning with global expectations for sustainable practices, and ultimately gaining a competitive edge by offering products with reduced carbon intensity.
- **Contribute to Carbon Neutrality and Sustainable Development:** By implementing the strategies outlined in this guidebook, HKMEs can contribute to broader carbon neutrality goals in Hong Kong, Mainland China, and the Asia-Pacific region. This aligns with international climate commitments, such as the Paris Agreement, and positions HKMEs as leaders in sustainable manufacturing.

1.2. How this Guidebook was Compiled

This guidebook was developed through a comprehensive approach combining literature review on EU CBAM policies with conference calls with European Commission representatives. We conducted deep-dive interviews and site visits with representative Hong Kong enterprises in Iron and Steel, Aluminium, and Polymers sectors to understand their baseline capabilities and identify technical gaps, gathering feedback through meetings with diverse manufacturing companies and stakeholders from industry associations and academia.

The case studies in this guidebook present fictional names but incorporate real examples from our interviews, accurately reflecting the challenges and opportunities facing CBAM in-scope enterprises.

1.3. Target Audience of this Guidebook

The primary audience for this guidebook includes:

- **HKMEs in CBAM-In-Scope Sectors:** Companies operating in sectors currently covered by CBAM, such as Iron and Steel and Aluminium, will find this guidebook essential for compliance and operational adjustments.
- **HKMEs in Other Manufacturing Sectors:** Enterprises in sectors expected to be included in the CBAM scope (e.g., Polymers and Organic Chemicals by 2026) should begin preparing now. Additionally, manufacturers indirectly impacted through supply chain demands or customer requirements will benefit from this guide.

The guidebook is also relevant to supply chain partners, industry associations, and stakeholders looking to understand how CBAM affects the manufacturing landscape and the broader implications for global trade.

1.4. How You Should Read this Guidebook

This comprehensive guidebook is structured to provide actionable insights and detailed guidance across its chapters. Below is an outline of its contents against the targeted audiences:

	Strategy: Top Management	Operation: Production, Supply Chain, R&D, IT	Expertise: Carbon / Energy / EHS / ESG Specialist(s)
Chapter 2: Understanding EU CBAM: Explains the CBAM framework, its objectives, and its relevance to HKMEs. This chapter also addresses common misconceptions and offers an FAQ section for clarity.	Read at least Section 2.3 so that you have a general idea of CBAM and its implications.	Read at least Section 2.3 so that you have a general idea of CBAM and its implications.	Read all and be the champion within your organization.
Chapter 3: Cornerstones of Carbon Management: Provides foundational knowledge about carbon emissions, global standards, and strategies for data collection and setting reduction goals. It emphasises the practical measures HKMEs can take to align with CBAM requirements.	Skimming this chapter is suggested.	Skimming this chapter is suggested.	
Chapters 4–6: Step-by-step Guidance and Case Study: Delve into sector-specific step-by-step guidance for industries such as Iron and Steel, Aluminium, with remarks on Organic Chemicals and Polymers which would likely be the next step extension of the CBAM scope. These chapters include best practices for data management, embedded emissions calculations, and compliance strategies.	Skimming at least one of the case studies is suggested.	Read at least one of the case studies. Case 1 addresses Bubble Approach and supply chain collaboration, Case 2 addresses Mass Balance Approach and Case 3 addresses PFC emissions and Allocation issue	
Chapter 7: CBAM Formalities and Data Points: Entail the data points and data requirements for CBAM formalities as well as the CBAM communication between importers and exporters.	Quickly skimming Section 7.2 can be helpful to understand what CBAM means in practice.	Supply Chain team should read this chapter. Production team and IT team may wish to read Section 7.2.	
Chapter 8: Lightweight Digital Solutions for Carbon Management in Manufacturing SMEs: Highlights the use of lightweight / low-cost digital tools to streamline carbon management processes and prepare for CBAM compliance.	Skimming Section 8.3 is suggested	IT team and Supply Chain team should read this Chapter	

Chapter 2: Understanding EU CBAM

2.1. Executive Summary

The European Union's Carbon Border Adjustment Mechanism (CBAM) is a regulatory framework designed to address carbon leakage and support the EU's ambitious climate goals. By applying a carbon price to certain high-emission imports, CBAM seeks to encourage the adoption of sustainable production practices globally while aligning with the EU's climate goals. For Hong Kong Manufacturing Enterprises (HKMEs), understanding CBAM is crucial to navigating its implications and preparing for its operational requirements.

For importers, traders and manufacturers, CBAM introduces specific compliance requirements, such as emissions data reporting and verification. Chapter 2 outlines these obligations, helping HKMEs and other stakeholders prepare for the operational demands of CBAM. By focusing on accurate data collection and carbon accounting practices, businesses can ensure compliance and mitigate potential risks.

Importantly, this chapter frames CBAM not simply as a regulatory challenge but as a driver for broader industry transformation. While the mechanism reflects the EU's approach to addressing carbon leakage, it also signals a global trend toward more stringent environmental standards. For Hong Kong, CBAM provides an impetus for strengthening carbon management capabilities, aligning with regional sustainability goals, and demonstrating leadership in the transition to low-carbon production.

This chapter aims to equip HKMEs with the knowledge to engage with CBAM effectively, focusing on its operational aspects while considering the broader implications for Hong Kong's economic and environmental priorities.

For readers seeking clarifications on the EU CBAM, Section 2.3 addresses common misunderstandings about the EU Carbon Border Adjustment Mechanism (CBAM) in a practical way.

2.2. Key Components of CBAM

The EU CBAM is a landmark policy developed to address carbon leakage and support the EU's climate ambitions by ensuring that imported goods reflect the carbon costs applied to domestic production under the EU Emissions Trading System (ETS). This section provides an overview of the key components of

CBAM and its phased implementation timeline, as well as the potential future expansion to additional sectors such as Polymers and Organic Chemicals.

The CBAM framework is structured around several core elements that define its scope, requirements, and operational mechanisms:

A. What: Scope of CBAM

CBAM initially applies to specific carbon-intensive sectors, including **Iron and Steel, Aluminium, Cement, Fertilisers, Electricity, and Hydrogen**. These industries were selected based on their high carbon intensity and significant contribution to global emissions.

Please note that the specific scope of the EU CBAM is defined using CN (Combined Nomenclature) codes, which are an EU-specific extension of the globally used Harmonised System (HS) codes. The first six digits of the CN code align with the HS classification, while the additional two digits provide greater specificity for EU purposes. Goods falling under CBAM's scope can be identified in Annex I to the CBAM Regulation, which lists the relevant CN codes. Importers should ensure that their products are classified correctly using these codes to determine whether they fall within the CBAM framework.

The EU CBAM focuses on greenhouse gases (GHGs) directly associated with the production processes of in-scope goods. The primary GHG covered under CBAM is carbon dioxide (CO₂), which is the most significant contributor to emissions in the targeted sectors. However, depending on the production processes and products, other GHGs such as perfluorocarbons (PFCs) and nitrous oxide (N₂O) should also fall within the scope.

Below is an overview of the CBAM sectors and examples of the products against their CN codes (the first 4 or 6 digits) and the GHGs. Please refer to Annex I to the CBAM Regulation for details (also as appendix of this Guidebook).

- **Iron and Steel (CO₂)**
 - **7201**: Pig iron in primary forms
 - **7207**: Semi-finished products of iron or non-alloy steel (e.g., billets, slabs, blooms)
 - **7308**: Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock-gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel

- **7318:** Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel
 - **7326:** Other articles of iron or steel
- **Aluminium (CO₂ and PFCs)**
 - **7601:** Unwrought aluminium (e.g., ingots, slabs).
 - **7606:** Aluminium plates, sheets, and strips.
 - **7610:** Aluminium structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, balustrades, pillars and columns); aluminium plates, rods, profiles, tubes and the like, prepared for use in structures
 - **7616:** Other articles of aluminium
- **Cement (CO₂)**
 - **2523 10:** Cement clinkers
 - **2523 29:** Other Portland cement
 - **2523 90:** Other hydraulic cements
- **Fertilisers (CO₂ and N₂O)**
 - **3102:** Mineral or chemical fertilisers, nitrogenous
 - **3105:** Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers; except: 3105 60 00
 - **2804 10:** Hydrogen
- **Ammonia (CO₂)**
 - **2814:** Ammonia, anhydrous or in aqueous solution.
- **Hydrogen (CO₂)**
 - **2814:** Ammonia, anhydrous or in aqueous solution.
- **Electricity (CO₂)**
 - **2716:** Electrical energy

The mechanism may expand to cover additional sectors, notably **Polymers** and **Organic Chemicals**, in the future. The European Commission shall present a report to the European Parliament and to the Council including an assessment on the possibility of the scope extension.

B. What: Emission Sources under CBAM

Under the EU CBAM framework, emission sources are categorised with a specific focus on the trade-related embedded emissions of imported goods, which differ from broader carbon management standards like ISO 14064-1.

Below is a detailed description of the emission sources under CBAM:

1. Direct Emissions

Direct emissions refer to greenhouse gas (GHG) emissions that are generated during the production processes of CBAM-covered goods. These emissions sources include:

- **On-Site Production Processes:** Emissions produced directly at the installation during the manufacturing of goods, such as emissions from combustion and other processes for production.
- **Heating and Cooling Production:** Emissions from the generation of heating and cooling used in the production process, regardless of whether the heating or cooling is generated on-site or off-site. That said, if heating or cooling is produced outside the installation but is used in the production process, the resulting emissions are still counted as direct emissions. The common emission sources in question are imports of heat flows and waste gases, the category of which differs from that under 14064-1 or GHG Protocol (where imports of heat flows and waste gases are considered sources for indirect emissions).

2. Indirect Emissions

Indirect emissions are those associated with the consumption of electricity during the production of CBAM goods. The calculation of indirect emissions depends on the quantity of electricity used, the country of origin of the electricity, the generation source, and the associated emission factors.

3. Embedded Emissions in Precursor Materials

In addition to the direct and indirect emissions from the production process, CBAM also considers the embedded direct (and indirect emissions if applicable) of relevant precursor materials used in manufacturing.

Note:

- During the **transitional phase** (until 31 December 2025), both direct and indirect emissions should be reported for all goods under CBAM.
- From 1 January 2026, while direct emissions should be declared for all CBAM-covered goods, the requirement to declare indirect emissions for certain sectors remains uncertain as of March 2025. Stakeholders

should stay informed about potential revisions to indirect emissions reporting requirements.

- It is suggested to keep track of the latest requirements.

C. Who: Parties Involved in CBAM and Their Obligations

The EU CBAM involves multiple parties, each with specific roles and obligations to ensure the system operates effectively. Below is a detailed breakdown of the key parties involved in CBAM (other than the authorities) and their respective obligations:

Importers of In-Scope Products

- **Who They Are:** All importers of CBAM-covered goods should register as **authorised CBAM declarants** in the CBAM registry, established and maintained by the European Commission. Registration is mandatory to legally import CBAM-covered goods into the EU. Please note that companies established outside the EU (such as in Hong Kong) may act as importers in the EU and are subject to the same CBAM obligations as companies established within the EU.
- **Obligations:**
 1. **Registration:** Should register as an authorised CBAM declarant in the CBAM registry maintained by the European Commission to legally import CBAM-covered goods.
 2. **Monitoring and Reporting:** Submit **quarterly reports** that entails the volume of imported goods, the **embedded emissions** of CO₂ / GHGs in these goods, based on emissions generated during their production, and whether any carbon price was paid for these emissions in the country of origin. This reporting obligation applies during the **transitional phase** of CBAM (from **October 1, 2023**, to **December 31, 2025**) when no certificates are required. During this phase, the reporting obligations are intended to familiarise importers with the system.
 3. **CBAM Certificate Purchases:** Starting from January 1, 2026, importers will need to purchase and surrender CBAM certificates annually to cover the embedded emissions of their imported goods. The price of CBAM certificates will be based on the average auction price of EU ETS allowances during the relevant period, ensuring alignment with the EU's carbon pricing system. Adjustments will be made for any carbon price paid in the country of origin, provided

sufficient evidence is submitted and validated by the competent authorities.

4. **Compliance Obligations:** By **May 31st** each year, importers should submit an annual CBAM declaration to the competent authority in their Member State and surrender the required number of CBAM certificates to cover the verified embedded emissions of the goods imported during the previous calendar year.
5. **Record-Keeping:** Maintain records related to imports (e.g., data on imported goods, emissions calculations, and surrendered certificates) for at least **four years** for verification and auditing purposes.
6. **Non-Compliance Consequences:** Importers failing to meet obligations may face financial penalties for non-compliance, restrictions on imports or other trade-related consequences, potential obligations to surrender additional CBAM certificates or pay further penalties for underreporting embedded emissions.

Exporters in Non-EU Countries

- **Who They Are:** Exporters are companies, facilities, or operators located in non-EU countries that produce goods covered by CBAM (e.g., steel, cement, aluminium, fertilisers, hydrogen, or electricity) for export into the EU.
- **Obligations:**
 1. **Provide Emissions Data:** Exporters are expected to provide detailed and verifiable data on the embedded emissions of their products to the EU importer. If exporters fail to provide emissions data, the importer should rely on default values set by the regulation. These default values are typically based on the average carbon intensity of the product's industry in the exporting country, which may be less favourable than actual emissions data.
 2. **Disclose Carbon Pricing:** Exporters should **document and communicate** any **carbon price paid** in the country of origin, such as: carbon taxes or costs under an emissions trading system (ETS) or similar mechanisms.
 3. **Adopt Transparency:** Exporters should ensure transparency in their production processes and emissions measurement to facilitate compliance for EU importers. Cooperation with verifiers and importers is essential to ensure accurate reporting and compliance with CBAM rules.

Verifiers (Independent Accredited Entities)

- **Who They Are:** Verifiers are independent third-party entities accredited to verify the embedded emissions data provided by exporters and submitted by importers. According to Regulation (EU) 2023/956, verifiers should be accredited by EU-based accrediting bodies, as defined in Regulation (EC) No 765/2008. Only accrediting bodies within the EU are authorised to determine who can act as accredited verifiers under CBAM. Verifiers operating in non-EU countries (e.g., Asia-Pacific) should obtain accreditation from an EU-based accrediting body to perform CBAM-related verification activities.
- **Obligations:**
 1. **Verification of Emissions Data:** Verifiers should assess and verify the accuracy of embedded emissions data provided by exporters or operators at the installation level, and ensure the verification complies with CBAM's specific methodologies and standards, including those outlined in Annex VI of Regulation (EU) 2023/956. Please note that installation visits are mandatory for verification unless specific criteria for waiving the visit are met (e.g., if sufficient data is available remotely and the verifier determines no physical visit is necessary).
 2. **Reporting:** Verifiers should issue verification reports to the operators of installations (not directly to importers). These reports document the verified embedded emissions and are then used by the importers to fulfil their CBAM obligations. Importers submit this verified data to the competent authorities as part of their quarterly and annual declarations.

D. When: Timeline for Implementation of the CBAM

The EU CBAM adopts a phased approach to its implementation, providing businesses with a structured timeline to adapt:

Transitional Phase (October 1, 2023 – December 31, 2025):

- **Quarterly Reporting Obligations:**

During this phase, importers of CBAM-covered goods are required to submit quarterly reports detailing the embedded greenhouse gas (GHG) emissions of their imports and any carbon prices paid in the country of origin. These reports should comply with the detailed reporting templates and methodologies outlined in Implementing Regulation (EU) 2023/1773, which specifies the rules for calculating embedded emissions and ensuring accuracy in reporting.

- **No Financial Obligations:**

Importers are not required to purchase CBAM certificates during this phase. The focus is on collecting accurate emissions data, building capacity, and allowing businesses and regulators to familiarise themselves with the reporting requirements and methodologies.

- **Capacity Building and Fine-Tuning:**

This period is intended to allow for the refinement of the CBAM framework based on insights gained from the reporting data. It also provides an opportunity for stakeholders, including industries and enforcement authorities, to prepare for the full implementation phase.

Full Implementation (Starting January 1, 2026):

- **Introduction of Financial Obligations:**

From 2026 onward, importers will be required to purchase and surrender CBAM certificates to cover the embedded emissions of their imported goods. The number of certificates corresponds to the verified emissions associated with the production of the imported goods.

- **Alignment with EU ETS:**

The cost of CBAM certificates will reflect the prevailing carbon price under the EU Emissions Trading System (ETS), ensuring a level playing field between EU domestic producers and foreign suppliers. This prevents carbon leakage by internalising the cost of carbon emissions for imports, incentivising cleaner production processes globally.

- **Verification and Compliance:**

Importers will need to ensure that the reported embedded emissions are verified by accredited entities, as stipulated in Regulation (EU) 2023/956. Non-compliance with reporting or certificate purchase requirements could result in penalties.

Future Sectoral Expansion and the Climate Club Concept (2026 and Beyond):

- **Planned Expansion to New Sectors:**

The EU plans to expand CBAM coverage to include additional sectors such as polymers and organic chemicals. These industries are integral to global supply chains and are particularly significant for export-dependent economies. For non-EU producers, the inclusion of these

sectors will require further adjustments to meet the CBAM's reporting and compliance requirements, which could create additional administrative burdens and costs.

- **Emerging "Climate Club" Dynamics:**

The CBAM framework reflects the EU's ambition to set a global standard for integrating carbon pricing into trade policies. By aligning the cost of CBAM certificates with the EU Emissions Trading System (ETS), the mechanism creates a de facto carbon pricing system for imports. The EU has signalled its openness to engage with trading partners on carbon pricing equivalence or mutual recognition mechanisms, framing this as part of a broader effort to encourage international cooperation on climate goals. However, this so-called "climate club" approach has sparked debate. Critics argue that CBAM could unintentionally penalise economies without comparable carbon pricing systems, particularly developing countries or regions with differing climate policies. While the EU considers CBAM a tool to foster global decarbonisation, concerns persist that it may impose additional barriers to trade and undermine principles of fair competition.

E. How: CBAM Administration

The CBAM framework imposes multiple obligations on importers (**and exporters via the importers**) to ensure compliance with its requirements. These obligations include registration, quarterly reporting, CBAM certificates, and annual filing and reconciliation. Each obligation involves specific actions and oversight from the European Commission, the CBAM registry, national authorities, and accredited verifiers. Below is a breakdown of importer obligations and the corresponding roles of these governing bodies:

Registration of Importers

National Authorities:

- Review and approve importer registration applications.
- Maintain a list of authorised importers who are entitled to participate in the CBAM system.

CBAM Registry:

- Serve as the digital infrastructure where registered importers are recorded and managed.

European Commission:

- Provide overarching guidance on registration procedures to ensure harmonisation across Member States.

Quarterly Reporting on Embedded Emissions

National Authorities:

- Receive and review quarterly reports submitted by importers.
- Validate the accuracy of embedded emissions data and the reporting templates used by importers.

Accredited Verifiers:

- Independently verify the emissions data and compliance with calculation methodologies.
- Issue verification statements confirming the accuracy of the reported data.

CBAM Registry:

- Serve as the platform where importers upload their quarterly reports and where national authorities can access these reports for validation.

European Commission:

- Provide standardised templates and guidelines for quarterly reporting to ensure consistency across all Member States.
- Monitor aggregate data for compliance trends and evaluate the effectiveness of the CBAM framework.

Purchasing and Holding CBAM Certificates

National Authorities:

- Issue CBAM certificates to importers within their jurisdiction.
- Monitor the number of certificates purchased and ensure they align with the emissions data provided in quarterly reports.

CBAM Registry:

- Track the issuance, purchase, and holding of CBAM certificates by registered importers in a centralised system.
- Provide transparency and facilitate monitoring by national authorities.

European Commission:

- Set the price of CBAM certificates, which is calculated based on the average auction price of EU ETS allowances over a predefined period.
- Oversee the functioning of the CBAM registry to ensure uniformity and transparency across Member States.

Annual Filing and Reconciliation

National Authorities:

- Review and validate the annual declarations submitted by importers.
- Ensure that the number of surrendered CBAM certificates matches the verified emissions for the year.
- Take enforcement actions in cases of discrepancies or non-compliance.

CBAM Registry:

- Record the submission of annual declarations and the surrendering of CBAM certificates by importers.
- Track certificate balances and ensure proper accounting for unused certificates.

European Commission:

- Provide guidance to ensure consistency in annual filing and reconciliation processes across Member States.
- Monitor Member States' enforcement of CBAM obligations to ensure compliance with EU regulations.

Verification of Embedded Emissions

Accredited Verifiers:

- Perform independent assessments of emissions data and ensure compliance with prescribed methodologies.
- Issue verification statements confirming the reliability of the reported emissions.

National Authorities:

- Maintain oversight over the accreditation of verifiers and ensure their impartiality and competence.

European Commission:

- Define the rules and standards for verifying emissions and accredit verifiers to ensure consistency across the EU.

Penalties for Non-Compliance

The CBAM framework includes strict enforcement measures to ensure compliance with its requirements. Penalties apply to importers who fail to meet their obligations, as outlined below:

Failure to Surrender CBAM Certificates:

Starting in 2026, importers should surrender the required number of CBAM certificates annually to cover the embedded emissions of their imports. If they fail to do so, they will incur a financial penalty equivalent to the EU ETS excess emissions penalty for that year. This amount may be significantly higher than the market price of CBAM certificates, ensuring that non-compliance is costlier than compliance.

Inaccurate or False Reporting:

Importers that submit inaccurate or falsified emissions data or fail to meet the verification requirements may face administrative fines. Repeated violations could result in additional enforcement measures, such as suspension of import rights for CBAM-covered goods.

Fraudulent Activity and Deliberate Evasion:

Fraudulent activities, such as misreporting embedded emissions or attempting to circumvent CBAM obligations, are subject to strict penalties. Member States are required to impose sanctions that are "effective, proportionate, and dissuasive," which may include criminal penalties under national laws.

Strategic Implications for Importers and Exporters

The strict penalty regime under CBAM will have a profound impact on importers' strategies, decision-making, and contractual arrangements with exporters. Importers face significant financial and operational risks if their CBAM obligations are not properly fulfilled, driving them to adopt more cautious and stringent measures when dealing with their supply chains. This includes:

- **Increased Scrutiny on Exporters:**

Importers will require exporters to provide detailed, verified, and reliable data on the embedded emissions of their goods, as well as information on any carbon pricing paid in the country of origin. A failure by exporters to provide accurate and verified information could expose importers to penalties for non-compliance, pushing them to seek alternative suppliers or renegotiate contracts to include clauses ensuring full data transparency and accountability.

- **Contractual Adjustments:**

Importers are likely to include specific contractual provisions requiring exporters to provide emissions data verified by accredited third-party entities. Contracts may also include indemnity clauses to hold exporters accountable for any penalties or additional costs incurred because of inaccurate or incomplete emissions data.

- **Supply Chain Reconfiguration:**

The risk of penalties may lead importers to reconfigure their supply chains, favouring exporters from jurisdictions with robust carbon accounting systems or recognised carbon pricing mechanisms. Exporters without adequate emissions tracking may find themselves at a competitive disadvantage in the EU market.

For exporters, this highlights the importance of aligning with CBAM requirements by ensuring that all emissions data and documents are accurate, transparent, and verified by accredited entities. Providing reliable and verifiable data will not only strengthen relationships with importers but also help exporters maintain their competitive position in the EU market. Failure to do so could lead to strained relationships with key trading partners, lost business opportunities, or exclusion from the EU market altogether.

2.3. Common Misunderstandings about EU CBAM

This section aims to help Hong Kong Manufacturing Enterprises (HKMEs) gain a clearer understanding of the EU Carbon Border Adjustment Mechanism (CBAM) by addressing common misconceptions in a practical format. By highlighting and correcting these misunderstandings, HKMEs can approach CBAM compliance with accurate information and avoid potential pitfalls or missteps.

1. CBAM Applies Only to Large-Scale Manufacturers?

Many HKMEs mistakenly believe that CBAM only targets large-scale manufacturers. However, CBAM applies to all non-EU entities exporting in-scope goods to the EU, irrespective of their size or production volume. The scope of CBAM is determined by the type of products and sectors covered, such as iron and steel, cement, aluminium, fertilisers, hydrogen, and electricity, and not the size of the exporting business.

2. CBAM Only Affects Certain Sectors?

It is true that CBAM currently applies only to specific sectors—iron and steel, aluminium, cement, fertilisers, hydrogen, and electricity—that are at high risk of carbon leakage. However, the misconception lies in thinking this is static. CBAM

was designed with the flexibility to expand to additional goods and sectors over time. While no definitive expansion has been confirmed yet, businesses should stay informed as the EU may broaden the scope to include other carbon-intensive products, such as polymers or organic chemicals, after the transitional phase.

3. CBAM Covers Only Simple Products, Utmost Streams in the Supply Chain?

A common misunderstanding is that CBAM applies exclusively to "simple products" or only to the utmost streams in the supply chain. In reality, CBAM covers both **simple goods** and **complex goods**, depending on the embedded emissions and production processes involved.

- **Simple Goods:** Simple goods are products whose embedded emissions are based entirely on emissions from their own production processes. Input materials for simple goods are considered to have zero embedded emissions under the CBAM methodology. An example would be primary aluminium, where emissions are calculated solely for its production.*
- **Complex Goods:** CBAM also applies to complex goods, which are products made using precursor materials that are themselves CBAM goods. For complex goods, the embedded emissions include not only those from their production but also the emissions from the relevant precursors used in the manufacturing process. For instance, in the cement sector, cement clinker, a precursor material, is included in the calculation of embedded emissions for Portland cement.*

** Pursuant to Regulation (EU) 2023/956, 'simple goods' means goods produced in a production process requiring exclusively input materials (precursors) and fuels having zero embedded emissions whilst 'complex goods' means goods other than simple goods. The definition in this Guidebook is an interpretation based on the regulation definition for easier understanding.*

This means that CBAM does not merely focus on the "utmost streams" of the supply chain or the final product. Instead, it accounts for emissions across multiple stages of production, particularly where precursor materials falling under CBAM are involved.

4. Compliance is a One-Time Effort?

A common misconception is that CBAM compliance is a one-time effort involving only a one-off annual audit. In reality, manufacturers will need to adopt a proactive and continuous approach to monitoring and maintaining carbon-related data and records. CBAM compliance is not limited to periodic audits but requires day-to-day management of emissions data to ensure accuracy and readiness for reporting obligations.

- **Quarterly Reporting Requirements:** During the transitional phase (2023–2025), importers are required to submit quarterly reports detailing the embedded emissions of their imported goods, calculated in alignment with CBAM methodologies. These reports should include accurate and up-to-date data, necessitating regular tracking and maintenance of carbon-related records throughout the year.
- **Record-Keeping Obligations:** Manufacturers should maintain complete and transparent records of all data relevant to determining embedded emissions, including supporting documents. These records should be kept for at least four years and be readily available for submission or review by EU authorities when necessary, emphasising the importance of ongoing documentation rather than one-time efforts.
- **Verification and Updates:** While annual reconciliation and verification of emissions data are required during the definitive phase starting in 2026, the CBAM framework stresses the need for continuous monitoring. Accurate day-to-day tracking ensures that any updates or corrections can be swiftly incorporated into quarterly reports, reducing the risk of discrepancies or penalties.
- **Financial and Operational Impact:** Relying on annual audits alone may result in outdated or incomplete data, which could lead to higher declared emissions or non-compliance penalties. By maintaining records daily, manufacturers can optimise their carbon accounting, minimise costs, and enhance their reputation for environmental accountability.

In summary, CBAM compliance requires manufacturers to shift from a reactive, one-time audit approach to a proactive, daily management system for carbon-related data. This ongoing process not only ensures accurate reporting but also prepares businesses for the evolving requirements under CBAM.

5. My Product Carbon Footprint Certificate Can Meet CBAM Requirements?

There is a common misunderstanding that a Product Carbon Footprint (PCF) Certificate, based on ISO 14067 or Life-Cycle-Assessment (LCA) methodologies, can directly satisfy CBAM requirements. This misconception even exists among some so-called CBAM "experts". However, this is not the case.

CBAM mandates specific emissions data at the installation level, calculated in line with CBAM methodologies, which are harmonised with the EU Emissions Trading System (ETS). These methodologies focus solely on emissions embedded in production (both direct and indirect), not the cradle-to-grave perspective of PCF or LCA approaches. Sole reliance on a PCF Certificate risks

non-compliance due to insufficient granularity or varying quantification methodology.

As an observation, the use of emission factors from LCA databases often lead to a significant “over-estimate” of the embedded emissions compared to the emissions based on CBAM requirements.

6. Reporting Embedded Emissions is Optional During the Transitional Period?

Some HKMEs mistakenly believe that CBAM reporting requirements are optional until the definitive period begins in 2026. This is incorrect.

As of 1 October 2023, reporting embedded emissions for in-scope goods is mandatory during the transitional phase. Importers should submit quarterly reports to the CBAM Transitional Registry, detailing emissions and carbon costs paid abroad.

7. Default Values Can Be Used Without Providing Actual Data?

The use of default values for emissions reporting under CBAM is allowed but subject to specific conditions and limitations:

- **Transitional Period (until 30 June 2024):** Default values can be used without quantitative limits if actual emissions data is unavailable, but importers should demonstrate reasonable efforts to retrieve actual data from operators. For subprocesses or input materials contributing **less than 20% to the total embedded emissions of complex goods**, estimated values (including default values) may be used.
- **Definitive Period (from 2026):** While default values remain an option, they are typically set higher than actual emissions due to a “mark-up” designed to maintain environmental integrity. This results in higher declared emissions and, consequently, higher carbon costs for importers.

Default values, which often significantly exceed actual emissions, effectively increase the carbon cost for businesses, making imported goods less competitive. Furthermore, EU buyers may perceive the reliance on default values as a lack of environmental transparency or commitment, potentially leading to financial and reputational “penalties” in the form of reduced market attractiveness or strained business relationships. Therefore, businesses should implement robust systems to collect and report actual emissions data, verified at the installation level, to minimise costs and maintain market trust.

8. CBAM is Only About Direct Emissions?

Some manufacturers believe CBAM focuses exclusively on direct emissions (e.g., from on-site combustion). However, CBAM also considers indirect emissions, such as those from purchased electricity used in production.

Furthermore, for certain products, emissions from precursors (input materials) should also be accounted for. Accurate reporting requires collaboration along the supply chain to collect data on emissions from upstream suppliers, underscoring the importance of strong partnerships.

9. CBAM Penalties Are Minimal and Avoidable?

Businesses may underestimate the consequences of CBAM non-compliance, assuming penalties are minor or negotiable. In reality, non-compliance can result in:

- Financial penalties, such as fines for failing to report or surrender CBAM certificates, which are calculated based on the EU ETS excess emissions penalty.
- Restricted access to the EU market, which could disrupt business operations.
- Significant reputational damage, as non-compliance with environmental regulations can harm relationships with EU partners and customers.

HKMEs may wish to take proactive steps to fully understand and meet CBAM obligations to avoid these risks.

10. CBAM is Just an EU Climate Policy, Not a Trade Policy

Some stakeholders view CBAM purely as a climate policy aimed at reducing greenhouse gas emissions. While this is its primary objective, CBAM also functions as a trade policy. By mirroring the carbon costs EU producers face under the ETS, CBAM prevents carbon leakage and ensures a level playing field between EU and non-EU producers. For HKMEs, understanding CBAM's dual role in climate and trade strategies is crucial to aligning their export plans with EU requirements.

Chapter 3: Cornerstones of Carbon Management

The purpose of this chapter is to emphasise the critical role of carbon management as the foundation for achieving compliance with the EU Carbon Border Adjustment Mechanism (CBAM), advancing toward carbon neutrality, and aligning with the broader sustainable development goals (SDGs) for HKMEs.

Carbon management is not merely a compliance exercise; it is a strategic approach that enables businesses to measure, monitor, and reduce their carbon footprint while maintaining competitiveness in markets with stringent climate policies like CBAM. For HKMEs, effective carbon management can unlock opportunities for more sustainable operations, foster stronger relationships with international trade partners, and prepare them for evolving global expectations on climate action.

It is important to distinguish between general carbon management principles and the specific requirements of CBAM. While carbon management focuses on long-term strategies for reducing greenhouse gas (GHG) emissions across the entire value chain, CBAM compliance canters on precise reporting and accounting for direct and indirect emissions embedded in exported goods, as mandated by EU regulatory frameworks.

By addressing these distinctions:

- The other guidebook, **Carbon Management Guidelines for Carbon Neutrality and Sustainable Development Targets of Hong Kong and Mainland China (“General Carbon Management Guidebook”)**, offers comprehensive information on carbon management applicable to HKMEs across all sectors, including those not currently covered under CBAM. This Guidebook also provides a **practical, step-by-step guide** for implementing a carbon management system.
- This chapter serves as a **condensed version** of the **General Carbon Management Guidebook** by outlining the cornerstones of carbon management.
- Chapters 4 and 5 delve into the technical details of implementing a carbon management system specifically designed to comply with CBAM requirements. Given the relatively higher impacts of CBAM on the Iron and Steel and Aluminium sectors, this guidebook uses these two industries as key examples to illustrate the application of CBAM requirements in carbon management.

3.1. GHG Emissions: Defining Scope

Accurate and transparent greenhouse gas (GHG) accounting begins with defining the scope and boundaries of emissions. For manufacturing companies, this process involves identifying all emissions sources across operations and the value chain while adhering to globally recognised frameworks such as the **GHG Protocol** and **ISO 14064-1**. These frameworks ensure that emissions are categorised, measured, and reported consistently, providing a foundation for effective carbon management.

Carbon emissions refer to the total amount of greenhouse gases (GHGs) released into the atmosphere, typically measured in **CO₂-equivalent (CO₂e)**. This metric accounts for the varying **global warming potentials (GWPs)** of different gases, such as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃). In the context of manufacturing processes, carbon emissions are categorised based on their sources, as outlined by **ISO 14064-1** and the **GHG Protocol Corporate Standard**:

1. Direct Emissions (Scope 1):

- Emissions from sources directly owned or controlled by the company. For manufacturers, these primarily include:
 - Combustion of fossil fuels in stationary equipment (e.g., boilers, furnaces, or generators).
 - Combustion of fossil fuels in mobile sources (e.g., motor vehicles, trains).
 - Process-related emissions from chemical reactions (e.g., cement production or steel manufacturing).
 - Fugitive emissions from leaks in industrial equipment (e.g., refrigerants or other gases).

2. Indirect Emissions from Energy Use (Scope 2):

- Emissions associated with the generation of purchased / imported energy, such as electricity, steam, heating, or cooling. While the company does not directly produce these emissions, they occur at the energy generation source.

3. Other Indirect Emissions (Scope 3):

- All other indirect emissions that occur across a company's value chain. These include:

- **Upstream activities** like the production of purchased goods, transportation, and waste management.
- **Downstream activities** like the use of sold products and their end-of-life treatment.

Terminology Note: GHG Protocols vs. ISO 14064-1

*While the **GHG Protocol** uses the terms **Scope 1**, **Scope 2**, and **Scope 3**, **ISO 14064-1** refers to the same emissions categories as **direct emissions**, **energy indirect emissions**, and **other indirect emissions**, respectively. The concepts are fundamentally aligned, but organisations should be aware of the terminology differences when applying these standards. You may refer to the *Carbon Management Guidelines for Carbon Neutrality and Sustainable Development Targets for Hong Kong and Mainland China* for more information about these standards.*

3.2. Setting GHG Boundaries

Defining boundaries is essential for determining which emissions sources are included in a company's GHG inventory. There are two types of boundaries to establish: **organisational boundaries** and **operational boundaries**.

Organisational Boundaries

Organisational boundaries determine which operations or facilities are included in a company's GHG inventory. Companies should decide how to consolidate emissions from their various business units and operations. The GHG Protocol and ISO 14064-1 offer two primary approaches for setting organisational boundaries:

1. Equity Share Approach:

- Under this approach, a company accounts for GHG emissions according to its share of equity in an operation.
- For example, if a company owns 30% of a joint venture, it would include 30% of the joint venture's emissions in its inventory.
- This approach reflects the company's economic stake in the operation.

2. Control Approach:

- The control approach consolidates GHG emissions based on **operational control** or **financial control**:

- **Operational Control:** A company accounts for 100% of the emissions from operations over which it has the authority to implement operational policies.
- **Financial Control:** A company accounts for 100% of the emissions from operations it controls financially (i.e., has the majority financial interest).
- **Please note that the control approach is most commonly used because it aligns with decision-making authority over emissions reduction activities.**

Manufacturing companies should select the approach that best aligns with their business operations and reporting objectives. Once chosen, this approach should be applied consistently over time to ensure comparability.

Operational Boundaries

Operational boundaries define which emissions sources within the organisational boundary are included in the GHG inventory. These boundaries are structured around the **three scopes of emissions** as set out above (i.e., Scope 1, Scope 2 and Scope 3).

Setting Boundaries for Manufacturing Companies

Manufacturing companies face unique challenges when setting GHG boundaries due to the complexity of their operations and supply chains. Key considerations include:

1. Multi-Tiered Supply Chains:

- A significant portion of a manufacturing company's emissions often occurs upstream in Scope 3, such as emissions from raw material extraction or processing.
- Companies should engage with suppliers to collect reliable data and include these emissions in their inventory.

2. Global / Regional Operations:

- Manufacturing companies often operate across multiple jurisdictions, each with varying regulatory requirements for emissions reporting.
- A consistent boundary-setting approach ensures that the company's inventory can be compared across regions and comply with local regulations.

3. Joint Ventures and Partnerships:

- Companies in joint ventures or partnerships should decide how to account for emissions based on their chosen consolidation approach (e.g., equity share vs. control).

4. CBAM Considerations:

- Under the **Carbon Border Adjustment Mechanism (CBAM)**, emissions boundaries are particularly important for calculating embedded emissions in exported goods.
- Manufacturers exporting CBAM-covered products to the EU should ensure their boundaries align with CBAM's requirements to accurately report embedded emissions.

Note: CBAM and Supply Chain Emissions

*The embedded emissions calculated under CBAM include the direct (Scope 1) and indirect (Scope 2) emissions from the production process. For complex goods, **the calculation must also include the embedded emissions of any precursor materials that are themselves covered by the CBAM regulation.** This rule transforms supply chain management by making emissions traceability a critical component of supplier qualification and regulatory compliance.*

As CBAM evolves, it may require reporting and pricing of embedded emissions for complex goods like machinery and electronics, increasing the importance of robust Scope 3 data. Companies exporting to the EU may wish to work closely with upstream suppliers to improve emissions data collection and reporting. To comply with CBAM and other emerging regulations, manufacturers may consider integrating Scope 3 emissions into their carbon management strategies, focus on supply chain transparency, and adopt methodologies aligned with ISO 14064-1 and GHG Protocol standards.

3.3. Monitoring, Reporting and Verification

For manufacturing companies, the foundation of effective carbon management lies in accurate measurement and transparent reporting of GHG emissions. ISO 14064-1 provides a globally recognised framework for quantifying and reporting organisational GHG emissions, offering manufacturers a clear, standardised approach that aligns with regulatory and market expectations. While the **GHG Protocol** is widely used in voluntary reporting, this section focuses on ISO

14064-1, as it is more familiar to manufacturing industries and easier for them to integrate it into broader quality, environmental and sustainability management systems including but not limited to ISO 9001, ISO 14001, ISO 50001. For easy reference purpose, the terms Scope 1, Scope 2 and Scope 3 should still be used.

Principles of ISO 14064-1 Reporting

ISO 14064-1 establishes a set of principles to ensure that GHG emissions reporting is accurate, transparent, and credible. These principles are crucial for manufacturers seeking to maintain trust with stakeholders, align with regulations, and achieve sustainability goals.

- **Relevance:** Ensure the GHG inventory appropriately reflects the organisation's emissions and supports decision-making.
- **Completeness:** Account for all relevant GHG emissions within the defined organisational and operational boundaries.
- **Consistency:** Use consistent methodologies for data collection, calculation, and reporting to enable year-over-year comparisons.
- **Accuracy:** Use high-quality data and minimise uncertainties in emissions calculations.
- **Transparency:** Provide clear and verifiable information, including assumptions, methodologies, and data sources.

Data Collection and Calculation

For manufacturers, ISO 14064-1 emphasises the importance of robust data collection systems and accurate emissions calculations. The following steps outline the process:

1. Identify Emissions Sources:

- Compile a comprehensive list of emissions sources across Scopes 1, 2, and 3.
- Focus on key emitting activities such as energy consumption, raw material use, and industrial processes.

2. Collect High-Quality Data:

- For Scope 1 and 2 emissions, gather direct measurement data (e.g., fuel consumption, energy usage) wherever possible.
- For Scope 3 emissions, engage with suppliers to obtain primary data or use industry averages and emission factors when primary data is unavailable.

3. Apply Emission Factors:

- Use verified emission factors to convert activity data (e.g., fuel use, electricity consumption) into CO₂-equivalent emissions.
- Manufacturers should use region-specific emission factors for purchased electricity to reflect variations in grid carbon intensity.

4. Document Assumptions and Uncertainties:

- Clearly document any assumptions used in emissions calculations, particularly for Scope 3 emissions where data availability may be limited.

5. Verification and Validation:

- Seek third-party verification to ensure the accuracy and credibility of the GHG inventory.

Reporting Requirements

ISO 14064-1 specifies the minimum requirements for GHG emissions reporting, ensuring transparency and consistency across organisations. Manufacturers should include the following elements in their GHG reports:

1. Organisational and Operational Boundaries:

- Clearly define the boundaries used to calculate emissions, including the scope (1, 2, and 3) and the approach to consolidation (e.g., operational control).

2. Emissions Data:

- Provide a breakdown of total emissions by scope, including key sources contributing to each scope.

3. Methodologies and Assumptions:

- Explain the methodologies used for data collection, calculation, and emission factor application.

4. Emissions Trends:

- Highlight changes in emissions compared to previous reporting periods, explaining any significant variations.

5. Reduction Initiatives:

- Report on emissions reduction efforts and progress toward specific targets, if applicable.

3.4. Implementation Strategies for Manufacturers

For manufacturing companies, implementing effective carbon management involves building robust data collection systems, identifying emissions reduction opportunities, and integrating carbon management into the overall business strategy. By following ISO 14064-1 principles, manufacturers can ensure accurate measurement, actionable reductions, and alignment with both regulatory and market requirements.

Data Collection and Management

Accurate data collection is the foundation of ISO 14064-1 compliance and effective carbon management. Manufacturers should prioritise high-quality data to create credible emissions inventories.

Emissions Reduction and Strategic Integration

Once emissions data is collected, manufacturers should focus on actionable reduction opportunities and integrate carbon management into their overall business strategy.

Reduction Opportunities by Scope:

- **Scope 1 (Direct Emissions):** Improve energy efficiency, switch to lower-carbon fuels, optimise processes, and manage fugitive emissions (e.g., refrigerants).
- **Scope 2 (Energy Indirect Emissions):** Transition to renewable energy sources and enhance energy efficiency across operations.
- **Scope 3 (Value Chain Emissions):** Engage suppliers, adopt sustainable procurement practices, optimise logistics, and redesign products for lower carbon intensity.

Strategic Integration:

- **Set Measurable Targets:** Establish science-based emissions reduction targets aligned with global climate goals.
- **Link to Financial Outcomes:** Quantify cost savings from energy efficiency and reduced regulatory risks, integrating carbon performance into investment decisions.
- **Embed in Business Culture:** Secure leadership support, train employees, and foster innovation around sustainability practices.
- **Leverage Competitive Advantage:** Highlight carbon management achievements in marketing and product development to attract customers and investors.

Chapter 4: Building a Carbon Management System for CBAM Compliance in the Iron and Steel Sector

For businesses in the iron and steel sector, particularly small and medium enterprises (SMEs), navigating the complexities of CBAM can seem daunting, especially when carbon management is not yet an integral part of their operational processes.

This chapter focuses exclusively on the technical details of carbon management for CBAM purposes. It provides an accessible yet thorough guide to implementing a Carbon Management System (CMS), enabling companies to identify, monitor, and manage carbon emissions throughout their production processes. The chapter deliberately excludes formal CBAM compliance procedures, such as reporting obligations or legal formalities, which will be covered in Chapter 7. Instead, the emphasis here is on equipping businesses with fundamental tools and strategies to measure and manage emissions as a prerequisite for CBAM compliance.

To make the content relatable and actionable, we employ two case studies representing real-world scenarios in the iron and steel sector. Both case studies address the full spectrum of carbon management, offering step-by-step guidance for diverse business models:

1. **Company Alpha:** A downstream manufacturing SME that procures steel, performing final processing steps like reheating, remelting, casting, forging, coating, and cutting. This case study highlights how downstream manufacturers can establish robust carbon monitoring systems for their own processes while managing the significant portion of emissions derived from their imported precursors.
2. **Company Bull:** An upstream steel production company that produces steel, selling them to companies like Alpha. This advanced case study delves into the full spectrum of carbon management, from defining system boundaries to applying methodologies like the Mass Balance approach for emissions tracking.

Through these case studies, readers will gain a hands-on understanding of setting up a carbon management system tailored to their operational needs. The chapter ensures that even SMEs with little to no prior experience in carbon management can follow the steps and implement practical solutions.

This chapter is an essential guide for carbon engineers, operational managers, and business owners who seek to proactively manage their carbon footprint in the context of CBAM. It prepares readers to address emissions challenges, leverage opportunities for operational efficiency, and align their business practices with the sustainability targets.

Here below are the key terms for this chapter (as well as Chapter 5), in addition to those which have already been covered in Chapter 2 and Chapter 3 (as well as the General Carbon Management Guidebook). It is suggested that the readers walk them through as a first step. Don't worry about these terms if you do not fully understand them; you may refer to these terms when navigating the case studies and the technical discussions.

- **Aggregated Goods Category:** Group of CBAM goods with different CN codes but similar CBAM characteristics; the said CBAM characteristics means the same or similar production route, system boundaries (inputs, outputs and corresponding emissions), emission monitoring and relevant precursors.
- **Bubble Approach:** A single, joint system boundary for a production process within an installation, which is applied when a production facility produces both a complex product and its precursor, and the precursor is entirely used to manufacture the complex product. By treating the precursor and the final product as part of a single production system, the embedded emissions are calculated collectively rather than separately, simplifying the overall emissions accounting process.
- **Calculation-based Methodology:** The approach involves calculating emissions based on the quantities of fuels and relevant materials consumed during production. It consists of two methods: Standard Method and Mass Balance Method.
- **CN Code:** Combined Nomenclature codes which are an EU-specific extension of the globally used Harmonised System (HS) codes primarily for customs purposes. The first six digits of the CN codes align with the HS classification, while the additional two digits provide greater specificity for EU purposes.
- **Complex Goods:** Goods produced from other CBAM goods (either simple or other complex goods). Please refer to the definition of Simple Goods.
- **Mass Balance Method:** The approach that tracks the carbon flow by accounting for the carbon quantities in all fuels and input materials, as well as in the output materials. It is commonly applied in complex production systems to monitor emissions more accurately.

- **Measurement-based Methodology:** The approach where emissions are determined by directly measuring the concentration of GHGs in the flue gas, as well as the flow rate of the flue gas for each emission source.
- **Production Process:** Chemical or physical processes carried out in parts of an installation to produce goods under an aggregated goods category and its specified system boundaries.
- **Production Route:** Specific technology used in a production process to produce goods
- **Simple Goods:** Goods produced from fuels and raw materials considered to have zero embedded emissions under CBAM.
- **Standard Method:** The approach that involves calculating emissions based on the quantities of fuels and input materials consumed during production multiplied by specific calculation factors such as the net calorific value of the fuel and the emission factor.

Case Study 1: Company Alpha and Rick

Overview

Rick, the Energy Engineer at Company Alpha, was tasked with setting up a Carbon Management System (CMS) to meet CBAM requirements in the last quarter of 2023. This effort required inter-departmental collaboration and a strategic approach to manage emissions across direct, indirect, and precursor-related sources. The case study follows his journey, addressing challenges like identifying emission sources, selecting appropriate methodologies, obtaining emissions data from suppliers, and ensuring compliance with CBAM regulations.

Step 1: Identifying Goods Subject to CBAM

Rick began by consulting the **supply chain team** to determine which exported goods would fall under CBAM's scope. The team informed him that while they had detailed export records, they only used **Chinese HS codes** and did not have EU **CN codes** which were used by their customers in the EU.

Rick explained that the **HS (Harmonised System) codes** are universal up to the first 6 digits and the iron and steel products (i.e., Articles of Iron or Steel in the HS Code system) subject to CBAM are defined by the first 4 or 6 digits. This makes the Chinese HS codes compatible for identifying iron and steel products under CBAM.

Call-Out Box: CBAM Goods in the Iron and Steel Sector

The iron and steel sector has a broad spectrum of products covered under CBAM. These include, but are not limited to:

7308: Structures and parts of structures (e.g., doorframes, window frames and shutters, prefabricated buildings of iron or steel).

7310: Tanks and containers made of iron or steel.

7318: Screws, bolts, nuts, and similar articles.

7326: Other articles of iron or steel (e.g., cast-iron parts).

These categories encompass a wide range of goods with significant implications for many manufacturing enterprises in Asia Pacific.

After clarifying this, Rick and the supply chain team cross-referenced their inventory of imported goods against the CBAM Annex I list using the HS codes. They found that all the products of the company would require emissions reporting under CBAM. This established the foundation for the subsequent steps in setting up the CMS.

Step 2: Establishing System Boundaries – A Team Effort

Having identified the relevant goods, Rick moved on to defining the system boundaries for the CMS. This required:

- **Collaboration with Production team:** To map out direct emissions from manufacturing processes like heating furnaces.
- **Input from Facilities Management team:** To include electricity consumption and associated indirect emissions.
- **Engagement with Supply Chain team:** To assess embedded emissions in imported steel raw materials.

This collaborative approach ensured all relevant emissions sources were captured within the CMS.

This collaborative effort ensured that Company Alpha's CMS covered all relevant emissions, including direct emissions from production, indirect emissions from electricity, and precursor-related emissions.

Step 3: Identifying Emission Sources – Rick’s Collaborative Approach

Working with other departments, Rick identified:

- **Direct emissions** from fuel combustion in reheating and remelting processes.
- **Indirect emissions** tied to electricity usage across production lines. Please note that, depending on potential changes of the regulations, the CBAM scope for iron and steel products may be limited to direct emissions during the definite period. Indirect emissions were calculated in this case study because they were for reporting in transitional period.
- **Embedded emissions in precursors**, provided by suppliers or estimated using default values.

After the supply chain team developed an understanding of embedded emissions in precursors, there were a few calls between Rick and the supply chain team and between Company Alpha and the supplier, Company Bull. The conversations revealed two critical challenges:

1. **Lack of Internal Data:** The supply chain team acknowledged that they did not have records or data on the embedded emissions of the steel procured. This was due to a lack of monitoring and reporting requirements in their current supply chain processes.
2. **Supplier’s Reluctance:** Company Bull informed that:
 - They did not monitor or track embedded emissions data for their production processes.
 - Even if such data existed, it was considered commercially sensitive, and they were unwilling to share it with Company Alpha. This reflects broader confidentiality concerns in supply chains, where suppliers may hesitate to disclose operational data to downstream buyers.

Step 4: Selecting Standard Method for Emission Quantification

In this step, Rick worked on selecting appropriate quantification methods tailored to each emission source, ensuring that Company Alpha could accurately calculate emissions while complying with CBAM requirements. The quantification methods were applied separately to direct emissions, indirect emissions, and embedded emissions in precursors.

Direct Emissions from Production Processes

For emissions generated by on-site production activities, such as reheating furnaces and remelting operations, Rick decided to use the **Standard Method**. This method involves calculating emissions based on activity data (e.g., fuel consumption) and applying emission factors. The formula is as follows:

Emissions (tCO₂e) =

*Fuel Consumption × Emission Factor × Net Calorific Value**

- **Data Source:** Fuel consumption data was provided by the production team while emission factors and calorific values were drawn from the standard values set out in Commission Implementing Regulation (EU) 2023/1773.
- **Rationale:** The Standard Method was chosen for its simplicity and alignment with available data, making it practical for Company Alpha's operations as a starting point of the CMS.

* The Oxidation Factor is set as 1, which is conservative assumption, to reduce monitoring efforts.

Indirect Emissions from Electricity Usage

For indirect emissions tied to electricity consumption, Rick used the following formula:

Emissions (tCO₂e) = Electricity Consumption × Grid Emission Factor

- **Data Source:** The facilities management team provided monthly electricity usage data **specifically for the production**. The grid emission factor was based on the IEA value*.
- **Rationale:** This approach ensures that indirect emissions are calculated in a straightforward, transparent manner, adhering to CBAM requirements.

Call-Out Box: Decision Tree for Determining Grid Emission Factors for CBAM Compliance

The determination of grid emission factors under CBAM compliance follows a structured process to ensure accuracy, flexibility, and alignment with regulatory guidelines. The steps below outline the decision-making flow:

Step 1: Is the electricity sourced via a direct technical link or a Power Purchase Agreement (PPA)?

- **If Yes:**

Determine whether the actual emission factor (EF) is verified.

- **If Verified:** Use the verified actual emission factor for the electricity-generating source. This is permissible under CBAM regulations when the electricity is directly supplied to the installation or governed by a valid PPA.
- **If Not Verified:** Proceed to Step 2.

- **If No:**

Move to Step 2.

Step 2: Is there publicly available data for an alternative emission factor for the national grid of the country of origin?

- **If Yes:**

Evaluate whether the data aligns with CBAM methodologies and is robust.

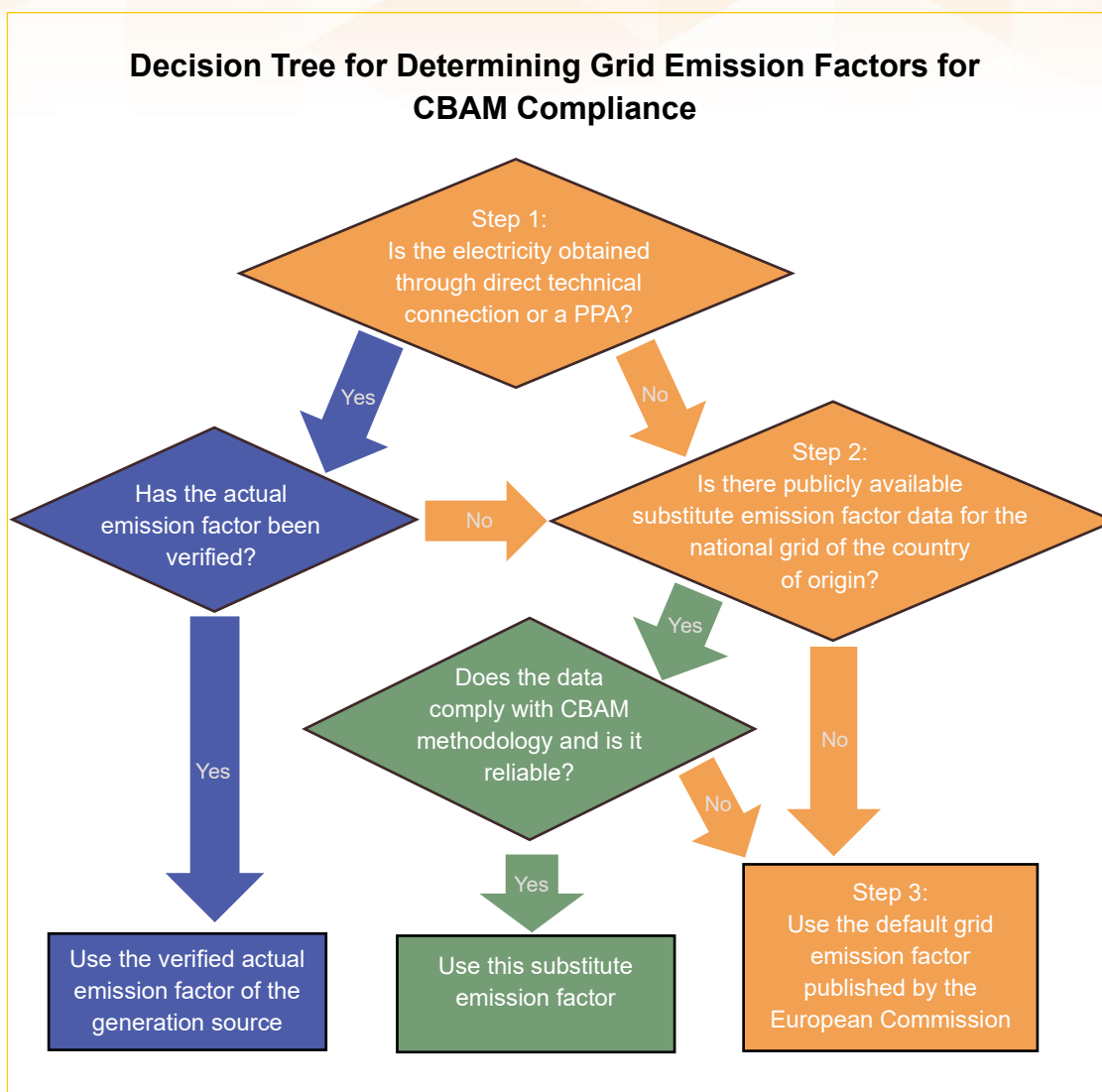
- **If It Aligns:** Use this alternative emission factor, provided it is reliable and consistent with CBAM requirements.
- **If It Does Not Align:** Proceed to Step 3.

- **If No:**

Proceed to Step 3.

Step 3: Is the default grid emission factor provided by the European Commission for the country of origin available?

- Use the default grid emission factor as published by the European Commission. These values are based on a 5-year average of International Energy Agency (IEA) data and are accessible via the CBAM Transitional Registry.



Embedded Emissions in Precursors

For embedded emissions in imported steel raw materials, Rick faced significant challenges as mentioned in Step 3.

Given this situation, Rick decided to use **default values** published by the European Commission ([Default values transitional period.pdf](#)) for embedded emissions in precursors during the transitional period (until 30 June 2024).

The formula for calculating embedded emissions with default values is as follows:

$$\text{Embedded Emissions (tCO}_2\text{e)} = \text{Quantity of Precursor (t)} \times \text{Default Emission Factor (tCO}_2\text{e/t)}$$

Default values are available as a temporary option when actual data from suppliers is unavailable. However, from 2025 onwards, stricter limitations will apply to the use of default values. Importers will need to demonstrate reasonable efforts to obtain verified emissions data from suppliers, as reliance on default values may lead to higher declared emissions and additional compliance costs.

Therefore, Rick and the supply chain team had to intensify their engagement with Company Bull to encourage emissions data tracking and sharing.

Step 5: Attributing Emissions to Production Processes and Products - Joint Efforts Required

In this step, the focus was to attribute emissions to **specific production processes** and then allocating those emissions to the three products (Product A, Product B, and Product C) based on Company Alpha's operational setup. As a downstream manufacturing SME, Company Alpha procures steel raw materials and performs final processing steps such as reheating, remelting, casting, forging, coating, and cutting. This operational context introduces specific challenges in emissions allocation, especially for shared processes like reheating and remelting.

Collaborations: Seeking Support from Departments

To address the complexities of emissions allocation, Rick engaged key departments, drawing on their expertise to ensure the allocation aligned with the engineering and business realities of the facility.

1. Engineering Team:

- Provided detailed insights into energy consumption and emissions sources for each processing step, such as reheating, remelting, and coating.
- Highlighted the shared equipment used for multiple products, which created challenges for emissions allocation.

2. Supply Chain Team:

- Supplied data on material flows and production volumes for the three products, ensuring emissions could be allocated proportionally based on the mass of each product if necessary.

3. Production Planning Team:

- Contributed scheduling information to identify overlaps in processing steps and assess resource utilisation across the production lines.

Attributing Emissions to Production Processes and Products

Emissions were first attributed to the processing steps performed by Company Alpha, which include:

1. **Reheating and Remelting:** Energy-intensive processes applied to all three products (shared equipment).
2. **Casting and Forging:** Processes where emissions depend on the specific product and its production requirements.
3. **Coating and Cutting:** Processes where emissions are more directly tied to individual product lines.

Direct Emissions:

Direct emissions from fuel combustion in reheating and remelting were identified as a **pain point** due to the shared nature of these processes across all products. After discussions with the engineering team, a **temporary approach** was adopted to allocate these emissions based on the **masses of the three products**, as this provided a straightforward and transparent method in the absence of more granular data. This approach aligns with CBAM's transitional guidance, which allows for practical allocation methods when precise measurements are not feasible.

Indirect Emissions:

Indirect emissions from electricity consumption were allocated based on **metered data**. Company Alpha had already installed electricity meters on most processing equipment, enabling engineering to allocate electricity uses across the processes for each product. While this method was accurate, it was **complicated and time-intensive**, highlighting the need to improve energy data collection in the future for a more streamlined calculation process.

Embedded Emissions in Precursors:

The allocation of emissions embedded in the steel precursor was relatively simple: emissions were allocated based on the **mass of steel used** for each product. This method was straightforward and aligned with CBAM's expectations for embedded emissions reporting.

By leveraging departmental collaboration and adopting practical allocation methods, Rick and the team successfully attributed emissions to production processes and allocated them to Products A, B, and C. While temporary solutions, such as mass-based allocation for shared processes, were necessary, the process highlighted opportunities for energy management improvement, particularly in energy data collection. These steps ensured compliance with CBAM requirements and set the stage for more streamlined emissions reporting in the future.

Alpha Company's Carbon Management Process Flow (Steps 2 – 5)

Inputs

- Semi-finished steel/steel products (**embedded emissions**)
- Natural gas
- Purchased electricity
- Auxiliary materials, coating materials



Production and Processing Stages

- Heating furnace (fuel combustion → **direct emissions**)
- Casting / forging (electricity consumption → **indirect emissions**)
- Coating and cutting (electricity consumption → **indirect emissions**)
- Power systems (electricity consumption → **indirect emissions**)



Outputs

- Products A, B, C
- Embedded emissions from raw materials contained in finished products

Step 6: Quantifying All Emissions

In this step, Rick compiled and calculated the total emissions allocated to each product based on the allocation of direct emissions, indirect emissions, and embedded emissions in precursors. This follows the allocation methodology established in Step 5, where emissions were attributed to production processes and then allocated to each product based on factors such as mass, energy use, and precursor inputs.

The calculation below is an example of the emissions allocated specifically to Product C.

Direct Emissions from Fuel Combustion:

- *Input Data:*
 - *Fuel type: Natural gas.*
 - *Fuel consumption: **150,000 m³** (allocated to Product C based on the **masses of the three products**)*
 - *Conversion factor (NCV): **0.03517 TJ/1,000 m³** (based on IPCC 2006 GI).*
 - *Emission factor: **56.1 tCO₂/TJ** (per CBAM standards)*
- *Calculation:*
 - *Emissions = $150,000 \times 0.03517 \times 56.1 = 295.96 \text{ tCO}_2\text{e}$*

Indirect Emissions from Electricity Consumption

- *Input Data:*
 - *Electricity consumption: **500,000 kWh (500 MWh)** (allocated to Product C based on metered data and calculation)*
 - *Grid emission factor: **0.35 tCO₂/MWh**.*
- *Calculation:*
 - *Emissions = $500 \times 0.35 = 175 \text{ tCO}_2\text{e}$*

Embedded Emissions in Precursors

- *Input Data:*
 - *Quantity of steel raw materials: **1,000 t** (allocated to Product C based on inventory records)*

- *Default emission factor for steel: 2.21 tCO₂/t (per Default Values for the Transitional Period of the CBAM).*
- *Calculation:*
 - *Emissions = 1,000 × 2.21 = 2,210 tCO₂*

Total Emissions

Rick consolidated all emissions to determine the company's total CBAM-relevant emissions:

<i>Emission Source</i>	<i>Data</i>	<i>Emission Factor</i>	<i>Result (tCO₂e)</i>
Direct Emissions	150,000 m ³ natural gas	56.1 tCO ₂ /TJ	295.96
Indirect Emissions	500 MWh electricity	0.35 tCO ₂ /MWh	175.00
Embedded Emissions	1,000 t steel raw materials	2.21 tCO ₂ /t	2,210.00
Total Emissions	965 t Product C		2680.96
Per unit emissions			2.78

Step 7: Negotiation Between Company Alpha and Company Bull

With the emissions calculations complete, Rick and the supply chain team turned their focus to addressing the embedded emissions in precursors. However, they faced additional challenges due to the relative sizes and market dynamics of Company Alpha and Company Bull.

Challenges Discussed

1. Relative Size and Influence:

Company Alpha is a medium-sized player that is successful in its specific area but represents only a small fraction of Company Bull's customer base. As a result, Company Bull is less incentivised to prioritise the requests of a single customer like Company Alpha, considering it has many other larger customers.

2. Company Bull's Perception of CBAM Implications:

Company Bull has never sold products directly to the EU and initially assumed that CBAM compliance did not affect them.

Negotiation Strategy

1. Illustrating CBAM Implications:

Rick emphasised that CBAM compliance will likely become a recurring issue for Company Bull as more customers, like Company Alpha, seek verified data to meet their own obligations. On the other hand, their

products might have been sold to the EU via traders, and under the CBAM regime, EU importers will need to obtain verified emissions data from Company Bull through those traders. The implications for Company Bull are, therefore, not as indirect as they initially thought.

The cost implications were also highlighted. If Company Bull does not provide verified data, their customers or the final importers will resort to default values, which are often much higher than actual emissions, potentially making the products in the value chain less competitive in the EU market.

2. **Proposing Third-Party Verification:**

To address Company Bull's confidentiality concerns, Rick suggested that Company Bull could engage an **accredited third-party verifier** to calculate and verify emissions data. This would ensure that Company Bull does not need to share sensitive production details with Company Alpha or other customers. Verified per unit emissions data would be sufficient for Company Alpha and the EU importers under CBAM regulations, as long as it complies with the verification standards set out in the CBAM regulations.

3. **Setting a Collaborative Timeline:**

Rick proposed that Company Bull begin collecting emissions data for the year 2023 by Q1 2024. Such data would then be **verified by an accredited verifier during Q2 2024**, allowing Company Alpha to transition from default values to actual data before the CBAM "definitive period" begins in 2026. This phased approach would provide both parties with sufficient time to align their compliance efforts and address data gaps.

Outcome of the Negotiation

After several discussions, Company Bull agreed to:

- Begin collecting emissions data for 2023 by the end of 2023.
- Engage a third-party verifier to verify the data during Q2 2024, ensuring compliance with CBAM verification requirements.

This agreement ensures that Company Alpha will have access to accurate emissions data before the transition from the CBAM transitional period to the definitive period. It also positions Company Bull to address similar requests from other customers and traders, aligning themselves with the emerging demands of the CBAM regime.

More details about the actions taken by Company Bull will be addressed in Case Study 2.

Step 8: Reporting and Verification - Facilitating Customer Communication while Mitigating Risks

In this step, Rick and the supply chain team focus on two critical aspects of its carbon management system: **reporting** and **verification**. These steps ensure compliance with CBAM requirements and facilitate communication with EU customers while maintaining confidentiality of sensitive information. The company should adopt a strategic approach to consolidate, format, and share emissions data effectively and prepare for verification to enhance credibility and streamline reporting.

Reporting: Consolidating and Communicating Emissions Data

The primary objective for Company Alpha is to consolidate the emissions data collected and calculated in earlier steps and prepare it for communication with all EU customers (importers). This involves aligning with the EU's CBAM requirements, particularly the use of the **CBAM Communication Template**, while safeguarding potential confidentiality concerns.

a. Strategic Use of the CBAM Communication Template

The European Commission provides a **voluntary communication template** (in Excel format) to facilitate the exchange of emissions data between operators (such as Company Alpha) and reporting declarants (EU importers). While its use is optional, following this standardised format offers several advantages:

- Ensures that all necessary emissions data, including embedded emissions and production process details, are presented clearly.
- Simplifies communication, especially when dealing with multiple EU customers or trading partners, as the same format can be used consistently across all interactions.

Rick took the key steps as follows:

1. **Populate the Template:** Consolidate emissions data (e.g., per unit emissions for Products A, B, and C) and input it into the relevant fields of the template. Ensure consistency with the methodologies used in earlier calculations.
2. **Use the Summary Tab:** Fill out the '**Summary_Communication**' worksheet, which contains the minimum information required by EU importers. This will help limit the disclosure of unnecessary details.

3. **Train Internal Teams:** Provide internal training to ensure the supply chain team members understand how to use the template effectively and address customer queries.

b. Internal Data Consolidation Process

Rick did the following to streamline reporting:

1. **Centralise Data:** Established a centralised database (at early stage a well-designed workbook at intranet) to store calculated emissions data for Products A, B, and C, categorised by direct, indirect, and embedded emissions.
2. **Streamline Updates:** Implemented a process to update emissions figures regularly to reflect any changes in production or energy use.
3. **Coordinate with EU Customers:** Worked with the supply chain team and proactively reached out to EU customers to determine their specific data needs and ensure timely submission of the required information.

c. Balancing Transparency and Confidentiality

While the communication template encourages transparency, Company Alpha should adopt measures to protect sensitive business information:

- **Provide Only Essential Data:** Share only the summary details required for CBAM reporting, avoiding disclosure of proprietary production data unless necessary.
- **Optional Summary Approach:** Operators can choose to share high-level, aggregated data rather than detailed emissions calculations to safeguard sensitive process details.
- **Confidentiality Mechanisms:** Explore the CBAM Transitional Registry portal (available from 2025), which allows for secure data sharing with multiple reporting declarants while ensuring confidentiality of sensitive emissions data.

Verification: Preparing for Verification of Emissions Data

Verification of emissions data is a critical step for building credibility with EU customers and ensuring CBAM compliance. While verification by accredited third parties is not mandatory during the transitional period, preparing for it early offers strategic advantages, such as reducing reliance on default values, reducing the confidential information to disclose and enhancing the trustworthiness of reported data.

a. Preparing for Verification

From Company Alpha's perspective, the preparation process involved ensuring that all emissions data is accurate, complete, and ready for review by an independent verifier:

1. Organised Supporting Documentation:

- Ensured all emissions calculations, data sources, and assumptions are well-documented and traceable.
- Maintained detailed records of energy consumption (direct and indirect), production volumes, and precursor inputs, as these will be reviewed during the verification process.

2. Engaged an Accredited Verifier:

- Identified and contracted an accredited verifier who complies with EU standards, such as those under Regulation (EU) 2018/2067.
- Early engagement with a verifier allowed time to resolve any discrepancies or gaps in the data and might lower the overall costs for the verification exercise (verification service fees and internal resources used for the verification).

3. Simulated the Verification Process:

- Conducted an internal audit or dry-run verification by replicating the steps a verifier would take to assess the data.
- Addressed any errors or inconsistencies identified during this internal review.

4. Focused on the Key Scope of Verification:

- The verifier would assess the accuracy of the emissions data, including direct, indirect, and embedded emissions, and ensure compliance with CBAM methodologies.
- Ensured alignment with the CBAM Implementing Regulation, particularly in terms of monitoring methods and reporting formats.

b. Verification Timeline

Company Alpha aimed to have the emissions data for 2023 verified by **Q1 2024**. This timeline allowed sufficient time to address any issues and update CBAM reports with verified data before the correction deadline of **31 July 2024**.

Step 9: Driving Emissions Reductions Through Collaboration

The “sustainable” step in Company Alpha’s carbon management journey focuses on leveraging **collaboration** to achieve long-term emissions reductions across its operations and supply chain. By engaging with external stakeholders and internal teams, aligning with global standards, and participating in international initiatives, Company Alpha can not only reduce its carbon emissions but also support its customers' and suppliers' efforts to align with the EU’s CBAM requirements and other climate policies.

1. Collaborating with Suppliers to Reduce Embedded Emissions

One of the largest contributors to Company Alpha’s emissions is the **embedded emissions in steel raw materials**, which is procured as a key input for its downstream manufacturing processes. To address this, Company Alpha worked closely with Company Bull to promote low-carbon steel production and align on data transparency.

See how Company Alpha and Company Bull worked together in Case Study 2.

2. Internal Collaboration to Drive Energy and Operational Efficiency

Within its operations, Company Alpha fostered collaboration across departments to identify and implement emissions reduction initiatives.

a. Energy Efficiency Projects

- As the fundamental efforts, Rick and the engineering team proposed to management and implemented a project to set up Energy Management System with ISO 50001 certification.
- Specific R&D projects were also planned and implemented to reduce energy consumption in energy-intensive processes such as reheating and remelting.
- Plans were also made to invest in energy-efficient equipment and explore renewable energy sources to reduce indirect emissions from electricity use.

b. Training and Awareness

- Conducted training sessions to ensure that employees across all levels understand the importance of emissions reductions and their role in achieving the company’s sustainability goals.
- Plans were made to establish internal metrics and incentives to encourage teams to identify and implement emissions reduction strategies.

Case Study 2: Company Bull and Mary

Overview

Following the agreement with Company Alpha, Mary, the EHS Manager at Company Bull, was assigned to lead the company's initiative to establish a Carbon Management System (CMS) for CBAM compliance.

As a steel producer, Company Bull's operations involve multiple upstream processes that contribute significantly to embedded emissions.

Step 1: Identifying Goods Subject to CBAM

Mary initiated the CBAM compliance project by identifying the company's products subject to CBAM. This foundational step ensured clarity on which goods required emissions monitoring and reporting under CBAM regulations.

Understanding CBAM Scope and Product Classification

Mary reviewed the CBAM Annex I list shared by Rick, which outlines the goods covered under CBAM regulations. As a producer that primarily manufactures **steel**, Company Bull's products were confirmed to fall within the scope of CBAM.

Collaboration with the Supply Chain Team

Mary worked closely with the supply chain team to cross-reference the company's product portfolio with CBAM's Annex I list. The steel products were identified as relevant:

1. Industrial Steel Bar - Spec A
2. Industrial Steel Bar - Spec B
3. Industrial Steel Bar - Spec C

These products, while differing in shape and application, share similar production routes, system boundaries and **the same CN Code**. Mary believed that this would simplify emissions monitoring and reporting under CBAM.

Ensuring Alignment with CBAM Characteristics

Mary also confirmed that Company Bull's steel production aligns with the primary CBAM characteristics, including:

- **Production Route:** The company exclusively uses the integrated **Blast Furnace-Basic Oxygen Furnace (BF-BOF)** route for producing steel. This route involves the transformation of raw materials like sintered iron ore and coke into pig iron, which is then converted into steel in the BOF.

- **System Boundaries:** Emissions from all processes, including raw material preparation, blast furnace operations, and BOF steelmaking, would need to be accounted for.

Call-Out Box: One Aggregated Goods Category or Three?

Mary discussed this concern with Rick and was of the opinion as follows:

Though the products are produced and sold in different specifications, they share the same production route within the installation, i.e., the production processes and system boundaries are consistent across the different forms of steel produced, as well as the same CN Code. Therefore, for CBAM compliance purpose, they should be considered one aggregated goods category for reporting.

By confirming these characteristics, Mary ensured that the CMS would be designed to meet CBAM's requirements for emissions monitoring and reporting.

Establishing Compatibility with Market Requirements

Mary recognised the importance of aligning CBAM compliance efforts with the expectations of EU importers and downstream customers like Company Alpha. Since Company Alpha relies on accurate emissions data from suppliers, Mary ensured that emissions data for the various forms of steel would be prepared in a format compatible with the CBAM Communication Template. This streamlined approach would facilitate reporting and strengthen Company Bull's position as a reliable supplier in the EU market.

Step 2: Establishing System Boundaries – Mapping Key Production Processes

After identifying CBAM-covered products, Mary moved on to establishing the system boundaries for Company Bull's production processes. This step was critical to ensure that all direct and indirect emissions associated with the manufacturing of the steel products were accurately captured and accounted for under CBAM regulations.

Defining the Scope of System Boundaries

Mary worked with the Production team to map out the production processes for steel. The system boundaries were carefully defined to include all key stages of steel production, from raw material preparation to the point where steel takes

its semi-finished forms. This comprehensive approach ensured that all emission sources, including those from auxiliary processes, were captured.

The key stages included in the system boundaries were:

1. Sinter Plant Operations:

- At the sinter plant, iron ore fines, coke, and fluxes like limestone are agglomerated into sinter, which serves as a raw material for the blast furnace. Emissions from this stage primarily include those from combustion and chemical reactions.

2. Blast Furnace Operations:

- In the blast furnace, sinter and coke are used to produce pig iron. During this process, iron oxides are reduced to iron metal, and significant amounts of blast furnace gas are generated. These gases are utilised to produce electricity for internal use, but the emissions associated with their combustion are included in the system boundaries as the electricity supports CBAM product manufacturing.

3. Basic Oxygen Furnace (BOF) Steelmaking:

- Pig iron from the blast furnace is converted into steel in the BOF. Scrap steel is also added during this process, and BOF gas is generated as a by-product. Emissions from both the reduction reactions and gas utilisation are accounted for in this stage.

4. Continuous Casting:

- The molten steel is cast into semi-finished forms. Emissions from auxiliary energy use, such as reheating during casting, were also included in the system boundaries.

Accounting for Electricity Usage and Waste Gas Utilisation

Mary ensured that the system boundaries captured both grid electricity and electricity generated from waste gases, as both energy sources are crucial for manufacturing CBAM-covered products:

- **Electricity from Waste Gases:** Blast furnace gas and BOF gas are combusted to generate electricity for internal use. While this reduces reliance on external grid electricity, the emissions from combusting these gases are included in the system boundaries because the electricity directly supports the production of the steel products.

- **Grid Electricity:** Any additional electricity purchased from the grid was also included in the system boundaries, with emissions calculated based on the IEA emission factor.

Ensuring Comprehensive Inclusion of Emissions

By defining the system boundaries to include all processes from raw material preparation to the casting of steel into its semi-finished forms, Mary ensured that both direct emissions (e.g., from fuel combustion and chemical reactions) and indirect emissions (e.g., from electricity usage) were comprehensively accounted for. This approach was aligned with CBAM's requirements, which mandate the inclusion of all emissions linked to the production of CBAM-covered goods.

Alignment with Downstream Processing Needs

In defining the system boundaries, Mary also considered the downstream processing steps typically performed by customers such as Company Alpha, which involve reheating, remelting, casting, forging, coating, and cutting. By ensuring that the emissions from Company Bull's upstream processes were accurately tracked and attributed to the semi-finished steel products, Mary provided a reliable foundation for downstream manufacturers to meet their own CBAM obligations.

Step 3: Identifying Emission Sources – A Comprehensive Breakdown

After successfully mapping the system boundaries, Mary progressed to identifying all emission sources within the defined boundaries for Company Bull's operations. This step was critical to ensure that all direct and indirect emissions associated with the production of steel in its semi-finished forms were accurately accounted for, as required under CBAM regulations.

Direct Emissions from Production Processes

Mary focused on quantifying **direct emissions** from the primary production processes, which arise from both fuel combustion and chemical reactions. The key sources of direct emissions were as follows:

1. Sinter Plant:

- Emissions from the sintering process stem from the combustion of coke and other fuels used to agglomerate iron ore fines into sinter. The chemical reactions during sintering also release CO₂.

2. Blast Furnace:

- The blast furnace is one of the most significant sources of CO₂ emissions. During this stage, coke is used as a reducing agent to convert iron ore into pig iron. The reduction reactions release CO₂, and a by-product, **blast furnace gas**, is generated, which contains carbon monoxide (CO) and CO₂. While the gas is utilised for electricity generation, its combustion emissions are included in the system boundaries.

3. Basic Oxygen Furnace (BOF):

- In the BOF, pig iron is converted into steel. The process involves blowing oxygen through the molten iron, which oxidises impurities like carbon, producing CO₂. Additionally, **BOF gas**, a by-product of this process, is captured and combusted, contributing to direct emissions.

4. Continuous Casting:

- Although this stage primarily involves shaping steel, auxiliary processes, such as reheating during casting, also contribute to direct emissions. These emissions are typically associated with fuel combustion in reheating furnaces.

Indirect Emissions from Electricity Usage

Mary also identified **indirect emissions** arising from the electricity used in the production processes. These emissions were categorised based on the electricity source:

1. Electricity from Blast Furnace and BOF Gas Utilisation:

- Blast furnace and BOF gases are combusted onsite to generate electricity, which is used in the production of steel. However, the emissions resulting from the combustion of these waste gases are already accounted for as direct emissions under CBAM rules. Consequently, the indirect emissions from using this electricity are considered nil to avoid double-counting.

2. Grid Electricity:

- Any additional electricity purchased from the grid is considered an indirect emission source. To quantify these emissions, Mary used grid emission factors provided by the European Commission, ensuring alignment with CBAM reporting requirements.

Call-Out Box: Innovation in Energy Efficiency and Decarbonisation

In 2022, Mary proposed and led the Electricity from Blast Furnace and BOF Gas Utilisation project as part of Company Bull's broader efforts toward energy savings and decarbonisation. By efficiently capturing and utilising waste gases from the blast furnace and BOF processes to generate electricity, the project significantly reduced the company's reliance on grid electricity. This initiative not only supported the company's sustainability goals but also aligned with its commitment to reducing carbon intensity in steel production. Mary's leadership in this project demonstrated a forward-thinking approach to resource efficiency and contributed to the company's readiness for carbon pricing systems like CBAM.

Comprehensive Approach to Emissions Attribution

To ensure compliance with CBAM regulations, Mary adopted a comprehensive approach to emissions attribution:

1. Raw Materials and Energy Inputs:

- All material and energy flows were analysed to determine their impact on emissions. For example, coke and limestone used in the blast furnace and sinter plant were identified as significant contributors to direct emissions. Additionally, electricity consumed across all stages—whether from internal generation or the grid—was traced and attributed to the respective processes.

2. By-Products and Waste Gas Utilisation:

- Emissions from the utilisation of by-products, such as blast furnace gas and BOF gas, were carefully tracked. Although these gases are beneficially reused to generate electricity, their combustion emissions were factored into the overall emissions inventory to avoid underreporting.

3. Product-Level Emission Allocation:

- To support CBAM compliance, Mary ensured that emissions from each process were attributed proportionally to the production of the steel products. This allocation was essential for calculating the specific embedded emissions of each product and preparing for downstream reporting requirements.

Alignment with CBAM Monitoring, Reporting, and Verification (MRV) Requirements

Mary's efforts to comprehensively identify emissions sources were guided by CBAM's detailed Monitoring, Reporting, and Verification (MRV) framework. The MRV system requires operators such as Company Bull to:

- Monitor and report **direct emissions** (e.g., from fuel combustion and chemical reactions) and **indirect emissions** (e.g., from electricity usage) with transparency and accuracy.
- Attribute emissions to individual products based on their share of total production.
- Ensure that all emissions data is prepared in alignment with the templates and methodologies provided by the European Commission.

By adhering to these MRV requirements, Mary ensured that all relevant emissions sources were captured, verified, and prepared for reporting.

Step 4: Selecting Quantification Method

The **carbon content method** is particularly suitable for the steelmaking sector due to the inherent characteristics of its production processes and the nature of its outputs. Steelmaking, such as through the Blast Furnace-Basic Oxygen Furnace (BF-BOF) route, involves significant carbon inflows and outflows, with carbon embedded in both the final steel products and by-products. The mass balance approach, which is central to the carbon content method, directly aligns with these characteristics by tracking carbon inflows from materials like coke and limestone and attributing emissions based on the carbon content of outputs. This ensures precise and transparent emissions reporting, which is crucial for compliance with CBAM requirements.

On the other hand, precursors (such as pig iron) are wholly used in producing final CBAM goods at Company Bull. That said, all carbon inflows are directly tied to the production of CBAM-covered goods. This further facilitates the application of the carbon content method with the "bubble approach" under CBAM adopted.

By combining the suitability of the carbon content method for steelmaking processes with the operational simplifications enabled by the "bubble approach", the sector achieves both accuracy and efficiency in emissions accounting and reporting.

Numerical Example to Showcase the Quantification Process under the Mass Balance Method

1. Inputs – Carbon Inflow:

- **Coke:** 700 tonnes (carbon content: 85%, based on laboratory analysis data provided by the supplier)
 - $\text{Carbon from coke} = 700 \text{ t} \times 0.85 = 595 \text{ tC}$
- **Limestone:** 480 tonnes (carbon content: 12%, based on 2006 IPCC Guidelines)
 - $\text{Carbon from limestone} = 480 \text{ t} \times 0.12 = 57.6 \text{ tC}$
- **Other Fuels (e.g., natural gas):** 188.5 tonnes (carbon content: 75%, based on supplier specifications)
 - $\text{Carbon from other fuels} = 188.5 \text{ t} \times 0.75 = 141.37 \text{ tC}$
- **Total Carbon Inflow** = $595 + 57.6 + 141.37 = 793.97 \text{ tC}$

2. Outputs – Carbon Outflow:

- **Steel:** 1,500 tonnes (carbon content: 1.5%, determined through in-house laboratory testing)
 - $\text{Carbon in steel} = 1,500 \text{ t} \times 0.015 = 22.5 \text{ tC}$
- **Slag:** 280 tonnes (carbon content: 5%, determined through in-house laboratory testing)
 - $\text{Carbon in slag} = 280 \text{ t} \times 0.05 = 14 \text{ tC}$
- **Total Carbon Outflow** = $22.5 + 14 = 36.5 \text{ tC}$

3. Carbon Converted to CO₂:

- The difference between carbon inflow and carbon outflow is converted into CO₂ emissions:
 - $\text{Carbon to CO}_2 =$
 $\text{Total Carbon Inflow} - \text{Total Carbon Outflow} =$
 $793.97 \text{ tC} - 36.5 \text{ tC} = 757.47 \text{ tC}$

4. Conversion to CO₂ Equivalent:

- Carbon is converted to CO₂ equivalent using the molecular weight ratio of CO₂ to C (3.664):
 - $\text{CO}_2 \text{ Emissions} = 757.47 \text{ tC} \times 3.664 = 2,775.4 \text{ tCO}_2$

By ensuring the accuracy and reliability of carbon content data, operators such as Company Bull can provide transparent and consistent emissions reporting, fully aligned with CBAM requirements.

Call-Out Box: How Carbon Content Data is Typically Obtained

The carbon content of input and output materials is a critical parameter in the mass balance method. Typically, this data is obtained through the following sources:

1. *Laboratory Testing and Sampling:*

For materials like coke, crude steel, and slag, carbon content is determined through in-house laboratory analysis or third-party testing. This involves sampling and using standardised testing methods, such as combustion analysis.

2. *Supplier Specifications:*

Fuel suppliers (e.g., natural gas providers) often supply data on the carbon content of their products. This information is verified periodically through sampling and testing to ensure accuracy.

3. *Default or Standard Values:*

Default factors from CBAM regulations and/or IPCC may be useful when operators may not have precise data for all materials.

Step 5: Attributing Emissions to Products and Consolidating Total Emissions

Attributing emissions to products and consolidating total emissions is a critical step in ensuring compliance with CBAM reporting requirements. This involves calculating **Specific Embedded Emissions (SEE)** for CBAM goods on a per tonne basis, encompassing both **direct emissions** and **indirect emissions**. For the iron and steel sector, where multiple products may fall under a single **aggregated goods category**, CBAM allows for the use of one set of SEE for reporting purposes, simplifying the process.

Key Considerations

1. Aggregated Goods Category:

CBAM goods in the iron and steel sector could be grouped into **aggregated goods categories** based on their characteristics and practically the CN codes.

2. Direct and Indirect Emissions:

- **Direct emissions** are allocated to products based on the total CO₂ emissions from the production process, as calculated in Step 4.
- **Indirect emissions** from electricity consumption are calculated separately and attributed to products by considering electricity usage and emission factors.
- **Indirect emissions** from purchased precursors are not relevant for Company Bull. (*please refer to Case Study 1 for details of managing purchased precursors related emissions*)

3. Production Unit Basis:

Emissions should be expressed as tonnes of CO₂ equivalent (tCO₂e) per tonne of product, ensuring alignment with CBAM requirements.

Quantifying SEE for Direct Emissions

Using the emissions calculated in Step 4, the SEE for direct emissions can be attributed as follows:

1. Total Direct Emissions:

From Step 4, the total direct CO₂ emissions for the reporting period were calculated as **2,775.4 tCO₂**.

2. Total Production Output:

The total production output was **1,500 tonnes of steel**

3. SEE for Direct Emissions:

$$\begin{aligned} SEE \text{ (Direct)} &= \text{Total Direct Emissions} / \text{Total Production Output} \\ &= 2,775.4 \text{ tCO}_2 / 1,500 \text{ t} = 1.85 \text{ tCO}_2\text{e/tonne}. \end{aligned}$$

Quantifying SEE for Indirect Emissions

Indirect emissions from electricity consumption are calculated separately and reported distinctly during the CBAM transitional period. The calculation is as follows:

1. Electricity Consumption:

Owing to the high-efficiency waste gas power generation project, only 187.5 MWh of electricity was purchased from the grid during the reporting period.

2. Emission Factor for Electricity:

Using the country-specific emission factor for the electricity grid, let's assume the factor is **0.4 tCO₂/MWh** (as per IEA data).

3. Total Indirect Emissions:

$$\text{Total Indirect Emissions} = 187.5 \text{ MWh} \times 0.4 \text{ tCO}_2 / \text{MWh} = 75 \text{ tCO}_2$$

4. SEE for Indirect Emissions:

Indirect emissions are then attributed to products on a per tonne basis:

$$\begin{aligned} \text{SEE (Indirect)} &= \text{Total Indirect Emissions} / \text{Total Production Output} \\ &= 75 \text{ tCO}_2 / 1,500 \text{ t} = 0.05 \text{ tCO}_2\text{e/tonne} \end{aligned}$$

Consolidating Total Emissions for SEE

The final SEE, combining both direct and indirect emissions, is calculated as follows:

$$\begin{aligned} \text{SEE (Total)} &= \text{SEE (Direct)} + \text{SEE (Indirect)} \\ &= 1.85 \text{ tCO}_2\text{e/tonne} + 0.05 \text{ tCO}_2\text{e/tonne} = 1.9 \text{ tCO}_2\text{e/tonne}. \end{aligned}$$

This consolidated SEE value represents the **total embedded emissions** per tonne of steel for CBAM reporting purposes.

Bull Company Steel Production Mass Balance Flow (Steps 2 – 5)

Inputs

- Iron ore fines, coke, limestone
- Other fuels (natural gas, etc.)
- Electricity (grid + waste gas power generation)

Carbon inflow measurement

Sintering

- Iron ore fines + coke agglomeration
- Combustion + reaction emissions

Direct emissions included

Blasts Furnace

- Sinter + coke → hot metal (pig iron)
- By-product: blast furnace gas (power generation)

Direct emissions included
(reduction reaction + gas combustion)

BOF Steelmaking

- Hot metal + scrap → molten steel
- By-product: BOF gas (power generation)

Direct emissions included
(oxygen blowing reaction + gas combustion)

Continuous Casting

- Molten steel → slabs / blooms / billets
- Reheating emissions

Carbon outflow measurement
(products + by products)

MASS BALANCE RESULTS
(TOTAL DIRECT EMISSIONS)

Step 6: Verification and Sharing of Information – Ensuring Transparency and Compliance

With the **Specific Embedded Emissions (SEE)** data for CBAM-covered goods ready, Mary moved on to data verification and information sharing with the customers including Company Alpha.

Verification of Emissions Data

1. Internal Validation

Before the verifier conducted the verification, Mary worked with her colleagues to review the data, ensuring accuracy and consistency in alignment with CBAM methodologies. This includes:

- Cross-checking the mass balance method calculations for direct emissions and verifying electricity emission factors for indirect emissions.
- Ensuring the accuracy of supporting data, such as material carbon content, production volumes, and electricity consumption.

2. Third-Party Verification

All SEE data should be verified by an accredited third-party verifier to ensure reliability and compliance with CBAM regulations.

Mary considered the key aspects as follows:

- **Accreditation:** Verifiers should be a body accredited by National Accreditation Bodies in EU Member States or equivalent bodies according to CBAM regulations.
- **Verification Scope:** The verifier assesses:
 - The methodologies used for SEE calculations.
 - The accuracy of input data, including carbon content, electricity usage, and emission factors.
 - Alignment with CBAM guidelines, such as no data inconsistencies or no double-counting of emissions.
- **Verification Statement:** The verifier provides a statement confirming the validity of the SEE values, which is essential for subsequent sharing with customers or through the EU registry.

Sharing Verified Information for CBAM Compliance

Company Bull has the following options to share verified emissions data with their customers:

- Using the **CBAM communication template** provided by the European Commission
- Sharing via the **EU CBAM Registry** (not available at the time when Mary made the decision)
- Other communication method as agreed with the customers / importers.

Mary engaged in discussions with multiple key customers regarding their minimum data requirements for emissions reporting. Each customer expressed **varying requirements** depending on not just CBAM-related obligations (for the customers or the final importers) but also the customers' internal reporting needs. Some customers requested detailed emissions data which were not necessary for CBAM purpose.

Recognising the challenge of meeting these diverse requirements, Mary consulted with the management team to identify a streamlined approach. Together, they decided to use the **summary tab of the CBAM communication template** for data sharing. This summary provided a balance between meeting customer needs and ensuring efficient compliance while protecting sensitive business data.

For more details about the communication template, please refer to details in Chapter 7.

Step 7: Driving Emissions Reductions – Strengthening Competitiveness

Having completed the carbon emissions quantification, verification, and data-sharing exercise, Mary had a critical realisation: **Company Bull had been lagging behind its international peers in decarbonisation efforts**. This discovery highlighted major challenges and risks for the company, reinforcing the urgent need to prioritise emissions reductions to safeguard its competitiveness and long-term viability in the market.

Mary's Key Findings and Implications

1. Higher Carbon Prices for Customers and Downstream Companies

Through the analysis, Mary identified that Company Bull's **Specific Embedded Emissions (SEE)** for its products were not lower than those of international competitors. This resulted in **higher carbon costs** under the CBAM framework, which directly impacted the company's customers and downstream companies.

- For CBAM-covered goods, customers importing Company Bull's products into the EU would need to pay a higher carbon price due

to the elevated SEE values. This increased cost burden could make Company Bull's products less attractive compared to lower-emission alternatives from competitors.

- The ripple effect extended to downstream companies relying on Company Bull's materials, as they faced higher production costs, potentially reducing their competitiveness in the market.

2. Impact on Profitability and Market Share

Mary also noted that the company's lag in decarbonisation posed a serious risk to its future profitability and market share.

- With carbon prices rising under CBAM, customers and downstream companies may shift to sourcing materials from international suppliers with lower embedded emissions and carbon costs.
- The gap between Company Bull's decarbonisation progress and that of its peers could erode its competitive position in global markets, particularly as sustainability and emissions reduction play an increasingly central role in procurement decisions.

3. Strategic Imperative to Decarbonise

Mary concluded that decarbonisation was no longer optional for Company Bull—it was a **strategic necessity**. Without a robust plan to reduce emissions, the company risked falling further behind, both financially and reputationally. This realisation aligned with the broader objectives of CBAM, which seeks to encourage emissions reductions across industries while avoiding carbon leakage and ensuring a level playing field.

Path Forward: Decarbonisation as a Competitive Advantage

To address these challenges, Mary proposed a clear set of actions to the management team to accelerate Company Bull's decarbonisation journey:

1. Invest in Low-Carbon Technologies

- Leverage renewable energy sources, aligning with global trends in clean energy transition.
- Adopt innovative, low-emission production technologies, such as hydrogen-based steelmaking, to significantly reduce direct emissions from industrial processes.

2. Collaborate Across the Value Chain

- Partner with suppliers and customers to drive emissions reductions across the entire supply chain. This could include sourcing low-carbon raw materials and supporting downstream companies in meeting their emissions targets.
- Engage with industry groups and policymakers to develop sector-wide decarbonisation initiatives and leverage available funding or incentives for green innovation.

3. Monitor and Benchmark Progress

- Leverage the monitoring and reporting system build for CBAM purpose and refine it to track emissions reductions and benchmark progress against international peers. Continuous evaluation will help identify areas for improvement and ensure alignment with CBAM's evolving requirements.

4. Communicate Sustainability Efforts

- Transparently communicate the company's decarbonisation strategy and progress to customers and stakeholders. This will not only enhance trust but also position Company Bull as a forward-thinking, sustainable supplier in the global market.

Chapter 5: Building a Carbon Management System for CBAM Compliance in the Aluminium Sector

For SMEs in the aluminium sector, the introduction of the CBAM introduces significant challenges, particularly for businesses that have not yet integrated carbon management into their operations. The aluminium sector faces unique complexities, such as managing sector-specific emissions like perfluorocarbon (PFC) emissions, attributing emissions to various products, and navigating additional reporting obligations. For many SMEs, understanding and implementing these requirements can be a challenging task.

This chapter is dedicated to the technical aspects of carbon management tailored specifically for CBAM compliance in the aluminium sector. It offers a practical, step-by-step guide to developing a Carbon Management System (CMS) that enables companies to measure, monitor, and manage their emissions effectively. While this chapter focuses on the technical and operational aspects, formal compliance procedures, such as CBAM reporting obligations and data communication, will be addressed in Chapter 7. The goal here is to provide businesses with the foundational steps they need to manage emissions as a core component of CBAM readiness.

To ensure the content is both actionable and relatable, this chapter introduces a case study based on a real-world scenario in the aluminium sector. The case study demonstrates the full spectrum of carbon management practices, providing detailed guidance for SMEs with diverse operational setups:

- **Company Canton:** This medium-sized aluminium producer operates an integrated facility that includes on-site production of pre-baked carbon anodes, primary aluminium smelting, and downstream forming processes. The case study follows the journey of Mora, the ESG Director at Company Canton, as she establishes a CMS aligned with CBAM requirements. The case study explores how Company Canton monitors emissions from production processes and addresses the allocation of emissions in accordance with CBAM rules.

Through this case study, you will gain a practical understanding of how to set up and implement a CMS tailored to the unique needs of the aluminium sector. The step-by-step approach ensures that even SMEs with limited prior experience in carbon management can effectively adopt the strategies outlined.

This chapter serves as a useful resource for operational managers, sustainability professionals, and business owners in the aluminium industry. It equips them to navigate sector-specific challenges, adopt efficient carbon management practices, and align their operations with the sustainability goals under CBAM and beyond.

Below are the aluminium sector specific rules / requirements, in addition to those introduced in earlier chapters of this guidebook:

- **PFC Emissions:** PFC emissions (CF_4 and C_2F_6 only), which are formed during brief upset conditions known as the ‘Anode Effect’, should be monitored and reported for CBAM purposes. The two calculation methods, i.e., Slope Method and Overvoltage Method, will be further elaborated in the case study.
- **Sector Specific System Boundaries:** Emissions from the production of pre-baked anodes and alumina, even if produced on-site, should be excluded from the system boundary for CBAM purposes (because anodes and alumina are not CBAM goods).
- **Aggregated Goods Category:** A grouping of the CBAM goods, ‘unwrought aluminium’ and ‘aluminium products’, may be monitored and reported as a joint process during the transitional period. And yet, this chapter, including the below case study, addresses only the method to treat each Aggregated Goods Category / production process separately, so as to address the **emission attribution among processes / products**.

Case Study 3: Company Canton and Mora

Overview

Mora, the ESG Director at Company Canton, obtained approval from the company leadership on a project to set up a Carbon Management System (CMS) to meet CBAM requirements. This effort required a strategic approach and supports from multiple departments to manage emissions across direct and indirect emission sources. The case study follows her journey, addressing challenges like identifying emission sources, selecting appropriate methodologies, obtaining emissions data from suppliers, and ensuring compliance with CBAM regulations.

Step 1: Identifying Goods Subject to CBAM

Understanding CBAM-Covered Goods in the Aluminium Sector

Mora reviewed CBAM Annex I, which outlines the goods covered under the regulation. In the aluminium sector, CBAM applies to two aggregated goods categories: **‘unwrought aluminium’** (e.g., primary aluminium ingots) and **‘aluminium products’** (e.g., rolled or extruded products). These categories encompass a wide range of goods with significant carbon footprints, requiring detailed emissions monitoring and reporting.

At Company Canton, Mora identified that the facility produces:

- Primary aluminium ingots through smelting.
- Aluminium products through forming processes, such as rolling and extrusion.

Since both categories are subject to CBAM, Mora ensured that emissions from these production processes would need to be included in the CMS.

Additionally, she noted that emissions from the production of pre-baked carbon anodes, a process conducted on-site, should be excluded as these are not classified as CBAM goods.

Cross-Referencing with Customs Codes

To align with CBAM requirements, Mora collaborated with the supply chain team to cross-reference the company’s product list against the Combined Nomenclature (CN) codes outlined in CBAM Annex I.

Managing Aggregated Goods Categories

During the transitional period, CBAM allows aggregated goods categories such as ‘unwrought aluminium’ and ‘aluminium products’ to be monitored and reported as a joint process. However, considering the “joint method” may not be allowed in the long run, and with an aim to ensure accurate attribution of emissions between these categories, Mora decided to treat each category separately in the CMS.

Step 2: Establishing System Boundaries

With the CBAM-covered goods identified in Step 1, Mora moved on to defining the system boundaries for Company Canton’s CMS. This step was critical to ensure that all relevant emissions sources were included in monitoring while adhering to CBAM’s aluminium sector-specific requirements.

Mora began by mapping the production processes at Company Canton to establish the system boundaries. The boundaries were defined to include emissions directly linked to the production of CBAM goods, while excluding emissions from non-CBAM processes, as specified in CBAM guidelines:

- **Included:**
 - **Direct emissions** from smelting operations (consuming carbon anodes in the electrolytic reduction process).
 - **Direct emissions** from downstream forming processes, such as rolling and extrusion.
 - **Indirect emissions** from electricity consumption used in smelting and forming processes.
 - **PFC emissions** (CF_4 and C_2F_6) generated during smelting due to the 'Anode Effect'.
- **Excluded:**
 - Emissions from the production of **pre-baked carbon anodes**, which, although produced on-site, are not CBAM goods.
 - Emissions embedded in purchased alumina, as alumina is also not classified as a CBAM good.

This approach ensured compliance with CBAM's sector-specific rules while avoiding incorrect reporting of non-CBAM processes. Please note that Mora is of the opinion that emissions from the production of **pre-baked carbon anodes** should duly be monitored for general carbon management purposes.

Step 3: Identifying Emission Sources

With the system boundaries clearly defined in Step 2, Mora moved on to identifying the specific emission sources within those boundaries. This step was crucial to ensure that all relevant emissions linked to CBAM-covered goods would be accurately monitored and reported.

Direct Emissions from Production Processes

Mora began by identifying the direct emissions generated during Company Canton's aluminium production processes. These emissions arise from fuel combustion and chemical reactions directly linked to the smelting and forming of aluminium products:

- **Smelting Operations:** The primary source of direct emissions was the electrolytic reduction process in the smelter, where carbon anodes are consumed, releasing CO₂ as a byproduct.
- **CO₂ Emissions from Natural Gas Combustion in Smelting Process:** In addition to the primary smelting operations, natural gas is often used as a fuel source in both the smelting process (e.g., for preheating or auxiliary heating systems) and in downstream forming processes (e.g., for furnaces and kilns). These emissions are a significant contributor to the facility's direct emissions and should be closely monitored.
- **CO₂ Emissions from Natural Gas Combustion in Forming Processes:** Downstream forming processes, including rolling, extrusion, also contribute to direct emissions from fuel combustion in equipment such as furnaces.

PFC Emissions from the Anode Effect

Mora then turned her attention to the PFC emissions (CF₄ and C₂F₆) produced during the '**Anode Effect**' in smelting operations.

Initially, Mora was unsure which method should be used, as both methods were technically viable and compliant with CBAM requirements. To make an informed decision, she consulted the Production team. The production team explained that the smelters used by the company were based on **prebake cell technology** (the Hall-Héroult process, where the anodes are pre-baked in separate furnaces before being used in electrolytic cells), which is more efficient and produces fewer emissions compared to Söderberg technology (where the anodes are baked in situ during the electrolysis process).

Given the operational setup and the need for efficiency, the team recommended the **Slope Method** – Please refer to Section 8.3 about the calculation details of the **Slope Method** and the **Overvoltage Method**.

They cited the following reasons for their preference:

- **Alignment with Existing Monitoring:** The production team already tracked **anode effect minutes per cell-day**, a key parameter for the Slope Method, making it easier to implement without altering current practices.
- **Efficiency:** The Slope Method provided a straightforward approach to correlating anode effect duration with PFC emissions, reducing the need for additional measurements or complex calculations.

- **Technology Compatibility:** The prebake cell technology used by the company allowed for precise monitoring of anode effect parameters, ensuring reliable data input for the Slope Method.

With such inputs, Mora decided to adopt the Slope Method for calculating PFC emissions.

Indirect Emissions from Electricity Consumption

Given the energy-intensive nature of aluminium production, electricity consumption was identified as a major source of **indirect emissions**. These emissions are associated with the generation of the electricity used in **Smelting Operations** and **Downstream Forming Processes**.

Mora planned to calculate indirect emissions using the grid emission factor of the country.

No Precursor Embedded Emissions

Mora also reviewed the requirements for reporting **precursor embedded emissions**, which apply to emissions associated with the production of raw materials. As the material inputs (alumina) were not CBAM goods, there were **no precursor embedded emissions** to report.

Step 4: Selecting Quantification Methods

The quantification methods for both direct and indirect emissions are critical to ensure compliance with CBAM regulations.

Mora worked with the Production team on selecting the methods for quantification. The examples below demonstrate the methods and the calculation.

Direct Emissions from Electrodes (Carbon Anodes)

Carbon anodes consumed during the smelting process release CO₂. The emissions were calculated using the stoichiometric relationship between carbon and CO₂:

Formula:

CO₂ emissions (t) = Carbon anode consumption (t) × Carbon content (%) × Oxidation factor × Emission factor (t CO₂/t C)

Example Calculation:

- Carbon anode consumption = 1,680 tonnes

- Carbon content = 98%
- Oxidation factor = 0.98
- Emission factor = 3.664 t CO₂/t C

$$\text{CO}_2 \text{ emissions} = 1,680 \times 0.98 \times 0.98 \times 3.664 = 5,910.8 \text{ t CO}_2$$

Direct Emissions from PFCs (Slope Method)

PFC emissions are calculated using the **Slope Method**, which estimates CF₄ emissions and derives C₂F₆ emissions using a weight fraction. The equations are:

1. **CF₄ emissions:**

$$CF_4 \text{ emissions (t)} = AEM \times (SEF_{CF_4} / 1,000) \times Pr_{Al}$$

2. **C₂F₆ emissions:**

$$C_2F_6 \text{ emissions (t)} = CF_4 \text{ emissions (t)} \times F_{C_2F_6}$$

Inputs:

- *AEM: 0.526 minutes / cell-day*
- *SEF_{CF₄}: 0.143 kg CF₄/t Al / (anode effect minutes / cell-day) for CWPB technology.*
- *Pr_{Al}: 4,000 tonnes of aluminium produced*
- *F_{C₂F₆}: 0.121 t C₂F₆ / t CF₄*

Calculate CF₄ emissions:

$$CF_4 \text{ emissions (t)} = 0.526 \times (0.143 / 1000) \times 4,000 = 0.301 \text{ t}$$

Calculate C₂F₆ emissions:

$$C_2F_6 \text{ emissions (t)} = 0.301 \times 0.121 = 0.0364 \text{ t}$$

Convert to CO₂-equivalents:

- *GWP_{CF₄} = 6,630*
- *GWP_{C₂F₆} = 11,100*

$$\begin{aligned} \text{PFC emissions (t CO}_2\text{e)} &= (0.301 \times 6,630) + (0.0364 \times 11,100) \\ &= 1,995.6 + 404.0 = 2,399.6 \text{ t CO}_2\text{e} \end{aligned}$$

Direct Emissions from Natural Gas Combustion

Natural gas is used in both smelting and forming processes. The emissions are calculated as:

Formula:

$$CO_2 \text{ emissions (t)} = \text{Fuel consumption (TJ)} \times \text{Emission factor (t CO}_2\text{/TJ)}$$

Smelting Process:

- *Fuel consumption = 11.30 TJ*
- *Emission factor = 56.1 t CO₂/TJ*

$$CO_2 \text{ emissions (t)} = 11.30 \times 56.1 = 633.93 \text{ t CO}_2$$

Forming Process:

- *Fuel consumption = 5.45 TJ*
- *Emission factor = 56.1 t CO₂/TJ*

$$CO_2 \text{ emissions (t)} = 5.45 \times 56.1 = 305.75 \text{ t CO}_2$$

Indirect Emissions from Electricity Use

Indirect emissions from electricity use are calculated using the grid emission factor:

Formula:

$$CO_2e \text{ emissions (t)} = \text{Electricity consumed (MWh)} \times \text{Grid emission factor (t CO}_2e\text{/MWh)}$$

Smelting Process:

- *Electricity consumption = 59,200 MWh*
- *Grid emission factor = 0.53 t CO₂e/MWh*
- *CO₂ emissions (t) = 59,200 × 0.53 = 31,376 t CO₂e*

Forming Process:

- *Electricity consumption = 5,735 MWh*
- *Grid emission factor = 0.53 t CO₂e/MWh*
- *CO₂ emissions (t) = 5,735 × 0.53 = 3,039.55 t CO₂e*

Summary of Emissions**1. Total Direct Emissions: 9,151 t CO₂e**

- *Electrodes (Carbon Anodes): 5,911 t CO₂*
- *PFCs (Slope Method): 2,400 t CO₂e*
- *Natural Gas Combustion (Smelting): 634 t CO₂*

- *Natural Gas Combustion (Forming): 306 t CO₂*
- 2. Total Indirect Emissions (Electricity Use): 34,416 t CO₂e**
- *Smelting Process: 31,376 t CO₂e*
- *Forming Process: 3,040 t CO₂e*

Step 5: Allocating Emissions

Based on the data from Step 4, Mora allocated the emissions from the smelting and forming processes to ensure compliance with CBAM regulations and maintain transparency in reporting. Mora calculated the Specific Embedded Emissions (SEE) for both direct and indirect sources for the smelting process, distributing these emissions between ingots sold in the market and those used as precursors for the forming process.

Recognising that 80% of the ingots were precursors for aluminium products and accounting for 10% scraps in forming, Mora integrated the precursor emissions with the emissions from the forming process to calculate the overall SEE for the final aluminium products. By consolidating emissions under a single Aggregated Goods Category for rolling and extrusion products, Mora ensured a unified and accurate emissions profile.

This step was critical to align with CBAM's requirements for precise emissions allocation and facilitate proper reporting of embedded emissions for all product categories.

See below the example of the relevant allocation calculations:

Smelting Process: Specific Embedded Emissions (SEE) for Ingots

The smelting process emissions are allocated to the total ingots produced.

1. Quantities of Outputs:

- Total ingots produced = 4,000 tonnes
- Ingots sold = 20% of 4,000 = 800 tonnes
- Ingots used as precursors = 80% of 4,000 = 3,200 tonnes

2. SEE (Direct) for Smelting:

- Total direct emissions from smelting = 8,945 t CO₂e (5,911 from anodes + 2,400 from PFCs + 634 from gas)
- SEE (Direct) for smelting:
SEE (direct; smelting) = 8,945 t CO₂e / 4,000 t = 2.24 t CO₂e per t ingot

3. SEE (Indirect) for Smelting:

- Total indirect emissions from smelting = 31,376 t CO₂e (from Step 4)
- SEE (Indirect) for smelting:

$$\text{SEE (indirect; smelting)} = 31,376 \text{ t CO}_2\text{e} / 4,000 \text{ t} = 7.84 \text{ t CO}_2\text{e per t ingot}$$

Such emissions data are applicable to ingots sold in the market and those used as precursors in forming process.

Forming Process: SEE for Aluminium Products

In the forming process, emissions are allocated to the aluminium products, which are produced based on 80% of the ingots produced in smelting process, with 10% scraps generated from the process.

Since the aluminium products from rolling and extrusion are part of the same Aggregated Goods Category, a single set of SEE (direct) and SEE (indirect) should be reported for these products.

1. Effective Production Output:

- Ingots used as input = 3,200 tonnes
- Scrap generation = 10% of 3,200 = 320 tonnes
- Net aluminium products output = 3,200 - 320 = 2,880 tonnes

2. SEE (Direct) for Forming:

- SEE (Direct) of precursors (ingots) = 2.24 t CO₂e/t
- Direct emissions from forming = 306 t CO₂ (from Step 4)
- Total direct emissions for forming:

$$\text{SEE (direct; forming)} = 2.24 + (306 / 2,880) = 2.24 + 0.11 = 2.35 \text{ t CO}_2\text{e per t product}$$

3. SEE (Indirect) for Forming:

- SEE (Indirect) of precursors (ingots) = 7.84 t CO₂e/t
- Indirect emissions from forming = 3,040 t CO₂e (from Step 4)
- Total indirect emissions for forming:

$$\text{SEE (indirect; forming)} = 7.84 + (3,040 / 2,880) = 7.84 + 1.06 = 8.90 \text{ t CO}_2\text{e per t product}$$

Final Overview of SEE**1. For Sold Ingots (from Smelting):**

- *SEE (Direct) = 2.24 t CO₂e/t ingot.*
- *SEE (Indirect) = 7.84 t CO₂e/t ingot.*

2. For Aluminium Products (from Forming):

- *SEE (Direct) = 2.35 t CO₂e/t product.*
- *SEE (Indirect) = 8.90 t CO₂e/t product.*

Canton Company Carbon Management Process Flow (Steps 2-5)

Prebaked Carbon Anode Production

- Not included in CBAM emissions, but monitoring is recommended



Smelting (Electrolytic Reduction)

- Alumina + prebaked anodes → aluminium ingots
- Consumption of carbon anodes in the cell
- Anode effect (PFC emissions)
- Electricity use for smelting (high energy consumption)

Direct emissions: CO₂ from carbon anodes, PFCs, natural gas heating

Indirect emissions: Smelting electricity consumption



Downstream Forming (Rolling / Extrusion)

- Aluminium ingots (precursor products) → aluminium finished products
- Equipment natural gas heating
- Electricity use for forming

Direct emissions: Natural gas combustion

Indirect emissions: Forming electricity consumption



Outputs

- Solid aluminium ingots
- Rolled / extruded aluminium products

Corresponding SEE values used for CBAM reporting

Step 6: Reporting and Verification

In the final stage of the CBAM compliance process, Mora focused on preparing the emissions report, gathering additional required data, and searching for an accredited verifier to ensure the accuracy and reliability of the reported information.

Preparation of the Emissions Report

Mora decided to use the official CBAM communication template for the reporting process, as it provided a clear and standardised format in line with CBAM requirements. She believed this approach would ensure consistency and facilitate understanding among stakeholders. Additionally, Mora planned to use the **summary tab** of the template to share the data with the customers, to ensure alignment and transparency within the supply chain.

Please refer to Chapter 7 for details of the communication template and all the data points.

Addressing Missing Reporting Elements

During the preparation of the report, Mora identified two missing elements that had not been collected in the earlier stages of the project:

1. Carbon Price Paid Information:

Mora realised that the CBAM regulation required reporting whether a carbon price had been paid for the embedded emissions in the country of origin. She confirmed that the company had **not paid any carbon price**, and this was duly noted in the report.

2. Additional Product-Specific Information:

Mora noted that additional details were required for both **unwrought aluminium** and **aluminium products** under CBAM reporting guidelines:

- **Unwrought Aluminium:**
 - Tonnes of scrap used for producing one tonne of the product.
 - Percentage of scrap that is pre-consumer scrap.
 - Content of alloys in aluminium: If the total content of elements other than aluminium exceeded 1%, the total percentage of such elements.
- **Aluminium Products:**

- Tonnes of scrap used for producing one tonne of the product.
- Percentage of scrap that is pre-consumer scrap.
- Content of alloys in aluminium: If the total content of elements other than aluminium exceeded 1%, the total percentage of such elements.

Mora promptly coordinated with the production and material management teams to gather this information, ensuring all required data was included in the final report.

Searching for an Accredited Verifier

To ensure compliance with CBAM requirements for emissions verification, Mora began the process of identifying and selecting an accredited verifier. Recognising the importance of working with a qualified and recognised entity, she followed a structured approach:

1. Understanding Accreditation Requirements:

Mora reviewed the CBAM guidelines, which stated that verifiers should be accredited by **National Accreditation Bodies (NABs)** within EU Member States. However, she noted that the supplementary legislation outlining the qualifications and methodologies for verifiers was still under development during the transitional phase. She believed that she would need to check this again in the second half of 2025.

2. Cross-Referencing with EU ETS Verifiers:

Since CBAM verification principles are aligned with those of the EU Emissions Trading System (EU ETS), Mora explored verifiers experienced in EU ETS compliance. This alignment ensured that the selected verifier would be familiar with the specific requirements and methodologies relevant to CBAM.

3. Selection Criteria:

Mora focused on several key criteria when narrowing down her options, including the verifier's expertise in emissions verification, their familiarity with aluminium production processes, and their compliance with international standards such as ISO 14065. She also considered the verifier's prior experience with transitional regulatory frameworks.

By following this rigorous process, Mora ensured that the selected verifier would meet CBAM's accreditation requirements and provide a thorough and credible review of the company's emissions data.

Step 7: Driving Emissions Reductions

The journey did not end with the completion of reporting and verification. Mora pivoted the company's efforts toward identifying actionable strategies that align with its status, e.g. its reliance on the **CWPB (Cold-Worked Precipitation-Based) technology**. The goal was to implement practical measures that not only reduce emissions but also maintain competitiveness in the market while complying with CBAM requirements.

Effective Monitoring and Reporting Progress

Mora emphasised that accurate and continuous monitoring is essential for identifying areas of improvement and driving meaningful emissions reductions. To strengthen the company's decarbonisation efforts, she proposed the following actions:

1. Integrated Monitoring Systems:

Mora advocated for the integration of monitoring tools across the relevant departments esp. in the production line. This would allow the company to detect and address inefficiencies promptly.

2. Data-Driven Decision Making:

By leveraging monitoring data, Mora planned to conduct periodic analyses of emissions trends and operational performance. These insights would inform the prioritisation of reduction strategies and provide a clear roadmap for continuous improvement.

3. Transparent Reporting:

Mora also ensured that emissions data would be transparently reported to internal stakeholders. This process would not only demonstrate compliance but also foster accountability and drive further innovation.

Strategies to Reduce Emissions in the CWPB Process

Acknowledging that CWPB technology is a significant emission source:

- **Improved Alumina Feeding Systems:**

Mora suggested upgrading to **automated alumina feeding systems** to maintain consistent alumina concentrations in the electrolytic bath, significantly reducing the likelihood of anode effects. She also recommended modifying the feeding mechanism to ensure better distribution of alumina across the cell, which would help stabilise bath chemistry and reduce emissions from PFCs.

- **Enhanced Process Control:**

To optimise operations, Mora proposed the implementation of **advanced control systems** capable of real-time monitoring and adjustment of parameters such as bath temperature, alumina levels, and anode-cathode distance. Additionally, she advocated for the use of **predictive analytics** to identify potential anode effects before they occur, allowing preemptive corrective actions.

- **Bath Chemistry Management:**

Mora emphasised the importance of frequent or continuous monitoring of alumina levels and bath composition. She recommended optimising the bath composition to minimise the conditions that lead to PFC formation, thereby reducing emissions and improving operational stability.

- **Anode Management:**

To address variability in anode performance, Mora advised sourcing **high-quality anodes** with consistent properties. She also encouraged the adoption of best practices for anode changing, which would minimise operational disturbances that could trigger anode effects.

- **Operator Training and SOPs:**

Mora proposed developing a robust **training program** to equip operators with the knowledge and skills needed to maintain stable cell conditions. She also recommended the establishment of **standard operating procedures (SOPs)** to ensure consistent practices that reduce the risk of anode effects and enhance operational reliability.

- **Emissions Capture and Treatment:**

Mora suggested reviewing the performance of the company's **Gas Treatment Centers (GTCs)** to ensure they are operating optimally and capturing emissions effectively. She also recommended exploring the installation of **secondary hooding systems** to capture a larger portion of gaseous emissions, further enhancing emissions management.

- **Energy Efficiency Improvements:**

Mora highlighted the need to improve energy efficiency within the CWPB process. She proposed measures to optimise **current efficiency** and reduce electrical anomalies, which would stabilise cell operations and decrease the frequency of anode effects. Additionally, she encouraged the exploration of renewable energy sources to further lower indirect emissions.

- **Research and Development (R&D):**

Mora encouraged management to stay informed about emerging technologies, such as **inert anodes** or alternative electrolytes, that could significantly reduce PFC emissions. She also suggested engaging in **pilot projects** to test these innovations in a controlled environment before full-scale implementation, ensuring the company remains at the forefront of technological advancements in emissions reduction.

Chapter 6: Potential CBAM Scope Extension to Other Sectors – Organic Chemicals and Polymers

6.1 Introduction: CBAM Evolution and Potential Scope Expansion

CBAM is a groundbreaking policy tool introduced by the EU to address **carbon leakage**—the risk that industries might shift production to countries with weaker climate policies to avoid carbon costs. By imposing a carbon price on imports equivalent to the price faced by EU producers under the EU Emissions Trading System (ETS), CBAM aims to ensure a **level playing field** for domestic and international businesses while encouraging global decarbonisation.

The scope of CBAM has been a topic of discussion since its early development. While the 2021 proposal envisioned a broad application, the finalised CBAM Regulation (2023) took a more phased approach, focusing initially on simpler, high-emission products during the **transition period** (2023–2026). However, the mechanism was designed with the flexibility to expand its scope to **other sectors** in the future. In this section, we briefly review the evolution of CBAM's scope, why certain sectors were excluded during the transition period, and the timeline for their potential inclusion.

CBAM Proposal in 2021: A Broad Vision

The **2021 CBAM Proposal** (COM/2021/564 final) introduced the CBAM mechanism to address **carbon leakage** by ensuring that imported products reflect their **embedded carbon emissions**, aligning with the EU ETS. CBAM aims to level the playing field for EU producers while incentivising third countries to adopt stricter climate policies.

The proposal focused on carbon-intensive sectors with significant trade exposure, including Cement, Iron and steel, Aluminium, Fertilisers and Electricity.

There were extensive negotiations among EU institutions and member states on whether other sectors, such as hydrogen, and more complex sectors, such as **organic chemicals** and **polymers**, should also be covered.

CBAM Regulation (2023): A Phased Approach

CBAM Regulation was adopted in 2023, taking a more **pragmatic and phased approach** to implementation. The final regulation focuses on the set of products including **Cement, Iron and steel, Aluminium, Fertilisers**,

Electricity and Hydrogen, to ensure proper testing of methodologies and administrative processes at the initial stage.

A **transitional phase (2023–2025)** was introduced, requiring importers to report embedded emissions without financial adjustments. This phase allows for refining methodologies and preparing for full implementation in 2026. The regulation also anticipates expanding CBAM to additional sectors, including **organic chemicals and polymers**, once robust data and methodologies are developed.

“Simplifying” CBAM: 2025 Update

The European Union has reached a political agreement to simplify its CBAM, primarily to ease the administrative burden on businesses. The most significant update is the introduction of a new exemption threshold of 50 tonnes of CBAM goods per importer, per year. This change is specifically designed to relieve SMEs and individuals importing small quantities from CBAM reporting obligations. While this simplifies compliance for many, the Commission notes that the measure is highly efficient, as 99% of emissions from imported CBAM goods will still be covered by the regulation, ensuring its climate objectives remain intact. **Please note that most suppliers in Asia Pacific will not be able to enjoy the said “relief” unless 100% of their customers in the EU are eligible for the said exemption.**

Timeline for Scope Expansion

The **CBAM Regulation explicitly allows for scope expansion** beyond 2026, as methodologies for calculating embedded emissions improve and the EU gains more experience with the mechanism. The inclusion of **organic chemicals and polymers** is widely regarded as a **natural next step**.

The inclusion of organic chemicals and polymers in CBAM would represent a significant step toward comprehensive carbon border protection. However, their inclusion will require careful preparation by manufacturers, particularly SMEs in regions like Asia-Pacific who export to the EU.

The following sections will explore:

- Why organic chemicals and polymers are likely candidates for inclusion.
- Practical steps that manufacturers can take now to prepare for CBAM compliance.

6.2 Organic Chemicals and Polymers: Why They May Be Included in CBAM

The inclusion of **organic chemicals** and **polymers** in the Carbon Border Adjustment Mechanism (CBAM) represents a logical step toward broadening its scope to align with the EU's climate ambitions. These sectors are critical to industrial supply chains and are associated with significant **embedded carbon emissions**. However, their inclusion in CBAM remains subject to further assessment by the EU, as the specific timing, methodology, and approach are yet to be determined.

What Are Organic Chemicals and Polymers?

For the purposes of CBAM, **organic chemicals** and **polymers** may refer to a broad category of products commonly used as building blocks across industries, such as:

- **Organic chemicals:** Examples include **ethylene**, **propylene**, and **methanol**, which are foundational for manufacturing plastics, textiles, and pharmaceuticals.
- **Polymers:** Examples include **polyethylene**, **polypropylene**, and **polyvinyl chloride (PVC)**, widely applied in packaging, construction, and consumer goods.

These materials are characterised by **energy-intensive production processes** and **complex supply chains**, making their definition and scope under CBAM a subject of ongoing evaluation by the EU.

Please note that determining which specific products will be included, and how their emissions will be calculated, remains an open question.

Why Were These Sectors Initially Excluded?

The exclusion of organic chemicals and polymers during the **2023–2026 transitional phase** was due to several factors:

1. Complexity of Emissions Calculations:

- These products are derived from diverse feedstocks (e.g., naphtha, ethane) and involve multi-output processes (e.g., steam cracking), making it difficult to assign emissions accurately to individual products.

2. Lack of Established Benchmarks:

- Unlike sectors such as cement or steel, organic chemicals and polymers lack clear reference points under the **EU Emissions Trading System (ETS)** for tracking emissions.

3. Administrative Challenges:

- Adding these sectors in the early stages would have imposed an administrative burden on regulators and importers, given the complex supply chains and varying production methods involved.

Why Are These Sectors Likely to Be Included?

Including organic chemicals and polymers in CBAM is a **natural progression** as the EU works toward comprehensive carbon pricing. However, **when** and **how** this inclusion will happen remains uncertain. While 2026 is often discussed as a potential timeline, the EU may require more time to refine methodologies and resolve technical challenges.

Key reasons for their eventual inclusion include:

1. Alignment with ETS:

- These sectors are indirectly regulated under the ETS through carbon pricing of **upstream feedstocks** and **energy inputs**. Including them in CBAM would ensure imports face the same carbon costs as EU producers.

2. Carbon Intensity:

- Organic chemicals and polymers are among the most **energy-intensive industrial sectors**, with production processes like steam cracking contributing significantly to carbon emissions.

3. Risk of Carbon Leakage:

- Without CBAM coverage, EU producers of these products are at a disadvantage compared to non-EU competitors who do not face equivalent carbon pricing.

While these factors suggest that inclusion is likely, the EU's decision will depend on the development of robust methodologies, availability of emissions data, and the broader progress of CBAM implementation.

Implications for Manufacturers and Exporters in Asia-Pacific

The potential inclusion of organic chemicals and polymers in CBAM will have significant implications for manufacturers and exporters in the **Asia-Pacific region**, particularly those supplying the EU market. Key considerations include:

1. Compliance with Carbon Reporting:

- Exporters may be required to calculate and report the **embedded emissions** of their products, using ETS-aligned methodologies. This will require robust **data collection systems** and **third-party verification** of emissions.

2. Increased Costs:

- If included in CBAM, importers will need to purchase **CBAM certificates** to cover the carbon emissions of the products imported, effectively increasing their costs. This could impact price competitiveness in the EU market.

3. Pressure to Decarbonise:

- Exporters may face growing pressure to adopt **low-carbon technologies** and improve energy efficiency to reduce embedded emissions and maintain market access.

Proactive preparation to meet potential CBAM requirements will be critical for Asia-Pacific manufacturers to remain competitive and sustain exports to the EU.

Challenges Ahead

Manufacturers and exporters in the Asia-Pacific region face several challenges in preparing for the potential inclusion of organic chemicals and polymers under CBAM, such as:

- **Complexity in emissions tracking and reporting.**
- **Higher costs of compliance**, including investments in decarbonisation.
- **Uncertainty around specific CBAM requirements** for these sectors.

We will address these challenges further in the next section, outlining **practical steps and suggested actions** for manufacturers to prepare for future CBAM requirements.

6.3 Preparing for CBAM: Steps for Manufacturers and Exporters in Asia-Pacific

The expected expansion of the **CBAM** to include **organic chemicals** and **polymers** will place significant compliance demands on manufacturers and exporters **as well as their upstream suppliers** in the **Asia-Pacific region**. Understanding the monitoring and reporting requirements is critical to preparing for these changes.

Understanding the Potential Requirements

CBAM, which builds on the principles of the ETS, mirrors ETS in a particular way by extending its scope beyond direct emissions from installations for organic chemicals and polymers. This means:

- **Direct Emissions:** Emissions from the production process at the manufacturing facility should be monitored and reported according to ETS methodologies.
- **Indirect Emissions:** Emissions from purchased electricity, steam, or heat used in production processes may also be included.
- **Embedded Emissions in Purchased Precursors:** The emissions embedded in raw materials or intermediate products (precursors) purchased from suppliers should also be monitored, reported, and verified, following ETS standards for direct emissions.

These requirements underline the need for robust **supply chain collaboration**, as data on embedded emissions will often need to be obtained from upstream suppliers.

Exploring the Potential Requirements on Monitoring and Reporting

1. Direct Emissions: Following ETS Methodologies

Under CBAM, direct emissions from the production process would likely be monitored and reported **in line with ETS requirements**.

For organic chemicals and polymers, this includes emissions from:

- **Fuel Combustion:** Emissions from burning fuels for heat and energy in on-site operations.
- **Process Emissions:** GHGs released as a direct byproduct of a chemical reaction (e.g., CO₂ from steam methane reforming).
- **Flaring Emissions:** Emissions from the controlled combustion of excess or waste gases in a flare stack.

ETS Quantification Methods:

- **Continuous Emissions Monitoring Systems (CEMS):** Direct measurement of emissions using approved monitoring equipment.
- **Calculation-Based Methods (Standard Approach and Mass Balance Approach):** Use of activity data (e.g., fuel consumption) and emission factors to estimate emissions when direct measurement is not feasible.
- **Fallback Approaches:** For processes with insufficient data or monitoring, conservative estimates may be used.

CBAM will require that direct emissions be monitored and verified by **third-party accredited verifiers**, following ETS rules.

2. Indirect Emissions: Extending Beyond ETS

Unlike the ETS, CBAM may require the inclusion of **indirect emissions** (at least for reporting purpose), specifically:

- **Electricity:** Emissions from the production of electricity purchased and consumed in manufacturing.
- **Steam and Heat:** Emissions from external heat and steam sources used in production.

Quantification of Indirect Emissions:

- Indirect emissions are calculated using the **grid emission factor** or the emissions intensity of the electricity supplier.
- For heat and steam, similar emission factors or supplier data are required.

Countries with coal-heavy electricity grids, such as some in the Asia-Pacific region, may face higher reported indirect emissions.

3. Emissions Embedded in Purchased Precursors

A unique aspect of CBAM is the requirement to report emissions embedded in **purchased precursors** (e.g., raw materials or intermediate products such as ethylene, propylene, or methanol) – for organic chemicals and polymers, such emission source is exactly where CBAM mirrors ETS. These emissions reflect the upstream carbon footprint of the materials used in production, extending the scope of required reporting beyond the manufacturer's own operations.

Quantification of Embedded Emissions:

- **Supplier Data:** Data on the embedded emissions of precursors should be obtained from suppliers. This includes the direct emissions from their production processes, calculated using ETS methodologies.
- **Supply Chain Collaboration:** Manufacturers should work with upstream suppliers to ensure transparency and accurate reporting of emissions data.
- **Default Values:** If supplier-specific data is unavailable or the data is not verified / reliable, CBAM may provide conservative default values for embedded emissions, potentially inflating reported emissions and associated costs, and subject to restrictions or even penalties.

4. Challenges in Emissions Attribution

The inclusion of direct, indirect, and embedded emissions under CBAM introduces significant challenges for manufacturers and exporters of organic chemicals and polymers.

Many production processes generate multiple products and byproducts. For example, **steam cracking** produces ethylene, propylene, and other chemicals. Accurately allocating emissions to each output requires precise process data and standard allocation methodologies.

Other Suggestions

In addition to focusing on monitoring and reporting, Asia-Pacific manufacturers and their upstream suppliers should consider the following measures to prepare for CBAM:

1. Invest in Decarbonisation:

- Improve energy efficiency and explore low-carbon alternatives for feedstocks and production processes.
- Transition to renewable electricity sources to reduce indirect emissions.

2. Collaborate with Supply Chain Partners:

- Work closely with upstream suppliers to obtain accurate emissions data for precursors.
- Strengthen relationships with EU importers to ensure alignment with CBAM compliance requirements.

3. Engage with Policy and Industry Developments:

- Monitor updates on CBAM regulations and ETS methodologies, particularly as they apply to organic chemicals and polymers.
- Participate in industry associations to advocate for practical solutions and gain insights into emerging compliance requirements.

4. Assess Financial Impacts:

- Conduct scenario analyses to estimate CBAM-related costs, including certificate purchases and investments in emissions tracking systems.
- Evaluate pricing strategies to maintain competitiveness in the EU market.

Summary

The inclusion of **direct emissions**, **indirect emissions**, and **embedded emissions in purchased precursors** under CBAM represents a significant expansion of reporting and compliance obligations compared to ETS. Manufacturers and exporters in the Asia-Pacific region should prepare by building robust emissions tracking systems, engaging with suppliers and clients, and investing in decarbonisation initiatives. Proactive preparation will not only ensure compliance but also strengthen competitiveness in a decarbonising global economy.

Chapter 7: CBAM Formalities for Importers

This chapter serves as a guide to understanding and navigating the compliance formalities under the EU CBAM.

While the chapter provides specific information tailored for the importers, we strongly recommend that the readers of this guidebook read and understand the importer-related content even if you do not (or do not plan to) act as an importer in the EU. This knowledge will help you understand what importers - your (end) customers - require, facilitating smoother communication. Additionally, by becoming familiar with importer obligations, you can assess and reject any unreasonable requests they may make, safeguarding your business interests while meeting CBAM requirements effectively.

This chapter specifically addresses the obligations during the **definitive period** (beginning in 2026), when CBAM will fully apply with financial obligations for importers, while also covering the **transitional period** (2023–2025) for completeness.

7.1. Registration

Overview

Registration is a mandatory step for EU-based entities intending to comply with the EU CBAM. During the definitive period (from 2026 onwards), companies importing CBAM-covered goods into the EU should register as authorised CBAM declarants if they are established in the EU. Companies established outside the EU but acting as the importer of record in the EU should coordinate with an EU-based customs representative for compliance.

Who Needs to Register?

- **EU Importers Acting as Declarants:**

Any EU-based entity importing goods subject to CBAM should apply for registration. Only registered declarants can submit annual emissions reports and purchase CBAM certificates.

- **Non-EU Entities:**

Companies outside the EU cannot register directly. Instead, they should work through an EU-based *indirect customs representative* who is registered as an authorised CBAM declarant.

Registration Process

1. Application Submission:

- Importers should apply for registration through the CBAM portal provided by the European Commission.
- The application requires submission of basic business details, including the company's Economic Operator Registration and Identification (EORI) number, which is mandatory for all entities engaging in customs activities within the EU.

2. Approval by Competent Authorities:

- The application is reviewed by the competent authorities of the respective EU Member State where the importer is established.
- Once approved, the importer is granted authorised CBAM declarant status and gains access to the CBAM (Transitional) Registry.

3. Access to the CBAM Registry:

- Registered declarants receive login credentials to the CBAM Registry, where they can perform activities such as reporting emissions, purchasing CBAM certificates, and managing compliance records.

Deadlines and Timing

- Registration should be completed well before the first reporting period in 2026 to ensure timely compliance. Importers should also consider any delays in the approval process by their Member State's competent authorities.

Additional Notes for Manufacturers and Exporters

Manufacturers and exporters in the Asia-Pacific region are not required to register under CBAM since they are not responsible for imports into the EU. However, understanding the registration process helps anticipate the needs of EU importers, including the type of emissions data or certifications they may request during the compliance process. Exporters should collaborate closely with their importers to ensure that all required data is available for registration and subsequent reporting.

7.2. Reporting

Overview

Reporting under the EU CBAM requires importers to provide detailed data on the embedded emissions of imported goods, along with information about carbon pricing mechanisms in the country of origin. This section outlines the data points required for compliance during both the transitional and definitive periods, along with explanations for each data point.

The reporting requirements are designed to ensure transparency and facilitate the effective implementation of the CBAM system.

Comprehensive Data Points for Reporting

Below is the complete list of data points that should be included in CBAM reports, along with detailed explanations:

1. Identification of the Imported Goods

- **Quantity of Each CBAM Good:**

- The quantity of imported CBAM goods should be reported, broken down by their Combined Nomenclature (CN) codes.
- The unit of measurement depends on the specific sector: for most goods, it is per tonne.

- **Sector-Specific Metrics:**

Each have unique metrics and greenhouse gases associated with their reporting. For example:

- **Alloy Content for iron and steel products:** Percentage of alloy materials in the product.
- **Recycled Input for aluminium products:** Tonnes of scrap used per tonne of steel.

2. Embedded Carbon Emissions

- **Direct Embedded Emissions:**

- Direct emissions refer to greenhouse gases released during the production process of the goods. This should be calculated per tonne of the imported good, using EU-approved methodologies that align with the EU ETS system.

- **Indirect Embedded Emissions (if applicable):**

- Indirect emissions, such as those generated from electricity used in production and those embedded in precursors, should also be reported where applicable.
- **Units for Reporting:**
 - Emissions should be expressed in tonnes of CO₂ equivalent (tCO₂e) per tonne of imported goods.
- **Default Values or Actual Values:**
 - During the transitional period, importers may use default values to estimate embedded emissions for reporting purposes. However, providing actual values, verified by third-party entities, will become mandatory during the definitive period.

3. Carbon Price Paid in the Country of Origin

- **Details to Report:**
 - The carbon price paid for the embedded emissions of the goods in their country of origin should be reported. This includes:
 - The amount of carbon tax or pricing paid.
 - Any financial support (e.g., subsidies) or rebates received by the producer.
 - This data is essential for determining potential reductions in the number of CBAM certificates that importers are required to surrender.

4. Verification of Emissions Data

- **Verification Requirements (Definitive Period):**
 - Starting in 2026, emissions data should be verified by an accredited third-party verifier. The verifier will ensure that the data aligns with EU methodologies and provide a verification report to accompany the CBAM declaration.
 - This verification report should be submitted alongside the annual CBAM report. Please note that the first annual CBAM report that requires verification to be submitted should be by the end of May 2027.
- **Verification During Transitional Period:**

- Independent verification is not mandatory during the transitional period. However, it is recommended to prepare for definitive-period requirements.

5. Supporting Documentation

- **Required Documents:**

- Copies of the emissions verification report (for the definitive period).
- Any supporting documentation related to the calculation of emissions, carbon pricing, and production processes.

- **Retention Period:**

- Importers should retain all records for a minimum of four years for potential audits by EU Member State authorities.

Reporting Timelines and Frequency

Transitional Period (2023–2025):

- **Frequency:** Quarterly reporting.
- **Deadlines:** Quarterly reports should be submitted within one month after the end of each quarter (e.g., Q4 2023 reporting is due January 31, 2024). Please note that the Q4 2025 report, due by January 31, 2026, should follow the transitional-period requirements.
- **Platform:** Reports should be submitted through the CBAM Transitional Registry.

Definitive Period (2026 and Beyond):

- **Frequency:** Annual reporting.
- **Deadline:** Reports for a given calendar year should be submitted by **May 31** of the following year (e.g., the report for 2026 is due by May 31, 2027).
- **Platform:** Reporting continues through the CBAM Registry, with additional functionalities for certificate management.

Considerations for Manufacturers and Exporters

Manufacturers and exporters in the Asia-Pacific region should support EU importers by providing reasonable and accurate data as required for reporting. It would be helpful to use or refer to the EU-provided communication template to ensure consistency and compatibility with importer submissions. It is also

important to prepare for definitive-period requirements by collaborating with accredited verifiers to verify emissions data.

7.3. Certificate Surrender

Overview

The surrender of CBAM certificates is a critical component of compliance under Regulation (EU) 2023/956. It ensures that the carbon costs of imported goods are aligned with the EU's carbon pricing framework. This section outlines the surrender process, deadlines, and additional considerations based on Chapter IV of the Regulation.

Key Requirements for Certificate Surrender

1. Annual Surrender Obligation

By **31 May of each year**, authorised CBAM declarants should surrender a number of CBAM certificates that corresponds to the embedded emissions of goods imported into the EU during the preceding calendar year.

2. Removal of Surrendered Certificates

Once surrendered, the CBAM certificates are immediately removed from the declarant's account in the CBAM registry.

3. Excess Surrender

If the competent authority determines that the number of certificates surrendered exceeds the required amount, the excess certificates will be repurchased.

4. Quarterly Balancing Requirement

At the end of each quarter, authorised CBAM declarants should ensure that their CBAM registry account contains a sufficient number of certificates that can cover at least 80 % of the embedded emissions.

Certificate Pricing and Procurement

1. Price Determination

The cost of CBAM certificates is based on the **weekly average price of EU ETS allowances**. This price is calculated as the average of the closing prices during each calendar week and published by the European Commission on the first working day of the following week.

2. Purchase of Certificates

Certificates are sold exclusively on a **common central platform** managed by the European Commission. Each Member State sells certificates to authorised CBAM declarants established within its jurisdiction.

3. Adjustments for Paid Carbon Pricing

The number of CBAM certificates required for surrender can be reduced by the documented carbon price already paid in the country of origin for the embedded emissions of the imported goods.

Considerations for Manufacturers and Exporters

The cost of CBAM certificates may indirectly impact manufacturers and exporters in the Asia-Pacific region by influencing pricing and demand for their goods. To manage these impacts:

- **Evaluate Supply Chain Adjustments:**

Explore lower-carbon production methods or alternative inputs to reduce embedded emissions and the number of certificates required.

- **Engage in Long-Term Planning:**

Collaborate with importers to forecast certificate costs and assess potential price impacts on exported goods.

7.4. Annual Reconciliation

Though there is no formally designated administrative process called "annual reconciliation" in the CBAM system, the concept of "annual reconciliation" effectively occurs as importers are required to submit their CBAM declarations with verification reports and surrender the corresponding number of CBAM certificates by 31 May of each year. This process ensures that the surrendered certificates accurately reflect the embedded emissions of goods imported during the previous calendar year. Importers are strongly recommended to conduct this reconciliation before the deadline to prevent discrepancies in carbon pricing obligations and to avoid penalties for non-compliance. Timely reconciliation allows importers to verify emissions data, account for any carbon price paid in the country of origin, and address any potential shortfalls in CBAM certificates well in advance of the cut-off date.

To ensure compliance with the CBAM system, importers may follow the below steps for annual reconciliation:

1. Conduct an Exercise to Reconcile "Emissions to Be Reported," "Emissions Verified (in Verification Reports)," and "CBAM Certificates Surrendered"

- **Compile Emissions Data:** Collect and process the embedded emissions data of imported goods for the preceding calendar year.
- **Ensure Verification:** Ensure the emissions data are verified by accredited verifiers with the verification reports confirming the accuracy of the emissions calculations.
- **Cross-Check Data:** Reconcile the following elements to ensure consistency:
 - **Emissions to Be Reported:** The emissions submitted in the quarterly CBAM reports during the year.
 - **Verified Emissions:** The emissions confirmed in the verification report.
 - **CBAM Certificates Surrendered:** The number of certificates surrendered by the importer during the reconciliation exercise.
- **Identify Discrepancies:** Pinpoint any inconsistencies between the reported emissions, verified emissions, and certificates surrendered. These discrepancies could arise from data errors, incomplete reporting, or incorrect calculations of embedded emissions.

2. Take Action according to the Reconciliation Results

- **Correct Emissions to Be Reported:** If discrepancies are identified in the reconciliation exercise, importers should take corrective action. This may involve:
 - Submitting revised emissions reports to replace inaccurate or incomplete data previously reported.
 - Updating the CBAM declaration to reflect accurate emissions figures in line with verification results.
- **Address Under-Surrendered CBAM Certificates:**
 - If the number of surrendered certificates is insufficient to cover the verified emissions, purchase and surrender additional certificates before the **31 May deadline** for reconciliation.
 - Ensure the shortfall is addressed promptly to avoid penalties for non-compliance.

- **Prepare Documentation:** Maintain robust documentation of all corrections and certificate purchases to demonstrate compliance during the competent authority review.

3. Monitor and Correct Errors Post Competent Authority Review

- **Review Feedback from the Competent Authority:** After submitting the CBAM declaration and surrendering certificates, the competent authority will conduct its review. If errors or irregularities are identified, the authority will notify the importer and request corrective action.
- **Rectify Errors Proactively:**
 - Amend the CBAM declaration or emissions data as required by the competent authority.
 - Purchase and surrender additional certificates if the authority identifies an under-surrender of certificates.
- **Strengthen Monitoring Systems:**
 - Implement robust systems to track the completeness and correctness of data received from suppliers.
 - Assist suppliers in setting up Monitoring, Reporting and Verification (MRV) systems to improve the accuracy and timeliness of emissions data in future reporting cycles.

Chapter 8: CBAM Data and Digitalisation for Manufacturers and Exporters (Installation Operators)

This chapter serves as a guide to understanding and navigating the data points under the EU CBAM for manufacturers and exporters. It breaks down these data requirements into manageable steps, offering practical guidance on data sharing and compliance with the CBAM system.

This chapter specifically addresses the obligations during the **definitive period** (beginning in 2026), when CBAM will fully apply with financial obligations for importers, while also covering the **transitional period** (2023–2025) for completeness.

8.1. Use of the EU Communication Template

The European Commission has provided an optional communication template to standardise and streamline the exchange of information between non-EU manufacturers/exporters and EU importers. This template is designed to help manufacturers provide the necessary data on embedded emissions and any carbon pricing paid in the country of origin.

Manufacturers/exporters are encouraged to use this template when responding to requests from EU importers. The use of a standardised format ensures that the information provided is clear, complete, and consistent with CBAM reporting requirements. This also helps importers fulfil their obligations under the CBAM Regulation.

Registry for Manufacturers

From 31 March 2025, manufacturers and exporters may submit emissions data through the CBAM Registry, which EU importers will use for compliance reporting. This feature will simplify the communication process by allowing manufacturers to input and manage their emissions data in a centralised platform. Once registered, manufacturers will be able to share data securely and efficiently with multiple importers, reducing the administrative burden on both parties.

Manufacturers should remain informed about updates from the European Commission regarding the development and availability of this registry. In the meantime, manufacturers should rely on direct communication with importers to provide the necessary data.

Data Points for the Communications

Please note that the contents below are based on EU Communication Template and should be consistent with those in the online registry.

8.2. Installation Information (i.e., Tab A_InstData)

1. Reporting Period

It should be the whole calendar year (i.e., from 1/1/2024 to 31/12/2024) in most cases, unless otherwise confirmed by the importer and the verifier.

2. Basic Installation Information

Name of the installation	Name in local language may be entered here. Optional
Name of the installation (English name)	Name in English is mandatory. For companies with more than one installation, each installation should be specified by name or ID.
Street, Number	Mandatory
Economic activity	Optional. For companies with multiple installations engaged in various economic activities, this field can be used to enter information about the sector or product for easy reference, e.g., crude steel production.
Post code	Mandatory. For jurisdictions where postcode system is not available (such as Hong Kong), 0000 may be entered.
P.O. Box	Mandatory. N/A may be entered if P.O. Box is not available.
City	Mandatory
Country	Mandatory
UNLOCODE	Mandatory. You may refer to UN/LOCODE Code List by Country and Territory for the specific code, e.g. “HK LCK ” for Lai Chi Kok in Hong Kong, China, “CN DGG” for Dongguan City, Guangdong Province, China.
Coordinates of the main emission source (latitude)	Mandatory. One of the easiest ways to get such information is to drop a pin at the target location at Google maps or other maps and identify latitude and longitude information in the URL in the address bar, e.g. 22.3366021,114.1480953 for Billion Plaza, 8 Cheung Yue Street, Cheung Sha Wan, Kowloon.
Coordinates of the main emission source (longitude)	
Name of authorised representative	Optional but recommended for better communication.
Email	
Telephone	

3. Verifier of the Report

It is optional during transitional period but mandatory during definite period. The verifier's accreditation information is key. For example, national accreditation body for Germany is DAkkS and you may find the verification bodies at its [website](#); that for the Netherlands is [RvA](#).

4. Aggregated Goods Categories and Production Processes

In principle, please note that all the Aggregated Goods Categories within the installation as well as the corresponding Production Processes should be identified and reported respectively.

Considering complexity of production processes in certain sectors, where the aggregated goods categories covered other than the finished products are wholly used to make the finished products, the production processes can be reported as one joint process (which is also called “bubble approach”). That said, in an installation where multiple Aggregated Goods Categories and multiple production processes are involved to make one final CBAM product, the installation can report multiple Aggregated Goods Categories but one “bubble approach” process.

Aggregated Goods Categories	
Aggregated Goods Category	Each of the categories should be selected from the drop-down list.
Route	Once a category is selected, it should indicate either “All Product Routes” or “Please select...”. For the latter situation, one or more specific production route(s) should be selected. For example, for the category of Unwrought Aluminium, specific production route such as “secondary melting (recycling)” should be selected.
Relevant Precursors	These fields should be automatically filled in when the Aggregated Goods Categories are selected.
Relevant Production Processes	
Aggregated Goods Category	Depending on whether “bubble Approach” is adopted, either each of the Aggregated Goods Categories should be entered or the category for final products should be entered.
Included Goods Categories	If “bubble Approach” is adopted, categories other than that for final products should be entered.
Name	Naming each of the processes is mandatory.

5. Purchased Precursors

Name	Name of the precursor
Production Process	The production process or in another word the Aggregated Goods Category should be selected per precursor.
Route	Once a production process is selected, it should indicate either “All Product Routes” or drop-down lists for specific production routes to be selected. Please note that, if specific production route information is applicable, it is mandatory information to report. With that, the installation may wish to collect information from the precursor supplier following the communication template.
Country Code	Country code is mandatory and the installation may refer to the codelist in the template for details.

8.3. Sources and Emissions (i.e., Tab B_Emlnst)

Because the guidebook is mainly aimed for HKMEs with less or nil experience in carbon management, details of Measurement based Approach will not be addressed in this guidebook.

1. Overall

Method	The three methods available in the template are Combustion, Process Emissions, and Mass Balance.
Source Stream Name	Each of the emission sources should be indicated as a separate row.
Activity Data (AD) and Unit	The amount of fuels or materials consumed or produced by a process as relevant for the calculation-based monitoring methodology, expressed mass in tonnes (t), or for gases as volume in normal cubic metres (Nm ³), as appropriate.
Net Calorific Value (NCV)	When tCO ₂ /TJ is used as EF Unit, NCV becomes mandatory. NCV should normally be provided where the emission source is a fuel input.
Oxidation factor (OxF), Conversion factor (ConvF), Biomass content (BioC)	They are optional and should be entered where applicable. In practice, OxF is often set as 1, which is conservative assumption, to reduce monitoring efforts. Please note that biomass content should normally be zero-rating when the biomass fraction is not known.
Energy and Emissions	They are calculated automatically for each source stream.

2. Standard Methodology (Combustion and Process Emissions)

Emission Factor (EF)	In order to provide the most accurate and reliable figures, the EU requires installations to measure and report CBAM-related emissions using data sourced directly from suppliers. Otherwise, either regional EF values or European Commission (EC)-published default EF values should be used.
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3. Mass Balance Methodology

Activity Data (AD)	Please note that carbon leaving the installation in products instead of being emitted is taken into account by output source streams, which have therefore negative activity data.
Carbon Content	They should be based on laboratory analysis or, if not available, standard carbon content factors.

4. PFC Emissions

Slope Method	The Slope Method calculates PFC emissions based on the frequency and magnitude of anode effects during the aluminium smelting process. Steps: Obtain Anode Effect Data: - Measure the Anode Effect Frequency (AEF) in anode effects per cell-day. - Measure the Anode Effect Duration (AED) in minutes per cell-day. Use the Emission Factor (Slope): - Use the slope factor provided (specific to the smelter's process or CBAM default values). It relates AEF and AED to PFC emissions. Calculate the Total PFC Emissions: - Use the formula: $\text{PFC Emissions (kg CO}_2\text{e)} = \text{AEF} \times \text{AED} \times \text{Slope Factor} \times \text{Global Warming Potential (GWP)}$ Slope Factor: Provided in kg of CF₄ per minute of anode effect. GWPs (CBAM default values; per IPCC AR4): - CF₄: 6,630 - C₂F₆: 11,100 Summarise Emissions for Reporting: - Add the emissions (in CO₂e) for CF₄ and C₂F₆ to obtain your total PFC emissions.
Overvoltage Method	The Overvoltage Method estimates PFC emissions based on deviations in cell voltage from a baseline during smelting. Steps: Measure Anode Effect Overvoltage (AEO) Determine the average anode effect overvoltage in volts (V). This is the difference between the actual operating voltage and the baseline voltage without anode effects.

	2. Determine Current Efficiency (CE) - Obtain the CE of the electrolysis process from plant data. This reflects the percentage of electrical current used to produce aluminium. 3. Apply the Overvoltage Coefficient (OVC) - Use the OVC for CF_4 and C_2F_6 emissions. These values are typically provided by: - Based on the manufacturing process. - CBAM guidelines (default values). 4. Calculate Emissions for Each Gas CF_4 Emissions: $\text{CF}_4 \text{ Emissions} = \text{AEO} \times (1 - \text{CE}) \times \text{OVC}_{\text{CF}_4} \times \text{GWP}_{\text{CF}_4}$ C_2F_6 Emissions: $\text{C}_2\text{F}_6 \text{ Emissions} = \text{AEO} \times (1 - \text{CE}) \times \text{OVC}_{\text{C}_2\text{F}_6} \times \text{GWP}_{\text{C}_2\text{F}_6}$ 5. Summarise Total PFC Emissions - Add the emissions for CF_4 and C_2F_6 to calculate the total PFC emissions in CO_2-equivalents (CO_2e): $\text{Total PFC Emissions} = \text{CF}_4 \text{ Emissions} + \text{C}_2\text{F}_6 \text{ Emissions}$
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8.4. Energy and Emissions (i.e., Tab C_Emissions&Energy)

1. Fuel Balance

Total Fuel Input	The amount for this field should be carried forward from Tab B. Under exceptional circumstance, the installation may input a manual entry where applicable to override the carried forward entry.
Direct Fuel for CBAM Goods, Fuel for Electricity, Direct Fuel for non-CBAM Goods	The respective amounts for these fields should be provided respectively in the row for manual entries, based on actual data.

2. GHG Emissions

Total Direct Emissions, including CO_2 Emissions, Biomass Emissions, N_2O Emissions and PFC Emissions	The amounts for these fields should be carried forward from Tab B. Under exceptional circumstance, the installation may input a manual entry where applicable to override the carried forward entry.
Total Indirect Emissions	This entry should always be entered manually.
GHG Emissions by Type of Monitoring Methodology	The amounts for these fields should be carried forward from Tab B.

3. Data Quality and Data Assurance

General Information on Data Quality	The installation may select from the drop-down list depending on the data collected, e.g. "Mostly measurements & national standard factors for e.g. the emission factor".
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	Please be cautious when selecting “Mostly default values provided by the European Commission”, which is considered low data quality.
Justification for use of default values (if relevant)	When default values are used, the installation may need to justify the reason, e.g., unreasonable costs for more accurate monitoring, or data gaps in place.
Information on Data Assurance	The installation should indicate whether the reporting data have been audited by an accredited verifier, by an independent internal audit team, subject to four eyes review, or none of these.

8.5. Processes and Specific Embedded Emissions Calculation (i.e., Tab D_Processes)

The information to be entered in this tab should be provided on a process-by-process basis.

1. Production Process

- Production level and production route information will be carried forward from Tab A.
- The product amount of the process should be provided manually.
- Such amount should be allocated into 3 parts:
 - Produced for the Market, i.e., the amount of the product (of this process) sold to the EU;
 - Consumed in Each of Other Processes within the installation;
 - Consumed for non-CBAM Goods within the installation.

2. Calculation of the Attributed Emissions (for Each Process)

Measurable Heat	The amounts and emission factors for import and/or export of the measurable heat should be entered manually.
Waste Gases	The amounts and emission factors for import and/or export of the waste gases should be entered manually.
Indirect Emissions from Electricity Consumption	Please note that source of emission factor should be provided, e.g. D.4(a) which means based on IEA data as required by the European Commission.
Electricity Exported from the Production Process	The actual amount should be entered and used as a deduction to the attributed emissions.

8.6. Purchased Precursors

The information to be entered in this tab should be provided on a precursor-by-precursor basis.

1. Production Process

- Purchased level and production route information will be carried forward from Tab A.
- The precursor amount should be provided manually.
- Such amount should be allocated into 2 parts:
 - Consumed in Each of Production Processes within the installation;
 - Sold or Consumed for non-CBAM Goods.

2. Calculation for Specific Embedded Emissions

- The following value should be entered based on the information provided by the precursor supplier(s):
 - Specific embedded direct emissions;
 - Specific embedded indirect emissions and the corresponding electricity consumption and emission factors.
- Source of the said values should also be indicated. Ideally the values should be measured by the precursor supplier(s). It is suggested that the installation should collect precursor emission data from the supplier(s) following the communication template.
- When default values are used, the installation may need to justify the reason based on the information provided by the supplier(s), e.g., unreasonable costs for more accurate monitoring, or data gaps in place.

8.7. Other Tabs

1. Additional Tools

- A tool to calculate the emissions attributable to heat production in combined heat and power units (CHP)
- A tool to calculate the carbon price due or paid in the jurisdiction of the installation.

2. Process Summary

- The tab calculates and summarises the carbon emissions information by process and should normally requires no further inputs.

3. Product Summary

- The tab calculates and summarises the carbon emissions information by product.
- The installation may wish to enter specific product information (especially according to transaction records) for the communication with the importer. The following information should normally be required:
 - CN code(s);
 - Product name(s);
 - Specific product information.

4. Summary for Communication

- The tab summarises all the information that is required for CBAM communication from the installation to the importer. No further inputs should be required.
- The installation may wish to share only this tab with the importer.

8.8. Digitalisation Solutions for SMEs

SMEs involved in the CBAM reporting process can leverage simple and cost-effective digitalisation solutions to streamline their data-sharing and compliance efforts. Below are some recommendations that are easy to implement with minimal or no additional cost:

1. Utilise Free or Low-Cost Spreadsheet Software

- Use readily available tools like Google Sheets or Microsoft Excel to organise, store, and track emissions data provided by suppliers or manufacturers. These tools can also help SMEs map data flows and identify areas prone to errors, such as during data transfer or calculations.

2. Centralise Data Storage and Apply the "Four-Eyes" Principle Digitally

- Store all CBAM-related data, such as emissions reports, invoices, and verification documents, in free or low-cost cloud storage solutions. Implement the "four-eyes" principle for data review by enabling shared access to spreadsheets or documents through cloud platforms (e.g., Google Drive, OneDrive, or Dropbox). This ensures that a second person reviews all entries and calculations, reducing the likelihood of errors without incurring additional software costs.

3. Use Free Templates for Standardised Communication

- Leverage the EU-provided communication template to standardise data exchanges with manufacturers or suppliers. This eliminates the need for SMEs to develop their own systems and reduces administrative burden.

4. Automate Simple Calculations

- Use built-in functions in spreadsheet software to automate calculations for emissions data, such as summing up embedded emissions or adjusting for carbon pricing paid in the country of origin. This reduces manual work and minimises errors during data processing.

5. Adopt Simple Data Verification Practices

- Regularly verify the accuracy of data by comparing supplier-provided information with invoices or production records. This can be done using basic digital tools without the need for specialised software.

6. Monitor Deadlines with Online Calendars

- Use free online calendar tools (e.g., Google Calendar, Outlook) to set reminders for CBAM reporting deadlines and reconciliation dates. This helps SMEs stay on track with their obligations without additional costs.

These solutions enable SMEs to digitalise their CBAM-related workflows without requiring significant investment, helping them fulfill compliance obligations efficiently and cost-effectively.

You may find more information about digitalising carbon management in the Carbon Management Guidelines for Carbon Neutrality and Sustainable Development Targets of Hong Kong and Mainland China.

Chapter 9: Guidebook Recap and Call to Action

Recap of Key Points

Throughout this guidebook, we have explored the intricacies of the EU CBAM and its implications for HKMEs.

Here's a brief recap:

- **Introduction:** We introduced the purpose of this guidebook, detailing how it aims to support HKMEs in achieving compliance with CBAM, fostering carbon management, and aligning with global sustainability goals.
- **Understanding EU CBAM:** We outlined the framework, objectives, and the phased implementation of CBAM, emphasising the need for HKMEs to adapt to these new trade regulations.
- **Cornerstones of Carbon Management:** This chapter provided foundational knowledge on carbon emissions, setting boundaries, and strategies for effective monitoring, reporting, and verification.
- **Sector-Specific Guidance:** Detailed case studies and step-by-step compliance strategies were provided for sectors like Iron and Steel, Aluminium, and potential future sectors like Organic Chemicals and Polymers.
- **CBAM Formalities and Data Points:** We discussed the specific data requirements and formalities for both importers and exporters, ensuring clarity on how CBAM operates in practice.
- **Digital Solutions for SMEs:** Highlighted the importance of digital tools in streamlining carbon management processes, particularly tailored for small and medium-sized enterprises.

Call to Action

As we conclude this guidebook, here is a summary of the actionable steps for HKMEs:

1. Prepare for CBAM Compliance:

- Understand the CBAM requirements that affect your exports to the EU, even if you are not an importer.
- Review your current carbon management practices to ensure they align with CBAM's reporting and verification standards.

2. Train Staff:

- Train your team, especially those involved in production, quality control, and environmental management, about CBAM regulations.
- Focus on carbon monitoring, emissions calculation, and the importance of accurate reporting.

3. Enhance Data Collection and Management:

- Implement or improve systems for precise data collection of emissions associated with your production processes.
- Collaborate with EU importers and engage with verifiers to understand how your emissions data will be used and verified.

4. Strategic Planning:

- Incorporate CBAM compliance into your strategic business planning. Consider how it might influence your product design, manufacturing processes, and supply chain logistics.
- Explore how compliance can enhance your competitive positioning in the EU market.

5. Engage with Supply Chain Partners:

- Work closely with your EU importers and other supply chain partners to ensure seamless data flow and compliance with CBAM.
- Participate in industry forums, workshops, and events to share best practices and influence policy.

6. Leverage Digital Tools:

- Adopt digital solutions for efficient carbon management that can aid in data aggregation, analysis, and reporting. These tools can simplify the compliance process.

7. Continuous Improvement:

- Regularly review and update your carbon management strategies. The regulatory landscape is evolving, and staying ahead requires adaptability.
- Aim not just for compliance but for leadership in sustainable manufacturing practices.

8. Advocate for Policy Influence:

- Engage with industry associations and policy makers to advocate for fair implementation of CBAM, considering the unique challenges faced by HKMEs.
- Provide feedback on how CBAM affects your operations and suggest adjustments that could benefit the Asia-Pacific region.

9. Stay Informed:

- Keep informed of any changes in CBAM regulations, particularly regarding sectoral expansion or adjustments in carbon pricing mechanisms.

List of CBAM-covered Goods and Greenhouse Gases

Cement

CN Code	Greenhouse Gas
2507 00 80 – Other kaolinic clays	Carbon dioxide
2523 10 00 – Cement clinkers	Carbon dioxide
2523 21 00 – White Portland cement, whether or not artificially coloured	Carbon dioxide
2523 29 00 – Other Portland cement	Carbon dioxide
2523 30 00 – Aluminous cement	Carbon dioxide
2523 90 00 – Other hydraulic cements	Carbon dioxide

Electricity

CN Code	Greenhouse Gas
2716 00 00 – Electrical energy	Carbon dioxide

Fertilisers

CN Code	Greenhouse Gas
2808 00 00 – Nitric acid; sulphonitric acids	Carbon dioxide and nitrous oxide
2814 – Ammonia, anhydrous or in aqueous solution	Carbon dioxide
2834 21 00 – Nitrates of potassium	Carbon dioxide and nitrous oxide
3102 – Mineral or chemical fertilisers, nitrogenous	Carbon dioxide and nitrous oxide
3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers; goods of this chapter in tablets or similar forms or in packages of a gross weight not exceeding 10 kg Except: 3105 60 00 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium	Carbon dioxide and nitrous oxide

Iron and Steel

CN Code	Greenhouse Gas
72 Iron and steel – Except: 7202 2 – Ferro-silicon 7202 30 00 – Ferro-silico-manganese 7202 50 00 – Ferro-silico-chromium 7202 70 00 – Ferro-molybdenum 7202 80 00 – Ferro-tungsten and ferro-silico-tungsten 7202 91 00 – Ferro-titanium and ferro-silico-titanium 7202 92 00 – Ferro-vanadium 7202 93 00 – Ferro-niobium 7202 99 – Other: 7202 99 10 – Ferro-phosphorus 7202 99 30 – Ferro-silico-magnesium 7202 99 80 – Other 7204 – Ferrous waste and scrap; remelting scrap ingots and steel	Carbon dioxide
2601 12 00 – Agglomerated iron ores and concentrates, other than roasted iron pyrites	Carbon dioxide
7301 – Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel	Carbon dioxide
7302 – Railway or tramway track construction material of iron or steel, the following: rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates (base plates), rail clips, bedplates, ties and other material specialised for jointing or fixing rails	Carbon dioxide
7303 00 – Tubes, pipes and hollow profiles, of cast iron	Carbon dioxide

7304 – Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	Carbon dioxide
7305 – Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406,4 mm, of iron or steel	Carbon dioxide
7306 – Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel	Carbon dioxide
7307 – Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel	Carbon dioxide
7308 – Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	Carbon dioxide
7309 00 – Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	Carbon dioxide
7310 – Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	Carbon dioxide
7311 00 – Containers for compressed or liquefied gas, of iron or steel	Carbon dioxide
7318 – Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel	Carbon dioxide
7326 – Other articles of iron or steel	Carbon dioxide

Aluminium

CN Code	Greenhouse Gas
7601 – Unwrought aluminium	Carbon dioxide and perfluorocarbons
7603 – Aluminium powders and flakes	Carbon dioxide and perfluorocarbons
7604 – Aluminium bars, rods and profiles	Carbon dioxide and perfluorocarbons
7605 – Aluminium wire	Carbon dioxide and perfluorocarbons
7606 – Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	Carbon dioxide and perfluorocarbons
7607 – Aluminium foil (whether or not printed or backed with paper, paper-board, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm	Carbon dioxide and perfluorocarbons
7608 – Aluminium tubes and pipes	Carbon dioxide and perfluorocarbons
7609 00 00 – Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	Carbon dioxide and perfluorocarbons
7610 – Aluminium structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, balustrades, pillars and columns); aluminium plates, rods, profiles, tubes and the like, prepared for use in structures	Carbon dioxide and perfluorocarbons
7611 00 00 – Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	Carbon dioxide and perfluorocarbons
7612 – Aluminium casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	Carbon dioxide and perfluorocarbons

7613 00 00 – Aluminium containers for compressed or liquefied gas	Carbon dioxide and perfluorocarbons
7614 – Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	Carbon dioxide and perfluorocarbons
7616 – Other articles of aluminium	Carbon dioxide and perfluorocarbons

Chemicals

CN code	Greenhouse gas
2804 10 00 – Hydrogen	Carbon dioxide

List of Abbreviations

Abbreviation	Full Form / Definition
AEM	Anode Effect Minutes (e.g., “1.5 minutes/cell-day” used for PFC calculations)
BioC	Biomass Content (used in emissions monitoring calculations)
BOF	Basic Oxygen Furnace
BF	Blast Furnace
CBAM	Carbon Border Adjustment Mechanism
CHP	Combined Heat and Power
CN	Combined Nomenclature (codes used by the EU for product classification)
CMS	Carbon Management System (a term used to describe a variety of technologies and practices that monitor, report and reduce carbon emissions)
CEMS	Continuous Emission Monitoring Systems (direct measurement of emissions using approved monitoring equipment)
CF₄	Carbon Tetrafluoride (a type of perfluorocarbon)
C₂F₆	Hexafluoroethane (a perfluorocarbon, also sometimes written as C ₂ F ₆)
ConvF	Conversion Factor (used in calculating emissions from fuel or process data)
CO₂	Carbon Dioxide
CO₂e	Carbon Dioxide Equivalent (expresses GHG emissions on a common scale, e.g., in tonnes of CO ₂ e)
CWPB	Cold-Worked Precipitation-Based (referring to a specific production technology)
DAkkS	Deutsche Akkreditierungsstelle (German Accreditation Body)
EC	European Commission

EF	Emission Factor (the coefficient used to convert activity data into GHG emissions)
EHS	Environment, Health and Safety (<i>mentioned as part of departmental roles</i>)
EORI	Economic Operator Registration and Identification (a customs identification number required in the EU)
ETS	Emissions Trading System (e.g., EU ETS – the EU carbon market)
EU	European Union
FHKI	Federation of Hong Kong Industries
GHG	Greenhouse Gas
GTC	Gas Treatment Center (facility for treating or capturing process gases)
GWP	Global Warming Potential (the factor relating the radiative forcing of a GHG to that of CO ₂)
HKME(s)	Hong Kong Manufacturing Enterprise(s)
HKU	The University of Hong Kong
ICCN	Institute for Climate and Carbon Neutrality
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISO 14064-1	International Standard for Greenhouse Gas (GHG) Emission Quantification and Reporting
LCA	Life-Cycle Assessment (a technique to assess environmental impacts associated with all the stages of a product's life)
MRV	Monitoring, Reporting and Verification (the system/process for ensuring emissions data accuracy)
NG	Natural Gas (<i>common fuel in process calculations, though “NG” is used only context-implicitly</i>)
NAB	National Accreditation Body (accrediting organisations responsible for verifier accreditation)

NCV	Net Calorific Value (the amount of energy produced per unit of fuel, mandatory when using emission factors in tCO ₂ /TJ)
OxF	Oxidation Factor (used in emissions calculations; often assumed to be 1 for conservatism)
PFC(s)	Perfluorocarbons (a group of potent greenhouse gases, e.g., CF ₄ and C ₂ F ₆)
PCF	Product Carbon Footprint
PPA	Power Purchase Agreement (a contract between an electricity generator and a power purchaser)
R&D	Research and Development
RvA	Raad voor Accreditatie (the accreditation body in the Netherlands)
SOP	Standard Operating Procedure (a set of step-by-step instructions compiled by an organisation)
SEF	Slope Emission Factor (used in the Slope Method for estimating PFC emissions)
tCO₂	Tonnes of Carbon Dioxide
tCO₂e	Tonnes of Carbon Dioxide Equivalent
UN/LOCODE	United Nations Code for Trade and Transport Locations (the standard used to indicate location codes in logistics and customs reporting)

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