

REPORT

*China's Low-Carbon Competitiveness and National Technical and Economic Zones*

# Implementing Greenhouse Gas Inventory Management Systems for Economic Zones in China

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### ***China's Low-Carbon Competitiveness and National-Level Economic and Technological Development Zones Implementing Greenhouse Gas Inventory Management Systems for Economic Zones in China***

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## Glossary of Terms

**Activity data (AD):** Data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time. In the energy sector, for example, the total amount of fuel burned is annual activity data for fuel combustion sources.

**Covered entities:** Industrial or commercial facilities within an economic zone that are required to report and take action to reduce greenhouse gas emissions.

**Equivalent carbon dioxide concentration:** The concentration of carbon dioxide that would cause the same amount of radiative forcing as a given mixture of carbon dioxide and other greenhouse gases.

**Emission factor (EF):** A coefficient that relates activity data to the associated emissions of a particular substance. Emission factors are often based on a sample of measurement data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions.

**Greenhouse gas (GHG):** Greenhouse gases are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, by the atmosphere and by clouds. This property causes the greenhouse effect. Water vapour (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>) and ozone (O<sub>3</sub>) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely man-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

**Greenhouse gas inventories:** Inventories must include all the major greenhouse gases in the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), nitrous oxides (N<sub>2</sub>O), methane (CH<sub>4</sub>), sulphur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). The goal of inventories is that their values should be neither far over nor below the real values in accordance with greenhouse gas inventory development principles of transparency, accuracy, completeness, relevancy and consistency.

**Source:** Any process or activity that releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere.

**Tier:** Methods for estimating emissions and removals are divided into "tiers" encompassing different levels of activity and technology detail. Tier 1 methods are generally straightforward (activity multiplied by default emissions factor) and require less data and expertise than the most complicated Tier 3 methods. Tier 2 and 3 methods have higher levels of complexity and require more detailed country-specific information on things such as technology type.

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## 1.0 Introduction

China is aggressively pursuing the development of low-carbon economic zones, and while there has been substantial work to define targets and indicators for achieving greenhouse gas (GHG) emission reductions, there is now a need to provide guidance and tools to help the zones transition.

GHG inventories for industrial and commercial facilities are an essential component of the transition to low-carbon operations as they provide the foundation for identifying abatement opportunities while measuring and assessing progress towards achieving facility-level GHG targets. A GHG inventory system that provides for frequent, accurate, consistent, complete and transparent reporting is crucial to the success of these low-carbon policies and central to industries transitioning to low-carbon operations.

Inventory management requires many different stakeholders to supply information, conduct analysis, provide critical review and expert judgement, manage the compilation of the inventory and disseminate inventory data to stakeholders. The intent of this paper is to identify concrete steps that economic zones overseeing low-carbon development and companies included in low-carbon programs can implement in order to establish an effective GHG inventory management system. Typical barriers and gaps that economic zones may face in implementing GHG inventory systems are also addressed.

This policy brief presents a collaborative approach between the economic zones that have the authority to manage and report GHG emissions and the companies that must deliver. The approach is based on best practices and formal standards for GHG inventory development. The guidance presented is oriented to help zones and their member companies to develop emission inventories for a wide range of GHG programs such as carbon trading, absolute caps and performance standards, which we refer to in this document as program rules. These program rules may evolve from either regional initiatives or national directives. This guidance will help both authorities and companies in economic zones understand the basic concepts related to inventory planning, development and management, as well as how to monitor, report and verify emissions.

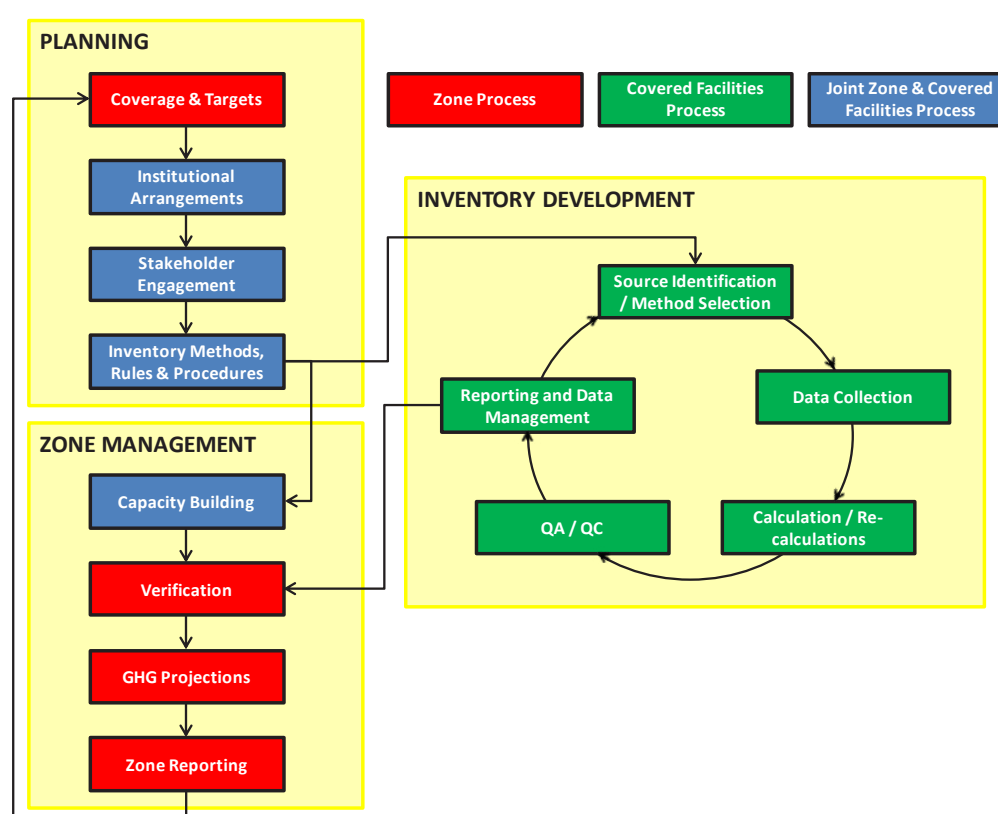
Section 2 of the report provides an overall conceptual framework for the development and implementation of a GHG inventory system for economic zones. Sections 3, 4 and 5 then outline process steps associated with planning, inventory development and reporting by covered entities, and zone management.

## 2.0 Framework for GHG Inventory Systems

Figure 1 presents a conceptual framework for the development and implementation of a GHG inventory system for economic zones. The framework identifies different processes for planning, inventory development and zone management that, if followed, can effectively measure, report and verify emissions from covered entities (i.e., industrial or commercial facilities included in the program that must report emissions).

The different colours correspond to the leading actor(s): red identifies processes conducted primarily by the economic zone authority, green identifies processes conducted primarily by the covered industrial and commercial facilities and blue identifies processes that require extensive collaboration and engagement between economic zones and industrial facilities (entities covered by the program rules).

The GHG inventory system is a cycle that requires constant improvement and refinement to adapt to potentially changing coverage and targets, as well as to maintain the integrity and quality of the inventory system. While Figure 1 implies discreet and ordered steps, in fact these processes overlap and are part of an annual cycle of reporting conducted at non-sequential stages. The following sections discuss the individual processes within each of the planning, inventory development and zone management phases.



**FIGURE 1: POTENTIAL FRAMEWORK FOR A GHG INVENTORY SYSTEM FOR CHINESE ECONOMIC ZONES**

### 3.0 Planning

While the State Council sets main strategies and targets for energy and climate change policies, due to the decentralized nature of governance in China, it is the provinces and municipalities that develop and implement GHG inventory systems for appropriate monitoring, reporting and verification (MRV). The State Council through the National Development and Reform Commission (NDRC) has recognized the need to establish or strengthen MRV systems for GHG emissions. The carbon trading pilot program has been a significant catalyst for the development of MRV systems and the NDRC has published guiding documents to support proper monitoring and reporting of GHGs, including *Greenhouse Gas Accounting and Reporting Guidelines for 10 Industries* (NDRC, 2013). However, it is clear that more work on GHG inventory development is required and the Ministry of Environmental Protection recognizes the absence of detailed assessment methods and lack of basic data for economic zones (Tian et al., 2014). The World Resources Institute and China National Institute of Standardization published a 2014 report entitled *Cornerstone for GHG Accounting*, which summarizes many of these gaps in corporate inventory development.



Typically, the local Development and Reform Commission is responsible for overall management. There are many challenges in leading this work, including compliance, data accuracy and consistency, and insufficient guidelines and regulations. The following sections outline planning processes that can address these challenges.

#### 3.1 Coverage and Targets

In the inventory development process, there are two central first steps. It must be decided which industrial and commercial facilities are to be covered by the GHG inventory system and how performance metrics or GHG targets are to be allocated to the facilities. Coverage simply refers to the facilities that are to be covered by the GHG inventory—those that will be required to report GHG emissions and track GHG performance. Identifying which facilities are to be covered by a zone inventory and emissions report will, to some extent, depend on the program rules—whether national, provincial or municipal. There may be limited requirements that cover specific economic sectors or there may be reporting thresholds that set emission or energy levels that stipulate which facilities need to develop inventories.

Coverage within a program is generally defined for facility GHG emissions that exceed a specific annual threshold. For example, the NDRC has identified coverage for entities emitting more than 13,000 tonnes of carbon dioxide equivalent (tCO<sub>2</sub>e) per year in its latest notice (NDRC, 2014). International programs also often identify which specific industries are included and which are not. Identifying specific industries can be especially helpful where there is insufficient data reported to economic zones to determine whether a facility exceeds a specific threshold. In many programs, there is an acknowledgement that thresholds will be ratcheted down over time, or that new different types of industries will be included in the future.

Coverage for most GHG inventory programs encompasses only direct emissions from sources that are owned or controlled by the covered entity, although some programs also include indirect emissions from electricity used but not produced onsite. Inventory management systems are considerably simpler if they do not include indirect emissions that occur upstream or downstream from the facility, and it is recommended that economic zones focus their efforts on direct emissions.

With the covered entities or facilities identified, the zone must then think about the targets that are to be allocated to each facility and how these rollup into overall zone performance. There are two choices here for the zone:

- Absolute targets track reductions in total emissions at a facility, specified simply as GHGs emitted.
- Emission intensity targets include total GHG emissions but are then divided by the sum estimate of activity level at the firm—for example, emissions per unit of production such as electricity generated or other metrics such as energy intensity (i.e., energy-use reductions per unit of output).

From an emission inventory perspective, an absolute target is often preferable because emissions under the target can be more easily quantified, whereas benchmarking industrial output adds a layer of complexity to data gathering and MRV.

If zones must report on a GHG target, there are two ways to think about this problem: top-down or bottom-up allocation of targets. In the case of the top-down approach, the zone could simply be handed a target from a higher political authority, say a -10 per cent reduction in absolute emissions or emission intensity against a base year of, for example, 2010. In this case, the target would be selected without doing any forward-looking analysis that assess for facilities what emission reductions are feasible and at what cost. It would then be up to the zones to determine how this target would be allocated between its facilities. Again, this can be arbitrarily done in a top-down approach in which all facilities are required to achieve the same emission reduction. The risk of this top-down and uniform allocation method would likely be higher costs for achieving the target, not reflecting the ability of different firms to achieve emission reductions at differentiated costs. High-cost outcomes associated with achieving targets would particularly be a risk if compliance flexibility, such as emission trading, were not enabled for emitters.

A more bottom-up target allocation would set about determining how to achieve the target based on what each facility could deliver at what cost. The objective would be to identify low-cost options across emitters, thereby lowering overall compliance costs. This more complex analysis would first identify current emissions at facilities, then project these into the future using some assumption about production growth, and finally identify mitigation opportunities that reveal the costs and emission reductions that would be feasible for the facility.

Setting GHG targets is a challenge given that targets lead to costs and competitiveness concerns. There is also a conflict for zones in differentiating targets between facilities that have different structures, costs, processes and harmonizing so that facilities can compete on an equal playing field. An equal playing field means that facilities can be subject to the same rules and benchmarked against each other.

## 3.2 Institutional Arrangements

Institutional arrangements identify how different organizations work together and interact to achieve the aims of the GHG inventory systems and overall GHG or energy program. These arrangements can either be formal or informal, including provisions that define the roles and responsibilities of all the organizations involved in the inventory preparation process, including key stakeholders.

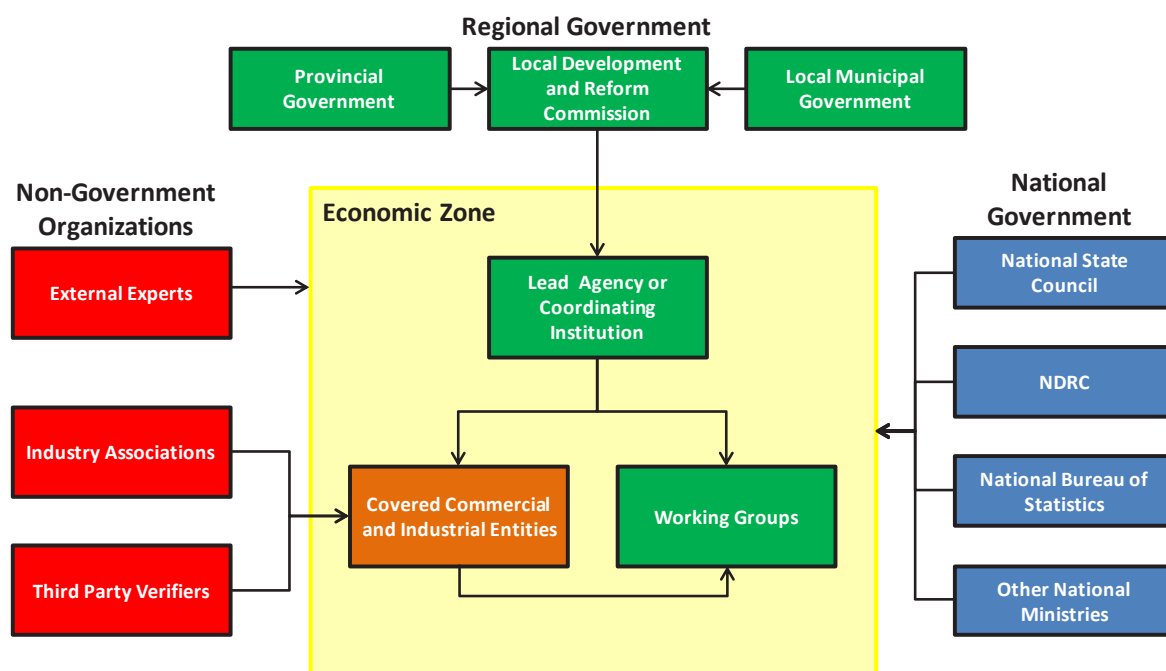
A central agency or lead coordinating institution is essential for coordination, driving the process and providing strategic guidance for these interactions. This agency must have the power to convene the stakeholders and lead institutions. Between different government departments and ministries it may be necessary to develop Memoranda of Understanding (MOU), so it is clear when and what will be contributed, and by whom, to the GHG inventory system.



It is important that all stakeholders have clear roles and that these are firmly engrained and institutionalized so that resources and capacity are available when required in the inventory-development cycle, and so that long-term continuity is ensured. A realistic assessment of both short-term and long-term resources should be conducted to determine how stakeholders can be expected to contribute. Evaluating roles and responsibilities over time is important, and therefore it would be useful to reassess and document the strengths and weaknesses of existing institutional arrangements.

Arrangements between governments and emitters typically require legal force with very well-defined reporting requirements. There are several other arrangements that can help guide the overall governance of the GHG system—for example, where external experts provide technical and peer review guidance, particularly on rule setting, inventory methods and forecasting. These experts could sit at academic institutions or at national ministries. Figure 3 sets out an example of institutional arrangements.

In addition to the institutional arrangements, consideration should be given to integration with other related programs, such as low-carbon city plans or energy-efficiency programs. These types of plans require similar coordination efforts, including data collection, verification, stakeholder and expert input, reporting and funding requirements. Integration may provide some resource efficiencies and avoid duplication of similar processes.



**FIGURE 2: EXAMPLE OF INSTITUTIONAL ARRANGEMENTS**

### 3.3 Stakeholder Engagement

There is value in including key stakeholders early in the inventory planning process. Private stakeholders include the covered entities, their industry associations and public and private institutions, civil society leaders and non-governmental organizations that may represent interests in climate change mitigation and local air quality. There should be room for all of these various organizations to provide comments and advice, and to voice potential concerns.

The engagement process is particularly important at the beginning of inventory development before coverage and rules have been set, so that there can be consensus on the objectives and criteria for success.

Engagement can build ownership and consensus, and including a broad range of stakeholders ensures that the necessary expertise and input are at the table in order to establish a robust GHG inventory system. The consultation process also improves transparency and trust among the stakeholders.

Initial engagements with stakeholders should seek to educate them about the emerging system by presenting the proposed GHG inventory process. These discussions should include plans for developing targets and establishing coverage, expected reporting requirements and institutional arrangements. Important design aspects to discuss include:

- A proposal on how covered entities will be determined
- A proposal on how specified targets will lead to overall emission reductions that are in line with national targets
- A proposal on how different government, industry and non-government organizations will work together
- Estimates of expected human, financial and technical resource needs for all stakeholders
- Development and approval of methodology guidance for preparation of inventories
- Needs and requirements for capacity building
- A proposal for baseline development
- A proposed schedule for implementation and reporting requirements

After an initial stakeholder consultation, it will be important to hold regular meetings to maintain communication, identify progress and solicit feedback. Stakeholder committees or working groups can be established to address specific aspects of the GHG inventory system that require development.

### 3.4 Inventory Methods, Rules and Procedures

Developing GHG emission inventories in China's economic zones requires explicit definitions, guidelines, methodologies, templates and tools to be made available. In this section, a general overview of some inventory methods rules and procedures is provided.

One of the first decisions relates to selecting a base year for which verifiable emissions data for covered entities are available and can then be used as a basis for setting and tracking progress towards a GHG target. Depending on the current level of reporting, it may be possible to select a historic baseline year for certain industries and facilities. Where data are lacking, it is important to prompt covered entities to begin inventory development as soon as possible so that reporting and target setting are not delayed.

Covered entities will need clear step-by-step guidance for identifying emission sources, collecting data to measure or estimate emissions, and establishing methods for estimating emissions and procedures for conducting quality assurance and verifying reported emissions. They will also need rules for what they need to report and the milestones for submitting reports. Conducting these tasks will require significant capacity building and resources, and it is best if the zone provides clear guidance, calculation templates and tools that can be adopted.

The following working groups or stakeholder committees could be initiated to develop appropriate guidance and rules for the GHG inventory system process:

- GHG inventory methods, templates and tools for covered entities (this working group could potentially be divided into different subsectors of industry—e.g., heavy industrial, commercial, transport)
- Reporting and verification requirements for covered entities
- GHG projections, target setting and coverage

Potential sources for inventory development methodologies that could be adopted include:

- China NDRC
- World Business Council for Sustainable Development *Greenhouse Gas Protocol*
- U.S. Environmental Protection Agency *Climate Leaders GHG Inventory Protocol*
- The *IPCC Guidelines for National GHG Inventories* refer to a hierarchy of calculation approaches and techniques ranging from the application of generic emission factors to direct monitoring.
- Industrial associations<sup>1</sup>

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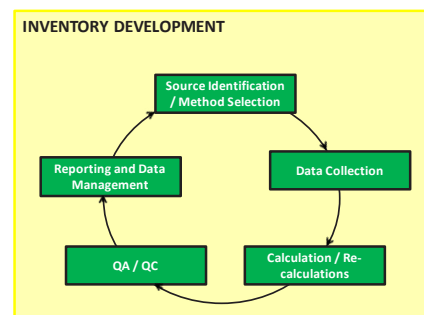
<sup>1</sup> See, for example, the International Aluminium Institute (2006), the American Petroleum Institute (2009) and the cement protocol of the World Business Council for Sustainable Development (2005).

## 4.0 Inventory Development

A facility GHG emission inventory can help companies to effectively understand their GHG emission risks and opportunities and to develop a planned response to manage these risks and opportunities. An emission inventory is essentially a best estimate of emissions from activities that occur at the facility and is, generally, not a precise measurement.

Before a reporting entity begins to prepare a GHG emission inventory, they should establish an inventory team that is responsible for implementation and coordination.

It is useful in this process to develop an inventory management plan to ensure the credibility and quality of the facility GHG inventory. This plan should include institutional, managerial and technical arrangements between personnel that identify who is responsible for collecting data, preparing the inventory, quality assurance and documentation. Specific steps to inventory development are discussed in the subsections below in more detail. In general, it is useful to institutionalize these roles with existing environmental management procedures that may already be in place, such as ISO 9000 (Quality Management) or ISO 14001 (Environmental Management).



### 4.1 Source Identification and Method Selection

For effective management of GHG emissions from a facility, it is important that operational boundaries and sources of emissions are clearly understood. The boundary of the facility is usually the physical property limits of the facility where direct emissions are from sources that are owned or controlled by the company (e.g., emissions from combustion in owned or controlled boilers, furnaces, vehicles; emissions from chemical production in owned or controlled process equipment). Indirect emissions from the generation of purchased electricity or steam may or may not be included in the inventory system depending on the rules of the program. Other types of indirect emissions that are a consequence of the activities of the company but occur at sources owned or controlled by another company are rarely included in facility inventories.

Direct emissions typically include the following activities:

- Generation of electricity, heat or steam from equipment such as boilers, furnaces, turbines or generators.
- Combustion of liquid and solid fuels at the site for other processes and equipment (note that carbon dioxide emissions from biomass fuels are not typically included).
- Physical or chemical processing that results in the release of GHG emissions (e.g., cement, aluminum, adipic acid, waste processing and ammonia manufacturing).
- Transportation of materials, products, wastes and employees. These emissions are only accounted if they are controlled by the company (e.g., vehicles that are company owned).
- Fugitive emissions resulting from intentional or unintentional releases (e.g., methane emissions from gas transport or HFC emissions from air conditioning equipment).
- Disposal of wastes at onsite facilities.

Acceptable methods to estimate GHGs will likely be defined for the program (Section 4.4 below provides some links for general inventory methods). Direct measurement of GHG emissions by monitoring concentration and flow rate is not common. More often, emissions are calculated based on a mass balance or stoichiometric basis specific

to a facility or process. The most common approach for calculating GHG emissions is through the application of documented emission factors. These factors are calculated ratios relating GHG emissions to a proxy measure of activity at an emission source.

Most program guidances will provide a tiered methodology approach, offering a choice between a simple and a more advanced calculation approach. The more advanced approaches result in more accurate emission estimates, but typically have more data requirements and require a more thorough understanding of the technologies used in the operations. Where it is up to the reporting entity to decide on the level of the approach, they will need to base the decision on the balance of achieving accuracy in reporting and the resources that are available, as well as whether the source contributes significantly to overall facility emissions. For example, if the source contributes significantly (e.g., 10 per cent of overall emissions), then there is a stronger case for using more complicated and advanced methodology (i.e., higher tier) that requires additional resources.

## 4.2 Data Collection

Once sources and estimation methods have been identified, the covered entity should document the applicable quantification method and detail the relevant data that is required to quantify each emission source. The data required can typically be reduced to a simplified calculation formula:

$$\text{Emissions} = \text{Activity Data (AD)} \times \text{Emission Factor (EF)}$$

Activity data (AD) represents information on the magnitude of human activity resulting in emissions or removals taking place during a given period of time. For example, the total amount of fuel burned annually is AD for fuel combustion sources. The emission factor (EF) would be an estimate of the GHG emissions per unit of fuel that has been derived from a sample of measured data. These emission factors might be derived by international institutions (e.g., published emission factors in the Intergovernmental Panel on Climate Change guidelines) or there may be national estimates available. In a few cases, facilities may be required to estimate their own emission factors from facility data. For example, information on the energy density of fuels can be used to estimate emission factors.

In many cases, companies may be able to rely on records of purchased quantities of commercial fuels such as natural gas, coal, diesel, heavy fuel oil, propane, etc. That can then be multiplied by relevant published emission factors in guidelines or from other approved sources. If indirect emissions from electricity consumption must be calculated, then the metered electricity consumption can be combined with supplier-specific emission factors from the local grid.

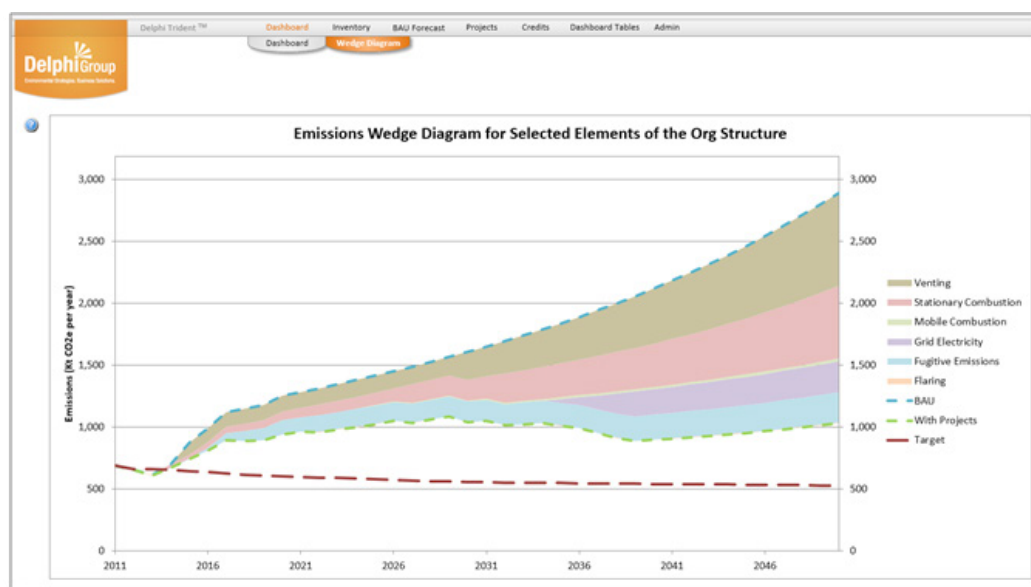
Finally, for large industrial point sources that operate almost continuously, it is possible that direct measurement using continuous emissions monitoring systems (CEMS) will be required.

## 4.3 Calculation and Recalculations

Guidelines may provide templates in the form of tables or software tools to complete emission calculations. If these are not provided, most calculations can be performed in spreadsheets. Activity data, emission factors and methodologies applied should be clearly referenced and outlined.

If there is a significant change to the calculation methodology or improvements in the accuracy of emission factors or activity data that are expected to have a significant impact on a covered entity's base-year emissions, then base-year emissions should also be recalculated to ensure consistency between all years. In addition, the discovery of significant errors may require that emissions be recalculated.

One example of a carbon and energy management tool is the Delphi Trident spreadsheet software, which can be used to develop GHG inventories as well as GHG and energy management strategies.



**FIGURE 2: EXAMPLE OF A CARBON AND ENERGY MANAGEMENT ACCOUNTING TOOL**

Source: DelphiGroup (2014).

#### 4.4 Quality Assurance and Quality Control

Quality assurance (QA) is a planned system of review procedures. It is performed by personnel that are not directly involved in the inventory compilation and development process. Quality control (QC) is a system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled. It is performed by the personnel compiling the inventory. Identifying QA/QC procedures can help to establish a cost-effective QA/QC program that improves transparency, consistency, comparability, completeness and accuracy in GHG inventories.<sup>2</sup>

Generic quality checks of how data is gathered and handled to check for transcription and conversion errors, as well as a review of the documentation of methods, references and data, must be completed. Examples of important QA/QC checks and reviews are summarized in Table 1.

**TABLE 1: EXAMPLE OF QA/QC INVENTORY CHECKS AND REVIEWS**

QC CHECKS	QA REVIEW PROCEDURES
There are no transcription errors in data input.	Expert peer review of calculations
Emissions are estimated and calculated correctly.	Audits to assess quality and identify improvements
Proper conversion factors are used.	Review of recalculation procedures
All sources and sinks are accounted for within facility boundary.	Review of the major causes of uncertainty in the data
Emission factors are appropriate for the source.	An overall review of the quality of the data input
Boundaries are appropriate.	

Source: Adapted from the World Resource Institute (2004) and Intergovernmental Panel on Climate Change (2006).

<sup>2</sup> These are the GHG inventory development principles as outlined by the United Nations Framework Convention on Climate Change and ISO Standard 14604-2.

The inventory personnel responsible for implementing QA/QC should attempt to integrate the GHG inventory review procedures with existing quality systems and should report practical measures to improve the quality of the inventory over time and correct and improve overall performance to the inventory team.

Detailed guidance on QA/QC is available from these sources:

- *The Greenhouse Gas Protocol* (World Resources Institute & World Business Council for Sustainable Development, 2004)
- ISO 14064-1 (ISO, 2009a)
- *Climate Leaders Greenhouse Gas Inventory Protocol* (U.S. EPA, 2005)

## 4.5 Reporting and Data Management

A GHG reporting and data management plan that outlines procedures and processes to document, report and archive the inventory is critical to ensuring the integrity of the GHG data and information. The plan serves to ensure that the inventory complies with the principles of completeness and transparency. Recommended steps and processes that should be included in the reporting and data management plan are outlined in Table 2 below.

**TABLE 2: REPORTING AND DATA MANAGEMENT PROCEDURES AND PROCESSES**

REPORTING AND DATA MANAGEMENT STEP	RECOMMENDED PROCEDURES AND PROCESSES
Data Collection	<ul style="list-style-type: none"> <li>• Data entry controls</li> <li>• Staff competency requirements</li> <li>• Documented procedures and schedule for data collection</li> <li>• Prescribed sampling methodologies</li> </ul>
Data Consolidating and Processing	<ul style="list-style-type: none"> <li>• Checks on conversion of data between origin and destination</li> <li>• Controlled and protected access to spreadsheets and databases</li> <li>• Approvals and testing procedures for changes to spreadsheets or models</li> <li>• Error checking procedures including data reconciliations, recalculation</li> </ul>
Data Transmission	<ul style="list-style-type: none"> <li>• Ensure ability to recover data in the event of incomplete data transmissions</li> <li>• Existence and adequacy of input, output and transformation error checking, routines</li> </ul>
Data Reporting	<ul style="list-style-type: none"> <li>• Distribution lists for reports</li> <li>• Documented procedures for management review of reports</li> </ul>
System Security and Recovery	<ul style="list-style-type: none"> <li>• Defined user access to greenhouse gas data</li> <li>• Documented process to ensure appropriate timing and frequency of data back-up</li> </ul>
Maintenance and Archiving	<ul style="list-style-type: none"> <li>• Clearly defined accountability and codes of conduct for staff and service providers</li> <li>• Internal audit procedures and schedules for management reviews</li> <li>• Documented data retention procedures for electronic and hardcopy records</li> </ul>

Source: Adapted from the World Resource Institute (2004) and World Business Council for Sustainable Development (2005)

## 5.0 Zone Management

### 5.1 Capacity Building

There are a number of key barriers to an effective GHG emission inventory system that can be overcome through capacity-building efforts. Common challenges that can be addressed through capacity building include developing and maintaining expert human resources for preparing GHG emission inventories within both the zone management structure and at the corporate level of reporting entities, as well as developing specialized tools for inventory development.

Typical challenges to inventory preparation and MRV that can be addressed through capacity-building efforts are identified in Table 3.

**TABLE 3: GHG INVENTORY SYSTEM CHALLENGES AND POTENTIAL CAPACITY-BUILDING EFFORTS**

CHALLENGE	CAPACITY BUILDING
Limited technical and analytical capacity for reporting entities	<ul style="list-style-type: none"> <li>Provide training workshops to review requirements, methods and inventory processes</li> </ul>
Limited zone management, technical and analytical capacity	<ul style="list-style-type: none"> <li>Provide adequate staff for lead agency and provide staff with training on management, reporting and GHG projection analysis</li> </ul>
Inadequate data-gathering systems in place	<ul style="list-style-type: none"> <li>Training for reporting entities on appropriate data measurement and collection</li> <li>Development of online platforms for reporting</li> </ul>
Limited methodological guidance	<ul style="list-style-type: none"> <li>Provide stakeholder working groups with funding and resources to develop appropriate guidance documents for inventory development</li> <li>Expert input and review from industry stakeholders</li> </ul>
Limited structures for reporting and data management	<ul style="list-style-type: none"> <li>Develop new data collection systems, including potentially online platforms for reporting.</li> <li>Adopt, develop and provide tools to measure or calculate emissions and templates for reporting emissions</li> <li>Set up a central database and if necessary set up legislation to collect data</li> </ul>
Difficulty in maintaining resources (loss of institutional memory and capacity)	<ul style="list-style-type: none"> <li>Focus training on multiple representatives</li> </ul>
Weak coordination capacity between zone and reporting entities	<ul style="list-style-type: none"> <li>Provide funding for stakeholder engagement and training on inventory management for zone and reporting entities</li> </ul>
Lack of political will, trust and buy-in from reporting entities	<ul style="list-style-type: none"> <li>Promote awareness of the importance of quality GHG inventory and achieving targets</li> <li>Encourage transparency and disclosure</li> </ul>
Limited verification capacity	<ul style="list-style-type: none"> <li>Develop a program for training and selecting third-party verifiers or for establishing a governing body.</li> </ul>

Capacity building can be facilitated through structured, regularly scheduled interactions among stakeholders, and through workshops and meetings that provide time and space for discussions.

It is also very important to determine sustainable funding for capacity building early in the process to ensure that gaps in inventory reporting and quality are limited and that improvements can be made over time. Inadequate budget support jeopardizes both the quality of the inventory and its usefulness in policy decision making.



## 5.2 Verification

Verification is an objective and systematic assessment of the accuracy and completeness of reported GHG information to pre-established GHG accounting and reporting principles. It involves an assessment of the risks of material discrepancies in reported data that may arise from the improper application of relevant standards and methodologies. The verifier seeks to provide a reasonable, but not absolute, level of assurance that the GHG emissions reported by covered entities are materially correct by prioritizing the assessment of data and associated systems that have the greatest impact on overall data quality.

While an independent, external third party often undertakes verification, this may not always be the case. Various programs have given government agencies the responsibility for verification. Pilot trading carbon programs in China currently employ third-party verification. Third-party verifiers are required to submit a formal written declaration that provides assurances that the inventory and reporting is correct.

Table 4 identifies typical steps to verification and different tasks and associated requirements that are recommended.

Third-party verifiers are typically required to use the ISO 14064-3 verification standard. This standard embodies the underlying principles of reporting in ISO 14064-1 of relevance, completeness, consistency, accuracy and transparency (ISO, 2009b). Examples of facility-level guidance for MRV include the European Union Emission Trading System’s monitoring and reporting guidance (European Commission, 2012), *The Greenhouse Gas Protocol Corporate Standard* (WRI & World Business Council for Sustainable Development, 2004). The International Partnership on Mitigation and MRV’s *MRV Tool: How to Set Up National MRV Systems* (n.d.) may also be useful in determining verification requirements.

**TABLE 4: VERIFICATION STEPS AND ASSOCIATED REQUIREMENTS**

VERIFICATION STEP	REQUIREMENTS
Selection	<ul style="list-style-type: none"> <li>Demonstrate that the verifier has no internal conflict and have the necessary competencies to complete the assessment</li> </ul>
Evaluation of Available Data	<ul style="list-style-type: none"> <li>Evaluate inventory to ensure that there is sufficient and appropriate evidence available for verification</li> </ul>
Developing Program Criteria	<ul style="list-style-type: none"> <li>Identify the program criteria highlighting any specific requirements that will be reviewed</li> <li>Verify objective, scope and level of assurance being provided</li> <li>Preliminary GHG assertion, baseline assertion and previous assertions if applicable</li> <li>Identify the assurance standard being used by the verification team (i.e., ISO 14064-3 and other applicable standards such as CSAE 3000 or CSAE 3410)</li> </ul>
Understanding of Operations	<ul style="list-style-type: none"> <li>Understand the entity’s technical operations and processes as well as GHG data management systems in place (measurements, calculation methodologies, reporting, etc)</li> <li>Document changes to operations, and organizational or operational boundaries since the prior verification</li> <li>Describe the responsible party’s data management system(s)</li> <li>Describe the existing quality control environment</li> </ul>

VERIFICATION STEP	REQUIREMENTS
Risk Assessment	<ul style="list-style-type: none"> <li>• The verifier must assess risks based on information collected. Potential risks include:               <ul style="list-style-type: none"> <li>» The ability for management to override internal controls</li> <li>» Inadequate, poorly controlled and/or poorly documented mechanisms for collecting data, quantifying emissions and preparing the GHG assertion including quality checks</li> <li>» Lack of staff competency in collecting data, quantifying emissions and preparing GHG assertion</li> <li>» Lack of management involvement in quantifying emissions and preparing the GHG assertion</li> <li>» Failure to identify accurately all the GHG sources</li> <li>» Risk of fraud—for example, in connection with emissions trading markets</li> <li>» Presenting information covering prior periods that is not prepared on a consistent basis—for example, because of changes in boundaries or measurement methodologies</li> <li>» Misleading presentation of information in the GHG assertion</li> <li>» Inconsistent quantification methods and reporting policies</li> <li>» Errors in unit conversion when consolidating information</li> <li>» Inadequate disclosure of material scientific uncertainties and key assumptions in relation to estimates</li> </ul> </li> </ul>
Materiality Assessment	<ul style="list-style-type: none"> <li>• Distinguish between misstatements that are significant and those that are not</li> <li>• Identify materiality and tolerable error thresholds being used</li> </ul>
Reporting and Plan for Controlling Risks	<ul style="list-style-type: none"> <li>• Identify members of the verification team including the peer reviewer and designated signing authority</li> <li>• Disclose and disseminate reports to the public</li> </ul>

Source: Adapted from Deutsche Gesellschaft für Internationale Zusammenarbeit (2013).

### 5.3 GHG Projections

An accurate and reliable zone inventory compiled from individual covered entities combined with a baseline projection is the cornerstone for developing and assessing the effectiveness of GHG mitigation policies. This is because in order to assess a policy we need to have an emissions baseline projection (i.e., reference case) against which potential actions or policies can be evaluated. This baseline emission projection is built from reported emission data and is a plausible and consistent description of how overall emissions can be expected to evolve in the absence of new policies or regulation directed at GHG emissions. The lead agency or coordinating institution is likely to be in the best position to prepare GHG projections but may need assistance from external experts to build and run associated projection models.

Different methods and models can be used to develop a baseline emission projection from inventory data. The simplest method is to base emissions on historic trends, but this is not likely to provide reliable estimates, as there are many socioeconomic changes that can alter future trends. Another method would be to conduct a bottom-up estimate of likely changes in demand for energy or services and changes in emission intensity or energy efficiency that do not include emission limits in the economic zone or additional policies that could be implemented to address climate change. Regional projections of demographic and economic growth could also be incorporated into the bottom-up emissions projections. Alternatively, general equilibrium economic models that apply a top-down approach could be used to generate projections of labour, capital and resource use to estimate the production of goods and services and the related emissions. There are also hybrid models that combine both bottom-up and top-down approaches. Table 5 identifies different models that could be adopted by economic zones to develop plausible and robust GHG projections and summarizes their strengths and weaknesses.

A comprehensive examination of zone policies would require full GHG inventories prepared for a number of historic years in order to be able to evaluate and understand historic trends.

**TABLE 5: POTENTIAL MODELS FOR ECONOMIC ZONE GHG PROJECTIONS**

TYPES OF MODELS		STRENGTHS	WEAKNESSES	EXAMPLES
CATEGORY	TYPE			
Bottom-up	Accounting	<ul style="list-style-type: none"> <li>Easy to use with lots of defaults available to reduce data requirements</li> </ul>	<ul style="list-style-type: none"> <li>Linkages with broader macroeconomic developments are missing</li> <li>Highly disaggregated data on specific technologies is required</li> </ul>	LEAP, MEDEE, MAED, RETSCREEN
	Optimization	<ul style="list-style-type: none"> <li>Significant technology detail required</li> <li>Allows for least cost analysis</li> </ul>	<ul style="list-style-type: none"> <li>Linkages with broader macroeconomic developments are missing</li> <li>Substantial resource requirements</li> </ul>	MARKAL/TIMES, POLES, RESGEN, EFOM
Top-Down	Simple extrapolation	<ul style="list-style-type: none"> <li>Simple model</li> <li>Lower resource and data requirements</li> </ul>	<ul style="list-style-type: none"> <li>Lack of technological and end-use details</li> <li>Not responsive to substitutions and prices</li> </ul>	Spreadsheet models
	Computable general equilibrium	<ul style="list-style-type: none"> <li>Allows for feedback effects on macroeconomic variables</li> <li>Allows for national fiscal policies like a carbon tax or emission cap to be analyzed</li> </ul>	<ul style="list-style-type: none"> <li>Lack of technological and end-use details</li> <li>Substantial resource requirements</li> <li>Difficult to define elasticities of demand</li> </ul>	ENV-Linkages, SGM, CETA
	Hybrid	<ul style="list-style-type: none"> <li>Allows for both technology detail and consistency with feedback effects on macroeconomic variables</li> </ul>	<ul style="list-style-type: none"> <li>Resource Intensive</li> <li>Difficult to calibrate and maintain</li> </ul>	WEM, NEMS, MARKAL-MACRO, IPAC, ENPEP

## 5.4 Zone Reporting

The economic zone should have a reporting protocol to determine what information is shared with the public and the frequency with which they will provide information. Since transparency is a key principle to GHG emission inventory development and management, the more information shared the better. In some jurisdictions, individual reports prepared by covered entities and associated verification reports are publicly available.

The following reporting requirements for economic zones are based on best practice from a number of different reporting protocols including the *Mitigation Goals Accounting and Reporting Standard* (2013) published by the World Resources Institute.

It is essential that the economic zone have a single focus point for all inventory and reporting issues to ensure that all reports and data from reporting entities are centralized and that coordination and inventory improvement can be managed.

**TABLE 6: POTENTIAL REPORTING REQUIREMENTS FOR ECONOMIC ZONES**

REPORTING CATEGORY	REQUIREMENTS
Target and Coverage	<ul style="list-style-type: none"> <li>▪ Description of geographic area of economic zone</li> <li>▪ Summary of overall target and time frame for compliance</li> <li>▪ Identification of commercial and industrial facilities (covered entities) that are included in the program</li> <li>▪ Identification of sector- or facility-level targets</li> <li>▪ Identification of the unit of output for intensity targets if applicable</li> <li>▪ Identification of GHG emissions included or excluded (e.g., indirect emissions)</li> <li>▪ Rules regarding trading emission reductions, offsets and sequestrations</li> </ul>
Historical Emissions and Progress	<ul style="list-style-type: none"> <li>▪ Presentation of historical trends in overall emissions and sector emissions including baseline emission levels</li> <li>▪ Complete GHG inventory for the most recent year, including a summary of trends in sector-level emissions</li> <li>▪ Any corrections, recalculations or revisions to calculation methodologies conducted since previous reporting</li> <li>▪ Identification of whether the target was achieved and the difference between the accountable emissions and allowable emissions under the target</li> <li>▪ The type, vintage and quantity of transferable emission reductions or offsets that are retired or sold</li> </ul>
Projections	<ul style="list-style-type: none"> <li>▪ Description of the baseline scenario (e.g., whether it is static or dynamic baseline, the time frame, assumptions and models applied)</li> <li>▪ Key emission drivers of the baseline scenario</li> <li>▪ The adopted policies and actions that are included in mitigation projections</li> <li>▪ Any corrections, recalculations or revisions to projection methods conducted since previous reporting</li> <li>▪ Results of any uncertainty analysis and/or sensitivity analysis undertaken</li> </ul>
Verification	<ul style="list-style-type: none"> <li>▪ Type of verification performed and summary of verification reports for covered entities</li> <li>▪ Mechanisms in place to prevent double counting of transferable emission reduction units</li> </ul>

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