

Corporate GHG Emission Inventories Lessons Learned: Protocols, Verifications, and Data Management Systems

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Foreword

Climate change has become a serious business issue and national and global programs, such as emissions trading and other voluntary initiatives, and the Kyoto Protocol (recently ratified by Russia, and came into force on February 16, 2005) are gaining momentum. Also, significant state and regional GHG emissions registry and regulatory development activities are underway in the U.S., e.g., the Regional Greenhouse Gas Initiative (RGGI) in nine (9) northeastern and mid-Atlantic states. Thus, for U.S.-based corporations, particularly those with existing assets in Kyoto Protocol Annex I countries (i.e., those with emission reduction commitments) such as the UK, EU, Japan, Canada, and Russia, and development interests in non-Annex I countries, climate change presents both business opportunities and risks.

In response to that, a number of companies in the U.S. and internationally are in the process of developing greenhouse gas (GHG) management plans, to serve as a guideline and provide background information for the implementation of action plans across the corporation. These initiatives need to be anchored by a comprehensive GHG strategy, and one of the first steps is development of tools that will facilitate the creation of reliable GHG information. Some of the primary tools companies are utilizing to manage their portfolio of GHG emissions liabilities and assets include GHG inventory protocol documents, GHG emissions and reduction project verification programs, and enterprise-wide data management systems.

This paper summarizes some of the collective industrial experience of URS Corporation and Environmental Resources Trusts in working with various corporate entities to help them better characterize and manage their GHG emissions inventories, reduce risks associated with their GHG liability exposure, and better position them to capitalize on potential emission reduction trading opportunities.

Protocol Documents

The GHG protocol document is the foundation upon which a corporate entity can develop a reliable and credible GHG inventory, as follows:

- Protocols, people, and processes need to be strong enough to deliver reliable GHG information, in an effective format that recognizes the national and international climate change regulatory environment. This structure must be capable of evolving in step with future climate change developments.
- GHG information must inform Corporate/Business Unit decisionmaking, and appraisal of performance against objectives set out in the corporate GHG management strategy.
- The GHG strategy must take into account the corporation's current and forecast GHG emissions portfolios, and maximize future opportunities while minimizing risks. It must be integrated and consistent with other core business objectives and plans.

Companies able to effectively integrate carbon management into their overall corporate business strategy may gain a competitive advantage. To effectively compete in this new "carbon market", it is necessary to develop a corporate-wide GHG accounting system, able to ensure accuracy, consistency, completeness, and transparency of GHG reporting. To meet this need, a GHG emissions inventory protocol document needs to be developed, and periodically updated as part of the entity's continuous improvement activities. It provides guidance to company personnel in obtaining reliable and meaningful GHG data.

The purpose of a GHG inventory protocol document is to provide guidance to corporate data coordinators and owners of GHG performance metrics, such that the development and management of the GHG inventory across all corporate assets is credible and verifiable. It is also intended to provide guidance to the final implementation design and roll out of any entity-wide data management system, i.e., an Environmental Management Information System (EMIS), and its ultimate use for accounting and reporting of GHG information.

Such a GHG inventory protocol guidance document is intended to support various corporate GHG goals and objectives, including:

- Secure reliable and meaningful GHG emissions data;
- Establish an emissions baseline against which future GHG performance can be measured;
- Identify opportunities for continual improvement in the entity's GHG data management and reporting processes;
- Provide the key reference and basis for future GHG inventory verification activities;
- Support corporate strategic management of GHG risks and opportunities;
- Ensure the confidence and reliance that the entity can place on GHG data for internal decision making and external reporting moving forward; and

- Support the evaluation of potential impacts of future legislative and regulatory developments and requirements.

The GHG protocol document provides a framework for the complete and reliable reporting of GHG data to stakeholders, both internal Corporate and Business Units, and external users. Also, the protocol supports a data collection process that can be efficiently integrated with an EMIS. Some of the primary elements of a corporate GHG emission inventory protocol document should include the following:

- Reporting goals
- Accounting and reporting guidelines
 - Principles
 - Performance indicators
 - Intensity ratio
 - Establishing base year emissions
 - Adjusting base year emissions
 - Reporting period
- Data management and quality considerations
 - Materiality
 - Guidance on de minimus source exclusions
 - Accuracy
 - Continuous improvement and minimization of inherent uncertainty
 - QA/QC
 - Documentation and verification requirements
 - Roles and responsibilities
 - Reporting processes, including data collection and aggregation across the organization
- Organizational boundary considerations
 - Operational control approach
 - Equity share approach
 - Non-operated joint ventures
 - Power purchase agreements/electricity trading
 - Production sharing agreements
 - Leased assets, contractor activities, tolling arrangements, etc.
 - Acquisitions and divestitures
- Operational boundary considerations
 - GHG gases included
 - Emission sources included
 - Direct and indirect emissions
 - Heat and steam imports/exports
- Emission estimation methodologies
 - Combustion sources
 - Venting sources
 - Fugitives
- Emission reduction projects and offsets

- Excluded sources
- Example calculations
- Conversion factors
- References

An example of some of the key activities, responsibilities, and issues associated with building a reliable GHG inventory from a corporate GHG emission inventory protocol is illustrated in Figure 1 below.

| | Key activities | Responsibility | Key issues |
|-----------|--|--|---|
| Section 2 | Accounting and reporting | <ul style="list-style-type: none"> • Corporate • Business Unit • Site/entity | <ul style="list-style-type: none"> • What are the key principles for reporting? • How should performance be monitored? • What is the reporting frequency and period? |
| Section 3 | Data management process and quality assurance | <ul style="list-style-type: none"> • Corporate • Business Unit • Site/entity | <ul style="list-style-type: none"> • What are materiality threshold, and de minimus source exclusions (if any)? • What are the appropriate management and reporting structure? • What are the appropriate QA/QC procedures? |
| Section 4 | Determine organizational boundaries of reporting | <ul style="list-style-type: none"> • Business Unit • With support from Site/entity and Corporate | <ul style="list-style-type: none"> • Which sites/entities are reportable? • How should GHG emissions be aggregated at the facility/Business Unit/Corporate level? |
| Section 5 | Define scope of operations within organizational boundaries and determine sources of emissions | <ul style="list-style-type: none"> • Site/entity • With support from BU and Corporate | <ul style="list-style-type: none"> • What processes are relevant to GHG reporting within each site/ entity? • How should outsourced emissions, imported and exported energy be reported? • What sources of emissions are reportable? |

Figure 1. GHG Protocol User Guide Illustration

Without the benefit of a well-developed protocol document upon which to base the corporate inventory, it is very likely that GHG emission inventory activities will be significantly variable and inconsistent across Business Units and facilities. Also, it is highly unlikely that the inventory will be able to surpass an intermediate, let alone high, standard of data uncertainty. Some examples of data quality issues associated with GHG inventories developed without a good protocol document include the following:

- Inconsistent data formats
- Current reporting year data not reported (copy of prior year)
- Incomplete data reported; significant data gaps
- No facility-specific information, or disaggregated data, reported
- Missing major GHG sources
- No fuel composition data reported
- Incorrect units of measure
- Lack of supporting documentation (e.g., calibration or billing records, etc.) and references

In addition to a formalized GHG emissions accounting and reporting protocol, other additional activities recommended in these situations include Business Unit and Corporate staff training program; an internal audit QA/QC program; a well organized data management system (spreadsheets, a database, and/or an EMIS, depending on the size and complexity of the organization and the inventory data); and external third party verification (when the company is ready).

There are several useful reference guidance documents for supporting the development of a corporate GHG emission inventory. One of the leading international guides has been developed by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). The WBCSD/WRI protocol¹ and other references (e.g., U.S. EPA Climate Leaders inventory management plan guidance², and the ISO draft reporting guidelines³) typically rely on other sources of information for GHG emission estimation methodologies, so periodic checks for updated information are advisable. Also, though these reference documents are very useful as guides to the development of a corporate GHG emission inventory, based on our experience a significant amount of additional specific details and corporate “customization” is required to develop a robust protocol document.

In the framework of a corporate entity-wide GHG inventory, the concept of materiality is defined in the context of the overall uncertainty in the reported data. A quantity is typically considered to be “material” if it would influence any decision or action taken by users of the information. This definition of materiality is consistent with verification guidelines and goals for the reliability of reported data. It is not the same as a de minimus emissions threshold for exclusion of specific sources from the inventory. While

¹ WBCSD/WRI, “The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard”, revised edition, 2003, www.ghgprotocol.com.

² www.epa.gov/climateleaders/protocol.html.

³ International Organization for Standardization, Working Group 5, “ISO 14064: Greenhouse Gases–Part 1: Specification with Guidance for Reporting”, 2004.

a de minimus exclusion from the inventory would contribute to overall uncertainty, completeness is only one component contributing to overall uncertainty in the inventory.

An aggressive materiality goal for overall uncertainty in a corporate GHG inventory is $\pm 5\%$, consistent with international and industry best practice reporting. It is recognized that this is a very challenging goal, and that most all companies do not achieve it the first time that an entity-wide GHG inventory is verified by an external third party. This level of assurance can be reflected in various stakeholder expectations of a corporate GHG emission inventory, e.g., stringent uncertainty requirements as part of the EU emissions trading scheme (EU ETS). With continuous improvements in reporting over time, $\pm 5\%$ is believed to be an appropriate and achievable long-term goal.

Uncertainties in the reported data arise from:

- Completeness of the inventory and any source exclusions that may make a significant impact on the overall reported data;
- Accuracy of the methodology used to quantify emissions. The absolute uncertainty associated with a source is directly related to its contribution to emissions. More accurate methods should be used for the sources that contribute the most to the overall emissions, whereas smaller sources can have larger uncertainties without a significant impact on materiality;
- Uncertainties in the underlying data, such as instrument accuracy based on calibrations and performance checks; and
- Potential weaknesses in the data management systems in place to control the quality of the data throughout the collection, reporting, and management processes.

Reliable GHG data require strong protocol guidelines and supporting management and information systems within the corporation. The GHG emissions estimation methodologies outlined within the protocol are subject to varying degrees of uncertainty. An understanding of the source and magnitude of these uncertainties will help company data coordinators manage continuous improvement of their GHG data quality. This will be important to provide internal and external users of the GHG information to draw appropriate conclusions on the corporate entity's GHG performance.

Verification Programs

A quality management system is important to ensure that the GHG inventory continues to meet internal and external expectations. However, it is recognized that unlike financial accounting, corporate GHG inventories are a scientific and engineering exercise without legally sanctioned accounting standards. A practical framework is needed to help design an inventory program and quality management system and to help develop a plan for its progression into the future. The basic components of this framework are:

- Methods – technical aspects of the inventory preparation. These are addressed in this Protocol document.
- Data – data collected for the inventory should be of high quality. The reporting entities and BUs are responsible for ensuring the quality of the GHG data.
- Inventory processes and systems – people and processes needed to complete the inventory, with particular emphasis on the EMIS.
- Documentation – transparent documentation of the inventory is essential to establishing its credibility.

Although principles and broad program design guidelines are important, any guidance on quality management would be incomplete without a set of practical measures that can be implemented on actual data and calculations. These measures should be implemented at multiple corporate levels, from the point of primary data collection to the final corporate approval process. These measures are most important to implement where data are initially collected, and where calculations and data aggregations are performed. Initially, it may be the final inventory totals at the corporate level that are viewed as the most useful. However, a company may wish to consider ensuring the quality of its data at various levels of disaggregation (e.g., facility, process, operations within a state or province, operational boundaries, etc.), so that they are better prepared for potential internal GHG program needs, external trading markets, or regulatory requirements in the future.

Another element of a quality management system is source category-specific quality checks and investigations. This component addresses the types of source-specific quality measures that can be employed for emission factors, activity data, and emission estimates. These quality measures include:

- Any default emission factors should be investigated to ensure that they properly represent the emissions of the given source. Site-specific factors are often more reliable than generic, published emission factors and should be compared with the default emission factors.
- Measures should be implemented to ensure the accuracy of the activity data used in the inventory. For example, data should be collected from metered or measured sources such as from purchase records or company measurements. Year-to-year comparisons of the activity data should be made to identify any quality issues. Activity data obtained from multiple sources should be compared, and the activity data itself should be evaluated to see that it is appropriate for the accuracy needed for a GHG inventory. Any biases in the activity data should be identified, and recommended corrective actions be developed and implemented.
- The emissions estimates for source categories should be compared with historical data or other estimates to see if they fall within a reasonable range. For example, any emission changes over 10 % from the previous year may warrant further investigation into the basis of the estimates.

Table 1 provides a list of actions to ensure quality data.

Table 1. General Quality Management Measures

| |
|---|
| Infrastructure |
| <ul style="list-style-type: none">• There should be clear roles and responsibilities for the accounting and reporting of GHG emissions at the entity, Business Unit and corporate levels• Responsible persons should be adequately trained to understand and implement the protocol• An EMIS will aid in consistent application of the protocol• Compliance with the protocol, and its consistent implementation across the corporation, should be assessed periodically by internal audits and technical reviews, and supported by external verification to identify areas of improvement• Implement adequate controls over reported GHG data at corporate, Business Unit, and facility levels |
| BU/Facility level controls |
| <ul style="list-style-type: none">• Maintain a copy of data inputs to EMIS and documentation on the source of this information• Confirm that any new data sources are included in the inventory and any data sources that are no longer relevant are not included• Check that changes in data or methodology are documented• Check a sample of input data for transcription and other sources of errors• Confirm the activity data units of measure (UOM) are consistent with EMIS data inputs and corresponding emission factors• Confirm that key source data (e.g., fuel flow rates, fuel composition, gas composition) are supported by appropriate monitoring and calibration regimes• Ensure clear understanding of uncertainties associated with emissions estimation methodologies and source data, and continuous improvement toward minimizing these uncertainties |
| Corporate level controls |
| <ul style="list-style-type: none">• Check that assumptions and criteria for selection of methods, activity data, emission factors, and other parameters are documented• Check that changes in data or methodology are documented, and have been performed consistent with appropriate change management procedures• Check that copies of cited references have been archived• Ensure that adequate version control procedures for any written methodologies or electronic files have been implemented• Identify GHG inventory process modifications or improvements that could provide additional controls or checks on quality• Check that entities' boundaries and status of control and ownership are correct• Review GHG performance of the current reporting period against past performance and forecasts• Perform periodic reviews, and updates as necessary, of the protocol to ensure continued appropriateness of the guidelines |

Verification is the confirmation, through provision of objective evidence, that a reported GHG inventory accurately reflects the actual GHG emissions of the reporting company.⁴ The overall objective of GHG inventory verification is to provide an independent view over the reliability of reported GHG data. Beneath this, several options exist including:

- Verification of corporate-level data: assurance over the total GHG emissions as reported in a corporate HSE report, for example. Such verification is typically supported by a public opinion on data reliability. It involves the assessment of corporate aggregation processes, as well as site visits at sample facilities, generally covering all types of corporate operations.
- Facility level verification: may be required for the purposes of emissions trading, or regulatory compliance regimes (e.g., EU ETS, RGGI, etc.). Such verification focuses on the installation, including detailed assessment of the GHG accounting and reporting processes within that facility.
- Gap analysis: for many companies, it will take some time to implement their protocols across all its Business Units. Therefore, it may choose to proceed with a lower level of assurance, to identify strengths and weaknesses in its current data collection and reporting processes, and the existence of and performance by quality system controls. This approach is beneficial for providing corporate management with a good understanding of the current reliability of its GHG inventory data, but does not enhance its credibility in a significant way.

Corporate GHG inventory verification activities should involve examination of some or all of the following:

- Boundary setting procedures.
- Methodologies and calculations used to generate emissions estimates.
- Original underlying records of production, fuel, and materials used.
- Process information, operational details, and equipment counts.
- Data management systems used for corporate environmental and energy data.
- Compiled GHG emissions inventory report.
- GHG accounting and reporting protocol.
- Supporting documentation and testimony for each of the above.

Corporate GHG inventories should be verified by internal “self-audits” and/or by an independent third party. Independent third parties are typically called upon to perform more extensive verification of calculations, original records, and GHG management systems. The robustness of a verification effort will depend in large part on the ultimate end uses of the GHG inventory results reported, as well as the complexity and size of a company’s GHG inventory.

⁴ Hammerschlag, R. and Barbour, W., “Verification and Certification”, February 2003, <http://www.nescaum.org/greenhouse/registry>.

A useful reference document for conducting GHG inventory verification is the Corporate Greenhouse Verification Guideline (CGVG).⁵ The CGVG is designed to assist and support GHG inventory verifications by providing policy neutral information on the scope and process of corporate GHG inventory verification. It builds on existing guidance and provides practical direction on the selection and application of corporate GHG inventory verification procedures, and is useful under a variety of reporting programs and objectives.

Adequate documentation of the application of the GHG protocol will ensure that the corporate entity and its Business Units can demonstrate the reliability of the reported information both internally and externally, and facilitate consistent accounting from year to year across the company. This requires maintaining the supporting “evidence” (in the form of an audit trail) of the GHG inventory compilation.

Key documentation that should be prepared and retained are shown in Table 2.

Table 2. GHG Documentation

| Corporate requirements |
|--|
| <ul style="list-style-type: none"> • Contracts and ownership agreements supporting ownership and the status and extent of control over each entity • Documentation of assessments made over excluded emission sources, including process and facility boundary diagrams • EMIS system documentation, including descriptions of the processes for data collection, input, calculation, and management • Annual GHG emissions inventory reports and statements • Results of any internal audit or third party verification activities |
| BU/Facility requirements |
| <ul style="list-style-type: none"> • Correspondence with suppliers of energy and fuel (e.g., invoices and fuel characteristics and composition) • Metering and calibration logs • Justification of the quantification methodology and emission factors used, including documented references and citations, and root data upon which site-specific factors were derived, particularly where EMIS provides multiple options • Documentation of any key assumptions and uncertainties associated with the GHG data • Description of GHG reduction projects and operational incidents that impact GHG performance • Explanation of trends in GHG emissions from historical data and forecasts • Facility/BU production and operational data records • Supporting spreadsheets detailing source data |

Some examples of corporate GHG inventory verifications lessons learned are described below.

⁵ Environmental Resources Trust (ERT), Inc., Washington, DC, November 2004, <http://ert.org>.

For one multi-national firm’s initial external 3rd party verification program, after a couple years of inventory data collection and reporting based on an internal GHG protocol document, the deviations identified in the facility and Business Unit audits were distributed as follows:

| <u>Type/Category of Deviation</u> | <u>% of Total Deviation</u> |
|-----------------------------------|-----------------------------|
| Protocol uncertainty | 40-50 |
| Protocol non-compliance | 30-40 |
| Calculations/reporting deviations | 10-20 |
| Lack of audit trail | < 5 |

Based on the verification audit findings, total deviations (i.e., misstatements) in the company’s data were estimated to be on the order of 20% of the corporate total reported emissions. Some of the major issues identified in that verification program included the following:

- Protocol not sufficiently detailed to enable consistent reporting across the corporation.
- Weaknesses in management systems and controls over GHG data.
- Lack of data available from and site access to facilities operated by others.
- Use of default factors when more accurate factors were available, i.e., not using the preferred alternative method specified by the protocol.
- Insufficient data quality assurance procedures, e.g., infrequent or insufficient calibration procedures, to support emission estimation approach used.
- No documentation justifying exclusion of insignificant sources.

In another corporate entity-wide GHG verification program, a second multi-national firm was going through an updated, multi-year 3rd party verification activity, after reporting GHG data for over 5 years, using their internal GHG protocol document, and a more sophisticated data management system than the first company. The deviations identified in their audits were distributed as follows:

| <u>Type/Category of Deviation</u> | <u>% of Total Deviation</u> |
|-----------------------------------|-----------------------------|
| Source omission | 20-30 |
| Instrumentation errors | 20-30 |
| Data accuracy | 15-25 |
| Factors-errors | 20 |
| Data input errors | 10 |

Based on the verification audit findings, total deviations (i.e., misstatements) in the company’s data were estimated to be on the order of <5% on a net error basis, and 5-15% on an absolute (gross) basis. After the company fully implemented their internal assurance process, based on the results of a couple “pilot” site verification audits, their post-closeout estimated corporate misstatements were reduced to on the order of 1-2%. This clearly shows the benefits of initial pilot site visits and implementation of a full, internal quality assurance process- -significantly improved reliability of the emission estimates from all sites.

Data Management Systems

Data management systems designed to enhance data quality and transparency are an integral part of ensuring reliable GHG reporting. These systems, which integrate personnel training and transparent documentation, will help ensure that reported GHG data are both credible (i.e., accurate, consistent, and complete), and verifiable.

GHG emission inventory data management systems can be successfully based on a variety of platforms. These options can include spreadsheets, a limited generic database application (using Access, for example), or a full enterprise EMIS utilizing custom software packages. At a certain size and complexity of an organization and its GHG emission inventory, using a purely spreadsheet-based system becomes unwieldy, unreliable, and costly to maintain and update. In addition, a spreadsheet-based system is limited in its data aggregation, benchmarking, and reporting functionality, as compared to a database application. Therefore, the focus of this discussion is on database applications.

Based on our experience with a variety of EMIS database applications, one of the key elements to a successful implementation project is the development of a detailed Configuration Plan. While a robust GHG protocol document is a critical element in the preparation of an EMIS Configuration Plan, it is only one of many inputs to the plan, and generally will not go into a great enough level of detail to fully support an EMIS implementation. An EMIS Configuration Plan must address all the details of the software/database design and configuration activities.

While the use of custom off-the-shelf (COTS) software aids in significantly focusing the effort, there are many design features, decisions, information needs, etc. that must be specified in the Configuration Plan. Some of the key elements to be included in an EMIS Configuration Plan include the following:

- EMIS goals and objectives
- Configuration/change management procedures
- Reporting guidelines
- Emissions normalization and performance indicators
- Included facilities and sources (materiality and source exclusions)
- Corporate entity model
- Platform standards
- Data handling procedures
- Standard facility architecture
- Other models, objects, and references
- Users, roles, and security
- Algorithms and emissions estimation logic (measurements and estimates)

- Periodicity
- Emission factor composition requirements
- CEMS usage and utility
- Emission factor derivation design details
- Default emission factors
- Characterization data requirements (i.e., facilities, sources, “infrastructure” data)
- Transaction data requirements (i.e., activity data, or time-stamped information that is expected to change over time/reporting periods)
- Reports
- Database enhancements and interfaces (inter-company connectivity)
- Testing plans (internal)
- Documentation requirements
- Corporate GHG emission inventory protocol
- Data collection and reporting requirements: registry and/or regulatory regime
- Data collection tool/data entry forms user guide
- Client acceptance test plan
- Program code documentation

For an enterprise-wide GHG inventory EMIS implementation project for a large, complex organization, depending on the availability of data and the client’s internal staff resources to support the implementation project, these projects typically take on the order of 6-9 months to complete. Depending on the COTS software purchase license fees, numbers/diversity of facilities and sources, interfaces required, data collection support, etc. an enterprise EMIS implementation project typically costs on the order of \$100,000s.

While such EMIS programs are more extensive than necessary for small- to intermediate-sized companies, non-energy intensive companies, and/or those with assets only in the U.S., many large, multi-national firms are faced with potential GHG emissions liabilities and asset values on the order of \$Millions+ per year. For those companies, developing and implementing an enterprise-wide GHG inventory EMIS is increasingly becoming an integral part of their overall corporate GHG strategy.

As described in the previous section, data quality enhancement, reduction in inherent uncertainty, and inventory verification are all issues germane to a GHG inventory EMIS. Table 3 below summarizes some of the data quality controls to be put into place associated with a GHG inventory EMIS system.

Table 3. EMIS Quality Management Measures

| EMIS controls |
|--|
| <ul style="list-style-type: none">• Confirm that bibliographical data references are included in calculation tools and associated documentation for all “primary” data (i.e., emission factors, activity data, calculation algorithms, and assumptions involved in estimating material GHG emissions)• Ensure that adequate version control procedures for any written methodologies or electronic files have been implemented• Ensure that EMIS and spreadsheet data controls are in place and implemented (e.g., access restrictions, system and data back-ups, variable type and value range checks, cell protection/dependency/precedence, error identifications, etc.)• Check that conversion factors are correct• Check all the data processing steps (e.g., data inputs, equations, calculated results, and recorded/reported data)• Check that input data and calculated data are clearly differentiated• Check a representative sample of calculations• Check the aggregation of data across source categories, Business Units, etc. |

Conclusions

Corporate entity-wide GHG emission inventory development is an important early step in a company’s strategy to address the impacts of climate change. A credible GHG emission inventory is critical to a company’s accounting and reporting of GHG emissions to various stakeholders, both internal and external. Protocol documents, verification programs, and data management systems are key elements of a corporate GHG emission inventory, and crucial to its successful design, development, roll-out, updating, and maintenance.