

Integrated Emissions Data Management Framework™ for Government and Corporate Greenhouse Gas Data Management, Modeling, and Reporting

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Abstract

Responses to climate change include a multitude of international regulatory and voluntary programs such as the Kyoto Protocol, regional regulatory programs such as the U.S. Regional Greenhouse Gas Initiative (RGGI) and voluntary programs such as the U.S. EPA Climate Leaders program. The greenhouse gas (GHG) emission data management required to make these programs successful include access to disparate emission data sources, emissions data monitoring and measurement, emissions modeling and estimation, risk calculation, emissions trading activity and reporting. Business-as-usual GHG emissions data and data from emission reduction activities such as carbon dioxide (CO₂) sequestration and clean technology initiatives also need to be captured, analyzed, maintained, and shared among federal agencies, international agencies, and corporations as part of GHG inventory and trading data management.

The Integrated Emissions Data Management Framework™ addresses these challenges by utilizing advanced decision support systems and tools and international GHG policies and standards to allow comprehensive, faster and more cost-effective integration of emissions data collection and measurement with emission modeling, estimation, verification and reporting. The IEDM Framework will allow government and corporate entities to manage the explosive growth in current and historical GHG emissions data, emissions verification and certification data, and carbon market trading data that will occur with the deployment of more detailed emissions monitoring and reporting under the new regulatory regimes. In addition embedded best practices for scalable and interoperable systems architecture help ensure more effective emissions data infrastructure development.

This paper summarizes the ten main business components of the IEDM Framework for emissions measurement, emissions verification, emissions reduction certification and carbon market trading data management.

Introduction

The entry into force of the Kyoto Protocol in February 2005 has catapulted the management of greenhouse gas (GHG) emissions to the top of the agenda for both corporate and government entities. The Kyoto Protocol considers the reduction of GHG emissions to be the primary method that countries around the world can use to help mitigate the effects of climate change. The Kyoto Protocol is a vast global effort for GHG emissions reductions, with over 160 countries ratifying the treaty. Within the U.S. a number of regional and state level programs for mandatory GHG emissions reductions are also being developed, including the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade program for seven northeastern states. Like the Kyoto Protocol, these mandatory U.S. programs will also require the management, reduction and reporting of GHG emissions.

In addition to the mandatory programs of the Kyoto Protocol, the growing trend of voluntary sustainability reporting by large international companies has also seen the rise of GHG emissions measurement, monitoring, and reporting activity across both the large-emitter and low-emitter sectors of the global economy. For example, the U.S. Environmental Protection Agency (EPA) Climate Leaders voluntary GHG emissions reduction program has seen diverse companies such as IBM, General Motors, General Electric, and Citigroup join the program and voluntarily commit to aggressive GHG reduction goals at their facilities.

Together these mandatory and voluntary programs have created a need for more precise management of GHG emissions inventory and emissions reduction data. The cap-and-trade programs of the market-based mechanisms of the Kyoto Protocol and RGGI have also resulted in a need to manage carbon market trading data. International guidelines and protocols for GHG emissions management and reporting have been developed by organizations such as the World Business Council for Sustainable Development and the Global Reporting Initiative. However the scope of these GHG guidelines lies in the area of global best practices and standards for emissions and emissions reduction quantification and disclosure. The guidelines do not extend to GHG emissions data management.

The Integrated Emissions Data Management Framework™ (IEDM Framework) addresses this gap by proposing an integrated business and information technology approach to GHG emissions and trading data management to meet the requirements of entities participating in mandatory programs. The IEDM framework can also be used by entities in voluntary programs.

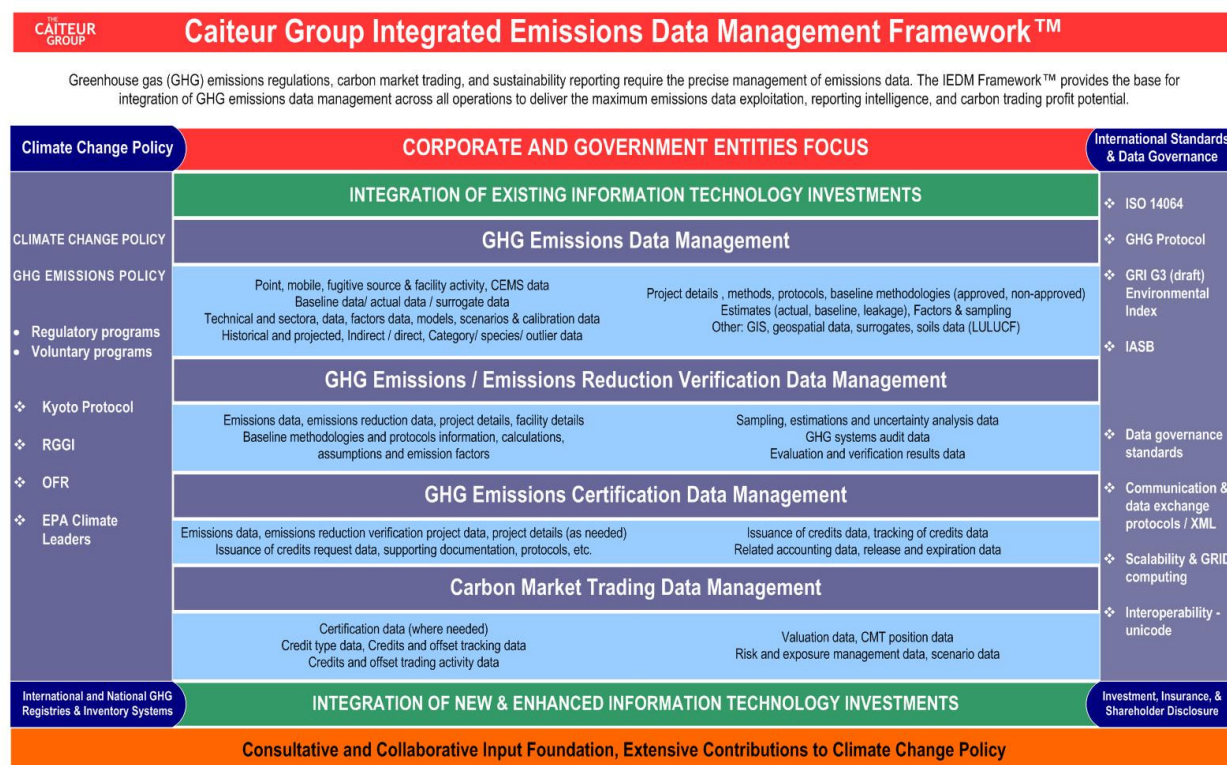
The Integrated Emissions Data Management Framework™

The IEDM Framework was specifically created to address the need for more precise management of GHG emissions data across all operations of government and corporate entities. Because of its focus on mandatory GHG emissions programs, it incorporates climate change policy such as the Kyoto Protocol and RGGI. The framework also recognizes the international GHG guidelines of the GHG Protocol Initiative, ISO 14064, and the Global Reporting Initiative (GRI) and therefore can be easily applied by entities involved in voluntary GHG emissions

reporting programs such as the EPA Climate Leaders and GRI sustainability reporting. The support of regulatory policy and guidelines is covered in more detail in the sections on *Incorporation of Climate Change and GHG Emissions Policy* and *Recognition of International GHG Standards and Protocols*.

Figure 1 is a summarized illustration of the top Business tier of the IEDM Framework. The complete framework is comprised of many additional layers and components. The remainder of this section of the paper will work through a representative sample of some of the components and how they can be applied in GHG market participating entities.

Figure 1. Summarized illustration of Business tier of the IEDM Framework



The IEDM Framework consists of ten components (eight layers and two pillars):

Four GHG emissions data management layers in the business tier are the fundamental data layers of the framework and support policy, guidelines and standards, and data governance. The layers are modular, so each module can be used separately or integrated with the other modules to eliminate data redundancy depending on the operating requirements of the entity.

- **The GHG Emissions Data Management layer** defines the IEDM Framework's guidance and information technology considerations for data management of emissions monitoring and measurement, GHG inventories, emissions modeling, emissions reductions, emissions

reporting including performance indicators and so on. It also includes modular integration considerations for specialized tasks such as the development of emissions factors and surrogates, scenario modeling and calibration, and risk and uncertainty analysis work for emissions reductions projects and submission of the required details to GHG registries. This layer ensures more effective, accurate and consistent GHG emissions data gathering, processing and analysis, and reporting.

- **The GHG Emissions and Emissions Reduction Verification Data Management layer** defines the IEDM Framework's guidance and information technology considerations for data management of GHG emissions and emissions reduction verification. To improve data accuracy and quality, this layer includes data input integration with the GHG Emissions Data Management layer that precedes it and integration of mandatory submission of required details to GHG registries. This layer helps establish a joint business and IT basis for an effective internal GHG verification protocol and process and also prepares the entity for independent third-party GHG verification. This layer can also be used on its own by third-party emission verifiers to structure the details of their verification databases.
- **The GHG Emissions Certification Data Management layer** defines the IEDM Framework's guidance and information technology considerations for data management of verification and certification activities for projects across reporting periods, requests for issuance of credits and their supporting documentation, and the actual issuance of credits for each project into appropriate accounts. This layer can be used on its own by certifiers and registries to help structure the details of their certification databases and other important elements of their GHG registries. Additionally this layer can be used by entities conducting GHG Emissions Reduction Projects to track issued credits, examine discrepancies between expected and actual (verified) reductions, and monitor adherence to verifier recommendations.
- **The Carbon Market Trading Data Management layer** defines the IEDM Framework's guidance and information technology considerations for data management of emissions trading investment, credit and offset trading activity and reporting, risk and exposure management and so on. This layer recognizes trading of Kyoto allowances and credits, Kyoto-recognized credits and non-recognized credits. The carbon market trading data management layer ensures effective tracking and traceability of credits and integration of emissions trading risk management with other elements of enterprise risk management for both government and corporate entities. As with the preceding layers, this layer can also be used on its own by carbon market trading entities to structure the details of their trading databases and communications with trading exchanges.

Two information technology investment layers in the Business tier are integral to the integration elements of the IEDM Framework and also support policy, guidelines and standards, and data governance where applicable.

- **The Integration of Existing Technology Investments layer** recognizes the role of existing GHG emissions-related systems throughout the entire IEDM Framework. Both government and corporate entities have significant existing investments in systems for monitoring, measurement and modeling, GIS data catalogs, estimation tools, and so on. The IEDM

Framework recognizes these systems and tools and directly incorporates them into the framework methodology.

- **Integration of New and Enhanced Information Technology Investments layer** defines the IEDM Framework's integration guidance for data and systems considered in the application of the IEDM framework and other related business and IT evaluations.

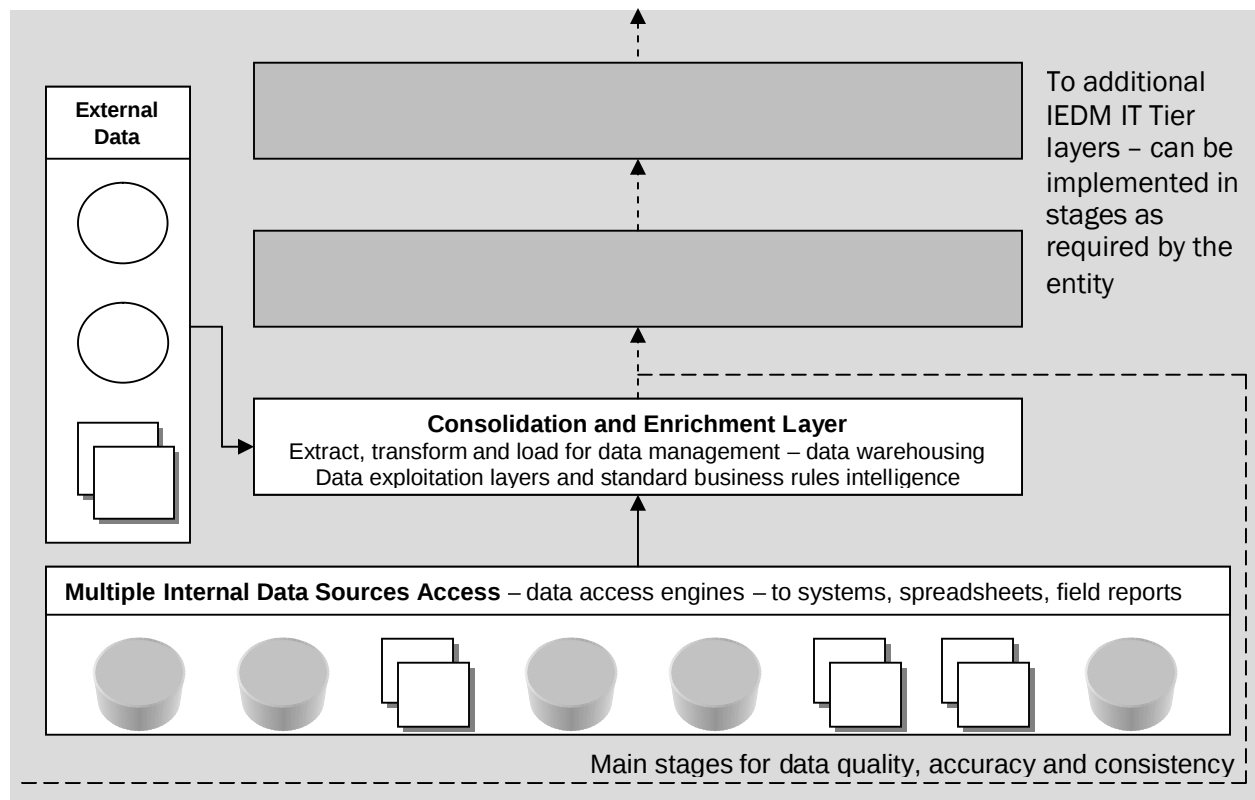
Four supporting components provide material input and reference to the IEDM Framework.

- The **Focus layer** and **Foundation layer** express the audience and scope and the collaborative foundation of the framework respectively. The foundation layer also recognizes direct contributions to global climate change policy.
- The **Climate Change Policy pillar** and **International GHG Standards and Data Governance pillar** recognize the critical external elements necessary to the framework. These are described further in the sections below.

IT Application of the IEDM Framework

The IEDM Framework also includes accompanying Information Technology (IT) tiers. A sample information technology workout of the framework is presented below in Figure 2.

Figure 2: Large entity – sample view of first two layers of an Information Technology tier of the IEDM Framework



The focus for this sample entity is the first two IT layers for data access and consolidation and enrichment with structures and schemas optimized for the development of an Emissions Management Information System (EMIS) to meet its current and long-term needs. This is a large entity that requires access to many sources of data on an entity-wide basis in a manner that significantly increases data accuracy, quality, and consistency.

The data sources are diverse and include manual-based systems and spreadsheets and more formal operational systems and databases for emissions measurement and modeling, finance and accounting, and so on. A consolidation and enrichment layer provides the data management structure and controls and some application of business rules for more accurate GHG emissions gathering and reporting and for ongoing access by other systems for modeling, estimation, verification, and so on. The consolidation and enrichment layer also provides the main IT foundation for greater data transparency in emissions verification and reporting.

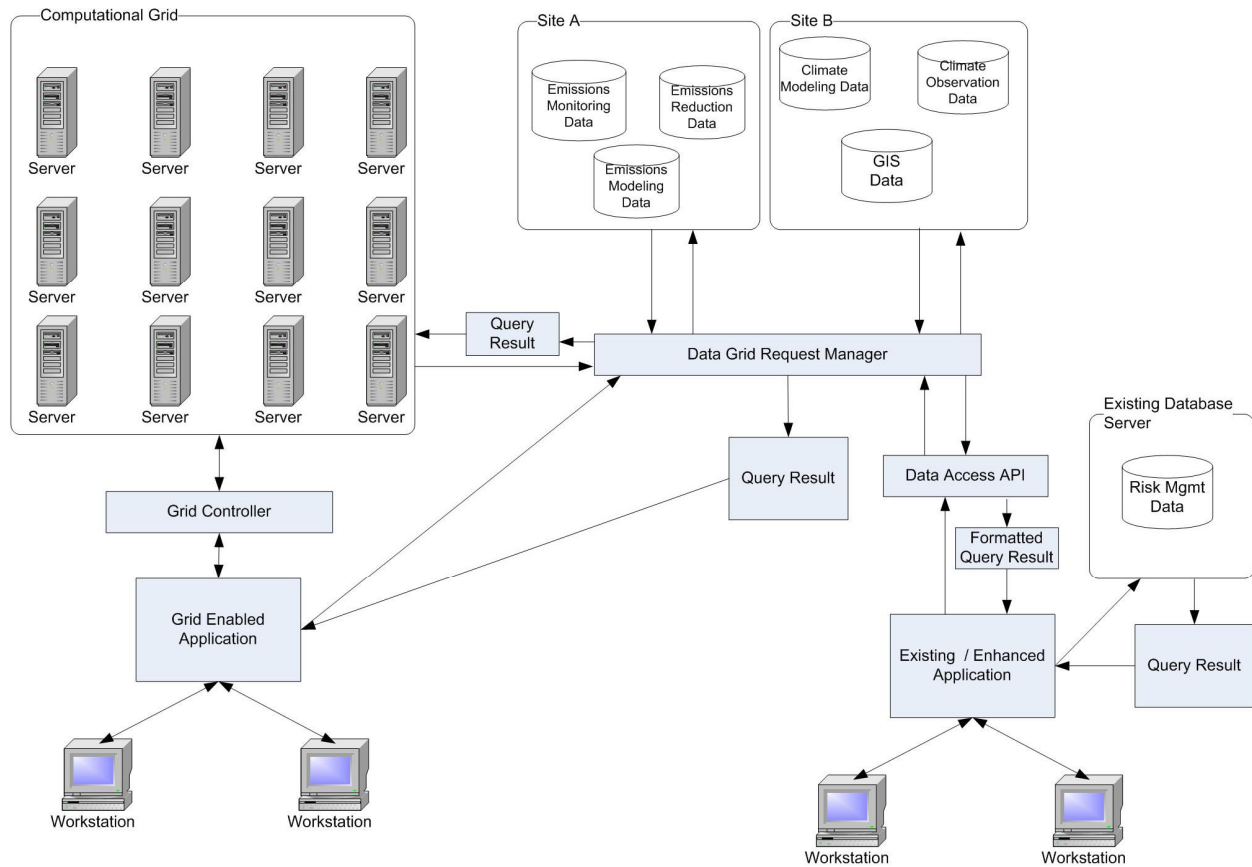
Ensuring System Scalability within the Framework

As with other key elements of the IEDM Framework, the robustness of EMIS scalability will depend on the business needs and regulatory requirements of the operating entity. To determine its system scalability needs, an entity should also assess the following:

- Number of reporting/operating facilities, sources, or related entities such as federal agencies, corporate subsidiaries or research centers
- Size and complexity of GHG inventories
- Size and complexity of carbon market trading program
- Size and complexity of climate data and emissions modeling and estimation programs, including predictive climate data modeling and sharing between agencies, subsidiaries or research centers
- Scale of utilization of complex, computational intensive data such as geospatial data and development of GHG emissions surrogates

Scalability needs can be addressed with a variety of computing options ranging from simple computer clusters, distributed systems and data farms to the more powerful options such as GRID computing. The GRID computing option (depicted below in Figure 3) is recommended for government and corporate entities and climate data research centers that require significant amounts of computing power, speed, and data distribution to meet the need for complex data modeling, emissions trading calculations and management or large volumes of GHG emissions data management over the medium to long-term.

Figure 3. Illustration of Computational GRID computing option for achieving scalability under IEDM Framework – suitable for large government and corporate entities and climate data research centers



All software and hardware technology platforms referred to in the IEDM Framework for use in an EMIS, such as data warehousing and GRID computing, are available, stabilized and widely accepted.

Incorporation of Climate Change and GHG Emissions Policy

The global nature of the effort to mitigate climate change through the reduction of GHG emissions is illustrated in the application of the market mechanisms that underpin the Kyoto Protocol and other mandatory programs such as RGGI. These market mechanisms and cap-and-trade programs offer national and regional regulators the opportunity to customize their regulatory programs to meet their GHG emissions reductions targets. This has resulted in a diversity of plans for regulation across various countries that are parties to the Kyoto Protocol and within various regions and states in the U.S.

The available policy mechanisms of the Kyoto Protocol include international emissions trading of Assigned Amount Units (AAUs), the Clean Development Mechanism (CDM)¹ for credits earned through emissions reduction projects in developing countries, and Joint Implementation (JI) for credits earned through emissions reduction projects in economies-in-transition countries. The CDM and JI mechanisms will result in large quantities of GHG emissions reductions that must be monitored, measured, verified and certified before the credits can be issued and traded. A similar process is required for other Kyoto recognized credits and domestic offsets generated by parties to the Kyoto Protocol within their national programs. The regulatory regimes that are planned under the Kyoto Protocol to help countries reach their GHG emissions reduction targets include the European Union Emissions Trading Scheme (EU-ETS) and the Canadian Large Final Emitter (LFE) system. These and other Kyoto party national programs will take full effect in January 2008 when the Kyoto Protocol's first five-year compliance period begins.

The RGGI agreement among the seven U.S. northeastern states is also planned as a mandatory program. RGGI will result in regulated reduction targets for carbon dioxide (CO₂) emissions from power plants in the states of New York, New Jersey, New Hampshire, Connecticut, Maine, Delaware, and Vermont beginning January 01, 2009. The RGGI program will use a similar process to the Kyoto Protocol, with emissions reductions that must be monitored, measured, verified and where necessary certified for issuance and trading of credits and use of offsets. RGGI plans to support three reporting modules – existing voluntary and mandatory reporting and new RGGI regulatory reporting to track GHG emissions data, allowances and credits, emissions trading data, and offsets data. The use of offsets and other recognized credits such as Kyoto credits by the RGGI program will also likely require additional data management controls.

The IEDM Framework recognizes and supports the climate change policies of the Kyoto Protocol and RGGI mandatory GHG emissions programs within the framework's **Climate Change Policy pillar**. In addition to the mandatory programs, the IEDM Framework also recognizes voluntary GHG emissions reduction programs such as the EPA Climate Leaders.

Financial management commentary regulations such as the UK's mandatory Operating and Financial Review (OFR) requirement are also supported by the IEDM Framework in the area of environmental matters reporting. Many listed entities are already dealing with the challenges posed by the emergence of environmental reporting in audited, annual financial reporting.

Recognition of International GHG Standards and Protocols

As with climate change regulatory policy, the global nature of the GHG emissions reduction mitigation effort has fueled the development of internationally-applicable guideline documents for GHG emissions management, emissions project reduction and emissions reporting guidelines. The main international guidelines for GHG emissions management and reporting are the GHG Protocol Initiative, ISO 14064, and the Global Reporting Initiative (GRI).

It must be clearly noted that these guidelines do not address the intricacies of GHG emissions data management. Instead the guidelines seek to address the global need for consistency and comprehensiveness in GHG emissions inventory quantification, reporting, and accounting as illustrated in Figure 4 below.

Figure 4. Summary of international guidelines and standards development for GHG emissions quantification, reporting, and accounting

International Guideline	Summary
World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) Greenhouse Gas (GHG) Protocol Initiative ²	The work of the GHG Protocol Initiative is focused on bringing harmonization and consistency to international GHG emissions accounting and reporting. The GHG Protocol has two guideline modules: the Corporate GHG Accounting and Reporting Standard and the Project GHG Accounting and Reporting Standard which aim to provide accounting methods to help companies identify and calculate their GHG emissions inventory and their GHG emissions reductions from projects.
International Organization for Standardization (ISO) ISO 14064 Greenhouse Gases Specification with Guidance ³	The intent of the ISO 14064 guidance is to help provide clarity, consistency, and transparency to GHG inventory and project quantification, reporting, and verification. The ISO has three guideline documents: ISO 14064-1 Guidance at the Organization Level for quantification and reporting of greenhouse gas emissions and removals, ISO 14064-2 Guidance at the Project Level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements, and ISO 14064-3 Guidance for the Validation and Verification of greenhouse gas assertions.
Global Reporting Initiative (GRI) Sustainability Reporting Guidelines ⁴	The GRI develops globally-applicable Guidelines for voluntary use by companies. The Guidelines lay out standard disclosure items , environmental, economic, and social performance indicators and principles for the reported information such as balance, timeliness, inclusivity, completeness, sustainability context, and accuracy. Tests to determine if each principle is being met are also included, such as adequate reporting on estimation methods, what data has been measured, and assumptions and techniques.
International Accounting Standards Board (IASB) IFRIC 3 Emission Rights (withdrawn) ⁵	In December 2004 the IASB issued guidance on accounting for GHG emissions with the release of IFRIC 3 Emission Rights and a later consideration to amend IAS 38 Intangible Assets. These have been withdrawn and the IASB now plans a more comprehensive future interpretation issuance through amendments to IAS 20: Accounting for Government Grants and Disclosure of Government Assistance . The IEDM Framework will embrace the new accounting standard upon its release.

An assessment of the GHG Protocol, ISO 14064 and GRI guidelines reveals that the common goals of these international GHG standards and protocols are:

- **Clarity and transparency** of the GHG emissions information provided – to ensure the information can be easily understood
- **Accuracy and Reliability** of the GHG emissions information provided – to ensure the information is credible and to allow for ease of replication, particularly of measurements, calculations, and estimates
- **Consistency** of the GHG emissions information provided – to ensure comparability and harmonization across entities and projects
- **Completeness** of the GHG emissions information provided – to ensure comprehensiveness and sufficiency of detail and appropriate reporting boundaries
- **Assurability and auditability** of the GHG emissions information provided – to allow for verification, validation, attestation and assertion of the data, both internally and by external independent third parties

The foundation of GHG emission quantification, monitoring, accounting, validation, and reporting therefore rests on accurate and effective management of GHG emissions data. The GHG Protocol, ISO 14064 and GRI international guidelines all clearly rely on data at their core, ensuring that none of their quantification and reporting principles can be effectively realized without the precise management of emissions data and the integration of related data activities and components as represented in the IEDM framework.

The IEDM Framework not only recognizes and supports the international GHG standards of the GHG Protocol, ISO 14064 and the GRI Environment Indicators in its **International GHG Standards and Data Governance pillar**, but also goes beyond these guidelines and protocols to take the important next steps for integrated GHG emissions data management, data exploitation, and reporting intelligence. This ensures that application of the IEDM Framework for management of emissions data will readily allow for incorporation of international GHG standards into an entity's overall emissions management strategy and EMIS development.

Incorporation of Data Governance Standards

The volume and frequency of data processing and data transfers required for GHG emissions measurement, verification and reporting necessitate the use of data governance standards for communication, interoperability and scalability. The IEDM Framework incorporates data governance standards in its **International GHG Standards and Data Governance pillar** to meet communication and interoperability needs including data exchange protocols/XML/XBRL, Unicode and other commonly used standards. Incorporation of these communication standards also helps entities meet the requirements of key GHG emissions data transfer and reporting systems such as the EPA's National Emissions Inventory NIF/NOF data exchange requirements and the Kyoto Protocol International Transaction Log (ITL) GHG Registry for the CDM.

Benefits of the IEDM Framework

The IEDM project research and analysis show that accuracy and consistency of data provided in EMIS systems can be significantly improved with an overarching framework that connects to climate change and GHG emissions policy, particularly for large international entities operating in multiple jurisdictions. The requirement to meet policy and regulation at facilities located in different countries adds a significant burden to corporate emissions data management.

Similarly for government agencies that must actively participate in carbon market trading to meet their national GHG emissions reduction target requirements under the Kyoto Protocol and other mandatory programs, building quality and consistency into data management from EMIS project initiation is a critical success factor over the long-term. The IEDM project research and analysis showed that the scale of emissions data management and the investments in decision-support tools for integrated data management and reporting required by government agencies is significant. This includes agencies involved in non-Kyoto programs such as the U.S. Climate Change Technology Program (CCTP) federal agencies. The research revealed that data quality and data integration are the two key benefits that an overarching framework can provide. Figure 5 summarizes ways in which the IEDM Framework can provide these improvements.

Figure 5. Summary of data management improvements and benefits provided by the IEDM Framework

Improve GHG emissions data quality and consistency
• Provide more effective GHG emissions data gathering, storage, processing and analysis across all operations – emissions monitoring, measurement and modeling, emissions verification and certification and emissions trading • Improve data transparency and quality of end results – resulting in reduced time and costs for GHG emissions verification and reporting • Significantly improve the emissions data verification process, for both internal GHG audits and external third-party verifications of GHG inventories and emissions reduction activities
Integrate GHG emissions and emissions trading data from multiple sources
• Reduce redundancies of data and increase speed of processing by integrating data from multiple sources, including emissions measurement, modeling, estimation, and verification • Provide easy reach through to the layers of emissions management and related data pools within the operating and reporting entity, and allow for use of common interfaces • Provide “one version of the truth” for emissions data management, reducing errors and improving version control, data tracking, data traceability and data governance, and significantly improving GHG emissions reporting intelligence across all operations
Reduce GHG emissions compliance costs and increase potential for trading profits
• Reduce costs of compliance for entities operating in mandatory GHG programs through incorporation of GHG emissions policy and recognition and support of international GHG guidelines and standards • Reduce costs of compliance through improvements to GHG emissions data quality and consistency (per above) and integration of emissions and emissions trading data from multiple sources (per above) • Provide an integrated base for emissions trading data exploitation and risk management to maximize carbon market trading participation and harmonization and reduce risk exposure

Conclusion

The development of the IEDM Framework is a necessary step forward in the area of GHG emissions and trading data management for climate change. It provides an immediately applicable data management and delivery approach that can be used by entities participating in the new GHG emissions mechanisms created by the Kyoto Protocol, RGGI, GRI and other similar programs, as well as by practitioners that deliver value-added services to those entities. The IEDM Framework is continuously advanced with new research, stakeholder input and timely incorporation of new climate change policies, mandates and guidelines.

References

¹ United Nations Framework Convention on Climate Change (UNFCCC), *Kyoto Protocol to the United Nations Framework Convention on Climate Change (Article 12) and Report of the Conference of Parties on its Seventh Session Held at Marrakesh from 29 October to 10 November 2001 Part Two – Decision 17/CP.7*, <http://cdm.unfccc.int>

² World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) Greenhouse Gas (GHG) Protocol Initiative, *Corporate GHG Accounting and Reporting Standard*, March 2004, and *Project GHG Accounting and Reporting Standard*, November 2005, www.ghgprotocol.org

³ International Organization for Standardization (ISO), ISO 14064-1:2006 *Greenhouses Gases Part 1*, ISO 14064-2:2006 *Greenhouse Gases Part 2*, and ISO 14064-3:2006 *Greenhouse Gases Part 3*, released March 01 2006, www.iso.org

⁴ Global Reporting Initiative (GRI), *2002 Sustainability Reporting Guidelines and Draft G3 Sustainability Reporting Guidelines*, released January 02, 2006, www.globalreporting.org

⁵ International Accounting Standards Board (IASB), IFRIC 3 *Emission Rights* released December 2004 and IAS 20: *Accounting for Government Grants and Disclosure of Government Assistance*, project under development, www.iasb.org

Keywords

Greenhouse gas GHG emissions data management
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Kyoto Protocol data, CDM data management
Climate change data management
GHG inventory data
GHG registry data, GHG verification data
Carbon market trading data, emissions trading data