Amulsar Gold Project

Carbon and Energy Management Plan

Version 1

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Revision Control

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1				
2				

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Glossary

AMR	Amulsar Annual Monitoring Report
CR	Commitment Register of the ESIA
CEMP	Carbon and Energy Management Plan
EBRD	European Bank for Reconstruction and Development
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
EU	European Union
GHG	Greenhouse Gas
HSEC	Health and Safety, Environmental and Community
Geoteam	Geoteam CJSC
GIIP	Good International Industry Practice
IFC	International Finance Corporation, a member of the World Bank Group (WBG)

Lydian	Lydian International Ltd
RA	Republic of Armenia
OPs	Operating Procedures
PEP	Project Execution Plan
WBCSD	World Business Council for Sustainable Development
WRI	World Resource Institute

Definitions

- Management Plans (MPs): Establishes specific requirements for various important environmental and social disciplines such as water, air and waste management, spill prevention, progressive site rehabilitation/closure, stakeholder engagement, cultural heritage protection, biodiversity preservation, etc. The main users of Management Plans are the department heads, superintendents and supervisors who track action implementation and translate specific actions to workers as necessary to ensure work is conducted in a responsible manner.
- Operating Procedures (OPs): Provide details on how to manage a specific environmental or social issue or area of risk. The main users of Operating Procedures are operations superintendents, supervisors and workers.
- Work Instructions (WIs): Define specific tasks to be conducted by workers to ensure effective controls are in place related to their work activity. The main users of Work Instructions are supervisors and workers who need to understand the risks associated with their work and how to control the associated risks.
- Forms / Templates / Checklists: Provide the means for ensuring effective management and control of documented information

See also Lydian HSEC STA 02 Glossary of HSEC Terms and Acronyms.

1 Introduction

Lydian International Ltd (Lydian) and its wholly-owned Armenian subsidiary, Geoteam CJSC (Geoteam), are developing the Amulsar Gold Project (the Project) in the central part of the Republic of Armenia (RA). The proposed Project will develop the gold deposit via open-pit mining and heap-leach processing using dilute cyanide solution.

A Mining Right (MR) for the Project was granted by the RA government in November 2014. This was based, in part, on the approval of the regulatory Environmental Impact Assessment (EIA) for the Project in October 2014. Some permits also exist for ongoing exploration and development activities with additional permits required for the construction and operation phase. The Project is currently in the early stages of development, with construction activities planned to start during the second quarter 2016 subject to financing.

In parallel with the EIA, an Environmental and Social Impact Assessment (ESIA) was undertaken in compliance with, amongst others, the Performance Standards (PS) of the International Finance Corporation (IFC) and the Performance Requirements (PR) of the European Bank for Reconstruction and Development (EBRD).

In mid-2015, a Value Engineering (VE) and Optimization process was initiated, with Lydian commissioning Samuel Engineering Inc. (Samuel) and other consultants to perform engineering design on several identified VE and Optimization concepts. The objective was to reduce capital expenditure without increasing operating costs or environmental and social impacts. The results from this work done in 2015, which were published in the NI “43-101 Technical Report: Amulsar Value Engineering and Optimization” in November 2015, included reduced capital and operational costs, making the Project more viable in a challenging economic environment.

Changes to the Project design as a result of the VE and Optimization work have resulted in the need to prepare a revision to the new EIA approved in October 2014 and amend the ESIA completed and disclosed in April 2015. The EIA was approved on 28th April 2016. The Project has also been subject to various health, safety, environmental and community/social (HSEC) commitments arising from the ESIA undertaken in compliance with the IFC PS and EBRD PR. The final version of the ESIA, denoted v10, published for public review and comment in June 2016, follows a series of public consultations and disclosure meetings in May & June 2016.

Both the EIA and ESIA make a number of commitments pertaining to the mitigation and management of E&S impacts. These commitments and requirements must be fulfilled as the Project moves forward. To facilitate implementation, all commitments made in the ESIA have been compiled into a full Commitments Register (CR) which will be used by Lydian for tracking purposes throughout the Project. Although many of the commitments apply to E&S management during Project implementation (construction, operation and closure), some apply to the Project design and engineering phase and must be addressed before construction works starts on site. The implementation of many of the commitments depends not only on the actions of full Project team.

E&S commitments are being managed by Lydian and Geoteam using the Environmental and Social Management System (ESMS). The ESMS includes the Management Plans (MPs), such as this one, that detail requirements that Geoteam and its contractors will follow in order to fulfil the Project's environmental and social commitments. For the purpose of this MP, "Contractor" means any all project participants, such as contractors working in the field on the project including but not limited to drilling contractors, construction contractors, camp service contractors, engineers, fabricators, suppliers, etc. Contractors should implement parts of the plans relevant to their activities, issuing their own management plans in line with the Geoteam ESMS, smaller contractors may fall directly under Lydian's OHSMS and ESMS and subject to specific training in the procedures relevant to the contract.

1.1 Commitments

ID.	Condition/actions	Public Commitment	Monitoring and compliance	Cross references and documentation	Responsibility
CEMP1	Prior to the 31st of March each year, an annual update report providing detailed interpretation of the GHG database will be completed covering the preceding year (1st of January to 31st of December). The report will cover the following issues: The annual and updated cumulative GHG emissions totals for all Scope 1 works on site; The annual and updated cumulative GHG emissions totals for all Scope 2 works; Comparison of data with previous years GHG levels for both Scope 1 and Scope 2 works; Discussion of notable changes in GHG emissions, either savings or increases; List of activities undertaken that have generated GHG including, where available GHG emissions generated by 3rd party contractors	The Project will continue to seek to reduce its GHG emissions throughout its lifecycle. The Project will prepare a Carbon and Energy Management Plan prior to construction. This will report annual emissions back-dated to based on best estimates the commencement of exploration at Amulsar.	Reports will need to be produced and will be available for inspection remotely or on site.	Construction Phase: PEP, Contractor Management Plan; FMP Operations: Maintenance schedules, fleet management, energy usage	Geoteam Site Health, Environmental, Safety and Security Manager Report to: Geoteam Project Director

ID.	Condition/actions	Public Commitment	Monitoring and compliance	Cross references and documentation	Responsibility
CEMP2	Bi-annually, the onsite GHG Emissions Database (including GHG emission generated by Scope 1 or Scope 2 works or generated by 3rd party contractors) will be updated to include the preceding audit. The data will be collected in the form of a spreadsheet and will be interpreted as part of the annual update report required under CEMP1. For clarity 3rd party contractors will be responsible for informing Lydian or Geoteam of the energy consumption used whilst working on the site. This information will then be reported to the Board and contribute to the Annual Monitoring Report (AMR) (CEMP1).	The Project will continue to seek to reduce its GHG emissions throughout its lifecycle. The Project will prepare a Carbon and Energy Management Plan prior to construction. This will report annual emissions back-dated based on best estimates to the commencement of exploration at Amulsar.	GHG Emissions database will need to be produced and will be available for inspection remotely or on site.	Construction Phase: Contractor Management Plan; FMP Operations: Maintenance schedules, fleet management, energy usage	Geoteam Site Environmental Manager

ID.	Condition/actions	Public Commitment	Monitoring and compliance	Cross references and documentation	Responsibility
CEMP3	Copy of the CEMP to be available on site in both Armenian and English language.	The Project will continue to seek to reduce its GHG emissions throughout its lifecycle. The Project will prepare a Carbon and Energy Management Plan prior to construction. This will report annual emissions back-dated based on best estimates to the commencement of exploration at Amulsar.	Copies will be available for inspection on site, or remotely if required.	SEP	Geoteam Site Senior Health, Environmental, Safety and Security Manager Geoteam Senior Social Manager
CEMP4	All operational staff, including Lydian, Geoteam and 3rd party contractor employees to be aware of relevant responsibilities for reducing GHG emissions applicable to their role. This briefing must be undertaken within 3 calendar months from the commencement of the contract. Employees can be briefed by way of either one to one, group presentation, toolbox talks or newsletter.	The Project will continue to seek to reduce its GHG emissions throughout its lifecycle. The Project will prepare a Carbon and Energy Management Plan prior to construction. This will report annual emissions based on best estimates back-dated to the commencement of exploration at Amulsar.	A register will be kept on site of when staff members have received training. This register will be available for review remotely or on site.	Construction Phase: Contractor Management Plan Operations Phase To be included in training manuals and other relevant staff information	Geoteam Senior Health, Environmental, Safety and Security Manager Geoteam Site Environmental Manager Contractor Site Environmental Manager

1.2 Scope, Background and Context

The Project is a greenfield mining proposal that will generate significant emissions[1] of carbon dioxide equivalent (tCO_2e)[2] per year as a result of the direct Greenhouse Gas (GHG) emissions within the physical project boundary and indirect emissions associated with offsite production of energy (i.e. purchased electricity). The CEMP requires the management and monitoring of GHGs, emitted during the Project life including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Open pit mining of gold ore will involve the large scale movement of rock, ore and other materials utilizing typical modern mining equipment and well established techniques. The ore will be processed within a heap leach facility where the metals will be extracted using adsorption-desorption techniques. The Project will support a workforce of up to 1500 during the peak of the construction phase and 657 during the operational phase of the Project.

This Carbon and Energy Management Plan (CEMP) requires annual reporting of GHG emission, in accordance with PS3 and PR3 (see Appendices 1 and 2) and through analysis of the source of GHG emission seeks, where practicable, continual improvement in the control of GHG emissions throughout the life of the Project. PS3 and PR3 require consideration for improving efficiency in consumption of energy, water as well as other resources and material inputs, the CEMP considers GHG emissions associated with energy and material usage. GHG emissions would be calculated using standard methodologies as defined by the World Business Council for Sustainable Developments (WBCSD) Greenhouse Gas Protocol (GHG Protocol) (appendix 3).

This CEMP reports on GHG emissions generated to date during the exploration phases of the Project (2008 to 2015) and this assessment provides the baseline scenario for the Project. From 2016, as the site moves into the construction phase, GHG emissions will be monitored and reported on an annual basis to take account of cumulative emissions over the lifetime of the Project. The CEMP reporting protocols will be developed during the construction phase and will continue to be implemented during the operational and closure phases of the Project.

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[1] Significant emissions refer to emissions greater than the threshold value of 25,000 tCO_2e per year for which annual quantification and reporting is required by IFC

[2] *Equivalent CO_2 (CO_2e) is the concentration of CO_2 that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas.*

1.3 Objectives and Goals

The objectives and goals and goals of the Carbon Energy Management Plan are:

- Develop and support air quality management programs, monitoring programs, mitigation and reporting programs related to greenhouse gas emissions during the construction, operation and closure phases of the project.
- Ensuring all relevant statutory requirements are met, as well as general conformance with IFC Performance Standards and guidelines.
- Monitoring and Improving data quality and consistency.
- Provide adequate and improved information for updating existing and future policies.
- Provide greenhouse gas emissions information to stakeholders on a periodic basis as part of the consultation programs and continued improvement process.
- Implement applicable best practice carbon management tools to control and minimize the GHG emissions during construction, operation and closure.
- Identify and implement reasonable and feasible measures to minimize and mitigate the release of greenhouse emissions during current and future stages of the project.

1.4 CEMP Process Description

This CEMP has been prepared to define how energy and GHG emissions will be monitored during construction, operation and closure of the mine. The CEMP addresses management procedures and the application of relevant mitigation measures identified in both the EIA and the ESIA.

The CEMP also provides a mechanism for assessing operations relating to fleet management, vehicle and electricity usage, as well as procedures for continually monitoring and mitigating GHG emissions generated by the Project. The data collected as a result of the CEMP will be included in the Amulsar Annual Monitoring Report (AMR) and the forthcoming Lydian Sustainability Report which will outline the HSEC performance of the project on a yearly basis. A summary of the annual report will be made publically available through the SEP.

A proactive attitude towards reducing the energy and carbon emissions of the Amulsar project will be adopted. The Geoteam environmental team will manage the monitoring and implementation of mitigation measures for energy usage, and will collect the monitoring information from contractors and subcontractors for inclusion in the annual GHG emissions report. The Geoteam social team will be responsible for the dissemination of information to stakeholders, local community representatives and the public.

Future reporting in the Amulsar annual Monitoring Report (AMR) will include the reporting of direct and indirect emissions generated by the Project as defined by the IFC Performance Standards and WBCSD's Greenhouse Gas Protocol and summarised below:

- **Direct GHG emissions (Scope 1 emissions):** Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from company owned or controlled boilers, furnaces, vehicles; as well as emissions from production in owned or controlled process equipment.
- **Indirect GHG emissions (Scope 2 emissions):** Indirect GHG emissions accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company.
- **Emissions not controlled by the Company (Scope 3 emissions):** These emissions are indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions and is an optional reporting category.

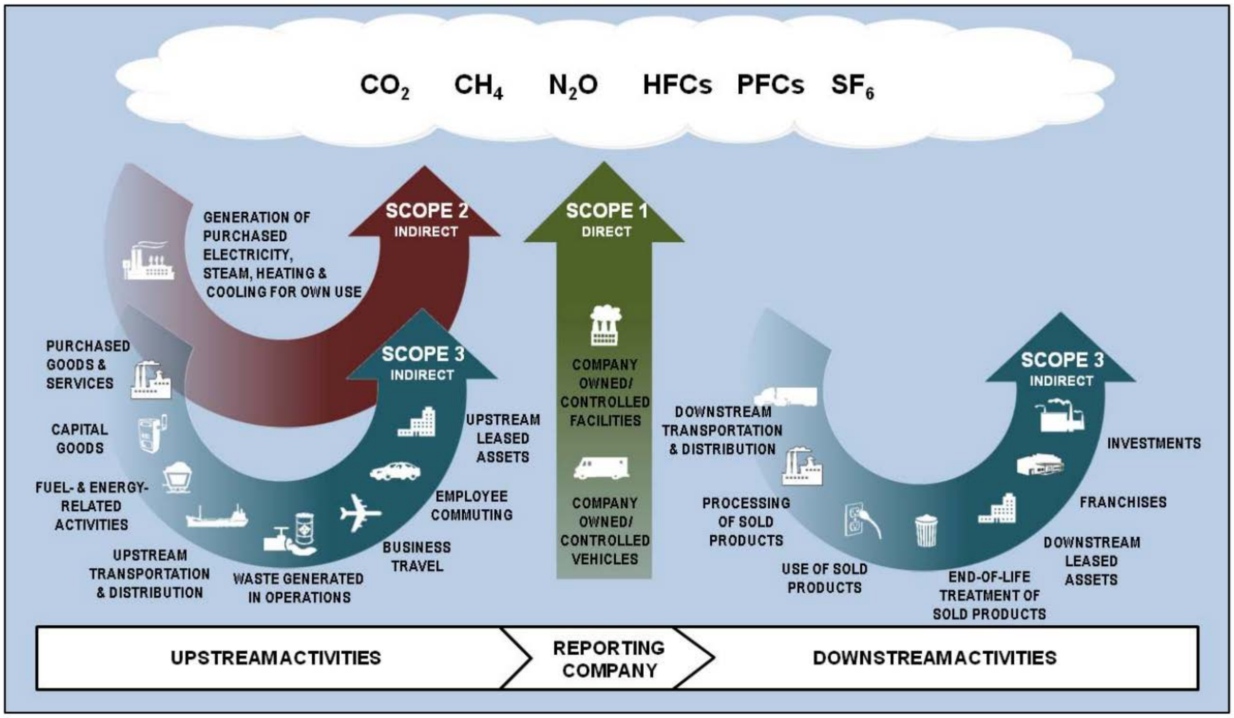

Figure 1: Overview of Scopes and Emissions

Direct emissions (Scope 1) include all the emissions generated within the physical project boundary and indirect emissions (Scope 2) are those associated with offsite production of energy (i.e. purchased electricity from the grid). The direct emissions will therefore include emissions resulting directly from Lydian's operations on-site and all activities undertaken by its contractors. The 'Contractors' for the Project would include any company working on site including but not limited to drilling contractors, camp service and construction contractors, engineers and fabricators. The contractors will be responsible for implementing the CEMP for their respective activities.

The accounting of Scope 1, 2 and 3 emissions will be in accordance with the Technical Guidance for Calculating Emissions included in the "*Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard*[3]" developed by the WBCSD and the WRI (World Resource Institute).

[3] WBCSD and WRI (2004) *GHG Protocol: Corporate Accounting and Reporting Standard 2004.* Available from the URL: http://www.wri.org/sites/default/files/pdf/measuring-to-manage.pdf *(accessed April 2016)*

The CEMP has been formulated as a reference document for use and implementation by Geoteam and 3rd party contractor personnel who are responsible for registering and controlling the data related to GHG emissions. The CEMP will be maintained as a 'Live Document' that will be revised periodically and expanded as required.

In summary the CEMP will:

- Identify responsibilities for GHG monitoring and development of GHG database
- Explain procedures and methods to collect data, including reporting and record keeping requirements.
- Define the sources to calculate GHG emissions.
- Establish report submission procedures.
- Provide measures for managing emissions associated with use of vehicles and electricity including procedures to calculate energy savings and corresponding reduction in GHG emissions.
- Describe Quality Assurance and Quality Control (QA/QC) procedures for accounting and reporting of GHG emissions.

2 Roles and Responsibilities

Geoteam is responsible for the implementation of the CEMP, either directly or indirectly through construction and operation contractors. Geoteam will ensure that sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Plan. Execution responsibility is shared between departments, based on the nature of the action required.

Specific responsibilities for Geoteam personnel related to this plan are as follows:

2.1 Geoteam Project Director

- Communicating the CEMP and specifying the Project's energy and GHG monitoring, commitments and requirements to all staff and contractors;
- Ensuring that the GHG database is complete, consistent, accurate and transparent and covers the activities described in the Project Execution Plan (PEP);

- Provide a description of data sources reported for Scope 1 and Scope 2 emissions to ensure accuracy and prevent double counting;
- Undertaking actions to address issues raised following audits and inspections of the GHG accounting procedure, and maintaining a system to track progress on action to correct any failures to manage them effectively and in accordance with the ESMS; and
- Ensuring that designated managers understand their responsibilities and that they have sufficient resources to carry out their function effectively.

2.2 EVP Sustainability

- Review the GHG emissions reports prepared by the Senior Manager Health, Environmental , Safety and Security every quarter;
- Review the annual monitoring emission reports; and
- Approve management measures for energy savings and allocate appropriate resources for their implementation.

2.3 Senior Manager Health, Environmental, Safety & Security (HESS)

- Agree and sign-off AMR by 31 March, based on data from 1 January to 31 December the GHG database, from the previous year starting in 2016;
- Identify opportunities for energy savings and reducing GHG emissions ;
- Monitor compliance with procedures and develop training and auditing tools that will raise awareness regarding GHG emissions;
- Documenting the implementation of the CEMP and particularly any significant change in GHG emissions;
- Review and update this management plan in order to ensure that the plan reflects up to date information and emerging best practice;
- Disseminate the vehicle and fleet management plan, and electricity usage plan and ensure that the measures are implemented by all relevant personnel;
- Coordinate QA/QC procedures and audits;

- Provide suitable training on the requirements of this CEMP and monitor training records to ensure that training is updated at regular intervals; and
- Reporting outcomes to the Project Director.

2.4 Site Environmental Manager

- Prepare AMR emissions reports from the GHG database
- Communicate the relevant contents of the CEMP to contractors' personnel and training all workers and subcontractors to ensure they understand their responsibilities with respect to this plan;
- Raise awareness for the contents of the CEMP requirements and commitments, with regard to energy and vehicle management, and with regard to all relevant procedures and standards;
- Implement the procedures required by the GHG Monitoring Program, compile all GHG emissions data and ensure that all reported data fulfills the standards and unsatisfactorily compiled data is rejected.
- Implement effective monitoring of onsite GHG emissions and input data into GHG Database. Comply with the vehicle, fleet and electricity usage requirements.
- Report operational improvements and practices that allow energy saving and GHG emissions improvements.
- Keep Geoteam fully informed of any site issues related to the monitoring program, fleet, vehicle, and electricity usage practices.
- Training personnel in Geoteam's requirements and commitments, regarding control and management of data and all relevant energy usage standards.
- Communicate the relevant contents of the CEMP to 3rd party contractors' workforce and training all workers and subcontractors to ensure they understand their responsibilities with respect to this plan;
- Raise awareness for the contents of the CEMP requirements and commitments, with regard to energy and vehicle management, and with regard to all relevant procedures and standards;
- Implement the procedures required by the GHG Monitoring Program, compile all GHG emissions data and ensure that all reported data fulfills the standards and unsatisfactorily compiled data is rejected.

2.5 Other roles

The Site Environmental Manager will be supported by several teams to compile the data required for GHG reporting and for implementation of management measures. The various teams and their respective roles in data collection have been provided below:

- *Plant Maintenance team* – Responsible for fleet management and performance and will be responsible for the compilation of data regarding fuel consumption for onsite power generation and for equipment and machinery. A maintenance schedule for all equipment and machinery will also be compiled by the team.
- *Operations Team* – The operations team will include the Production Managers and will be responsible for reporting the amount of explosives used during construction and operations. The team will also provide summary updates to the Site Environmental Manager for GHG reporting, regarding the operational issues such as fuel use and economy, based on haul distance and gradients and other factors that influence fuel use in the reporting period.
- *3rd party contractors* – The 3rd party contractors will provide the information relating to fuel consumption for activities being undertaken by them.
- *Surveying Team* – The surveying team will provide information regarding the land use changes and will provide updates regarding location of temporary facilities such as site compound to minimise the distances to be travelled within site.
- *Administration Team* – The Administration team will provide the data relating to the electricity drawn from the grid for the project activities. The details regarding use of electricity generated on site by the conveyor will also be collated by the Administration team.

Each team will be responsible for the compilation of data required for GHG emissions accounting and ensure that the GHG database is updated for the Site Environmental Manager to prepare internal audit and yearend AMR.

3 Project Activities

The project activities will comprise of pre-construction, construction, operation and closure phases. A summary of activities to be undertaken during each phase of the project is provided in Figure 1.

2008-2016

EXPLORATION PHASE

Construction activities during the exploration phase

- Temporary access tracks and site compound, renovation and reclamation works
- Geological investigations
- Collection of environmental and social baseline data

Two years

PRE- CONSTRUCTION PHASE

Construction activities to upgrade the access or improve physical condition of the site

- Drainage control structures, improve of access, parking and office facilities
- Temporary sewage, power and water facilities. Relocation of irrigation and power facilities affected by the Project
- Temporary water intake at the Arpa for early construction activities
- Relocation of the irrigation pipeline, archaeological clearances

CONSTRUCTION PHASE

Construction activities

- Construction camp for operation staff
- Storage facilities for explosives, reagents, cyanide and storage cells for transfer of hazardous waste. Landfill for non-hazardous waste. Domestic waste water treatment.
- Electrical power and water supply infrastructure
- Main construction with the following components: open pits, BRSF, crushing and screening plant, run of mine (ROM) ore stockpile, topsoil stockpile, drainage system, haul and access roads, overland conveyor and truck load-out area, heap leach facility
- Passive Water treatment

Ten years

OPERATION PHASE*

Following components will operate during the operation phase

- Mobile plant conducting drilling, extraction, loading and haulage operations
- Static plant conducting crushing, screening, processing and pumping
- Conveyor
- HL additional equipment

(*)A full list of the equipment to operate at this stage is included in the document NI 43-101 Technical Report. Amulsar Value Engineering and Optimization Armenia.

Two years

CLOSURE PHASE

Plan dismantling with the following activities

- Progressive removal and rehabilitation of processing facilities, structure non-essential and closure of conveyor system
- HLF closure activities including regrading, cover replacement and surface water controls
- Progressive rehabilitation of affected areas, reclamation of pit areas and BSRF

GHG Emissions quantification and reporting

Figure 1. Project related activities

4 GHG emissions Exploration phase (2008 to 2015)

The emissions associated with the project for the exploration phase extending from 2006 till date have been estimated to be 6429 tCO_2e with the maximum annual GHG emissions of 1,338 tCO_2e for the year of 2013. The annual GHG emissions for the exploration phase have been presented in Figure 2. The exploration phase for the Project comprised of exploratory and survey works, physical works associated with construction of access tracks and site compound, renovation works associated with Gndevaz channel and rehabilitation and reclamation works undertaken for Kechut landfill. The estimation of GHG emissions does not include Scope 2 emissions as the exploration phase did not involve use of any purchased electricity. The Scope 1 emissions consider the fuel consumption for onsite power generation and use of equipment and machinery. Scope 3 emissions associated with air travel have also been accounted as it has a significant contribution to the overall GHG emissions associated with this phase of the Project.

Appropriate assumptions have been made for the calculation of emissions associated with this phase of the Project using professional judgment.

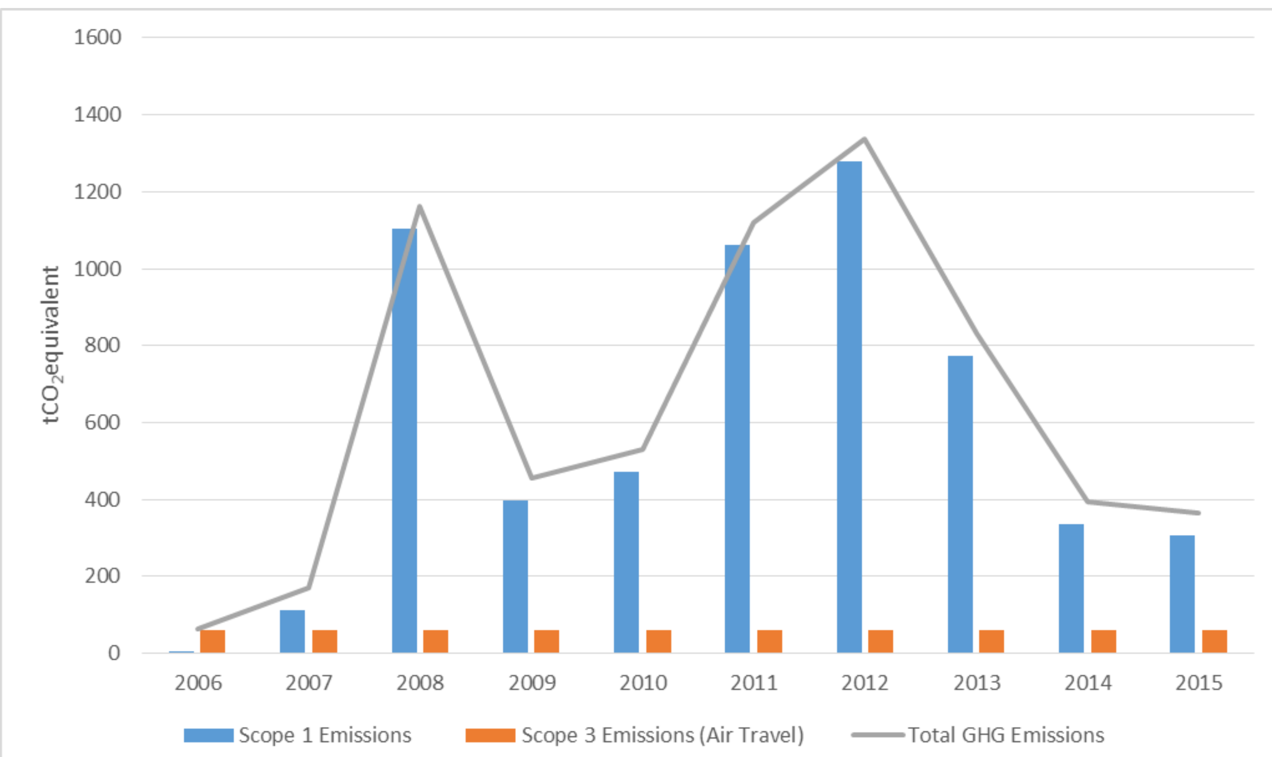

Figure 2 – Emissions generated during the exploration phase

5 Projection of GHG Emissions

The Chapter 6.4 of the ESIA assesses the GHG emissions that will be produced during construction, operation and closure phases of the Amulsar Project. The emissions have been calculated using standard methodologies defined by the WBCSD Greenhouse Gas Protocol (Appendix 3) and based on the fuel and energy demands for the Project predicted as part of the TR (Value Engineering and Optimisation) report (43-101 Feasibility Report). The methodology used for estimation of GHG emissions is provided in Chapter 6.4 and the detailed calculations are presented in Appendix 6.4.1, copies of the relevant tables which are relevant to the Scope 1 and Scope 2 activities are included in Appendix 4 of the CEMP.

Based on the estimates provided in the 43-101 report the predicted GHG annual emissions amount to 31,700 tCO_2e for the construction phase and 92, 200 tCO_2e annually for the operational phase. GHG emissions for closure phase of the mine equates to an average of 2, 500 tCO_2e per annum. The cumulative total GHG emissions for the project are 996,700 tCO_2e. Table 1 and Figure 4 provide a summary of the estimated annual emissions.

Table 1: Estimated summary of annual GHG Emissions

0	**Exploration Phase (2006-2015)***	**Tonnes of CO_2e**
	Scope 1 Emissions	
	Stationary and mobile combustion	600
	Scope 3 Emissions	
	Emissions associated with air travel	100
	Sub-total	**700**
1	**CONSTRUCTION (2 YEARS)**	
	Scope 1 Emissions	
	Stationary combustion	1,400
	Company owned construction machinery (e.g. Haul trucks, dozers, excavators) and transport	17,800
	Blasting	200
	Land use	7,100
	Scope 2 Emissions	0
	Energy imported from the grid	5,200
		31,700
	Sub-total	

2	**OPERATIONAL PHASE (10 YEARS)**	
	Scope 1 Emissions	
	Company owned construction machinery (eg. Haul trucks, dozers, excavators), transport and generation from conveyor	66,100
	Blasting	2,600
	Scope 2 Emissions	0
	Energy imported from the grid	23,500
		92,200
	Sub-total	
3	**DECOMMISSIONING AND CLOSURE (2 YEARS)**	
	Scope 1 Emissions	
	Company owned construction machinery (eg. Haul trucks, dozers, excavators) and transport	800
	Scope 2 Emissions	0
	Energy imported from the grid (averaged over years 1 and 2)	1,700
	Sub-total	**2,500**
Cumulative GHG emissions (Exploration, construction, operation and decommissioning phases)		**996,700**

Note – GHG emissions for exploration phase have been calculated based on the actual fuel consumption data and air travel data

All figures have been rounded off to nearest hundred

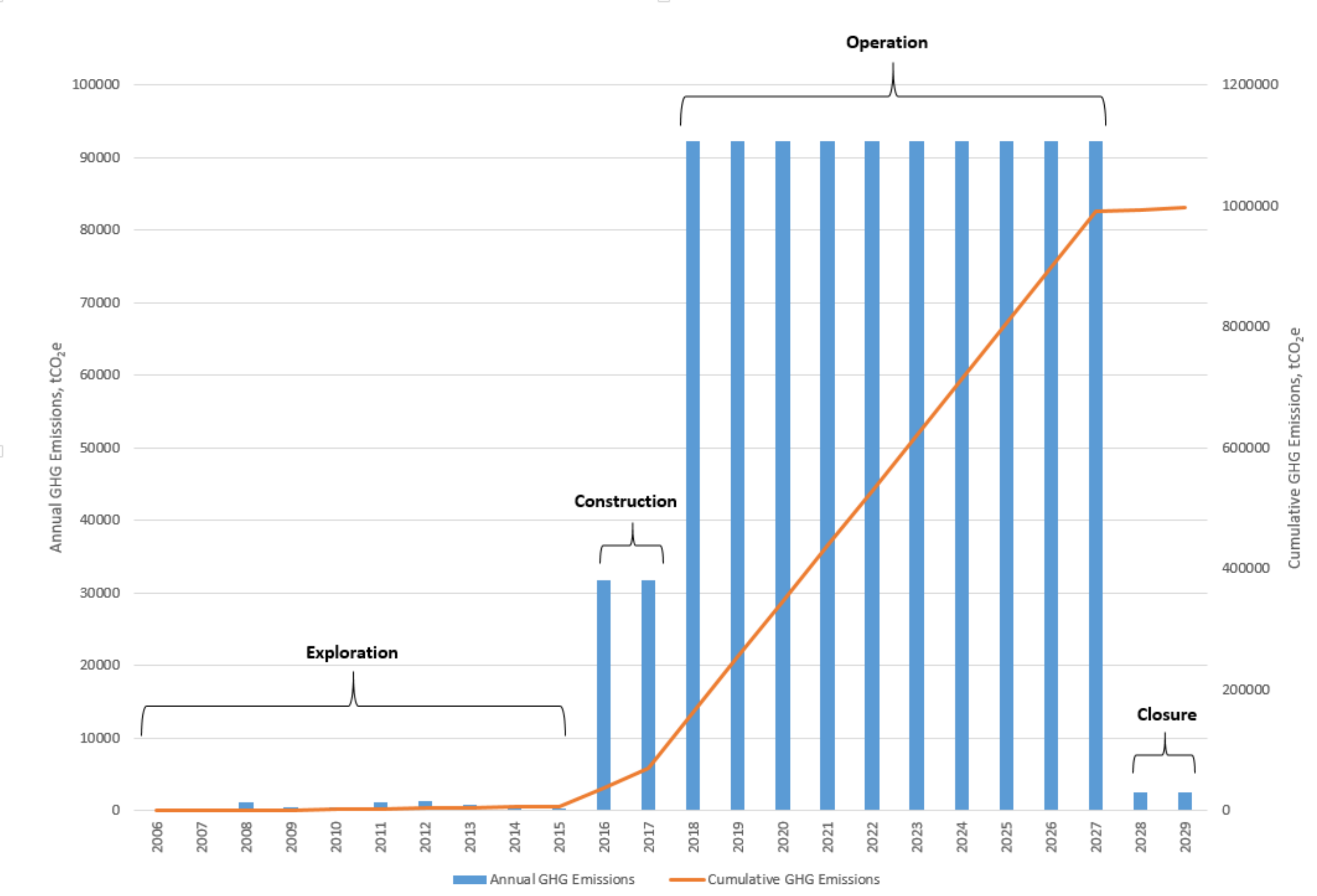

Figure 4: Projected Annual and Cumulative GHG Emissions

(Note: The above graph provides the calculated GHG emissions for the exploration phase and the projected emissions for construction, operation and closure phases)

6 GHG Emissions Accounting and Reporting

The GHG reporting will comprise of three main steps; Accounting, Quantification and Reporting. Figure 5 below provides a flow chart of what each step will entail and a further description is provided in subsequent sections.

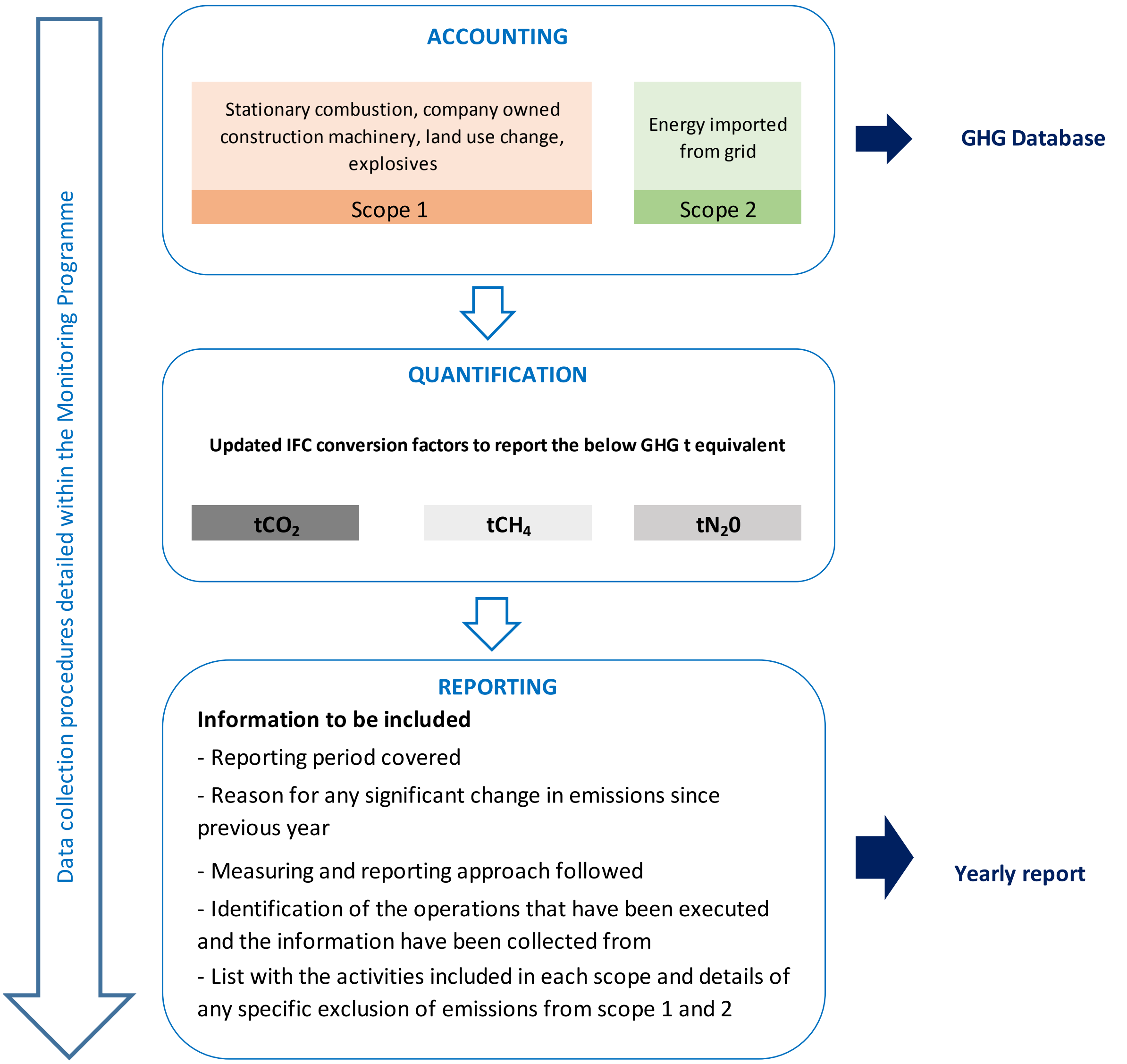

Figure 5: Key Steps involved in GHG Emissions Reporting

6.1 GHG Accounting

This section details out how the data related to GHG emissions will be collected during the various phases of the Project along with procedures to be adopted for GHG accounting and reporting.

6.1.1 Direct emissions (Scope 1 emissions)

The direct emissions for the Project will include all emissions released within the physical project boundary and will include emissions associated with the contractor's activities taking place within the site.

The emissions during the construction phase will largely be associated with land use change, fuel consumption on site for generation of electricity, heat or steam, fuel consumption for construction equipment and machinery and the use of explosives for blasting operations.

The emissions during operation phase will be associated with the use of on-road vehicles for hauling of ore and barren material and off-road vehicles for mining of ore and other materials,

The data pertaining to these emissions will be recorded under the following categories:

Stationary Combustion [4]– All emissions associated with the combustion of fuels within the physical boundary of the site, including onsite worker's accommodation, electricity heat or steam generation will be included in this category. Stationary combustion devices include diesel generators, pumps, boilers, furnaces (e.g. smelting furnace), and space heating.

The data relating to the fuel consumption for each stationary combustion unit will be accounted for by data from purchasing and accounting records for quantities of fuels received and used on a periodic basis as determined by site management. The QA/QC procedures will be checking the purchasing/accounting records against the department usage log books or other methods of recording usage by department. The checks and balance scheme may be revised dependent on operational purchasing and accounting programs.

Mobile Combustion – This category will include emissions associated with the use of equipment and machinery at site.

The construction phase will involve use of equipment and machinery for earthworks, civil, mechanical and electrical works. As the construction activities for the project will be managed by a number of contractors, the Contractors Site Environmental Manager will be provided training on reporting of data for the emission

[4] *Stationary combustion defined in WRI/WBCSD guidance: "Calculation tool for direct emissions form stationary combustion", accessed April 2016 : http://www.ghgprotocol.org/files/ghgp/tools/Stationary_Combustion_Guidance_final.pdf*

inventory. The fuel consumption data for each piece of equipment and machinery will be recorded in the log book at the time of re-fuelling by the operator and will be supplied to the Site Environmental Manager.

The operation phase will involve use of on-road vehicles for hauling of ore and barren material and off-road vehicles for mining of ore and other materials. The list of equipment's to be used during the operation of the mine has been included within Appendix 8 of the TR (Value Engineering and Optimisation) report (43-101 Feasibility Report) and would be used as a starting point and would include equipment such as mass excavators, crushers, drilling equipment, conveyors, haul trucks and fork lifts. Any additional equipment and machinery will be added to the list and will be updated by the Site Environmental Manager.

As practical and feasible, equipment and machinery with remote performance monitoring system will be procured and a site wide automation system will be used. Process controls for extracting the fuel consumption data will be integrated into the system. Fuel consumption data for equipment and machinery not equipped with remote performance monitoring systems will be maintained by the purchasing and accounting department and collated by the Site Environmental Manager.

Explosives – The type and amount of explosive used will be recorded through blast design schedule by the Contractors and reported to the Site Environmental Manager and will be included in the GHG emission inventory.

Land Use Change – This category will be applicable to the construction phase and will involve GHG emissions due to land use change. Chapter 6.4 of the ESIA provides an estimate of the total GHG emissions associated with the land use change of the Project. The disturbed land area for the Project has been estimated to be 862.3 ha (Table 6.4.2 of the ESIA) and the total GHG emissions associated with the land disturbance have been estimated to be 14,238 tCO2e (Table 6.4.3 of the ESIA) for the entire life of the mine. A project specific average GHG emission factor per ha of disturbed land area has been calculated based on these estimates to be 16.5 tCO_2e per ha of disturbed land area.

The Surveying team will provide an estimate of the disturbed land area (with respect to baseline land use) to the Site Environmental Manager, who will be responsible for estimating the GHG emissions associated with the land use using the project specific average GHG emission factor (16.5 tCO_2e per ha). Since the emission factor has been calculated considering the entire life of the mine, the emissions will be considered only in the reporting period in which the land disturbance takes place and will not be considered on a cumulative basis. The Survey Team will provide an estimate of the area reclaimed and revegetated progressively for the reporting period for estimating GHG emissions.

6.1.2 Indirect Emissions (Scope 2)

Emissions from Purchased Electricity – The emissions associated with the purchased electricity during pre-construction, construction and operation phases will be accounted through meter reading and accounts billing and will take account of the nuclear power generation that minimises the GHG emissions associated with electrical consumption from the Grid. The site administration team will be responsible for informing the Site Environmental Manager of these figures. The electrical load analysis is presented in Appendix 7 of the TR (Value Engineering and Optimisation) report (43-101 Feasibility Report) and includes power load for mine maintenance facilities, crushers and transfer conveyors, HLF, ADR plant, and Arpa River water supply pump station.

6.1.3 Emissions not controlled by Lydian (Scope 3)

The Scope 3 emissions associated with the Project will include emissions associated with the production of raw materials, transportation of purchased goods to site and electricity consumption associated with the labour accommodation in hotels (construction phase only). Considering the nature and scale of the Project, these emissions are expected to be negligible in comparison to Project Scope 1 and Scope 2 emissions. It is thus proposed to exclude the reporting of the Scope 3 GHG emissions for the construction and operation phases of the Project.

6.2 Quantification

GHG emissions in tonnes of CO_2e will be reported internally on a regular basis as determined best by the site management team and in the AMR, prepared within 3 months of the end of each calendar year. The Carbon Emissions Estimator Tool[5] from IFC provides the conversion factors that will be used to calculate the GHG emissions from different sources and used to convert them into units of CO_2e. The quantification

[5] http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/CB_Home/Measuring+Reporting/

of the GHG emissions should be calculated with the latest version of the IFC Carbon Emission Estimation Tool (CEET).

Emissions are determined for each source by multiplying the total amount of energy or fuel by the appropriate emissions factor for CO_2, CH_4 and N_2O. An illustration of this calculation for units of fuel consumed is shown in Figure 6. Regardless of whether the amount purchased is reported in volume or mass, it is converted to units of energy based of the fuel's calorific value. Totals for CH_4 and N_2O are multiplied by their global warming potential (GWPs) to calculate CO_2 equivalent emissions.

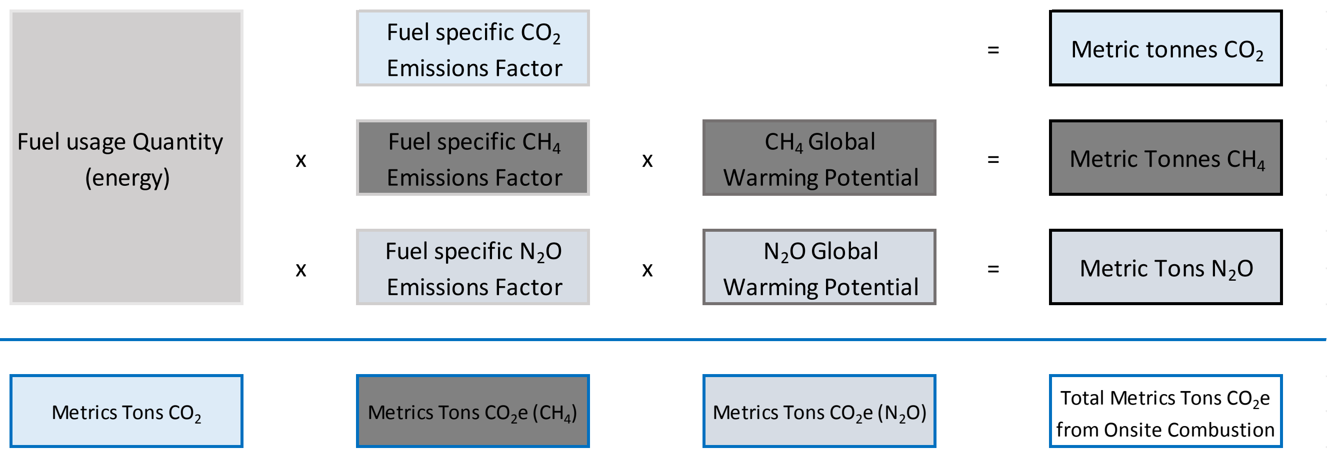

Figure 6. Example on-site fuel combustion emissions calculation. Source: GHG Emissions. Inventory Management Plan

6.3 Reporting

The reporting requirements will be in accordance with the Corporate Standard from the WRI and the WBCSD *"Measuring to Manage: A Guide to Designing GHG and Reporting Programs"* [1]. The emissions data will be reported separately for each scope and for the following GHGs separately: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) in metric tonnes and finally in metric tonnes of CO_2 equivalent (CO_2e).

Internal Reporting

Internal reports will be prepared and submitted to the Senior Manager HESS by the Site Environmental Manager. These bi-annual reports will report the total GHG emissions in metric tonnes of CO_2e and will be calculated for per metric tonnes of production, taking account of ore & barren rock, ore and gold produced. The summaries will include the following information:

- Period that report covers
- Key activities undertaken during the reporting period such as
  - Notable changes to working methods;
  - Changes in machinery or equipment;
  - New processes or activities commissioned,
  - Split between energy generated from onsite conveyor and drawn down by the distribution grid.
- Total GHG emissions for the reporting period.
- GHG emissions per tonne of production.
- Potential reasons for difference in GHG emission figures from previous reports.
- Identified carbon and energy management opportunities.

The report will be submitted to the Board, after sign off from the Senior Manager HESS.

Annual Report

The Site Environmental Manager will be responsible for compilation of the AMR, for review and sign-off by the Senior Manager HESS. The report will include the following information:

- Period that report covers.
- Annual GHG emissions and GHG emissions per tonne of production.
- Key activities undertaken during the reporting period.
- Details of activities covered under each scope.
- Basis for GHG emission calculations.

- GHG emission reductions achieved as compared to previous reporting period.
- Carbon and Energy Management Opportunities identified for next year

The contents of the report will be published in the Amulsar Annual Monitoring Report (AMR) and the Lydian Sustainability Report.

6.3.1 Quality assurance

All activities relating to energy and carbon emissions will be subject to regular quality inspection (within the ESMS) and will be audited as part of the ESHS audits. Geoteam will also inspect the completeness of the contractors GHG database to assess the consistency of the data.

As the operation develops, areas of improvement will be identified to verify accuracy and relevance. The Senior Manager HESS will ensure that the GHG accounting and quantification includes all the emissions associated with the Project and any exclusions will be justified and clearly defined in the report.

7 Carbon Management

7.1 Design mitigation measures

A number of design details aimed at reducing the potential GHG emissions of the project have already been incorporated into the sites design and are outlined in the following objectives. This section highlights the broad objectives aims and provides an explanation of how, when and who will be responsible for implementing and monitoring its requirements.

Objective1	**Minimize the footprint of the project and the associated land clearance requirements**
How will this be implemented? a) To a practical extent the footprint of temporary facilities, such as construction access roads and laydown areas, will be designed to coincide with longer term project requirements to reduce disturbance and long term impacts to soils. **When will this action be achieved?**	

During the 2 year construction period

Who will monitor this action?

Site surveying team will provide updated site working progress plan marking out the location of temporary structures to the Site Environmental Manager who will include those details within the internal reporting mechanism and the AMR.

b) Where short-term disturbance is required for infrastructure development, soils will be stockpiled on a temporary basis with soil returned and revegetated following completion of construction reducing the longer term footprint of the project.

When will this action be achieved?

During the 2 year construction period

How will this action be monitored?

Site surveying team will provide updated site working progress plan marking out the location of temporary structures to the Site Environmental Manager who will include those details within the internal reporting mechanism and the AMR.

c) Reclamation of exploration works (drilling pads, access roads) will be ongoing during the construction phase to restore and revegetate previously disturbed areas which will not be affected by the operations phase of the Project. Seeding will be undertaken using locally native species or culturally appropriate plants, and to tie in with adjacent vegetation types, where considered appropriate and essential to prevent erosion.

When will this action be achieved?

During the 2 year construction period

How will this action be monitored?

Site surveying team will provide information to the Site Environmental Manager regarding the progress of the restoration of the exploration works. The Site Environmental manager will then include those details within the internal reporting mechanism and the AMR.

d) On completion of the construction phase, all equipment and temporary installations and buildings not required for future operational use will be dismantled and removed. All construction waste will be disposed of in an appropriate manner. Pits, hollows and excavation trenches will be filled with the appropriate stockpiled materials. compacted, scarified and revegetated, as appropriate.

When will this action be achieved?

During the 2 year construction period

How will this action be monitored?

Site surveying team will provide information to the Site Environmental Manager regarding the progress of the restoration of the exploration works. The Site Environmental manager will then include those details within the internal reporting mechanism and the AMR.

Objective 2	**Use of the estimated 3MW provided by the regenerative drive system in place on the overland conveyor between the BRSF and the HLF?**

How will this be implemented?

Electricity generated will fed back into the distribution grid via a metering point, prior to this point any electricity to be used for on-site demand at that particular time would be recorded including: crushing circuit and ancillary facilities and overland conveying, ADR plant, solution management pumping, ancillary facilities and water distribution systems.

When will this action be achieved?

Throughout the construction (once the conveyor has been built) and operational phases.

How will this action be monitored?

Site administration staff will monitor the split of electricity used from either the conveyor or drawn down from the distribution grid. This data will then be passed to the Site Environmental Manager who will use the IFC Carbon Emissions Estimation Tool:

(http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/CB_Home/Measuring+Reporting/)

to calculate the GHG emission associated with the energy used from the distribution grid and then incorporate within the internal reporting mechanism and the AMR.

Objective 3	**Haul routes within the mining areas to be designed to reduce energy demands on mobile machinery**

How will this be implemented?

Where practicable and safe to do so, haul roads will avoid steep gradients (steeper than 1 in 10) to reduce the energy demands of haulage vehicles. The haul roads will be kept evenly graded and smooth to reduce wear and strain upon mobile plant.

When will this action be achieved?

Throughout the construction and operation phases of the project

How will this action be monitored?

The site surveying team will provide the Site Environmental Manager with using site progress plan, the results of which will be summarised into internal reporting and the AMR. The Site Environmental Manager will undertake regular visual inspections of haul roads to check the quality and smoothness of the routes.

Objective 4	**All buildings to be occupied by site based staff will be insulated to prevent heat losses**

How will this be implemented?

All buildings, including temporary cabins will be fitted with thermal insulation to ensure that the internal temperature can be maintained at 20°C in accordance with IFC requirements.

When will this action be achieved?

This will be undertaken throughout the construction and the operational phases of the project

How will this action be monitored?

The site administration team will provide a summary of the insulation properties of all of the buildings used to accommodate site based staff to the Site Environmental Manager. The Site Environmental Manager will incorporate this information into internal reports briefly noting the insulating qualities of any new buildings constructed or imported to site, this information would be summarised in the AMR.

Objective 5	**The use of modern, energy efficient electrical and mobile plant with fuel efficient engines**

How will this be implemented?

The procurement of modern high efficiency equipment will be undertaken from the outset of the project. New machines, equipped with the highest energy efficiency rating will be purchased to undertake the majority of the construction and operational activities.

When will this action be achieved?

The majority of the machines will be procured in the early construction and operational phases. In later phases replacement machines or additional machines may be required.

How will this action be monitored?

The plant maintenance team will provide the energy efficiency details of all new plant purchased to the Site Environmental Manager who will maintain an active list of the machines used on site. Any new plant purchase will be identified through internal reporting and summarised into the AMR.

Objective 6	Consider use of remote sensed fleet management software to manage utilisation, condition, maintenance and efficiency of use within each area of mining activity

How will this be implemented?

Consider the use of remote monitoring on mobile plant that will allow operational management staff to remotely access details relating to utilisation, condition and efficiency of the machine operations.

When will this action be achieved?

The majority of the machines will be procured in the early construction and operational phases. In later phases replacement machines or additional machines may be required.

How will this action be monitored?

Any new plant purchase will be identified through internal reporting, in addition the approach to fleet management will be documented in the AMR.

Objective 7	Process plant will be fitted with fuel consumption performance management software

How will this be implemented?

All processing plant (crushers, for example) will be installed from the outset of the project with a software system that actively manages the fuel consumption to ensure efficient performance.

When will this action be achieved?

The processing plant will be installed on site during the construction phase and will be maintained throughout the operational phase.

How will this action be monitored?

The fuel usage data will be reported in the GHG database, managed by Site Environmental Manager, and the results accounted and audited in the AMR.

Additional GHG mitigation opportunities will be explored further as the project design is advanced and operational activities are developed. At this early stage the objectives outlined will require significant consideration to establish if they are practical and cost effect. These objectives include the following:

Objective 8	**The use of biofuel (biodiesel) in mobile equipment (including light vehicles and, in future, the potential for larger mining equipment, should fuel blends become available)**

How will this be implemented?

This approach requires further understanding of the opportunity to source a reliable and secure source of biodiesel, and will also require an assessment of the life-cycle emissions to ensure the source of the biodiesel is not compromising overall GHG emissions (this is particularly true when considering potential land use implication of biodiesel). At the time of writing, such a source of biodiesel has not been identified, however the Project will continue to monitor potential options. The technology is deliverable, and has been proven on large scale mining operations in Indonesia where a Komatsu 785 for example have been powered using European Standard (EN 14214) based bio diesel fuel.

When will this action be achieved?

This potential GHG saving will be kept under review throughout the life of the site.

How will this action be monitored?

Should any mobile equipment be powered using bio-diesel blends then its use will be recorded by the plant maintenance team and the allowance recorded on the GHG database, managed by the Site Environmental Manager the assessment of the use of biofuel blends will be assessed and audited in the AMR.

Objective 9	**The potential for using energy efficient lighting such as CFLs or LEDs for site lighting where practicable. Motion sensors will also be employed to improve use efficiency where safety requirements allow.**

How will this be implemented?

The detailed design stage will identify the areas in which motion sensors and LED and CFL light bulbs will be used. The new buildings and outdoor lighting will be installed in accordance with detailed designs.

When will this action be achieved?

This will be undertaken during the construction phase of the site, as the various elements of the project are built.

How will this action be monitored?

The Site Environmental Manager will inform the annual report at the completion of the construction phase identifying the percentage of lighting provided on site that is controlled by motion sensors and CFLs or LEDs.

Objective 10	**Scheduling of operations to minimise haulage distances, double handling, and maximising vehicle utilisation.**

How will this be implemented?

As the mine logistics and scheduling are progressed, consideration will be given to optimizing vehicle and equipment movements so as to minimize operational distances and times.

An example of this includes the movement of barren rock from the Tigranes and Artavazdes deposits to the BRSF, a distance of 3.8km. These areas will be reclaimed and closed with barren rock from the Erato deposit (1 km away) during the later stages of the mine. This scheduling of operations will avoid the emissions that would otherwise be generated by double handling material from the BRSF to backfill the Tigranes and Artavazdes voids, thus significantly reducing the haul travel distances during mining of Erato pit.

When will this action be achieved?

Opportunities to undertake these actions will be implemented throughout the construction and operational phases of the site.

How will this action be monitored?

The fuel consumption information will be maintained on the GHG emissions database, managed by the Site Environment Manager. The AMR will include information relating to any operational scheduling adjustments that have resulted in further savings in GHG emissions.

Objective 11	**Consideration for space heating**

How will this be implemented?

The potential of utilising:

1. Directing waste oil from the Project for use in space heating will be investigation from the onset of the construction period.
2. The potential for using excess heat from the rocks collected through ground and air source heat pumps will be considered for space heating in buildings situated close to potential heat sources.

When will this action be achieved?

This opportunity will be reviewed throughout the construction and operational phases of the project, and if practicable and commercially viable will be implemented.

How will this action be monitored?

Once installed the energy output from oil burner and/or heat pumps will be recorded by the Site Environmental Manager and then incorporated in to the AMR.

Objective 12	Potential heat recovery to supplement space heating arising from the possible incineration of waste on site.

How will this be implemented?

Should the incineration of hazardous and non-hazardous waste be developed on site then the excess heat generated could be utilised within the nearby buildings for space heating.

When will this action be achieved?

This opportunity will be reviewed throughout the construction and operational phases of the project, and if practicable and commercially viable will be implemented.

How will this action be monitored?

Once installed the energy output from this heat recovery will be recorded by the Site Environmental Manager and then incorporated in to the AMR.

Objective 13	GHG emission improvements in the Armenian national power grid supply

How will this be implemented?

The Armenian national power grid is supplied primarily by nuclear power plants, followed by gas-fired thermal and hydropower. The Project has investigated the potential to purchase “green” energy (specifically, hydropower from a nearby hydroelectric plant) to supply the Project. However, the Armenian grid cannot currently differentiate energy sources when purchasing electricity. Green energy contributions to the national grid are expected to increase in the near-term with the commissioning of the Iran-Armenia Wind Farm and the Jermaghbyur Geothermal Power Plant. This trend is expected to result in a reduction in the GHG emissions over the Project lifetime.

How will this action be monitored?

Lydian will continue to monitor and support renewable energy sources in Armenia; any change to the potential for renewable energy supply would be published through publically available emissions

reporting from the Armenian grid. Such reductions occur these would be reported in Scope 2 project emissions and reported in the AMR.

7.2 Fleet Management

This section describes the procedures for managing the energy performance of the equipment and machinery to be used for the construction and operational phases of the Project. This plan is applicable to all the equipment and machinery being used for the Project including plant owned by Lydian/Geoteam and its contractors but does not apply to the vehicles used for passenger transport such as cars and buses (dealt within Vehicle Management Plan).

Fleet Management System

Site-wide automation system with bespoke process controls for drills, crushers, conveyors and haul trucks will be considered for fleet management analysis. The systems provide data on the working and idle hours, fuel consumption, start and stop times and will maintain a record of the maintenance activities. The process controls will include provisions for reducing idling hours and assessing when the equipment requires diagnostic maintenance to improve its energy performance.

Selection of haul routes

As practical and feasible, the safest and least environmentally sensitive haul routes will be selected for the transportation of materials to the site. A list of selected routes for transportation from major ports to site will be maintained and will be provided to the suppliers with the procurement contracts.

Procurement of new equipment and machinery

The person responsible for the procurement of new equipment and machinery will ensure that fuel efficiency is considered as a key factor in the selection of any new equipment and machinery for the Project. Energy performance data of different models available for the same piece of equipment will be evaluated and the analysis will be factored in the final selection. Equipment with remote performance monitoring facilities will be given preference.

Maintenance

Maintenance records for all company owned and contractor owned equipment and machinery will be maintained on a schedule during the mine life. Each department head will be responsible for ensuring that all the equipment and machinery used by their department is fit for its intended use. The Site Environmental Manager will summarise ongoing maintenance and machinery efficiency to identify any factors that may have affected the GHG emissions in the accounting period.

Trained Operators

Each department's head will be responsible for ensuring that the equipment and machinery is operated by an authorised person who is well trained in the use of that equipment or machinery and energy efficiency procedures.

Fuel Consumption Data

The fuel consumption data for the company owned equipment and machinery will be collated by the department heads and collated on a database and used as the basis for estimation of GHG emissions.

7.3 Vehicle Management Plan

The vehicle management plan will apply to all the vehicles used for passenger transport and would relate to cars and buses for transport of workers from the workers accommodation to the site. All the light passenger vehicles owned or contracted by Lydian, where practicable and available for purchase within RA, will comply with applicable EU emission standards. All vehicles will be maintained using a preventive maintenance schedule and unless specifically prohibited by the vehicle's manufacturer warranty or recommendations. All vehicles operating on petrol must use unleaded petrol.

Receipts of fuel refill will be maintained and entered in a log book and complied as a record of fuel consumption data in the GHG database (the database will be managed by the Site Environmental Manager, Purchasing Manager, other appropriate Department Manager or delegate). Vehicle replacement will be reviewed when they reach 10 years of service or 100,000 miles, whichever comes first. However, there may be circumstances in which vehicles may be replaced sooner (such as excessive maintenance or repair costs) or retained longer (such as low maintenance costs).

A centralised vehicle booking request system will be used so that maximum sharing of resources can be achieved. The workers buses will be scheduled at fixed times to maximise the number of people travelling in one journey. Records for all vehicle rentals and leases will be maintained to document the distance travelled or the fuel consumption data in the GHG database.

7.4 Energy Management

The project electricity usage will be tracked throughout the life of the Project to manage the electricity purchased from the grid. An energy information management system will be used to monitor the energy usage for various project operations. An annual review of the electricity consumed will be carried out to evaluate the energy performance and document the energy improvements.

Feasibility for use of renewable energy solutions such as small scale wind or solar for ancillary operations or office buildings or ground source heat pumps for heating/cooling will be explored. Potential for purchasing green electricity from the local grid will also be considered.

8 Climate Change

The impacts of climate change on the Project have been considered in Chapter 6.4 of the ESIA report. According to Intergovernmental panel on Climate Change (IPPC) global climate models, the average annual temperature in the region of the Project is predicted to increase between 0 and 2.3°C above the baseline of 1960-1990 by 2030.

The downscaled climate change projections for Armenia for the 2011-2030 period, which best aligns with the Project timeframe, for a high emission scenario, it is predicted that the annual temperature will rise between 0-1°C by 2030, summer months will experience higher temperature increases as compared to winter and annual precipitation will decrease by 7%. These climate change forecasts will lead to decreased water flow by approximately 7%, reduced precipitation from snow (between 7-11%), and will accelerate the desertification process.

These projected changes are deemed to be within the proposed design and operational tolerances of the Project, and therefore no material impacts on the Project are predicted. It is therefore not proposed to monitoring any monitoring for assessing the impacts of climate change on the Project.

9 Authorization

Approved By: ___________________________________ ___________________

Executive Vice President Sustainability Date

Performance Standard 3
Resource Efficiency and Pollution Prevention

January 1, 2012

Introduction

1. Performance Standard 3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.[1] There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention[2] and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world. These are often implemented through continuous improvement methodologies similar to those used to enhance quality or productivity, which are generally well known to most industrial, agricultural, and service sector companies.

2. This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. In addition, this Performance Standard promotes the ability of private sector companies to adopt such technologies and practices as far as their use is feasible in the context of a project that relies on commercially available skills and resources.

Objectives

- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
- To promote more sustainable use of resources, including energy and water.
- To reduce project-related GHG emissions.

Scope of Application

3. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1.

Requirements

4. During the project life-cycle, the client will consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and the environment.[3] The principles and techniques applied during the project life-cycle will be

[1] For the purposes of this Performance Standard, the term "pollution" is used to refer to both hazardous and non-hazardous chemical pollutants in the solid, liquid, or gaseous phases, and includes other components such as pests, pathogens, thermal discharge to water, GHG emissions, nuisance odors, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light.

[2] For the purpose of this Performance Standard, the term "pollution prevention" does not mean absolute elimination of emissions, but the avoidance at source whenever possible, and, if not possible, then subsequent minimization of pollution to the extent that the Performance Standard objectives are satisfied.

[3] Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment, and materials, taking into consideration prevailing local factors such as climate, geography, infrastructure, security, governance, capacity and operational reliability. Financial feasibility is

tailored to the hazards and risks associated with the nature of the project and consistent with good international industry practice (GIIP),[4] as reflected in various internationally recognized sources, including the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

5. The client will refer to the EHS Guidelines or other internationally recognized sources, as appropriate, when evaluating and selecting resource efficiency and pollution prevention and control techniques for the project. The EHS Guidelines contain the performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from the levels and measures presented in the EHS Guidelines, clients will be required to achieve whichever is more stringent. If less stringent levels or measures than those provided in the EHS Guidelines are appropriate in view of specific project circumstances, the client will provide full and detailed justification for any proposed alternatives through the environmental and social risks and impacts identification and assessment process. This justification must demonstrate that the choice for any alternate performance levels is consistent with the objectives of this Performance Standard.

Resource Efficiency

6. The client will implement technically and financially feasible and cost effective[5] measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with a focus on areas that are considered core business activities. Such measures will integrate the principles of cleaner production into product design and production processes with the objective of conserving raw materials, energy, and water. Where benchmarking data are available, the client will make a comparison to establish the relative level of efficiency.

Greenhouse Gases

7. In addition to the resource efficiency measures described above, the client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring.

8. For projects that are expected to or currently produce more than 25,000 tonnes of CO_2-equivalent annually,[6] the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary,[7] as well as indirect emissions associated with the off-site

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based on commercial considerations, including relative magnitude of the incremental cost of adopting such measures and actions compared to the project's investment, operating, and maintenance costs.

[4] GIIP is defined as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally. The outcome of such exercise should be that the project employs the most appropriate technologies in the project-specific circumstances.

[5] Cost-effectiveness is determined according to the capital and operational cost and financial benefits of the measure considered over the life of the measure. For the purpose of this Performance Standard, a resource efficiency or GHG emissions reduction measure is considered cost-effective if it is expected to provide a risk-rated return on investment at least comparable to the project itself.

[6] The quantification of emissions should consider all significant sources of greenhouse gas emissions, including non-energy related sources such as methane and nitrous oxide, among others.

[7] Project-induced changes in soil carbon content or above ground biomass, and project-induced decay of organic matter may contribute to direct emissions sources and shall be included in this emissions quantification where such emissions are expected to be significant.

production of energy[8] used by the project. Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice.[9]

Water Consumption

9. When the project is a potentially significant consumer of water, in addition to applying the resource efficiency requirements of this Performance Standard, the client shall adopt measures that avoid or reduce water usage so that the project's water consumption does not have significant adverse impacts on others. These measures include, but are not limited to, the use of additional technically feasible water conservation measures within the client's operations, the use of alternative water supplies, water consumption offsets to reduce total demand for water resources to within the available supply, and evaluation of alternative project locations.

Pollution Prevention

10. The client will avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release. This applies to the release of pollutants to air, water, and land due to routine, non-routine, and accidental circumstances with the potential for local, regional, and transboundary impacts.[10] Where historical pollution such as land or ground water contamination exists, the client will seek to determine whether it is responsible for mitigation measures. If it is determined that the client is legally responsible, then these liabilities will be resolved in accordance with national law, or where this is silent, with GIIP.[11]

11. To address potential adverse project impacts on existing ambient conditions,[12] the client will consider relevant factors, including, for example (i) existing ambient conditions; (ii) the finite assimilative capacity[13] of the environment; (iii) existing and future land use; (iv) the project's proximity to areas of importance to biodiversity; and (v) the potential for cumulative impacts with uncertain and/or irreversible consequences. In addition to applying resource efficiency and pollution control measures as required in this Performance Standard, when the project has the potential to constitute a significant source of emissions in an already degraded area, the client will consider additional strategies and adopt measures that avoid or reduce negative effects. These strategies include, but are not limited to, evaluation of project location alternatives and emissions offsets.

Wastes

12. The client will avoid the generation of hazardous and non-hazardous waste materials. Where waste generation cannot be avoided, the client will reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and the environment. Where waste cannot be recovered or reused, the client will treat, destroy, or dispose of it in an environmentally sound manner that includes the appropriate control of emissions and residues resulting from the handling and processing of the waste material. If the generated waste is considered hazardous,[14] the client will

[8] Refers to the off-site generation by others of electricity, and heating and cooling energy used in the project.

[9] Estimation methodologies are provided by the Intergovernmental Panel on Climate Change, various international organizations, and relevant host country agencies.

[10] Transboundary pollutants include those covered under the Convention on Long-Range Transboundary Air Pollution.

[11] This may require coordination with national and local government, communities, and the contributors to the contamination, and that any assessment follows a risk-based approach consistent with GIIP as reflected in the EHS Guidelines.

[12] Such as air, surface and groundwater, and soils.

[13] The capacity of the environment for absorbing an incremental load of pollutants while remaining below a threshold of unacceptable risk to human health and the environment.

[14] As defined by international conventions or local legislation.

adopt GIIP alternatives for its environmentally sound disposal while adhering to the limitations applicable to its transboundary movement.[15] When hazardous waste disposal is conducted by third parties, the client will use contractors that are reputable and legitimate enterprises licensed by the relevant government regulatory agencies and obtain chain of custody documentation to the final destination. The client should ascertain whether licensed disposal sites are being operated to acceptable standards and where they are, the client will use these sites. Where this is not the case, clients should reduce waste sent to such sites and consider alternative disposal options, including the possibility of developing their own recovery or disposal facilities at the project site.

Hazardous Materials Management

13. Hazardous materials are sometimes used as raw material or produced as product by the project. The client will avoid or, when avoidance is not possible, minimize and control the release of hazardous materials. In this context, the production, transportation, handling, storage, and use of hazardous materials for project activities should be assessed. The client will consider less hazardous substitutes where hazardous materials are intended to be used in manufacturing processes or other operations. The client will avoid the manufacture, trade, and use of chemicals and hazardous materials subject to international bans or phase-outs due to their high toxicity to living organisms, environmental persistence, potential for bioaccumulation, or potential for depletion of the ozone layer.[16]

Pesticide Use and Management

14. The client will, where appropriate, formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach targeting economically significant pest infestations and disease vectors of public health significance. The client's IPM and IVM program will integrate coordinated use of pest and environmental information along with available pest control methods, including cultural practices, biological, genetic, and, as a last resort, chemical means to prevent economically significant pest damage and/or disease transmission to humans and animals.

15. When pest management activities include the use of chemical pesticides, the client will select chemical pesticides that are low in human toxicity, that are known to be effective against the target species, and that have minimal effects on non-target species and the environment. When the client selects chemical pesticides, the selection will be based upon requirements that the pesticides be packaged in safe containers, be clearly labeled for safe and proper use, and that the pesticides have been manufactured by an entity currently licensed by relevant regulatory agencies.

16. The client will design its pesticide application regime to (i) avoid damage to natural enemies of the target pest, and where avoidance is not possible, minimize, and (ii) avoid the risks associated with the development of resistance in pests and vectors, and where avoidance is not possible minimize. In addition, pesticides will be handled, stored, applied, and disposed of in accordance with the Food and Agriculture Organization's International Code of Conduct on the Distribution and Use of Pesticides or other GIIP.

17. The client will not purchase, store, use, manufacture, or trade in products that fall in WHO Recommended Classification of Pesticides by Hazard Class Ia (extremely hazardous); or Ib (highly

[15] Transboundary movement of hazardous materials should be consistent with national, regional and international law, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

[16] Consistent with the objectives of the Stockholm Convention on Persistent Organic Pollutants and the Montreal Protocol on Substances that Deplete the Ozone Layer. Similar considerations will apply to certain World Health Organization (WHO) classes of pesticides.

hazardous). The client will not purchase, store, use, manufacture or trade in Class II (moderately hazardous) pesticides, unless the project has appropriate controls on manufacture, procurement, or distribution and/or use of these chemicals. These chemicals should not be accessible to personnel without proper training, equipment, and facilities to handle, store, apply, and dispose of these products properly.

EBRD Performance Requirement 3

Resource Efficiency and Pollution Prevention and Control

Introduction

1. This Performance Requirement (PR) recognises that increased economic activity and urbanisation can generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. Therefore, resource efficiency and pollution prevention and control are essential elements of environmental and social sustainability and projects must meet good international practice (GIP) in this regard.

2. This PR acknowledges the importance of using best available techniques and GIP to optimise resource use and efficiently prevent and control release of pollutants into the environment.

3. This PR outlines a project-level approach to resource management and pollution prevention and control, building on the mitigation hierarchy, the principle that environmental damage should as a priority be rectified at its source, and the "polluter pays" principle. The project-related impacts and issues associated with resource use, and the generation of waste and emissions need to be assessed in the context of project location and local environmental conditions.

Objectives

4. The objectives of this PR are to:

- identify project-related opportunities for energy, water and resource efficiency improvements and waste minimisation
- adopt the mitigation hierarchy approach to addressing adverse impacts on human health and the environment arising from the resource use and pollution released from the project
- promote the reduction of project-related greenhouse gas emissions.

Scope of application

5. The client will, as part of its environmental and social assessment process, identify the relevant requirements of this PR, and how they will be addressed and managed through the project life cycle. The implementation of the actions necessary to meet the requirements of this PR will be managed under the client's overall environmental and social management system (ESMS) and project-specific environmental and social management plans (ESMPs). The environmental and social assessment and management requirements are provided in PR 1.

Requirements

Resource efficiency

6. The environmental and social assessment process will identify opportunities and alternatives for resource efficiency relating to the project in accordance with GIP. In doing so, the client will adopt technically and financially feasible[1] and cost effective[2] measures for minimising its consumption and improving efficiency in its use of energy, water and other resources and material inputs as well as for recovering and re-utilising waste materials in implementing the project. The key focus will be on activities that are considered the project's core functions, but similar opportunities in the client's other business activities that are not part of the project will also be considered. Where benchmarking data are available, the client's assessment will make a comparison of

[1] Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment, and materials, taking into consideration prevailing local factors such as climate, geography, infrastructure, security, governance, capacity and operational reliability. Financial feasibility is based on commercial considerations, including relative magnitude of the incremental cost of adopting such measures and actions compared with the project's investment, operating and maintenance costs.

[2] Cost-effectiveness is determined according to the capital and operational cost and financial benefits of the measure considered over the life of the measure. For the purpose of this PR, a resource efficiency or GHG emissions reduction measure is considered cost-effective if it is expected to provide a risk-rated return on investment at least comparable to the project itself.

its operations with GIP to establish the relative level of efficiency.

7. The client will integrate resource efficiency measures and the principles of cleaner production into product design and production processes with the objective of conserving raw materials, energy and water and, at the same time, reducing release of pollutants into the environment.

Pollution prevention and control

8. The client's environmental and social assessment process will determine the appropriate pollution prevention and control methods, technologies and practices ("techniques") to be applied to the project. The assessment will take into consideration the characteristics of the facilities and operations that are part of the project, the project's geographical location and local ambient environmental conditions. The assessment process will identify technically and financially feasible and cost-effective pollution prevention and control techniques that are best suited to avoid or minimise adverse impacts on human health and the environment. The techniques applied to the project will favour the prevention or avoidance of risks and impacts over minimisation and reduction, in line with the mitigation hierarchy approach and consistent with GIP, and will be appropriate to the nature and scale of the project's adverse impacts and issues.

9. Clients will structure the projects to meet relevant EU substantive environmental standards, where these can be applied at the project level.[3] Certain projects that, due to their nature and scale, would be subject to the EU Industrial Emissions Directive and will be required to meet EU Best Available Techniques (BAT) and related emission and discharge standards, regardless of location.

10. Where no EU substantive environmental standards at project level exist, the client will identify, in agreement with the EBRD, other appropriate environmental standards in accordance with GIP. In addition, projects will be designed to comply with applicable national law, and will be maintained and operated in accordance with national laws and regulatory requirements. When host country regulations differ from the levels and measures presented in EU environmental requirements or other identified appropriate environmental standards, projects will be expected to meet whichever is more stringent.

11. Projects involving new facilities and operations are expected to meet EU substantive environmental standards or other agreed environmental standards, and national regulatory requirements from the outset. Projects that involve rehabilitation of existing facilities and/or operations are expected to meet the requirements of paragraph 9 and/or 10 over a reasonable period of time, to be determined by a formal assessment of their performance against the applicable standards.

12. In respect of projects located in the EU member states and the EU acceding, candidate and potential candidate countries which involve the rehabilitation of existing facilities and/or operations and where relevant EU substantive environmental standards have been identified, the time frame to achieve compliance with these standards should take into account any nationally agreed time frames. For projects in all other countries, the time frame for achieving compliance with EU substantive environmental standards should take into account local conditions and the cost of application, and should be consistent with the European Neighbourhood Policy and any bilateral agreements or action plans agreed between the EU and the relevant host country.

13. Throughout the project life cycle, the client will apply pollution prevention and control techniques consistent with the mitigation hierarchy approach to minimise potential adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective. This applies to the release of pollutants due to routine, non-routine or accidental circumstances.

[3] For the purpose of this PR, EU environmental standards can be applied at the project level where the EU secondary legislative document itself contains clear quantitative or qualitative requirements that are applicable at the project level (as opposed to the ambient level, for example).

Greenhouse gases

14. The client's environmental and social assessment process will consider alternatives and implement technically and financially feasible and cost-effective options to avoid or minimise project-related greenhouse gas (GHG) emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, techniques or processes, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring.

15. For projects that currently produce, or are expected to produce post-investment, more than 25,000 tonnes of CO2-equivalent annually, the client will quantify these emissions in accordance with EBRD Methodology for Assessment of Greenhouse Gas Emissions. The scope of GHG assessment shall include all direct emissions from the facilities, activities and operations that are part of the project or system, as well as indirect emissions associated with the production of energy used by the project. Quantification of GHG emissions will be conducted by the client annually and reported to the EBRD.

Water

16. Clients must seek to minimise the project's water use, and in situations where a project-specific water supply needs to be developed, the client will seek to utilise water for technical purposes that is not fit for human consumption, where feasible.

17. All technically and financially feasible and cost-effective opportunities for water minimisation, reuse and recycling in accordance with GIP must be identified and considered as part of the project design.

18. For projects with a high water demand (greater than 5,000 m3/day), the following must be applied:
    - a detailed water balance must be developed, maintained and reported annually to the EBRD
    - opportunities for continuous improvement in terms of water use efficiency should be identified
    - specific water use (measured by volume of water used per unit production) must be assessed
    - operations must be benchmarked to available industry standards of water use efficiency.

19. The client will need to consider the potential cumulative impacts of water abstraction upon third party users and local ecosystems. Where relevant, the client will assess the impacts of its activities on the water supply to third parties and will need to demonstrate that its proposed water supply will not have adverse impacts on the water resources crucial to third parties or to sensitive ecosystems. As part of the client's environmental assessment process, the client will identify and implement appropriate mitigation measures that favour the prevention or avoidance of risks and impacts over minimisation and reduction in line with the mitigation hierarchy approach and GIP.

Waste[4]

20. The client will avoid or minimise the generation of hazardous and non-hazardous waste materials and reduce their harmfulness as far as practicable. Where waste generation cannot be avoided but has been minimised, the client will reuse, recycle or recover waste, or use it as a source of energy; where waste cannot be recovered or reused, the client will treat and dispose of it in an environmentally sound manner.

21. If the generated waste is considered hazardous, the client will assess technically and financially feasible and cost-effective alternatives for its environmentally sound disposal considering the limitations applicable to transboundary movement and other legal requirements.

22. When waste disposal is transferred offsite and/or conducted by third parties, the client will obtain chain of custody documentation to the final destination and will use contractors that are reputable and legitimate enterprises

[4] For the purposes of this PR, waste is defined as a heterogenous mixture of gaseous, liquid and/or solid substances/materials which need to be treated using adequate physical, chemical and/or biological processes before it can be safely disposed of into the environment.

licensed by the relevant regulatory agencies. The client should also ascertain whether licensed disposal sites are being operated to acceptable standards. Where this is not the case, clients will consider alternative disposal options, including the possibility of developing their own recovery and disposal facilities at the project site.

Safe use and management of hazardous substances and materials

23. In all activities directly related to the project, the client will avoid or minimise the use of hazardous substances and materials, and consider the use of less hazardous substitutes for such substances and materials so as to protect human health and the environment from their potentially harmful impacts. Where avoidance or substitution is not feasible, the client will apply appropriate risk management measures in order to minimise or control the release of such substances/materials into air, water and/or land resulting from their production, transportation, handling, storage, use and disposal relating to project activities.

24. The client will avoid the manufacture, trade and use of hazardous substances and materials subject to international bans or phase-outs due to their high toxicity to living organisms, environmental persistence, potential for bioaccumulation, or potential for depletion of the ozone layer.

Pesticide use and management

25. Clients who manage or use pesticides will formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach for pest management activities. The client's IPM and IVM programme will coordinate use of pest and environmental information together with available pest control methods, including cultural practices, biological, genetic and, as a last resort, chemical means to prevent unacceptable levels of pest damage. When pest management activities include the use of pesticides, the client will strive to reduce the impacts of pesticides on biodiversity, human health and the broader environment and, more generally, to achieve a more sustainable use of pesticides as well as a significant overall reduction in the risks and uses of pesticides consistent with the necessary crop protection.

26. The sustainable use of pesticides shall include:
    - avoiding, or if not possible, minimising, the impacts of pesticides on biodiversity, human health and the broader environment
    - reducing the levels of harmful active substances by replacing the most dangerous ones with safer (including non-chemical) alternatives
    - selecting pesticides that are low in toxicity, known to be effective against the target species, and have minimal effects on non-target species, such as pollinating insects and the environment
    - the promotion of low-input or pesticide-free crop farming
    - minimising damage to natural enemies of target pests and preventing the development of resistance in pests.

27. The client will handle, store, apply and dispose of pesticides in accordance with GIP.

The Greenhouse Gas Protocol

MEASURING TO MANAGE: A GUIDE TO DESIGNING GHG ACCOUNTING AND REPORTING PROGRAMS

WRI and WBCSD

Measuring to Manage: A Guide to Designing GHG Accounting and Reporting Programs

World Business Council for Sustainable Development

WORLD RESOURCES INSTITUTE

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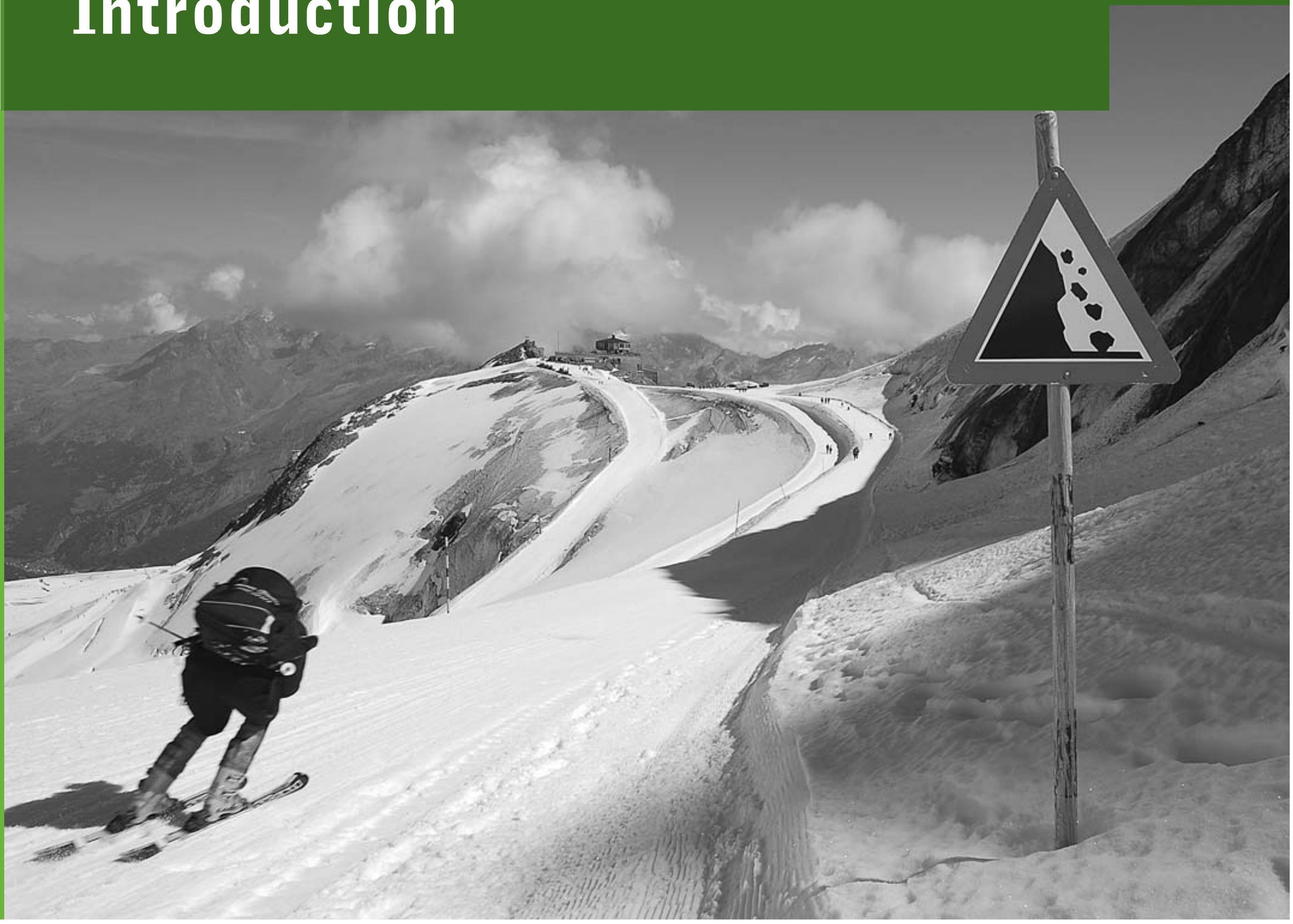
1 Introduction



As concern about climate change climbs to unprecedented levels, one of the most important steps that a country, region, or state can take to address it is to establish a sound and credible platform to account for and report greenhouse gas (GHG) emissions from corporations. While a process for reporting national (country-level) GHG emissions exists under the United Nations Framework Convention on Climate Change (UNFCCC), this guide focuses on programs to promote the accounting and reporting of emissions at the corporate level. These programs can facilitate corporate GHG management, improve the quality and consistency of GHG data, support regulatory programs, and provide information to stakeholders.

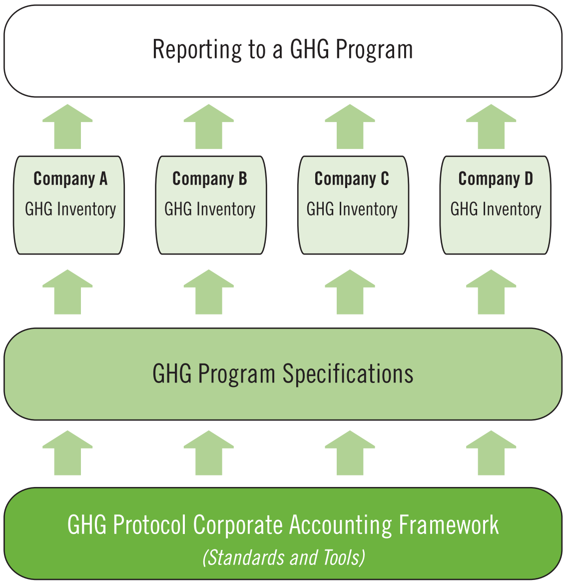
Over the past decade, numerous efforts to design and implement programs to promote the measurement and management of corporate GHG emissions have emerged around the world. These programs are being developed at different geographic scales – including national, regional, state or provincial, and municipal – and support different functions – such as voluntary reporting of GHG emissions, GHG regulatory systems, and tracking progress towards GHG reduction targets – but all are based on a corporate-level GHG accounting and reporting platform. As such, a common set of questions arises regarding their design and implementation: What type of GHG program is needed to meet which objectives? What geographic area should a program cover? What should its accounting, calculation, and reporting specifications include? How can the quality of reported information be ensured?

This publication aims to help interested groups, such as governments, industry associations, and environmental organizations, address these questions to design and implement effective GHG programs based on internationally accepted standards and methodologies for GHG accounting and reporting.

GHG Programs and Standards: What and Why?

In the context of this guide, *GHG program* refers to a program that promotes the development of corporate GHG inventories – that is, quantified lists of corporations' GHG emissions and sources.[1] Many GHG programs also have additional objectives that build on the corporate GHG accounting component, for example, to register GHG emissions and reductions, to track progress towards GHG reduction targets, to support national climate change strategies, to support GHG trading programs, to facilitate GHG mitigation activities, or to provide information to shareholders and investors. All of these program types build on a corporate GHG accounting and reporting platform, and can therefore apply the design lessons in this guide.

FIGURE 1.1 The GHG Protocol Framework as the Foundation for GHG Inventories and Programs

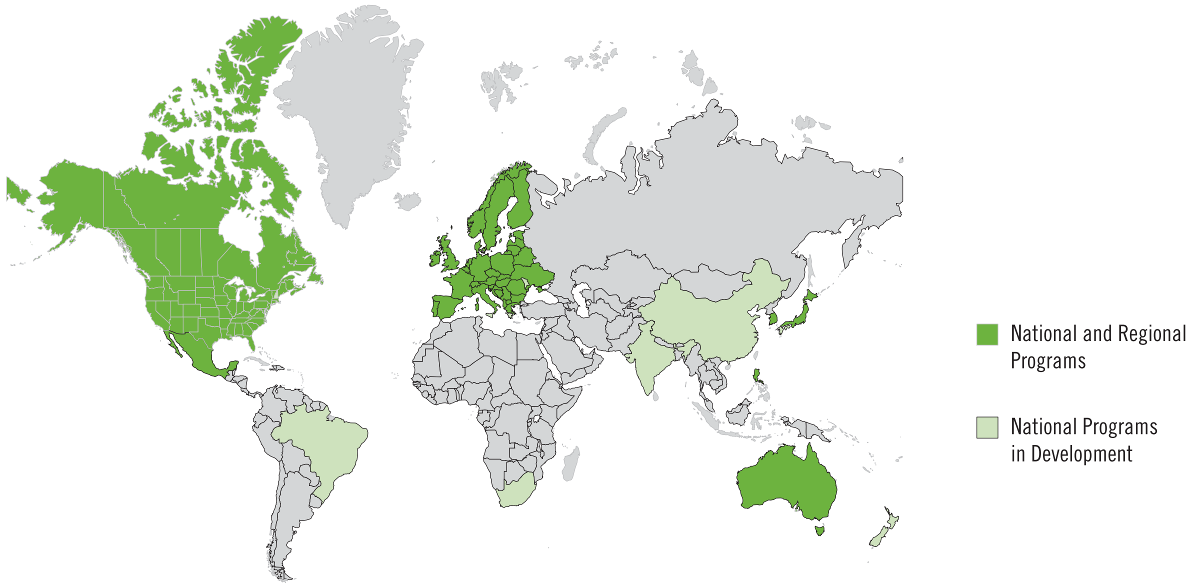


To maximize the utility of GHG information reported to GHG programs, the information should be based on a GHG accounting and reporting standard – that is, a framework that incorporates commonly accepted accounting approaches, concepts, and terminology to establish a true and fair account of GHG emissions. In the context of corporate GHG accounting and reporting, the *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (*Corporate Standard*, WRI/WBCSD 2004) is the accepted international standard, having been widely implemented by companies, industry associations, and GHG programs, and adopted by the International Organization for Standardization (ISO) as the basis for its ISO 14064-1 *Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals* (ISO 2006). Figure 1.1 illustrates the relationship between GHG standards, inventories, and programs.

Some of the advantages of basing a GHG program on the *Corporate Standard* are as follows:

- The *Corporate Standard* is consistent with ISO 14064-1. ISO 14064-1 explicitly cites the *Corporate Standard* as the basis for its accounting and reporting framework.
- The *Corporate Standard* enjoys a widespread sense of legitimacy among its users and other stakeholders as a result of having been developed through an inclusive process convened by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The *Corporate Standard* was developed over a period of several years by several hundred individuals from industry, government, research institutions, and environmental groups.
- The *Corporate Standard* has been widely tested and implemented. A recent analysis by WRI estimated that nearly 1,000 companies from a range of economic sectors had used the *Corporate Standard* to develop a GHG inventory.
- Using the *Corporate Standard* will help a new GHG program and its participants to be consistent with other programs around the world. Since its original version was published in 2001, the *Corporate Standard* has become the basis for most of the world's corporate GHG accounting and reporting programs and has also informed the design of GHG emission trading programs. Box 1.1 provides an overview of selected programs based

FIGURE 1.2 Programs Using the GHG Protocol



BOX 1.1 Selected GHG Programs Based on or Informed by the GHG Protocol

The following are several examples of national and regional GHG programs based on or informed by the *Corporate Standard*. This is not meant to be an exhaustive list; rather, it reflects those programs with which WRI and WBCSD have worked most closely and from which much of the experience outlined in this publication is drawn. The list is also limited to those programs that have advanced at least to the stage of providing draft program specifications. Additional programs are in earlier stages of development in Brazil, China, and India.

The Business Leaders Initiative on Climate Change (BLICC) is an international network of companies from several industries aiming to reduce their impact on climate change. Administered by the consultancy firm Respect, BLICC began in 2000 at the initiative of corporate leaders from international companies including DHL, IKEA and The Body Shop. BLICC members produce GHG inventories based on the *Corporate Standard*, and BLICC publishes periodic reports of its members' climate change strategies, outcomes, and best practices.

The California Climate Action Registry was established by California statute as a non-profit, voluntary registry for GHG emissions. The purpose of the Registry is to help companies and organizations with operations in California establish GHG emission baselines. The California Climate Action Registry has been involved in designing The Climate Registry, with which it is expected to merge in 2009 – 10.

The Canadian GHG Challenge Registry is a voluntary, publicly accessible national registry of GHG baselines, targets, and reductions. Administered by the Canadian Standards Association, its aim is for participants from all economic sectors and geographic regions to demonstrate meaningful contributions to reducing Canada's GHG emissions. Participants develop GHG inventories, set GHG targets, and prepare GHG action plans.

carboNZero is a program administered by Landcare Research in New Zealand to measure, manage and mitigate carbon dioxide (CO_2) emissions from organizations, products and services, and events. The program aims to assist individuals and organizations to reduce GHG emissions, and provides guidance on measuring, managing, and offsetting CO_2 emissions.

The Chicago Climate Exchange (CCX) is a legally binding emission allowance trading system. Participants make a voluntary and legally binding commitment to meet annual GHG reduction targets. Participants who reduce emissions below their targets may sell or bank surplus allowances, while those who emit above their targets purchase CCX Carbon Financial Instrument® contracts.

Climate Leaders is an industry-government partnership administered by the United States Environmental Protection Agency (EPA) that works with companies to develop climate change strategies. Participants set corporate-wide GHG reduction targets and create GHG inventories to measure progress towards those targets.

Climate Savers, a voluntary program administered by the World Wildlife Fund, works with companies to set and meet targets to reduce CO_2 emissions.

The European Union Emission Trading Scheme (EU-ETS) is a mandatory, multi-national GHG emission trading scheme launched in 2005 and administered by the European Commission. Under the EU-ETS, regulated installations monitor and report their CO_2 emissions, and annually surrender emission allowances equivalent to their CO_2 emissions in that year.

Greenhouse Challenge Plus is a partnership between industry and the Australian government to reduce GHG emissions, promote awareness of GHG abatement opportunities, improve energy efficiency, integrate GHG management into business decision-making, and provide more consistent reporting of GHG emissions. Greenhouse Challenge Plus is part of Australia's national climate change strategy, announced in 2004. The program is managed by the Australian Greenhouse Office as part of the Australian Government's Department of the Environment and Water Resources.

on or informed by the *Corporate Standard*, while Figure 1.2 illustrates where such programs have been and are in the process of being established.

While the *Corporate Standard* provides a consistent accounting and reporting framework for developing corporate GHG inventories, it was designed as a policy- and program-neutral standard. This means that it was not designed to serve a specific policy or program, but rather to provide a foundation on which a range of policies and programs could be built. As such, it incorporates some degree of flexibility, leaving certain accounting and reporting decisions to the discretion of its users. GHG program designers, therefore, may adopt the *Corporate Standard* as a foundation, while developing customized accounting and reporting specifications to meet their needs and objectives. This publication aims to facilitate that process by providing guidance to GHG program designers on what decisions they need to make in developing their program specifications, and how to go about making those decisions, drawing on WRI's and WBCSD's experience working with partners to advise and implement GHG programs in various countries around the world.

Using this Guide

This publication is designed for staff from government agencies, environmental groups, and industry associations interested in establishing corporate GHG accounting and reporting programs. It walks the reader through the major decisions involved in setting up a GHG program, engaging stakeholders to make those decisions, and implementing the program, as summarized in Figure 1.3.

BOX 1.1 Selected GHG Programs Based on or Informed by the GHG Protocol *(continued)*

The Mexico GHG Program is a voluntary GHG accounting and reporting program created as a partnership between the Mexican Secretariat of Environment and Natural Resources (SEMARNAT), WRI, WBCSD, and the Center of Private-Sector Studies for Sustainable Development (CESPEDES). Participating companies, which include Mexico's entire cement, petroleum, and beer brewing sectors as well as a significant portion of its steel sector, make a voluntary commitment to create and publicly report corporate GHG inventories each year.

The Philippine GHG Accounting and Reporting Program (PhilGARP) is a voluntary GHG accounting and reporting program created as a partnership between the Manila Observatory, Philippine Business for the Environment, the Department of Environment and Natural Resources, the Department of Energy, WRI, and WBCSD. PhilGARP is designed to train participating businesses and organizations operating in the Philippines on GHG management based on the GHG Protocol standards and tools, to assist participants in the creation of corporate GHG inventories, and to provide a platform for public reporting and information dissemination on GHG management issues.

The Regional Greenhouse Gas Initiative (RGGI) is an effort by northeast and mid-Atlantic U.S. states to design a regional cap-and-trade program covering CO_2 emissions from power plants in the region. Subsequent to its first phase, RGGI may be extended to cover other sources and gases. Participants in RGGI include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

The Climate Registry is a collaboration between states, provinces, and tribes in North America aimed at developing and managing a common GHG emission reporting system that is capable of supporting various GHG emission reporting and reduction policies for its member states, provinces, tribes, and reporting entities.

Established by Section 1605(b) of the U.S. Energy Policy Act of 1992, the Voluntary Reporting of Greenhouse Gases Program encourages corporations and other private and public entities to submit annual reports of their entity-wide GHG emissions, emission reductions, and sequestration activities. The Program aims to provide a means for voluntary reporting that is complete, reliable, and consistent and permits participants to create a public record of their emissions, emission reductions, and/or sequestration achievements.

Readers not already familiar with GHG accounting and reporting issues should familiarize themselves with international GHG accounting and reporting standards by reading the *Corporate Standard,* available at www.ghgprotocol.org.

Notes

1. The term *corporate inventory*, in this publication, is used as a short-hand to distinguish GHG accounting and reporting emissions at the corporate, organizational, or entity level from accounting and reporting emissions from facilities only, from accounting for GHG reductions from specific projects, and from the GHG inventories developed at the national, state, or municipal level. As such, non-profit organizations, government agencies, and other non-corporate entities can also create "corporate" GHG inventories.

FIGURE 1.3 Steps in Designing and Implementing a GHG Program

CHAPTER 2 Program Objectives and Principles
- 2.1 What should be the objectives of the program?
- 2.2 What GHG accounting principles should the program adopt?
- 2.3 What program design principles should the program adopt?

CHAPTER 3 Elements of GHG Program Structure
- 3.1 Which sectors, sources, and gases should the program cover?
- 3.2 What geographical boundaries should the program adopt?
- 3.3 How should the reporting entity be defined?

CHAPTER 4 Accounting and Reporting Specifications
- 4.1 How should organizational boundary approaches be defined?
- 4.2 How should indirect emissions be treated?
- 4.3 How should base year establishment and adjustment be addressed?
- 4.4 Should emission accounting thresholds be established?
- 4.5 Should sector-specific calculation protocols be adopted?
- 4.6 What reporting requirements should be specified?

CHAPTER 5 Inventory Quality Management
- 5.1 Which inventory quality management methods should be adopted by the program?

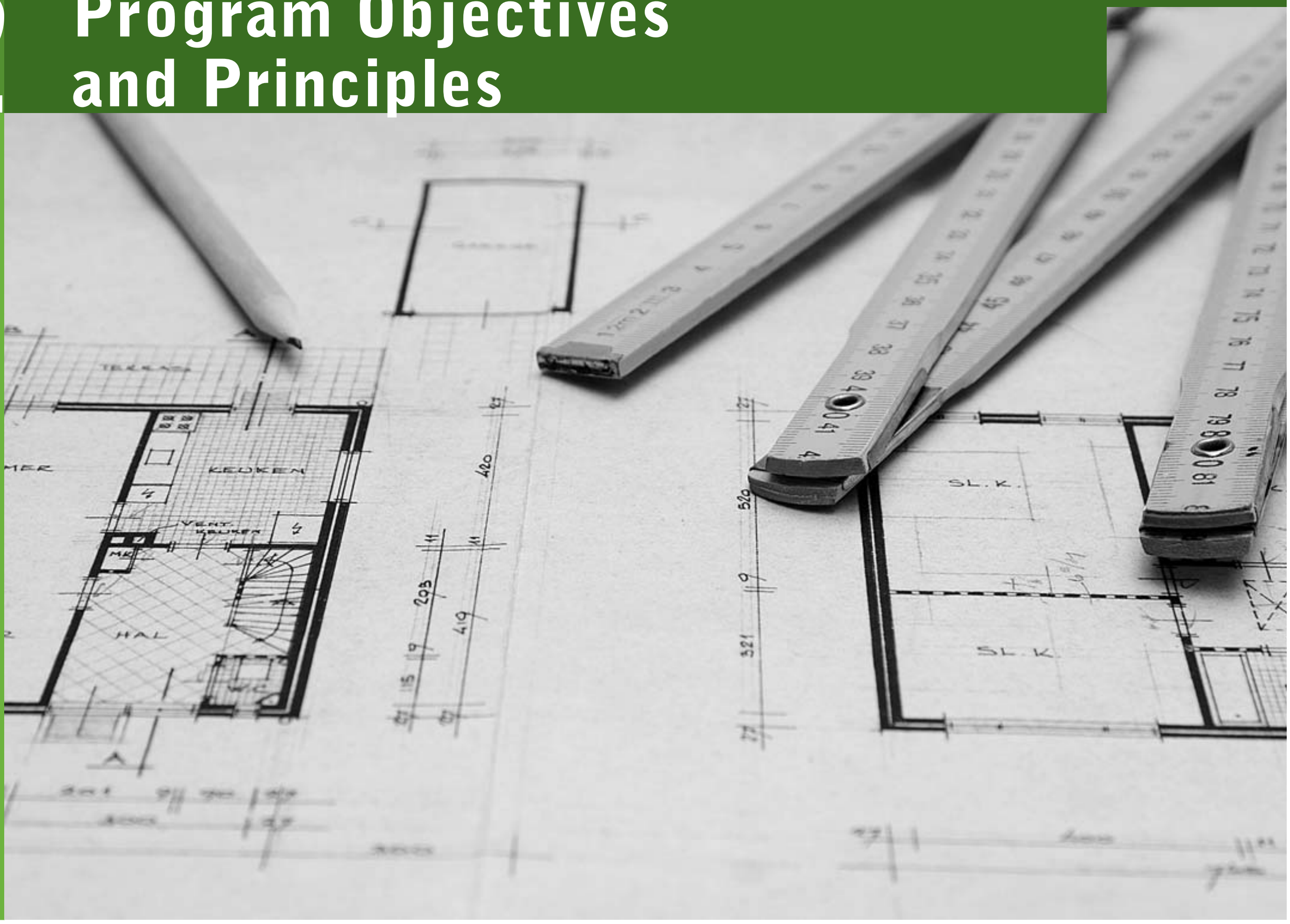
CHAPTER 6 Implementation Processes

PHASE I: PROGRAM DESIGN
- 6.1 Establishing partnerships
- 6.2 Identifying program objectives and principles
- 6.3 Developing program structure and specifications

PHASE II: PROGRAM IMPLEMENTATION
- 6.4 Building local capacity
- 6.5 Recruiting and training business participants
- 6.6 Collecting, reviewing, and publishing inventories

PHASE III: PROGRAM REVIEW
- 6.7 Conducting a structured feedback process
- 6.8 Identifying next steps

2 Program Objectives and Principles



GHG programs can serve a range of objectives, from promoting voluntary action against climate change to supporting regulatory initiatives. It is critical to engage stakeholders — such as corporations, industry associations, government agencies, environmental groups, and technical experts — early in the program design process to reach agreement on the program objectives, as well as the GHG accounting and program design principles that will guide the development of the program. These objectives and principles then serve to influence decisions related to the program structure; technical accounting, calculation, and reporting specifications; and quality control systems; as well as the program implementation process (see Figure 2.1).

The key program design decisions addressed in this section are:

2.1 What should be the objectives of the program?

2.2 What GHG accounting principles should the program adopt?

2.3 What program design principles should the program adopt?

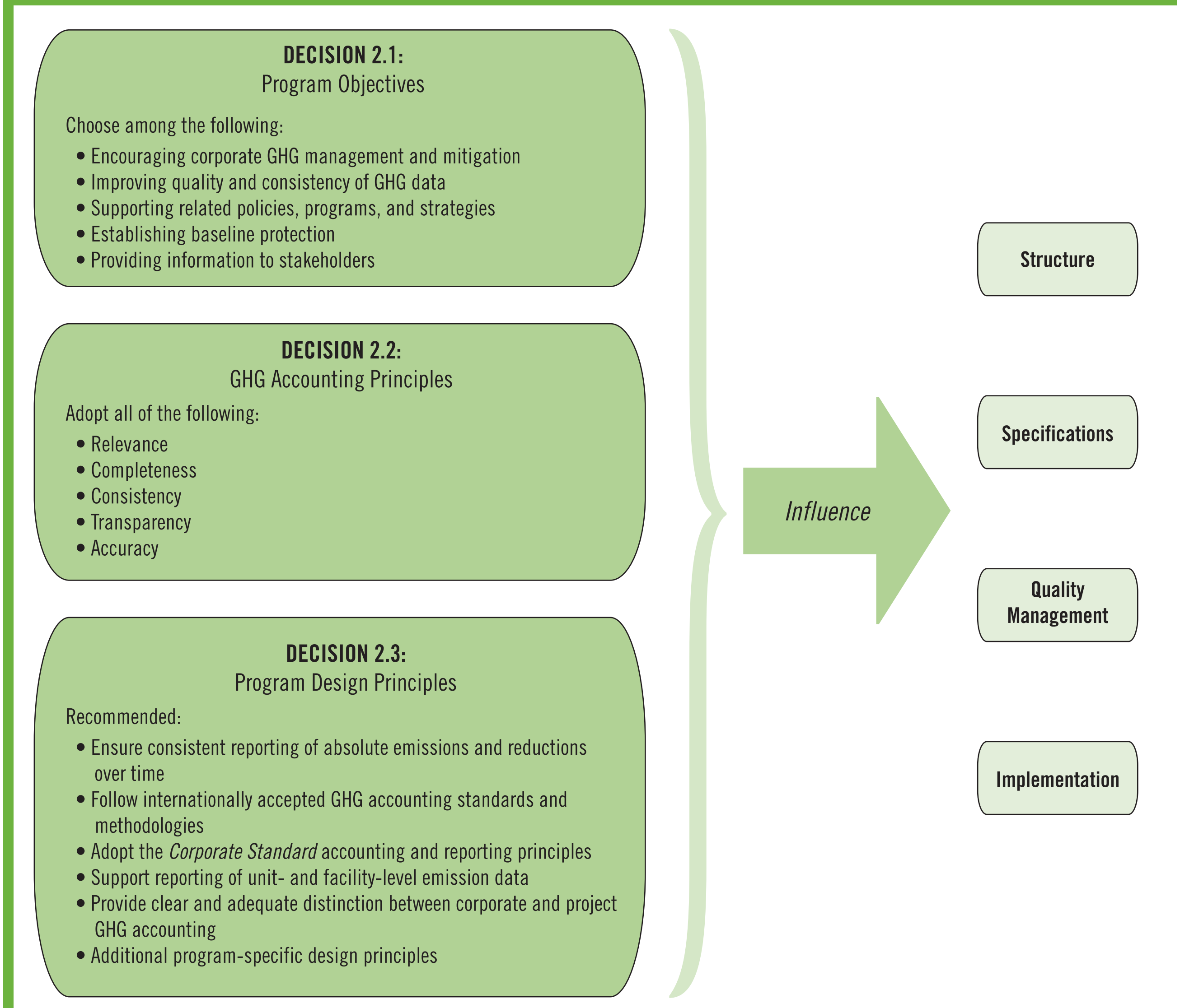
Decision 2.1 Defining Program Objectives

This section describes some of the most common program objectives and briefly introduces how they can influence program design decisions. Chapters 3 through 6 will explore in further detail how they influence the program structure; accounting, calculation, and reporting specifications; quality management techniques; and the implementation process. During this phase, program designers should also consider which indicators they will develop and track in order to determine whether the program is meeting its objectives throughout its implementation process.

ENCOURAGING CORPORATE GHG MANAGEMENT AND MITIGATION

Increasingly, corporate executives understand that climate change is an important business issue, with implications for their supply chains; operations; business models; product mixes; risk assessment; and investor, stakeholder, and employee relations. GHG programs can help companies take the initial steps towards assessing the risks and opportunities associated with climate change by conducting an inventory of their GHG emissions. Some programs go a step further, for example, by working with participants to develop GHG reduction targets. Programs whose principal aim is to encourage corporate GHG management might adopt specifications that allow participants some flexibility to choose the approach most relevant to their strategies and priorities, while seeking throughout the implementation process to expose participants to a range of GHG management strategies and business opportunities.

FIGURE 2.1 The Relationship of Program Objectives and Principles to Design and Implementation



IMPROVING THE QUALITY AND CONSISTENCY OF GHG DATA

By offering guidance, standards, and resources on GHG accounting, calculation, and reporting, GHG programs can improve both the quality and the consistency of reported GHG data, with benefits to stakeholders and companies within and outside of the program:

- Specifications on accounting and reporting decisions, as well as customized GHG calculation tools, can ensure that data reported to the program are based on consistent approaches by all participating companies, and likewise by different facilities belonging to a single company.
- To the extent that the standards and tools harmonize with those of other programs, for example by taking an international standard like the GHG Protocol as their basis, they can improve global data consistency.
- Quality management tools, including inventory management plans and verification protocols, can help participating companies improve the quality of the data they report.

To the extent that data quality and consistency is an important goal for a GHG program, program designers should pay special attention to customizing calculation protocols for their program, and to developing the inventory quality management approaches, which are outlined in Chapters 4 and 5.

SUPPORTING RELATED POLICIES, PROGRAMS, AND STRATEGIES

Some GHG programs are intended to provide the foundation for, or to complement, other related programs, such as mandatory GHG cap-and-trade programs; voluntary GHG management programs; and national GHG inventories, climate change strategies, and air quality reporting programs. GHG programs can provide governments with information that is key to making informed decisions regarding national climate commitments, policies, and strategies. Box 2.1 describes the role of the Mexico GHG Program in Mexico's national climate change strategy. To support related programs and strategies effectively, program designers need to ensure that the elements of program structure addressed in Chapter 3, as well as the technical specifications described in Chapter 4, are consistent with the other programs they aim to support. Additionally, they need to incorporate data quality measures strong enough to support the relevant program functions. Box 2.2 describes the experience of The Climate Registry in designing a program to support a range of both voluntary and regulatory functions.

ESTABLISHING BASELINE PROTECTION

The past decade has been a time of great uncertainty for businesses seeking to incorporate GHG issues into their corporate strategies. The international mechanism establishing binding limits on GHG emissions – the Kyoto Protocol – entered into force in 2005, more than seven years after it was negotiated, and its emission caps are set to expire in 2012. In the United States, a patchwork of state and regional regulation has evolved in the absence of a coordinated national GHG mitigation policy. The future of international climate change policy post-2012 is unclear, and much of the world is not currently subject to GHG regulation. As a result, many companies find themselves in an uncertain situation in which they must make long-term investment decisions without knowing what GHG restrictions they may face in the future. In response, some GHG programs, such as the California Climate Action Registry, have sought to establish and "protect" their participants' baseline emissions. This refers to developing and certifying inventories of participants' GHG emissions and ensuring, insofar as is possible, that any future regulatory programs take into account participants' pre-regulatory, voluntary efforts to reduce their emissions. The concept of baseline protection has been recognized in legislation introduced before the U.S. Congress, which has proposed considering "early action" in companies' allocations of GHG allowances, and has cited a range of GHG registries and reporting programs as examples of what could contribute to proof of early action (S. 2191). A program design that incorporates stringent quality assurance measures may strengthen participants' claim to credit for early action.

PROVIDING INFORMATION TO STAKEHOLDERS

Finally, many GHG programs aim to provide information on corporate GHG emissions to external stakeholders – such as investors (through programs such as the Carbon Disclosure Project[1]), environmental groups, and researchers – on which to base decisions related to investments, risk assessment, and policy and advocacy positions. Designers of such programs should consider the most useful level of disaggregation of GHG information to satisfy the targeted stakeholder groups. They should also ensure that their accounting and calculation methodologies are sufficiently transparent and consistent and that participants are able to provide additional context to their reported emission information.

BOX 2.1 The Role of a GHG Accounting and Reporting Program in Mexico's National Climate Change Strategy

One significant objective that can be served by GHG programs is to support and contribute to the development of national strategies on climate change. Mexico, which in 2004 launched the first corporate GHG accounting and reporting program in a non-Annex-I country, adopted a National Strategy on Climate Change in 2007. The National Strategy cites the Mexico GHG Program as an important capacity-building instrument and source of information to promote climate change mitigation in the industrial sector. Specifically, the Mexico GHG Program contributes to two elements of the National Strategy:

- Identification of GHG mitigation measures in the industrial sector; and
- Progressive valuation of carbon in the national economy.

With respect to energy sector mitigation measures, the National Strategy proposes that the Mexico GHG Program build on its existing platform and portfolio of activities to account for and report 80 percent of Mexico's industrial GHG emissions, promote the identification and implementation of GHG reduction projects, serve as a registry of voluntary GHG reductions, and identify best practices by sector.

In addition to promoting mitigation measures by sector, the National Strategy outlines a medium-term, step-by-step approach for the progressive valuation of carbon in the national economy, beginning with voluntary GHG accounting and reporting, progressing to GHG caps in the energy sector, and culminating in a national cap-and-trade scheme linked to international GHG markets. The Mexico GHG Program can facilitate this strategy by building the capacity of its participants in GHG accounting and emission trading and by contributing to the formulation of sectoral baselines and benchmarks. The experience gained through the Mexico GHG Program in carbon markets and sectoral baseline formulation can accelerate the integration of specific industry sectors into an emergent national scheme, and subsequently into other regional or international emission trading schemes.

During the development of the National Strategy, the Mexico GHG Program played an important role in facilitating dialogue between stakeholders from different industrial sectors and government agencies, providing a venue through which the intersecretarial commission that developed the strategy could solicit feedback from participating companies and incorporate it, as appropriate, into the strategy.

BOX 2.2 Designing a Program to Meet Multiple Objectives: The Climate Registry

The Climate Registry is being developed by a coalition of states, provinces, and tribes in North America to serve as a policy-neutral reporting platform and repository for GHG emission information. Given the patchwork of voluntary and mandatory programs that is continuing to evolve in the region, The Climate Registry's challenge has been to meet the information needs of both types of programs without dictating the structure of mandatory programs to its member states. As such, The Climate Registry has developed two distinct modules, which were under review at the time of publication: one to ensure minimum quality standards and fundamental data consistency between state mandatory programs, and another to structure a prescriptive program for voluntary reporting that standardizes best practices and results in the collection of high-quality, verified data. The two modules would share common basic data elements, source categories, gases, quantification approaches, reporting responsibilities, verification systems, and data collection systems. However, they would differ in other ways. For example, the voluntary module would require reporting at the corporate level, whereas the mandatory module would leave the decision of whether to require corporate- and/or facility-level reporting to state-level regulation.

Decision 2.2 GHG Accounting Principles

As in financial accounting and reporting, generally accepted principles also guide GHG accounting and reporting to ensure that reported information represents a faithful, true, and fair account of a company's GHG emissions. The *Corporate Standard* identifies five commonly accepted principles: relevance, completeness, consistency, transparency, and accuracy (see Box 2.3). These principles are intended to underpin all aspects of GHG accounting and reporting and to guide the implementation of the *Corporate Standard*.

A decision for a GHG accounting and reporting program is whether to augment this set of principles to fit its specific needs. Most GHG programs – including Climate Leaders, the Mexico GHG Program, and Canada's GHG Challenge Registry – either explicitly adopt or recommend the *Corporate Standard* principles, but others have made modifications or incorporated additional principles. South Korea's GHG Emission Information System and Australia's Greenhouse Challenge Plus, for example, adopted the five principles and also added the principle of cost-effectiveness.

BOX 2.3 GHG Protocol Corporate Standard Principles

The *Corporate Standard* outlines five generally accepted accounting principles that underpin most GHG programs, as follows:

Relevance: Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.

Completeness: Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions of emission sources.

Consistency: Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

Transparency: Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

Accuracy: Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

Decision 2.3 Program Design Principles

In addition to adopting principles to guide accounting decisions, some program designers have also found it useful to consult their stakeholders on additional principles specifically to govern the program design process. Based on WRI's and WBCSD's experience with GHG accounting and reporting, and building on the consensus recommendations from various program design processes, the following design principles provide a framework for a successful and credible program:

- *Ensure the consistent reporting of absolute emissions and reductions over time:* To support effective action on climate change, a program should track emissions and reductions based on absolute emissions, not intensity metrics. Intensity measurements can be valuable as performance indicators that are independent of company growth, and can provide helpful benchmarks for achieving emission reductions. However, to monitor overall environmental effectiveness, a program needs to ensure transparent and consistent reporting of absolute emissions.
- *Follow internationally accepted GHG accounting standards and methodologies:* A program should adopt credible, broadly accepted accounting and reporting standards and quantification methodologies, such as those featured in the GHG Protocol and the International

BOX 2.4 Program Design Principles in a Philippine GHG Program

The Philippine GHG Accounting and Reporting Program (PhilGARP) based the design process of its pilot phase on the principles that the program should:

- Use the broadly accepted GHG Protocol accounting and reporting standards and be designed based on the five principles of the *Corporate Standard*
- Not interfere with or pre-determine any existing or future national climate policies
- Be built on a flexible and adaptive platform that will meet both present and future stakeholder needs
- Coordinate with existing relevant reporting programs and information programs operating in the Philippines
- Be expandable, allowing interaction and integration with other local, regional, or international programs
- Strive to be relevant and accessible to important sectors in the Philippines, such as the small- and medium-sized enterprise (SME) and agricultural sectors

These principles guided a number of design decisions and implementation steps, including the decision to coordinate emission factors with agencies working on the Clean Development Mechanism in the Philippines, and to keep participation costs low in order to attract SMEs.

Panel on Climate Change (IPCC) guidelines. Adopting best practice GHG standards and methodologies would ensure environmental credibility; enable the program and its associated GHG policies or measures to link with other sub-national, national, or international registries and policies; and simplify business participation for companies already following best practice methodologies.

- *Adopt the* Corporate Standard *accounting and reporting principles:* A GHG program should require reporting entities to account, report, and verify their GHG emissions according to the five principles, which are described in the *Corporate Standard* and based on established financial accounting and reporting practices. This will promote the best data quality and the highest possible degree of rigor and credibility of the reported information.
- *Support reporting of unit- and facility-level emission data:* Besides corporate-level reporting, it is also useful to support the disaggregation of reported data to the unit or facility level, even if this level of disaggregation is not reported to the public. There are three reasons for this. First, unit- or facility-level data are more useful than corporate-level data for conducting benchmarking exercises and identifying opportunities to improve efficiency. Second, most regulatory GHG programs regulate at the unit or facility level. In order to support a future GHG regulatory program, or to link with existing programs that regulate other air emissions such as NO_x, unit- or facility-level disaggregation is necessary. Finally, emissions reported at the unit or facility level can also be rolled up to the city, state or province, region, or sector level, enabling the program to serve as a foundation for multiple types of GHG policies and programs, be they multi-sectoral or sector-specific, mandatory or voluntary, national or sub-national.
- *Provide a clear and adequate distinction between corporate and project GHG accounting:* Corporate GHG accounting, which results in an inventory of a company's GHG emissions and sources, is based on a different approach than project accounting (also known as offset accounting), which results in a quantification of the GHG benefits of a unique GHG mitigation project. In corporate GHG accounting, a company measures its reductions in GHG emissions by comparing its emissions from year to year. In project accounting, on the other hand, GHG reductions are calculated against a hypothetical "baseline," or the emissions that would have occurred absent consideration of GHG mitigation.[2] Reductions as measured against these different reference points are subject to distinct considerations, and GHG programs must clearly distinguish between these two types of GHG accounting. Additionally, some GHG programs may serve functions that require joint consideration of both corporate and project accounting concepts, for example, establishing net corporate GHG emissions in the context of GHG mitigation instruments such as offsets and renewable energy certificates. Such programs should ensure that each accounting approach is used for its appropriate purpose.

Program designers may also adopt additional principles to guide the development of their program. Box 2.4 outlines the additional principles adopted by PhilGARP.

Notes

1. www.cdproject.net
2. For further guidance on project accounting, see WRI/WBCSD 2005.

Elements of Program Structure

3

Once designers and stakeholders reach an agreement on program objectives and principles, characteristics of the program structure will begin to come into focus. This section reviews the main elements of program structure — including sector, source and gas coverage; geographic boundaries; and defining the reporting entity — in light of their relationship to program objectives and principles, likely impacts on program participation, relevance to the local economy, consistency with related programs and initiatives, and cost and technical feasibility.

The key program design decisions covered in this section are:

3.1 Which sectors, sources, and gases should the program cover?

3.2 What geographical boundaries should the program adopt?

3.3 How should the reporting entity be defined?

Table 3.2 summarizes how these decisions have been addressed in several GHG programs.

Decision 3.1 Sector, Source, and Gas Coverage

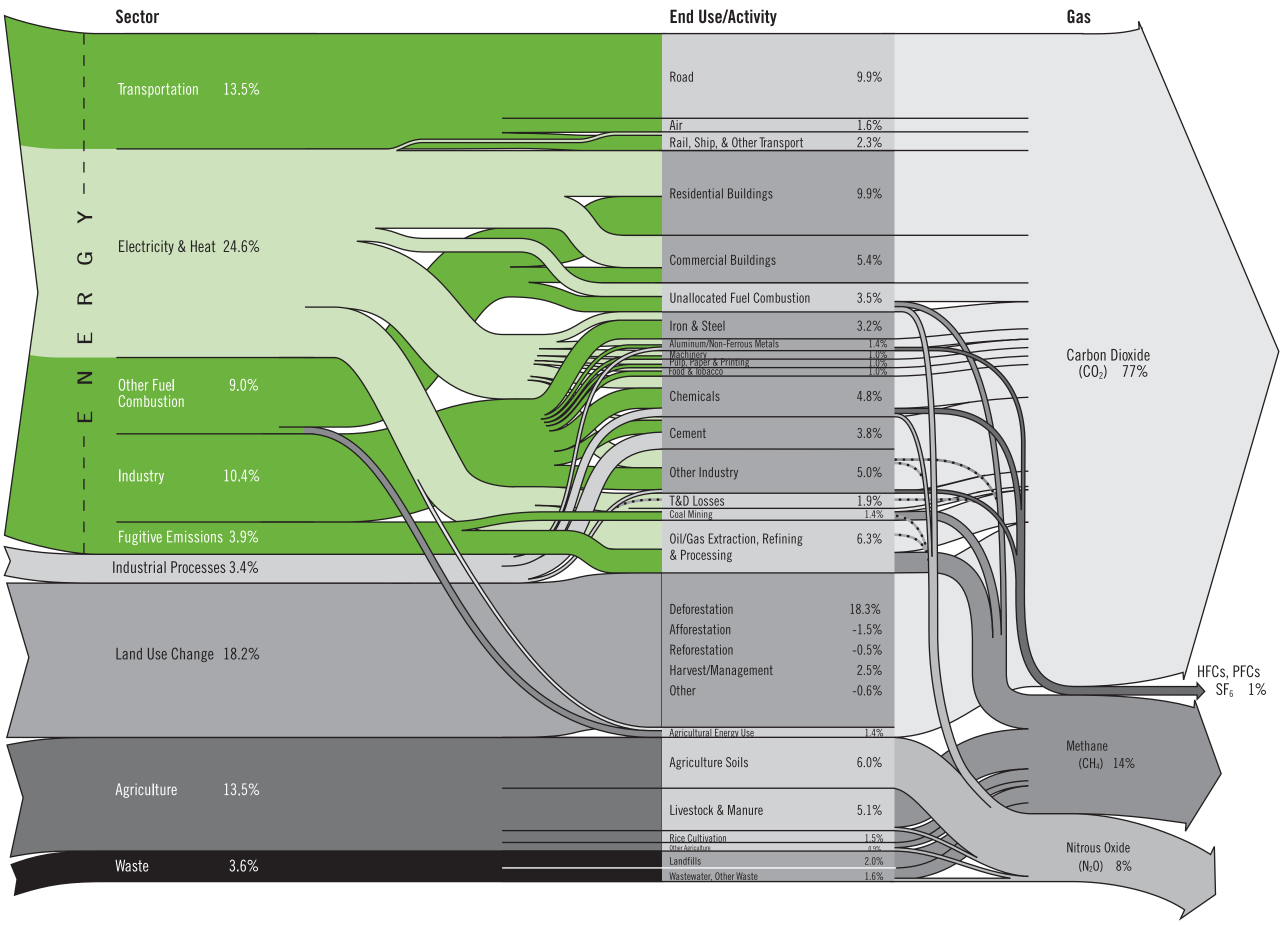
OVERVIEW OF SECTORS, SOURCES, AND GASES

GHG emissions can be viewed through three lenses: (1) which *sector* comprises the activities that generate the GHG emissions, (2) which type of *source* physically emits the GHGs, and (3) which *gas* is emitted. As shown in Figure 3.1, sectors, sources, and gases are inextricably linked – as are decisions about how to cover each in a GHG program.

The major economic sectors with respect to GHG emissions are:

- *Energy:* The energy sector accounts for approximately 60 percent of global GHG emissions, and includes the generation of electricity and heat, transportation, and the generation of energy for industry, as well as other fuel combustion and fugitive emissions. GHG emissions from the energy sector consist primarily of carbon dioxide (CO_2), as well as smaller amounts of methane (CH_4) and nitrous oxide (N_2O).
- *Industrial Processes:* In the industrial process sector, GHGs occur as a by-product of, or as fugitive emissions from, industrial processes not directly related to energy-consuming activities. Examples of industries intensive in process GHG emissions include the aluminum, chemical, cement, and iron and steel industries. Emissions from industrial processes include all six major GHGs.
- *Land-use Change:* This sector is different from other sectors in that some activities, such as deforestation, logging, and cattle ranching, emit GHGs – specifically CO_2 and CH_4 – into the atmosphere, while other activities, such as afforestation and reforestation, absorb CO_2. Overall, the land-use change sector is one of the largest contributors to GHG emissions, accounting for 18 percent of global emissions. However, in some regions of the world, including the United States, this sector absorbs more CO_2 than it emits.

FIGURE 3.1 Global Greenhouse Gas Emissions



Reprinted from Baumert 2005. All data are for 2000. All calculations are based on CO_2-equivalent, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 41,755 million metric tons of CO_2-equivalent. Land use change includes both emissions and absorptions. Dotted lines represent flows of less than 0.1 percent of total GHG emissions.

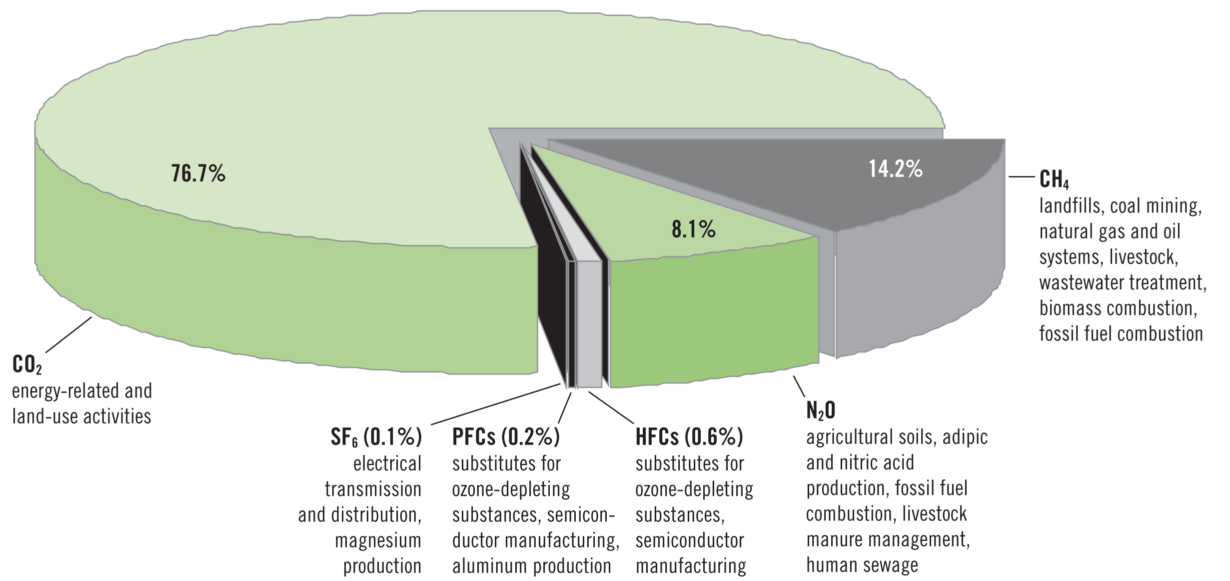
- *Agriculture:* The agriculture sector is a significant contributor to global GHG emissions, accounting for approximately 13.5 percent of global emissions. The primary GHGs from agricultural activities are N_2O and CH_4. The largest contributors to GHG emissions in this sector are soil management activities – such as fertilizer application and other cropping practices – which emit N_2O. CH_4 emissions from livestock and manure management are also significant.
- *Waste*: Activities from the waste sector that emit GHGs (mostly CH_4) include solid waste landfill, wastewater handling and treatment, and sewage treatment.

In many cases, programs and regulations target a subset of the sectors described above. For example, while power generation and transportation are both part of the energy sector, they might be addressed separately under GHG programs or regulations.

Within each sector is a range of GHG-emitting activities and sources. A GHG source is any physical unit or process that releases GHGs into the atmosphere. Categories of GHG emission sources include:

- *Stationary combustion:* Sources include boilers, heaters, furnaces, ovens, dryers, and other stationary equipment that uses fuel to produce energy.
- *Mobile combustion:* Sources include transportation devices such as cars, trucks, trains, airplanes, and ships.
- *Process emissions:* Sources include non-combustion processes that emit GHGs during the manufacturing of products, materials, or chemicals such as aluminum, ammonia, cement, iron and steel, lime, paper and other wood products, adipic acid, nitric acid, and semiconductors.
- *Fugitive emissions:* Fugitive emissions are emissions that result from intentional or unintentional releases of GHGs into the atmosphere. Fugitive emission sources include agricultural soils that release nitrous oxide (N_2O); livestock, landfills, coal mines, natural gas pipelines that release methane (CH_4); and refrigeration and air conditioning equipment that release hydrofluorocarbon (HFC) emissions.

FIGURE 3.2 Major Greenhouse Gases and Sources



Based on data from the Climate Analysis Indicators Tool, WRI, 2000.

Most GHG programs focus on the six major anthropogenic GHGs (also known as the Kyoto gases because they are covered by the Kyoto Protocol), as shown in Figure 3.2. In addition to the six Kyoto gases, there are also other GHGs, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), as well as GHG precursors, such as carbon monoxide (CO), nitrogen oxides (NO_x), and volatile organic compounds (VOCs).

SECTOR, SOURCE, AND GAS OPTIONS FOR GHG PROGRAMS

Most GHG programs cast a fairly wide net with regard to which sectors, sources, and gases to include. Especially in the case of voluntary accounting and reporting programs, there is little downside to including all relevant sectors, sources, and gases, as long as reporting companies indicate transparently where data are either unavailable or subject to greater uncertainty. There are, however, three exceptions to this rule of inclusiveness. The first is in the case of accounting and reporting systems designed to support regulatory programs. With regard to sectoral coverage, stakeholders debate the merits of whether and how to regulate GHG emissions from different sectors and sources, and to date, GHG regulation has focused primarily on direct sources in subsets of the energy sector. Additionally, in a regulatory context, data accuracy is of utmost importance, and it is necessary to develop protocols and tools that ensure sufficient accuracy. The EU Emission Trading Scheme, for example, covers only CO_2 from a limited number of sectors during its first phase from 2005 to 2007. Additional gases and sectors may be phased in later.

The second exception concerns emissions from land-use change and agriculture, which have not been well represented in GHG programs to date. This is due to several related factors. First, these sectors are unique in that they both emit and absorb carbon, and the emissions occur on a much less regular basis than those from energy use and industrial processes. Additionally, and not coincidentally, there is a lack of widely accepted accounting protocols for land-use change and agriculture. Finally, characterizing emissions and sinks for these sectors can be more costly and difficult than for point sources of GHG emissions and for emissions that can be estimated by a mass balance approach.

The third exception concerns the non-Kyoto gases, which typically have not been included in GHG programs. The ozone-depleting GHGs (such as CFCs and HCFCs) are regulated under the Montreal Protocol on Substances that Deplete the Ozone Layer, so including them in GHG programs has been seen as redundant. Reporting on non-Kyoto gases, however, may be relevant to companies that are replacing ozone-depleting substances with new chemicals. Additionally, the inclusion of GHG precursors could be considered in the future, based on the results of work by the IPCC and other research organizations to establish the direct and indirect global warming potential of these substances. Among them, the one that might especially deserve consideration is NO_x, which may be relevant to GHG program participants due to air pollution issues and the fact that air-quality regulations often include NO_x. The *Corporate Standard* requires emission data for the six Kyoto gases to be reported separately, while allowing (but not requiring) emission data from the other GHGs to be reported separately under optional information.

GHG program designers need to determine whether it makes sense to include or exclude specific sectors, sources, or gases. These issues are interrelated, and decisions about them hinge on the strategic objectives and guiding principles that each GHG program will follow. In particular, program designers may want to consider the relationship of sector, source, and gas coverage to the following outcomes:

- *Program participation:* If a key objective of the GHG program is to attract a broad range of participants, then all sectors, sources, and gases should be included. Even if specific calculation protocols and tools for a particular sector, source, or gas cannot be made available by the GHG program at the time of its launch, participants from all sectors can still have the opportunity to develop GHG inventories based on existing methodologies or estimates. A program that seeks, for example, to promote the identification of the broadest possible range of emission reduction measures should encourage all entities to participate, regardless of whether they own or control direct emission sources.
- *Relevance to the local economy:* While Figure 3.1 shows the role of sectors, sources, and gases in the global economy, it is important to remember that this picture can look quite different for any particular geographic region. Most regions have certain sectors, sources, and gases that play a particularly prominent role in their economy. While it may not be necessary to exclude those sectors, sources, and gases that are less prominent, the program might give special consideration – for example, by developing customized emission factors or calculation protocols – to those that are more prominent. For example, if agriculture forms the basis of a program's local economy, it may be particularly important to emphasize the inclusion of sources from the fugitive emission category, as well as CH_4 and N_2O. Box 3.1 describes the consideration of sectoral priorities in developing a GHG accounting and reporting program for Brazil.
- *Consistency with related programs and initiatives:* The specifications provided by other relevant programs and initiatives – such as GHG registries in other regions where prospective participants have operations, or reporting programs that cover non-GHG air emissions – may help inform the decision of which sectors, sources, and gases to include in the program. Consistency can help reduce costs for participants in multiple programs and facilitate linkages with the other programs.
- *Cost and technical constraints:* In some cases, cost or technical constraints may make it difficult for a GHG program to provide calculation protocols and tools for a particular sector, source, or gas, or for participants to acquire data for them. This does not mean that these sectors, sources, or gases should be explicitly excluded from reporting under the program, but it may justify providing phase-in options that allow participants either to exclude particular gases or sources from their GHG inventory or to use a simplified (and potentially less accurate) accounting methodology for those gases or sources for a certain period of time, with the intent of phasing in the missing elements as their GHG accounting capacity matures. In such cases, it is important to apply the principle of transparency; programs should require disclosure and justification of omitted gases and/or data collection limitations.

Program designers might also consider phasing in certain sectors, sources, or gases over time. The California Climate Action Registry, for example, permits its participants to exclude gases other than CO_2 during the first three years of their participation. After the three years, they must include all six Kyoto gases. This gives participants the opportunity to "learn by doing" – to become familiar with the GHG accounting and reporting process without having to tackle all gases and sources at once.

Decision 3.2 Geographic Boundaries

A geographic boundary is the physical location within which a GHG program participant must account for and report its emission sources. For GHG programs, the main issue is to define a boundary that enables participants to include and report on their most relevant emission sources. Depending on the program context, there are several options that can be pursued separately or in combination:

- *Sub-national reporting:* Participants report emissions from all required sources located within a particular state, province, or other sub-national region.
- *National reporting:* Participants report emissions from all required sources located within the national borders.
- *Global reporting:* Participants report emissions from all required sources throughout their global operations.

Some GHG programs incorporate more than one reporting scale. For example, the California Climate Action Registry requires reporting all sources in California, and also allows participants the option of reporting national emissions. The Climate Registry is considering requiring reporting of all sources in North America, with data disaggregated by country and state or province. Reporting of global emissions would be optional.

As with every program design decision, the most relevant criteria in selecting geographic boundaries are the objectives and principles set by the GHG program. For instance, if facilitating linkages with national climate policies is a key priority, then accepting national-level emission data should be strongly considered. However, if the GHG program is more focused on stimulating regional environmental and economic development benefits, then accepting sub-national emission data could be a more attractive option. Table 3.1 summarizes the advantages and disadvantages associated with the three main options.

TABLE 3.1 Advantages and Disadvantages of Different Geographical Boundary Options

GEOGRAPHICAL BOUNDARY OPTIONS	ADVANTAGES	DISADVANTAGES
Sub-national (e.g. state, provincial, regional)	• May provide a learning experience for companies that wish to participate in a GHG program but are not yet in a position to account for and report national emissions • May help companies prepare for and/or facilitate compliance with a sub-national GHG regulatory program	• Limits potential opportunities to link with national GHG programs • For companies with national or global operations, does not provide a complete GHG profile • If a patchwork of programs evolves in different sub-national regions, creates administrative burden for companies participating in multiple programs • Can create some additional accounting complications, for example when accounting for electricity created by a participant outside the region and imported into the region
National	• Facilitates linkages with other national programs • For companies with national operations, provides a more complete GHG profile than sub-national programs • Provides a platform on which participants can report progress towards their national GHG reduction targets • More potential to identify GHG reduction opportunities, as compared to sub-national reporting • Many potential GHG program participants already maintain nationwide GHG inventories • May help companies prepare for and/or facilitate compliance with a national GHG regulatory program • Consistent with boundaries of national inventories submitted to the UNFCCC	• May be too complex and burdensome for some companies, particularly those with highly decentralized management structures • For companies with global operations, reporting at a national level will not provide a complete GHG profile • Less opportunity to identify GHG reduction opportunities as compared to global reporting
Global	• Facilitates linkages with other international programs • Provides a complete picture of a company's emissions • Maximizes potential to identify GHG reduction opportunities	• Likely to be too complex and burdensome for some companies; may limit participation • May limit opportunities to link with national or sub-national programs, unless disaggregated reporting is also included

Decision 3.3: Defining the Reporting Entity

GHG programs can define the reporting entity – the type of business unit eligible to report its GHG emissions to the program – at the corporate level, the facility level, or both.

CORPORATE-LEVEL REPORTING

Under corporate-level reporting, a company reports emissions from all of its facilities, subsidiaries, and other business units, as determined by its organizational boundaries (see Decision 4.1). The advantages of corporate-level reporting include:

- Providing a more comprehensive view of a company's overall emission performance;
- Facilitating corporate-level risk management and GHG strategy development; and
- Preventing "cherry-picking," wherein, in a voluntary setting, a company reports emissions from facilities with better GHG performance while excluding facilities with worse GHG performance.

Defining the reporting entity at the corporate level is consistent with the definitions and rules of financial accounting, which are based on ownership or control.

Within the corporate-level reporting approach, programs may require reporting at the level of the parent company, or they may permit a subsidiary to report independently in cases where its parent company is not participating in the reporting program. This decision should be evaluated in light of the program objectives. If the program aims to promote complete and transparent corporate GHG reporting, and to provide the most relevant information to stakeholders such as investors, reporting should occur at the level of the parent company. If, on the other hand, the program prioritizes outreach and participation, independent reporting by subsidiaries might be permitted.

While permitting independent reporting by subsidiaries, a program can still take certain measures to improve transparency. The Climate Registry, for example, requires each subsidiary participating independently of its parent company to identify its parent company and to provide information on its corporate legal structure. This information is already available in a company's financial report, and therefore does not cause an additional reporting burden, but does provide context to users of the reported information.

TABLE 3.2 GHG Program Structure Decisions in Selected GHG Programs

PROGRAM NAME	DECISION 3.1: SECTOR, SOURCE, GAS COVERAGE	DECISION 3.2: GEOGRAPHIC BOUNDARIES	DECISION 3.3: REPORTING ENTITY
California Climate Action Registry	*Sectors:* All *Sources:* All *Gases:* Only CO_2 required during the first three years of participation; six Kyoto gases required beginning in the fourth year of participation	Participants may choose to report emissions for only California operations, or for U.S. operations with California emissions disaggregated; a protocol for reporting global emissions was under development at the time of publication	Corporate level
Canadian GHG Challenge Registry	*Sectors:* All *Sources:* All *Gases:* Six Kyoto gases included on an optional basis	Flexible, depends on participant	Flexible, depends on participant
Chicago Climate Exchange	*Sectors:* All *Sources:* Large emission sources[1] in which participant's equity share is greater than or equal to 20 percent; additional sources optional *Gases:* Six Kyoto gases	All U.S. large emission sources, plus Canadian large emission sources for Canada-domiciled participants and Mexican large emission sources for Mexico-domiciled participants	Corporate level
Climate Leaders (United States)	*Sectors:* All *Sources:* All *Gases:* Six Kyoto gases	U.S. operations required, international operations optional	Corporate level
European Union Emission Trading Scheme	*Sectors and Sources:* Power plants, boilers, refineries, production and processing of ferrous metals and ores, mineral industry (cement, ceramics, glass, lime), production of pulp and paper; aviation likely to be added after 2010 *Gases:* CO_2 during phase I (2005 – 2007); all Kyoto gases available for opt-in for specific activities during phase II (2008 – 2012)	Operations within EU member states	Facility level
Greenhouse Challenge Plus (Australia)	*Sectors:* All *Sources:* All *Gases:* Six Kyoto gases	Australian operations; participants can apply to report separately on extra-national emissions	Parent company required to report emissions for all subsidiaries and joint ventures
Greenhouse Gas Emission Information System (South Korea)	*Sectors*: All, with special guidance for the petrochemical, power generation, semiconductor, and steel sectors *Sources:* All *Gases:* Six Kyoto gases	Facilities outside of South Korea may be registered, but they will not be included in participants' GHG inventories	Facility level
Mexico Greenhouse Gas Program	*Sectors:* All *Sources:* All *Gases:* Six Kyoto gases	Mexican operations only	Corporate level
Philippine Greenhouse Gas Accounting & Reporting Program	*Sectors:* All *Sources:* All *Gases:* Six Kyoto gases	Philippine operations only	Corporate level
Regional Greenhouse Gas Initiative (Northeastern United States)	*Sectors:* Electric power *Sources:* Electric generating units with a nameplate capacity exceeding 25 megawatts *Gases:* CO_2	Sources within RGGI states[2]	Unit level
The Climate Registry[3] (North America)	*Sectors:* All *Sources:* All *Gases:* Six Kyoto gases	All operations in Canada, Mexico, and the United States, disaggregated by country, state, province, territory and (if applicable) tribal area; global emissions optional	Corporate level, with data disaggregated by facility

1. The Chicago Climate Exchange defines large emission sources as follows: For participants not primarily engaged in electricity production and with annual emissions equal to or greater than 200,000 metric tons CO_2-equivalent, facilities and activities that release emissions estimated to be equal to or greater than 5 percent of the participant's total emissions; for participants with annual emissions less than 200,000 metric tons CO_2-equivalent, facilities or activities that release at least 10,000 metric tons of CO_2-equivalent per year; and for participants primarily engaged in electricity production, electric power generation facilities with a rated capacity of at least 25 megawatts.
2. At the time of publication, RGGI states included: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont.
3. These program structure characteristics pertain to voluntary reporting under The Climate Registry.

FACILITY-LEVEL REPORTING

Facility-level reporting focuses on emissions associated with a discrete business operation or a facility within a corporate boundary. Regulatory programs are generally based on facility-level data, and the owner or operator of a regulated facility is required to report emissions for the entire facility. Key benefits of defining the reporting entity at the facility level are:

- Supporting a current or future regulatory program; and
- Facilitating the evaluation of emission performance and identification of reduction opportunities at the facility level.

A disadvantage of facility-level reporting, especially in a voluntary context, is that some participants may consider facility-level data to be confidential.

INTEGRATED CORPORATE- AND FACILITY-LEVEL REPORTING

A third option in defining the reporting entity is to require reporting at both the corporate and facility levels. This option is most suitable for programs that are designed to serve multiple objectives, including promoting corporate GHG management and providing a foundation for a regulatory program. The Climate Registry requires reporting at both the corporate and facility levels.

The decision of how to define the reporting entity is related to the question of disaggregation of reported emission data, as discussed in Decision 4.6.

BOX 3.1 Incorporating Key Sectors in a GHG Program for Brazil

While engaging stakeholders to plan a GHG accounting and reporting program for Brazil, it became clear that a corporate GHG program that did not explicitly address the country's key sectors of forestry, agriculture, cattle ranching, and biofuels would lack credibility. Emissions from land use, land-use change and forestry, for example, are Brazil's largest source of GHG emissions, and are likely to continue to increase due to deforestation as agricultural areas expand and large-scale transport and power projects are implemented, especially in the Amazon. It is estimated that deforestation in the Brazilian Amazon increased about 32 percent over the last decade (INPE 2002). During initial consultations, stakeholders indicated that better measurement and reporting tools in the agriculture and forestry sectors would help provide reliable data and promote accountability and more effective management strategies and practices at the corporate level. Consequently, the partners developing Brazil's GHG accounting and reporting program are investigating the development of improved GHG accounting protocols and calculation tools for these sectors in order to incorporate them into the program.

4 Accounting, Calculation, and Reporting Specifications

The *Corporate Standard* provides a basic framework for accounting for and reporting GHG emissions at the corporate level. A number of technical accounting and reporting decisions, however, are left to its users to make based on their individual or programmatic goals. This chapter provides guidance to help program designers think through those decisions in the context of their programs' objectives. The decisions are:

4.1 How should the organizational boundary approaches be defined?

4.2 How should indirect emissions be treated?

4.3 How should base year establishment and adjustment be addressed?

4.4 Should emission accounting thresholds be established?

4.5 Should sector-specific calculation protocols be adopted?

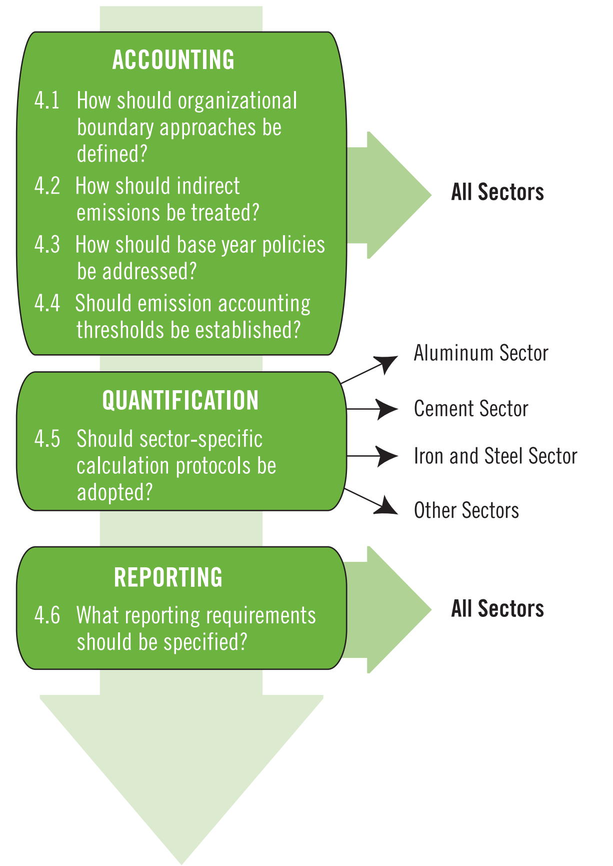
4.6 What reporting requirements should be specified?

As shown in Figure 4.1, decisions 4.1 through 4.4 pertain specifically to accounting for GHG emissions. Table 4.5 illustrates how several GHG programs have addressed these decisions. Decision 4.5 pertains to quantification, and decision 4.6 pertains to reporting (as does the discussion of reporting platforms in Chapter 6). The same accounting and reporting specifications generally apply to all economic sectors, whereas quantification specifications are developed on a sector-by-sector or process-by-process basis. Therefore, GHG programs often develop one document outlining accounting and reporting specifications, and a separate series of documents to address quantification issues by sector. Alternatively, other programs simply adopt the *Corporate Standard* as their accounting and reporting specifications. This can be an efficient approach for programs that can handle a degree of discrepancy, or that require a degree of flexibility, in how their participants address certain accounting decisions – for example, those programs with small numbers of participants from diverse industry sectors. Quantification protocols for some sectors are often developed after the program has been launched, whereas at least a pilot version of the accounting and reporting specifications should be established prior to the program launch.

Decision 4.1 Consolidation Approaches for Setting Organizational Boundaries

GHG programs that require reporting at the corporate level – as opposed to at the level of individual facilities or business units – need to specify one or more methods for consolidating the emissions from each of a company's facilities to the corporate level. Consolidation is the process of combining emissions from the lower level of facilities or business units to the higher level of the parent company, and is also referred to in the *Corporate Standard* as setting the organizational boundaries of a GHG inventory. Setting organizational boundaries helps a parent company assemble its total emissions from the emissions of all its group

FIGURE 4.1 Program Specification Decision Categories



companies and other corporate entities within a specific geographic area (such as a city, state or province, region, country, or the world). Lower-level corporate entities may include wholly owned operations, joint ventures, subsidiaries, associated companies, or facilities.

The *Corporate Standard* is based on financial accounting rules to define the structure of the reporting company and relationships among parties involved. It presents three approaches to consolidate GHG emissions, the equity share approach and two control-based approaches:

- *Equity Share*: Under the equity share approach, a company accounts for GHG emissions from each operation according to its share of equity in the operation. The equity share reflects economic interest – that is, the rights a company has to the risks and rewards flowing from an operation. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation, and equity share is the same as the ownership percentage. In that case, for example, if a company owned 60 percent of an operation, it would include 60 percent of that operation's emissions in its inventory; likewise, if it owned 10 percent of the operation, it would include 10 percent of the operation's emissions.
- *Control*: Under the control approach, a company accounts for 100 percent of the GHG emissions from operations over which it has control. It does not account for GHG emissions from operations in which it owns an interest but has no control. Control can be defined in either financial or operational terms. Therefore, when using the control approach to consolidate GHG emissions, companies can choose either the *operational control* or *financial control* criterion:
  - *Operational Control*: A company has operational control over an operation if the company or one of its subsidiaries has the full authority to introduce and implement its operating policies in the operation. This criterion is consistent with the accounting and reporting practice of many regulatory and emission trading programs that require reporting on emissions from facilities which companies operate (i.e., for which they hold the operating license).
  - *Financial Control*: A company has financial control over an operation if the former has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities. Financial control usually exists if the company has the right to the majority of benefits of the operation, however these rights are conveyed.

Consolidation approaches for setting organizational boundaries are explained further in Chapter 3 of the *Corporate Standard.* In most cases, the company that has operational control over an operation also has financial control, and vice versa. Table 4.1 summarizes the equity and control approaches and their definitions.

TABLE 4.1 Consolidation Approaches and Definitions

CONSOLIDATION APPROACH	TYPICAL DEFINITION	ACCOUNTING OF EMISSIONS
Equity Share	Percent ownership	By equity share (0% to 100%)
Financial Control	Group company or subsidiary consolidated in financial accounts	100% of emissions if financial control 0% of emissions if no financial control By equity share if joint financial control
Operational Control	Operator, holder of operating license	100% of emissions if an operator 0% of emissions if not an operator

The *Corporate Standard* specifies that the reporting company must define its organizational boundaries according to one of the three consolidation approaches. Alternatively, the company may report according to both the equity share approach and one of the control approaches. In either case, the company must transparently document and explain which approach has been chosen. The rationale for this approach is that not all possible GHG reporting objectives are best served by the same consolidation approach; therefore each company should choose the approach that best serves its unique objectives.

In the context of a GHG program, however, providing that level of flexibility may conflict with other program goals. For example, if two companies participating in the program jointly own a facility and choose different consolidation approaches, the potential exists for the emissions from the jointly owned facility to be either over- or under-reported in the GHG program. Likewise, an accounting and reporting system intended to serve as the basis for a regulatory program will need to specify one particular approach. In general terms, the options available for GHG programs for treatment of organizational boundaries are as follows:

- *Set no requirements:* Under this approach, each program participant can choose the equity share or either control approach. This has been the most commonly chosen option by GHG programs to date, especially among voluntary programs that focus on promoting corporate GHG management as their main objective.
- *Require a control approach (financial or operational):* To date, this approach has been used by PhilGARP, which requires reporting on the basis of operational control, and is also being considered by The Climate Registry and the Mexico GHG Program.
- *Require the equity share approach:* This option has been implemented by the Chicago Climate Exchange, which requires reporting based on equity share because it allocates GHG allowances based on equity share.[1]
- *Require both the equity share and a control approach:* To date, no program has implemented this option, although The Climate Registry considered it during the process of developing its specifications.

TABLE 4.2 Advantages and Disadvantages of Consolidation Policy Options

CONSOLIDATION POLICY OPTION	ADVANTAGES	DISADVANTAGES
Set no requirements	• Permits participants to choose the approach that most closely aligns with their business goals, corporate structure, and cost constraints • Avoids deterring participation with reporting requirements that may not align with the participants' own objectives	• Provides a less comprehensive view of participants' emission profiles and the related risks and opportunities than if participants were required to report using both approaches • When different participants choose different approaches, compromises the ability of stakeholders to compare emission data consistently across companies • Risks over-reporting or under-reporting emissions for participants that are related to each other and choose different approaches, and therefore: – Reduces clarity for stakeholders – Provides an inadequate basis for a regulatory program – Reduces the utility of information for cross-checking sectoral emissions with the national inventory
Require a control approach	• Standardizes reported information • Prevents over- and under-counting by requiring a single approach • Facilitates interpretation and application of reported information (for example in national inventories or in prospective regulatory programs) • Facilitates performance tracking of GHG management policies and aligns with typical regulatory approaches • Unlikely to significantly compromise participation, since most companies, when given the choice, choose the operational control approach	• Compromises information disclosure, since information based on the control approach excludes operations that the reporting entity owns but does not control, and therefore does not fully reflect corporate financial risks and opportunities • May inconvenience electric power providers and certain other companies by requiring them to depart from their common practice of using equity share[1]
Require the equity share approach	• Standardizes reported information • Prevents over- and under-counting by requiring a single approach • Facilitates the analysis and management of corporate climate-related financial risk	• Creates burden associated with obtaining data from operations in which participants hold an equity share but do not control • Does not align with most regulatory programs
Require both a control approach and the equity share approach	• Provides maximum information to stakeholders • Facilitates a range of uses including both financial and regulatory risk analysis, corporate climate strategy development, national inventory input, and serving as a basis for regulatory program development or implementation	• Creates increased burden on program participants • Dual reports may confuse some stakeholders

[1] In the United States, the electric power sector generally uses equity share accounting because of the complex ownership structures common in the industry, which make equity share accounting more representative of corporate emission footprints. In addition, emissions data in the sector is more transparent, well-measured, and readily available than for other sectors, which reduces the data collection difficulties posed by equity share reporting in other sectors.

TABLE 4.3 Classification of GHG Emissions

DIRECT VS. INDIRECT	SCOPE
Direct GHG Emissions: Emissions from sources that are owned or controlled by the reporting company.	**Scope 1:** All direct GHG emissions.
Indirect GHG Emissions: Emissions that are a consequence of the activities of the reporting company, but that occur at sources owned or controlled by another company.	**Scope 2:** Indirect emissions associated with the generation of electricity, heat, or steam purchased for own consumption. **Scope 3:** Other indirect emissions, such as those associated with the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting company, electricity-related activities (e.g., transmission and distribution losses) that are not covered in Scope 2, outsourced activities, or waste disposal.

Table 4.2 outlines the advantages and disadvantages of each option.

In addition to these advantages and disadvantages, program developers may also wish to consider aligning their choices with other reporting programs (such as other GHG programs or air quality programs) in which their prospective members participate.

In addition to the four options outlined above, program designers might consider a hybrid approach to organizational boundary requirements. For example, a program might require reporting based on one of the control approaches, but also permit participants to report on equity share on an optional basis. Alternatively, a program could require participants to report using a control approach and also to declare entities and projects in which they hold an equity share but do not control. In this case, participants would list subsidiaries, associated or affiliated companies, joint ventures and partnerships, and jointly owned projects that they do not control without providing GHG data for these entities. This would help users of the inventory to understand whether participants had equity share in GHG-intensive operations that were not included under the control approach, without requiring participants to prepare emission information for those operations.

Decision 4.2 Defining Operational Boundaries (Categorizing Emission Sources)

In addition to specifying how program participants should consolidate the emissions from their facilities to the corporate level, GHG programs also need to address the question of which types of GHG sources should be included in the inventory report, and how they should be classified. Under the *Corporate Standard*, this process is known as setting operational boundaries. The *Corporate Standard* defines emissions by classifying them as direct and indirect emissions, and by "scope," as shown in Table 4.3.

The *Corporate Standard* requires companies to account for both Scope 1 and 2 emissions. Scope 2 is a special category; although Scope 2 emissions do not come from sources owned or controlled by the reporting company, they often compose a significant share of a company's total emission profile, with important implications for GHG risk assessment and management. In comparison to other indirect emissions, data for Scope 2 emissions can usually be easily compiled and verified. Scopes 1 and 2 are reported separately in order to prevent double counting of the same emissions (for example, by both an electric utility and its customers) under the same scope. Scope 3 includes indirect emissions other than those associated with the generation of purchased electricity, heat, or steam. Because of the wide range of possible Scope 3 sources, and because of the potential difficulty associated with accounting for their emissions, Scope 3 is optional under the *Corporate Standard*. Some GHG programs, however, have elected to require certain types of Scope 3 emissions, as discussed below.

The question for GHG program designers is whether to require the reporting of any Scope 3 sources, in addition to Scopes 1 and 2, or to make all Scope 3 sources optional. Most voluntary programs that focus primarily on improving corporate GHG management strategies – including the California Climate Action Registry, The Climate Registry, and Climate Leaders[2] – make all Scope 3 sources optional. In certain sectors, however, select Scope 3 emissions represent an important share of relatively easily quantified emissions, and therefore have been incorporated in some programs' accounting requirements. For example, through the WBCSD Cement Sustainability Initiative, the cement sector has developed an accounting and reporting protocol that includes the accounting and reporting of Scope 3 emissions associated with purchased clinker, a GHG-intensive input to cement production. Cement sector participants in the Mexico GHG Program and in PhilGARP follow this approach. Likewise, PhilGARP has specified that its service-sector participants account for and report on their Scope 3 emissions from business travel and employee commuting. Box 4.1 describes why and how a GHG program in New Zealand incorporated Scope 3 into its accounting and reporting requirements.

An additional possibility is to require only Scope 1, excluding Scopes 2 and 3. This approach is suited to regulatory systems that cap and reduce emissions from a specific subset of direct sources. Such programs need to establish legal liability for compliance with respect to emissions, which can generally be established only for direct sources. In addition, most such programs operate at the facility (as opposed to the corporate) level. Since different facilities within the same company may trade electricity, heat and steam among each other, Scope 2 information is not necessarily particularly meaningful. In any other context, however, the absence of indirect emission requirements

BOX 4.1 Scope 3 Requirements in a New Zealand GHG Program

The carboNZero Programme is an initiative administered by Landcare Research Ltd. New Zealand to measure, manage and mitigate CO_2 emissions from organizations, products and services, and events. The overall aim of the program is to assist individuals and organizations to take action to reduce GHG emissions with the highest level of credibility and integrity.

As a first step towards reducing and mitigating emissions, participants prepare a CO_2 inventory based on the *Corporate Standard*. The program requires participants to measure their emissions from Scopes 1, 2 and 3 in order to understand the impacts of both the emissions that they can control and the emissions that they can influence through their supply chains.

Many of the carboNZero Programme's participants are high-profile early adopters of climate change mitigation practices, and as such, their actions – including their indirect emissions – are closely scrutinized. For example, Scope 3 emissions due to maritime freight are of particular importance to overseas consumers, even though most exporters do not commission or pay for this freight. Therefore, reporting Scope 3 emissions has become important, as has the demand for mitigating or offsetting them.

The carboNZero Programme separates Scope 3 emissions into operational, one-time, and unintended emissions. Participants in the carboNZero Programme are expected to reduce operational emissions, including Scope 3 operational emissions, each year. One-time emissions include activities such as new construction and the acquisition of equipment. Participants are encouraged to achieve lower emission intensity for these activities. Unintended emissions include fugitive emissions and accidents, and these should be eliminated before the next inventory is prepared. The program encourages participants to address their supply chain emissions through procurement, specification and contracting.

in this approach seriously compromises the utility of the resulting GHG inventories for most purposes, including analyzing GHG risks and mitigation opportunities. It is also inconsistent with the *Corporate Standard*, which requires Scope 2.

Decision 4.3 Establishing Base Year Policies

The base year is the year against which a reporting company's GHG emissions are tracked over time. Either a single year or a series of consecutive years can be identified as the base year. In the latter case, base year emissions are the average of annual emissions in the series of consecutive years identified as the base period. Selecting a base year serves a number of corporate and programmatic purposes, such as tracking emissions over time, presenting annual GHG data in context, establishing and tracking progress toward GHG targets, and providing a starting point against which adjustments can be made as the company experiences structural changes such as acquisitions or divestitures.

The *Corporate Standard* requires that companies choose and report a base year for which verifiable emission data are available and that they specify their reasons for choosing that particular year. Many companies choose as their base year the first year that they accounted for their GHG emissions and developed a GHG inventory, but some companies reach further back if data are available. The *Corporate Standard* also requires that companies develop a base year emission recalculation policy, and clearly articulate the basis for and context of any recalculations. Companies are to adjust their reported base year emissions in the event of mergers, acquisitions, and divestments; changes in the outsourcing and insourcing of emitting activities; changes in calculation methodology or improvements in the accuracy of emission factors or activity data that result in a significant impact on the base year emission data; and discovery of significant errors, or a number of cumulative errors that are collectively significant. These requirements are described further in Chapter 5 of the *Corporate Standard*.

GHG program designers will need to address the following questions to develop specifications for their program:

- Should the program establish a common base year for all participants, and if so, should it be a single year or a series of years?
- Should the program establish a specific base year emission recalculation policy and/or significance threshold?

SHOULD THE PROGRAM ESTABLISH A SPECIFIC BASE YEAR REQUIREMENT, AND IF SO, SHOULD IT BE A SINGLE YEAR OR A SERIES OF YEARS?

Most programs that are designed primarily as voluntary GHG accounting and reporting programs allow participants a great deal of flexibility in establishing their base year. Consistent with the *Corporate Standard*, the Mexico GHG Program and PhilGARP permit participants to choose any year or series of consecutive years for which they have reliable data. The California Climate Action Registry, The Climate Registry, and Australia's Greenhouse Challenge Plus permit participants to choose any single year (California specifies that it must be 1990 or later). This flexibility probably reflects the fact that in voluntary accounting and reporting programs, little is to be gained by setting restrictions on which years participants choose. While specifying a single year might assist stakeholders to compare companies' progress over time, it could present practical difficulties in voluntary programs, in which participants join in different years. In this regard, specifying a single base year could result in the exclusion of companies that lack data for that year. Some of these programs, however, have specified that participants choose a single base year rather than a series of years. This may enhance consistency between reporting entities and reduce complexity in calculating and adjusting base year emissions.

Programs that serve additional purposes, such as establishing GHG reduction targets or action plans, are only slightly more restrictive. Climate Leaders specifies that the base year is the most recent year for which data are available when the participant joins the program. (Although emissions can be reported as far back as 1990, years other than the most recent year for which data are available when the participant joins will not be considered the base year for the purpose of tracking progress towards a target). The Canadian GHG Challenge Registry, on the other hand, recommends the earliest year after 1990 for which data are available.

Only GHG trading programs have prescribed common base years for all participants. The Chicago Climate Exchange specifies 1998 – 2001 or 2000, and the UK Emissions Trading Scheme, which ended in March 2007, used 1998 – 2000. In the EU Emission Trading Scheme, base years are assigned by member countries during allowance allocation. The fact that both the Chicago Climate Exchange and the UK Emissions Trading Scheme used a series of consecutive years rather than a single base year may reflect a desire to mitigate the possibility of choosing a single year in which a participant's emissions were abnormally low or high.

SHOULD THE PROGRAM ESTABLISH A SPECIFIC BASE YEAR EMISSION RECALCULATION POLICY AND/OR SIGNIFICANCE THRESHOLD?

Most GHG programs, including Climate Leaders, the Mexico GHG Program, PhilGARP, and The Climate Registry, are consistent with the recommendations of the *Corporate Standard*, described above, in terms of when their participants are required to adjust their base year emissions. In addition to the recalculation triggers already mentioned, the California Climate Action Registry also requires companies to adjust their base year emissions in the case of a shift in the location of an emission source (into or out of the U.S. or California, depending on the reporting company's chosen geographic boundaries).

The programs vary significantly, however, in their treatment of base year recalculation significance thresholds. According to the *Corporate Standard*, whether base year emissions should be recalculated in the face of structural adjustments or the other triggers depends on the cumulative significance of the changes. The *Corporate Standard* does not specify what constitutes "significant." However, some GHG programs do establish a specific "significance threshold" for base year adjustment. Both the California Climate Action Registry and Greenhouse Challenge Plus establish a 10 percent significance threshold for base year adjustments; their participants must recalculate its base year emissions if the cumulative effect of structural and methodological changes over time exceeds 10 percent of base year emissions. The draft specifications of The Climate Registry establish a stricter 3 percent threshold, which, if adopted, will supplant California's current 10 percent threshold, seen in California's experience as too flexible. Three percent was chosen to increase the integrity of emission tracking over time, particularly in light of many companies having GHG reduction targets on the order of one to five percent, which might be obscured by allowing a higher significance threshold for base year recalculations. Although Climate Leaders does not have a specific required threshold, EPA reviews and discusses this issue with companies as part of each Inventory Management Plan review, and companies generally choose a threshold of less than 3 percent.

Decision 4.4 Establishing GHG Accounting Thresholds

GHG accounting thresholds address the question of how to treat small GHG sources for which emission data may be difficult to gather. Two key concepts related to accounting thresholds are *de minimis* thresholds and materiality thresholds. A *de minimis* threshold defines a quantity of emissions that a company is permitted to exclude from its inventory. For example, a company or a GHG program could establish a 3 percent *de minimis* threshold. If the company owned a small source such as lawn mowers, which could be shown with a simple estimate to contribute less than 5 percent of the company's total emissions, then it could exclude the lawn mower emissions from its inventory. If the company had more than one source type that it wished to exclude, for example, lawn mowers as well as emissions from a certain chemical process, then the estimated sum of the emissions from both the lawn mowers and the chemical process would need to be below the *de minimis* threshold to be excluded. The company would need to provide an estimate to establish (and show to a verifier, if applicable) that the emissions from excluded sources really were below the *de minimis* threshold, and the verifier would need to establish that the estimate was reasonable. Data on the actual emissions from the excluded sources (such as fuel bills for the lawn mowers) would not be required.

A *de minimis* threshold can be set by a GHG program, and can be stated either as a percent (of the reporting company's total emissions) or as an absolute quantity (for example, tons of CO_2-equivalent). The *Corporate Standard*, however, recommends against the use of a *de minimis* threshold, on the grounds that it conflicts with the principle of completeness. Additionally, since reporting companies must collect some amount of data for small sources in order to prove they do not exceed the *de minimis* level, there is little practical benefit to excluding such sources from the inventory. The *Corporate Standard* advises instead to estimate emissions for small sources, record how each estimate was calculated, and transparently record and justify estimates that may be of lower quality and/or higher uncertainty. Despite this recommendation, a number of companies and GHG programs have still found it useful to define a *de minimis* threshold.

A second related concept is that of a materiality threshold, which comes into play in the process of inventory verification. A materiality threshold is used to determine whether an error in or omission from an inventory constitutes a material discrepancy – that is, whether the error or omission results in a reported quantity of emissions that is sufficiently different from the true quantity of emissions (as determined by the verifier) that it will influence decisions made by the inventory's users. The *Corporate Standard* recommends 5 percent as a rule of thumb for a materiality threshold; however, it notes that a verifier should assess whether an error or omission of a smaller size may still be misleading given the purpose and context of the report. For example, if a verifier determines that a reporting company has underestimated its emissions by 2 percent, and if adjusting the inventory by 2 percent would prevent the company from achieving a pre-established GHG reduction target, then such a discrepancy would most likely be considered material even though it is smaller than the 5 percent materiality threshold.

The key issue faced by GHG programs with respect to accounting thresholds is whether to define them at all, and if so, at what level. In addressing this decision, a GHG program needs to consider the balance between the accounting principles defined by the *Corporate Standard*, as well as any additional principles that have been defined by the program itself. First, the question of thresholds presents a tradeoff between completeness and accuracy. A higher threshold will result in a less complete inventory, but the data that are included in the inventory are more likely to be accurate than if the threshold were lower, since under a lower threshold reporting companies may be forced to resort to more uncertain estimates if cost or methodological constraints prohibit the collection of highly accurate data for every source. Conversely, requiring highly accurate data may mean that completeness will be sacrificed, as emissions requiring costly quantification or subject to limitations of data availability or methodologies will be eliminated. Second, the issue of establishing thresholds also involves the principle of relevance. Each program will need to determine at what point omitted data or the inclusion of less accurate data becomes relevant for its stakeholders. Finally, transparency is crucial – GHG programs should take measures to ensure that any excluded sources or less accurate data are disclosed and justified.

In addition to the accounting principles, practical considerations also come into play when determining whether to establish one or more accounting thresholds. Having a *de minimis* threshold gives greater flexibility to participants by allowing them to exclude from their inventories sources that are especially costly or difficult to estimate. Allowing a *de minimis* threshold may therefore increase support and participation in a voluntary program. However, *de minimis* thresholds come at the cost of completeness, and may result in underestimating the magnitude of corporate emission footprints.

Established GHG programs differ in their treatment of *de minimis* emissions. The California Climate Action Registry established a *de minimis* threshold of 5 percent, such that a reporter could exclude from its inventories any sources that, combined, account for no more than 5 percent of entity-wide emissions. The draft specifications of The Climate Registry also include a *de minimis* threshold but propose a lower threshold of 3 percent. In contrast to this approach, Climate Leaders does not include a *de minimis* threshold because it conflicts with the principle of completeness. Instead, reporters to Climate Leaders must make a good faith effort to provide a complete, accurate, and consistent accounting of their GHG emissions, and for cases where emissions are difficult to quantify, reporters must provide an estimate based on available data, even if the quantification is less rigorous.

If verification is required under the program (see Chapter 5), then a materiality threshold should be established. Five percent is an accepted rule of thumb for materiality thresholds, but programs that incorporate an emission reduction target component should also consider whether smaller errors or omissions might also be material in light of the target levels of their participants. If so, a tighter materiality threshold may be justified.

If the designers of a GHG program do decide to set GHG accounting thresholds, they may also wish to consider whether to define them by percentage, by ton, or both. Australia's Greenhouse Challenge Plus, for example, suggests a materiality threshold of either 5 percent or 100,000 tons of CO_2-equivalent.

Decision 4.5 Calculation Protocols

In addition to providing program participants with guidance or specifications on accounting questions (related to boundaries, base year, and accounting thresholds), it is generally also useful to provide calculation protocols to guide participants through the process of quantifying their GHG emissions. The primary purpose of calculation protocols is to ensure that program participants with the same emission sources and processes use the same methodologies – or at least methodologies of the same quality – to calculate those emissions. Calculation protocols can also provide additional sector-specific accounting and reporting guidance beyond the general program specifications. The California Climate Action Registry has developed sector-specific protocols for the cement, forestry, and power utility sectors.

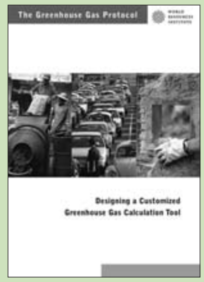
Calculation protocols typically consist of quantification specifications and calculation tools. Quantification specifications include an overview of the protocol with information on the sector, sources, and processes that it covers; one or more approaches for measuring, calculating, or estimating GHG emissions; guidance on collecting activity data and selecting appropriate emission factors;

likely emission sources and the scopes they fall under for the sector in question; and additional information, such as quality control practices and program-specific instructions. Calculation tools are spreadsheets or software to carry out GHG calculations, and can apply to calculating emissions from processes that are specific to a certain sector (such as HFC-23 emissions from HCFC-22 production), or to processes that are common to many sectors (such as stationary or mobile combustion). Calculation tools are sometimes incorporated into software that serves as both a calculation tool and a reporting platform; see Box 6.4 for further discussion of this option. The GHG Protocol currently offers 16 cross-sector and sector-specific calculation protocols (see Resources).

The key questions for GHG program designers are, for sectors for which calculation protocols already exist, whether to adopt them as they are or to customize them, and for sectors for which no calculation protocol exists, whether to create new protocols. To answer these questions, program designers should examine sectoral considerations and geographic considerations.

- *Sectoral considerations:* Many GHG programs look first to sectors with significant emissions in the region covered by the program, as it is especially important to facilitate the development of high-quality inventories in such sectors. The national inventories supplied to the UNFCCC can be helpful for identifying these sectors. Additionally, program designers should consider the quality of any existing calculation protocols available for the sector, and whether representatives of the sector have expressed interest in developing or customizing a calculation protocol.
- *Geographic considerations:* Increasing the accuracy and relevance of calculation protocols for users in a specific country or region is a significant objective of providing customized calculation protocols. Geographic circumstances can affect which quantification methods and emission factors are used, which gases and emission sources are included, and whether and how compatibility with existing local programs and regulations is addressed. Some questions to consider are:
  - Do the quantification methods or emission factors and other data in existing calculation protocols need to be adjusted to better reflect the geographic context in which they will be used?
  - Considering the geographic context in which the calculation protocol will be used, should it also track energy use or air emissions besides GHGs?
  - Does the geographic context offer any ways to simplify or specify elements of existing calculation protocols to make them more user-friendly, for example by providing country-specific defaults and eliminating technologies that are not used in the area covered by the program?

BOX 4.2 Designing a Customized GHG Calculation Tool



Designing a Customized Greenhouse Gas Calculation Tool (WRI, 2007) is designed to assist in the adaptation of existing GHG Protocol calculation tools for a specific GHG program or to more closely reflect national or regional circumstances. The guide describes a stakeholder process that helps create more effective tools and builds capacity and momentum for their adoption and implementation by companies and other relevant stakeholders. It also explains the basic framework necessary for an entity-level GHG calculation tool, methods to enhance the relevance and utility of a calculation tool to meet specific objectives, and the stakeholder process to facilitate the adoption of the tool by the targeted users. It can be downloaded from the GHG Protocol's website at www.ghgprotocol.org.

Further guidance on customizing GHG calculation protocols, which may also be useful when designing a new calculation protocol, can be found in *Designing a Customized Greenhouse Gas Calculation Tool* (see Box 4.2).

Decision 4.6 Reporting Requirements

A GHG report presents critical elements of a reporting company's GHG inventory to its stakeholders, who may include corporate management, shareholders, regulators, environmental groups, researchers, and the general public. Most GHG accounting and reporting programs require, or at least recommend, that their participants include a specific set of details regarding their emissions, inventory boundaries, and methodologies in their GHG reports. The *Corporate Standard* specifies a set of required and optional reporting elements, as listed in Box 4.3.

GHG program designers need to determine:

- Whether to require further disaggregation of emission data, including by facility or business unit, by geographical boundaries (nation, state or province, etc.), and/or by activity type (stationary combustion, mobile combustion, etc.);
- Which reporting elements to make available to the public, as opposed to the GHG program administrators only; and
- Whether to require reporting on any of the optional elements listed in Box 4.3, or on any additional elements.

GHG programs also need to implement a reporting platform for the GHG inventories they collect. This activity is discussed further in Chapter 6, but should be considered in conjunction with the reporting requirement decisions outlined in this section.

BOX 4.3 *Corporate Standard* Reporting Elements

The *Corporate Standard* requires that reporting companies present public GHG reports that are complete, consistent, accurate and transparent; are based on the best data available at the time of publication while being transparent about their limitations; communicate any material discrepancies identified in previous years; and include the companies' gross emissions for their chosen inventory boundaries separate from and independent of any GHG trades in which they might engage.

The *Corporate Standard* requires specific information about the reporting company and its inventory boundaries as well as its emissions. It also lists additional elements related to emissions and performance and GHG offsets; these elements are optional, but should be included where applicable.

Required Information

A public GHG emission report that is in accordance with the *Corporate Standard* shall include the following information:

Description of the company and inventory boundary

- An outline of the organizational boundaries chosen, including the chosen consolidation approach
- An outline of the operational boundaries chosen, and if Scope 3 is included, a list specifying which types of activities are covered
- The reporting period covered

Information on emissions

- Total Scope 1 and 2 emissions independent of any GHG trades such as sales, purchases, transfers, or banking of allowances
- Emission data separately for each scope
- Emission data for all six GHGs separately (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in metric tonnes and in metric tonnes of CO_2-equivalent
- Year chosen as base year, and an emission profile over time that is consistent with and clarifies the chosen policy for making base year emission recalculations
- Appropriate context for any significant emission changes that trigger base year emission recalculation (acquisitions/divestitures, outsourcing/insourcing, changes in reporting boundaries or calculation methodologies, etc.)
- Emission data for direct CO_2 emissions from biologically sequestered carbon (e.g., CO_2 from burning biomass/biofuels), reported separately from the scopes
- Methodologies used to calculate or measure emissions, providing a reference or link to any calculation tools used
- Any specific exclusions of sources, facilities, and/or operations

Optional information

A public GHG emission report should include, when applicable, the following additional information:

Information on emissions and performance

- Emission data from relevant Scope 3 emission activities for which reliable data can be obtained
- Emission data further subdivided, where this aids transparency, by business units/facilities, country, source types (stationary combustion, process, fugitive, etc.), and activity types (production of electricity, transportation, generation of purchased electricity that is sold to end users, etc.)
- Emissions attributable to own generation of electricity, heat, or steam that is sold or transferred to another organization
- Emissions attributable to the generation of electricity, heat or steam that is purchased for re-sale to non-end users
- A description of performance measured against internal and external benchmarks
- Emissions from GHGs not covered by the Kyoto Protocol (e.g., CFCs, NO_x), reported separately from scopes
- Relevant ratio performance indicators (e.g. emissions per kilowatt-hour generated, tonne of material production, or sales)
- An outline of any GHG management/reduction programs or strategies
- Information on any contractual provisions addressing GHG-related risks and obligations
- An outline of any external assurance provided and a copy of any verification statement, if applicable, of the reported emission data
- Information on the causes of emission changes that did not trigger a base year emission recalculation (e.g., process changes, efficiency improvements, plant closures)
- GHG emission data for all years between the base year and the reporting year (including details of and reasons for recalculations, if appropriate)
- Information on the quality of the inventory (e.g., information on the causes and magnitude of uncertainties in emission estimates) and an outline of policies in place to improve inventory quality
- Information on any GHG sequestration
- A list of facilities included in the inventory
- A contact person

Information on offsets

- Information on offsets that have been purchased or developed outside the inventory boundary, subdivided by GHG storage/removals and emission reduction projects. Specify if the offsets are verified/certified and/or approved by an external GHG program (e.g., the Clean Development Mechanism, Joint Implementation).
- Information on reductions at sources inside the inventory boundary that have been sold/transferred as offsets to a third party. Specify if the reduction has been verified/certified and/or approved by an external GHG program.

LEVEL OF DISAGGREGATION OF EMISSION DATA

Most GHG programs are consistent with the *Corporate Standard* in requiring that reported emission data be disaggregated at least by scope and by gas. Only the Canadian GHG Challenge Registry does not require disaggregation by scope, and even then, it encourages it by awarding extra leadership points to companies that provide it. Disaggregation by scope is necessary to correctly interpret GHG data and to avoid double-counting. (A detailed description of issues related to double-counting can be found in the *Corporate Standard.*) Requiring disaggregation by gas is also common; all programs except Climate Leaders (which requires disaggregation by source) and Canada's GHG Challenge Registry require disaggregation by gas (and Canada, again, awards extra points for it). Disaggregation by gas is helpful in interpreting GHG data, but can occasionally create confidentiality concerns for certain types of companies.

Disaggregating data by geographical boundary is also useful in some contexts. Most national programs simply require national-level data and do not require further disaggregation. The Climate Registry is the exception to this rule. Because it is designed to support state- and province-level functions, disaggregation by state or province is required. The California Climate Action Registry also requires, for participants that choose to report their U.S. emissions, disaggregation of California emissions. This facilitates comparison with those participants that operate only in California or that choose only to report their California emissions, which is the only level of reporting required by the program.

Another way to disaggregate data is by source or activity type – that is, by disaggregating direct (Scope 1) emissions into stationary combustion, mobile combustion, process emissions, and fugitive emissions. The California Climate Action Registry, Climate Leaders, and The Climate Registry include this level of disaggregation. The Mexico GHG Program and PhilGARP have considered requiring it, but have not yet done so. In addition to promoting transparency and providing additional context to users of the GHG reports, disaggregating emission information at this level may also facilitate a cross-check for the national GHG inventories required by the UNFCCC.[3]

A final way to disaggregate data is by facility, wherein reporting companies provide emission data to the GHG program on a facility-by-facility, or even unit-by-unit, basis. (See Decision 3.3.) For the reporting company, the main advantage of facility-level disaggregation is to improve accuracy, since more site-specific emission factors may be available at this level to quantify emissions. Also, this process is likely to help identify where specific units or facilities are especially inefficient. From the perspective of the GHG program, facility-level data is useful in the context of regulatory programs and is likely to be necessary for providing linkages between voluntary corporate-level reporting programs and any regulatory facility-level emission reduction programs. The main disadvantage of using a more disaggregated approach is its relatively higher cost for reporters. In some cases, companies already collect disaggregated information, and for these sources the cost difference may not be very significant; however, for other source types, collecting information at the facility or unit level may be more difficult. Additionally, some companies have resisted reporting facility-level data to GHG programs, even if the disaggregated information would not be publicly

TABLE 4.4 Advantages and Disadvantages of Disaggregation Approaches

DISAGGREGATION ELEMENT	ADVANTAGES	DISADVANTAGES
Scope	• Facilitates correct interpretation of GHG data • Helps avoid double-counting • Consistent with the *Corporate Standard*	• Minimal
Gas	• Facilitates correct interpretation of GHG data • Consistent with the *Corporate Standard*	• Generally minimal for CO_2 and CH_4 • Concerns may arise in the case of HFCs, PFCs, and SF_6; emissions of these gases are often facility- and process-specific, so confidential production information could be derived from emission data
Geographical Boundary	• Can support functions implemented at different geographic levels • Facilitates comparison of participants operating at different geographic scales	• Slightly increased reporting burden
Source or Activity Type	• Provides transparency and additional context to users of the GHG reports • Facilitates cross-check with the national GHG inventories required by the UNFCCC	• Slightly increased reporting burden
Facility	• Can improve accuracy if more site-specific emission factors can be used • Facilitates identification of opportunities to improve performance • Consistent with regulatory programs that are implemented at the facility level	• Increased burden on participants • Some participants may consider facility-level data confidential

TABLE 4.5 GHG Accounting Decisions in Selected GHG Programs

PROGRAM NAME	DECISION 4.1 ORGANIZATIONAL BOUNDARIES	DECISION 4.2 OPERATIONAL BOUNDARIES	DECISION 4.3 BASE YEAR	DECISION 4.4 ACCOUNTING THRESHOLDS
California Climate Action Registry	Control (financial or operational), equity share, or both; participants must use the same approach each year	Scope 1 required Scope 2 (including purchased cooling, as well as electricity, heat, and steam) required Scope 3 optional	Base year: The first year for which emissions are reported; participants can also establish "baseline," a historic datum against which to measure emissions over time, as far back as 1990 Recalculation policy: Same as *Corporate Standard*, but also a shift in the location of an emission source (into or out of CA/US geographic boundary) Significance threshold: 10%	De minimis: 5% Materiality threshold: 5%
Canadian GHG Challenge Registry	Recommends control approach for operations that are majority-owned/ controlled; equity share for operations where there is significant influence but not control	Recommends including Scope 1, Scope 2, and significant Scope 3 sources	Base year: 1990 or earliest date where accurate data are available; single year preferred but average of multiple years acceptable Recalculation policy: Historic emissions should be recalculated in the event of changes in facility ownership, reduction project or offset ownership, inventory boundaries, and assumptions or methodologies Significance threshold: None specified	De minimis: None specified Materiality threshold: None specified
Chicago Climate Exchange	Equity share	Scope 1 required Scope 2 optional	Base year: For participants in the program's first phase (2003 – 2006), base year emissions are the average of 1998 – 2001 emissions; participants in the program's second phase (2007 – 2010) may choose either the 1998 – 2001 average or the single year 2000 Recalculation policy: Base year emissions must be adjusted to reflect facility acquisitions and sales; changes in calculation methodologies do not trigger base year recalculation unless approved by the CCX Executive Committee Significance threshold: None specified	De minimis: None specified, but activities estimated to release less than 5% of the participant's total direct emissions are optional Materiality threshold: None specified
Climate Leaders (United States)	Control, equity share, or both; participants must use the same approach each year for purposes of target tracking	Scope 1 required Scope 2 required Scope 3 optional, unless participant sets carbon-neutral target	Base year: Most recent year for which data is available after participant joins program; may also include other years back to 1990 but these are not considered base years Recalculation policy: As stated in *Corporate Standard,* plus "changes in status of leased assets" Significance threshold: Partners define their own threshold, which is reviewed and refined in consultation with U.S. EPA	De minimis: Sources can be excluded from the inventory only if it is justified that they represent an insignificant amount of the participant's total emissions and either (1) there is insufficient scientific understanding to develop a reliable method for estimating emissions, or (2) an estimation method exists but would require excessive cost to get data[1] Materiality threshold: Established by participant and verifier; subject to U.S. EPA approval
European Union Emission Trading Scheme	Not applicable[2]	Scope 1 required	Base year: Specific to each member state; shifting towards allocating allowances by means of benchmarking and auctioning Recalculation policy: Not applicable Significance threshold: Not applicable	De minimis: Thresholds of 1 kilotonne of CO_2 or 2% of total emissions and 5 kilotonnes or 10% of total emissions for de minimis must at least be estimated while "minor sources" which can be estimated or calculated using simplified methods. Materiality threshold: 5% for installations with emissions of less than 500 kilotonnes CO_2 per year, 2% for larger installations

TABLE 4.5 GHG Accounting Decisions in Selected GHG Programs (*continued)*

PROGRAM NAME	DECISION 4.1 ORGANIZATIONAL BOUNDARIES	DECISION 4.2 OPERATIONAL BOUNDARIES	DECISION 4.3 BASE YEAR	DECISION 4.4 ACCOUNTING THRESHOLDS
Greenhouse Challenge Plus (Australia)	Operational control recommended; reporters can apply for permission to use a different approach, and must disclose difference in emissions calculated by operational control and the alternate approach	Scope 1 required Scope 2 required Selected Scope 3 required	Base year: Earliest relevant point in time for which there is reliable data (most often the first year in the program) Recalculation policy: As stated in *Corporate Standard* Significance threshold: 10%	De minimis: None specified; where data are unavailable or estimates are uncertain this should be transparently documented and justified Materiality threshold: None defined; use as guide 5% or 100,000 tons CO_2-equivalent, but left to discretion of verifier
Greenhouse Gas Information System (South Korea)	Not applicable	Scope 1 required Scope 2 optional	Base year: None specified Recalculation policy: Not applicable Significance threshold: Not applicable	De minimis: None specified, but participants are permitted to exclude small or highly uncertain sources Materiality threshold: None specified
Mexico Greenhouse Gas Program	Control (financial or operational) or equity share permitted; operational control recommended	Scope 1 required Scope 2 required Scope 3 optional	Base year: Any year or series of years for which there is reliable data Recalculation policy: As stated in *Corporate Standard* Significance threshold: None specified	De minimis: None specified Materiality threshold: None specified
Philippine Greenhouse Gas Accounting & Reporting Program	Operational control	Scope 1 required Scope 2 required Scope 3 required for cement sector (imported clinker) and service sector (business travel and employee commuting); otherwise optional	Base year: Any year or series of years for which there is reliable data Recalculation policy: As stated in *Corporate Standard* Significance threshold: None specified	De minimis: None specified Materiality threshold: None specified
Regional Greenhouse Gas Initiative (Northeast United States)	Not applicable	Scope 1 required	Base year: Approximately 2000 – 2002 Recalculation policy: Not applicable Significance threshold: Not applicable	De minimis: Not applicable[3] Materiality threshold: None specified[4]
The Climate Registry[5] (North America)	Control approach (financial or operational) required; both control and equity share encouraged; disclosure of equity investments required for operations where there is equity ownership but not control	Scope 1 required Scope 2 required Scope 3 optional	Base year: Single year for which verifiable emission data are available; specify reasons for selecting that year Recalculation policy: As stated in *Corporate Standard* Significance threshold: 3%	De minimis: 3% Materiality threshold: 5%

1 In practice, this policy results in no *de minimis* sources, since U.S. EPA provides technical assistance to estimate smaller sources using simplified methodologies.

2 Since the EU Emission Trading Scheme, the Greenhouse Gas Information System, and the Regional Greenhouse Gas Initiative define the reporting entity at the facility level, organizational boundary consolidation does not apply. By the same logic, there is no need for a recalculation policy or significance threshold in the event of structural changes.

3 The Regional Greenhouse Gas Initiative only covers major electric generating sources, so *de minimis* is not applicable.

4 Data for the Regional Greenhouse Gas Initiative are reported through Continuous Emission Measurement Systems (CEMS) and are subject to electronic, field, targeted, and random audits.

5 These accounting decisions pertain to voluntary reporting under The Climate Registry.

available, due to confidentiality concerns. Table 4.4 lists the advantages and disadvantages of disaggregation options.

PUBLIC REPORTING

A related question is whether the program should make corporate emission data available to the public at the facility level. Some companies have expressed concerns that unit or facility disaggregation would require them to expose confidential information and place them at a competitive disadvantage. The program must decide whether to keep facility- or unit-level information confidential within the GHG program and aggregate the data to the corporate level for the purpose of public reporting, or to make facility-level data available to the public. The California Climate Action Registry aggregates facility-level data to the corporate level for purposes of public reporting, such that users of public data can only view entity-wide data. The draft specifications of The Climate Registry suggest making facility-level data public to enhance disclosure, transparency, and utility of reported data, but to allow companies to opt out of making facility data public in cases where confidentiality would be compromised.

REQUIRING ADDITIONAL ELEMENTS

In addition to the required and optional reporting elements listed in Box 4.3, program designers should consider whether there are additional reporting elements that make sense in light of their objectives, principles, and specifications. Some examples include the following:

- *List of* de minimis *sources:* This is relevant if the program specifies a *de minimis* threshold, as does The Climate Registry.
- *Information on equity holdings:* This may be relevant for programs that prescribe a control approach, but wish to elicit information on companies that may have significant risk exposure through their holdings in other companies, without creating the burden that all participants must report based on both the control and the equity share approach. The Climate Registry also has this requirement.
- *Information on performance metrics:* This is especially relevant for programs that incorporate GHG reduction targets or benchmarking.
- *Information on verification status:* This is relevant for those programs that require verification.

Notes

1. Unlike most regulatory emission trading programs, which assign allowances to the operators of individual facilities, the Chicago Climate Exchange measures emissions and assigns allowances at the corporate level. As such, the Chicago Climate Exchange has found it more appropriate to assign emissions and allowances based on corporate ownership shares of facilities rather than based on whether the company controls them.
2. Under Climate Leaders, Scope 3 reporting is optional and is not generally taken into account in setting corporate GHG reduction targets. However, companies that set a Climate Leaders goal to go "carbon neutral" are required to expand their operational boundaries to include at least one significant Scope 3 or otherwise optional source, such as employee commuting, employee business travel, product transport, or international operations.
3. Although national GHG inventories are prepared through a fundamentally different process than are corporate GHG inventories (the former uses a top-down approach based on fuel and material imports and exports, whereas the latter uses a bottom-up approach based on corporate activity data), some government officials have pointed out that given sufficient participation in corporate GHG reporting programs by companies from key sectors, corporate emissions data could provide a valuable cross-check on certain elements of national GHG inventories. This has not been tested in practice, but it is worth considering in the design of national GHG programs.

Inventory Quality Management 5

The credibility and utility of a GHG program depend heavily on the adherence of the information it collects to the commonly accepted GHG accounting principles of relevance, completeness, consistency, transparency, and accuracy. Program designers need to develop an approach to inventory quality management that balances their program objectives with available resources. To date, GHG programs have developed and adopted a range of quality management tools, including inventory management plans, direct technical assistance, desktop reviews, site visits, and verification, each of which can be used in isolation or as part of a quality management portfolio. This chapter presents a framework for evaluating inventory quality, explains program-level options for inventory quality management, and discusses those approaches in light of costs and benefits to the program and its participants. The key decision in this chapter is:

5.1 Which inventory quality management methods should be adopted by the program?

Decision 5.1 Inventory Quality Management Methods

ELEMENTS OF INVENTORY QUALITY

Inventory quality relates to four principal elements of GHG inventory development: methods, data, inventory processes and systems, and documentation. Methods comprise the technical aspects of inventory preparation, such as emission calculations. Data are basic pieces of information on activity levels, emission factors, and operations. Inventory processes and systems refer to the institutional, managerial, and technical procedures for inventory preparation. Finally, documentation refers to the record of methods, data, processes, systems, assumptions and estimates used to prepare an inventory.

To manage inventory quality at the program level, a program can implement processes – such as technical assistance and inventory management plans – that encourage companies to address these elements at the front end of the inventory development process, and/or undertake activities such as desktop reviews, site visits, and verification that evaluate after the fact how effectively companies have addressed these elements in developing their inventories.

TECHNICAL ASSISTANCE

One quality management option for GHG programs is to provide participants with direct technical assistance in preparing their GHG inventories, inventory management plans, and/or data management and collection systems. Technical assistance can be provided by program staff, or by experts contracted by the program. Components of technical assistance might include assessing existing data and data collection systems to identify gaps; proposing additional data collection activities; identifying GHG sources, facilities, and calculation methodologies (including emission factors and global warming potentials); and determining whether base year adjustments are necessary.

INVENTORY MANAGEMENT PLANS

An inventory management plan (IMP) is a document to help reporting companies institutionalize the completion of high-quality annual GHG inventories. An IMP provides a template for inventory developers to think through their inventory methodology and to avoid common pitfalls related to the establishment of inventory boundary conditions, emission quantification, data management, base year establishment and recalculation, management issues, and review and verification. IMPs are typically developed by the reporting company as they develop their initial GHG inventory report, and are updated to reflect changes in the inventory development process.

A typical IMP includes the following sections, which can be customized to suit program needs:

- *Participant information:* Company name, address, contact information, and GHG management objectives
- *Boundary conditions:* Organizational and operational boundary descriptions
- *Emission quantification:* Quantification methodologies and emission factors
- *Data management:* Data sources, collection processes, and quality assurance
- *Base year:* Policy on base year adjustments for structural and methodological changes
- *Management tools:* Roles and responsibilities, training, and file maintenance
- *Auditing and verification:* Auditing, management review, and corrective action

The Climate Leaders program pioneered the IMP concept, which it uses in combination with direct technical assistance, desktop reviews and site visits conducted by program staff or consultants contracted by the program to assess the quality of its participants' GHG reports (see Box 5.1). PhilGARP has also adopted the IMP approach, which it uses in combination with desktop reviews conducted by its program staff. Neither Climate Leaders nor PhilGARP requires third-party verification, although a few participants do pursue it.

DESKTOP REVIEWS

A desktop review consists of studying a participant's GHG inventory along with relevant supporting information such as an IMP, activity data, and emission factors, and can be conducted by program staff, contractors retained by the program, or, when done as part of a verification, by the verifier. Depending on the depth of the information reviewed, a desktop review can help determine whether all of the program requirements have been reported, whether inventory boundaries have been set correctly, whether any base year adjustments are necessary, and whether the correct calculation methodologies have been applied.

BOX 5.1 Quality Assurance in the Climate Leaders Program

Climate Leaders was launched by the U.S. Environmental Protection Agency (EPA) in 2002 as an industry-government partnership that works with companies to develop and implement long-term climate change strategies. The partnership involves three components central to a robust GHG management strategy:

- Inventory corporate emissions based on Climate Leaders GHG Inventory Guidance, which expands on the *Corporate Standard* to define how participants should account for and report their GHG emissions
- Develop an IMP that describes the process for completing and maintaining a high-quality, corporate-wide inventory
- Set a forward-looking, aggressive GHG reduction target

Climate Leaders' approach to inventory quality management involves hands-on technical assistance, a detailed IMP, and a desktop and onsite review process. EPA provides significant technical assistance in developing the inventory and IMP, and works closely with each company in the program to review them and to provide guidance in setting an aggressive GHG reduction target. In addition, EPA performs detailed desktop reviews of both the inventory data and IMP, and conducts a risk-based on-site IMP review, to ensure the data and IMP meet EPA's quality standards. The specific components of EPA technical assistance are as follows:

- Up to 80 hours of direct technical assistance to participating companies in developing the initial inventory and IMP, including: 1) a kick-off call to identify data collection and management systems already in place and any gaps in current data collection activities; and 2) detailed technical follow-up and guidance on what additional data gathering activities would be valuable and where smaller sources might be estimated using simplified methodologies;
- Desktop inventory data review to evaluate whether all sources and facilities specified in the IMP are included, year-to-year consistency, baseline adjustments, calculation methodologies (including emission factors and global warming potentials), and sufficiency of inventory to evaluate progress towards a GHG reduction goal;
- Desktop IMP review to determine consistency with the *Corporate Standard* and Climate Leaders guidance on organizational and operational boundaries, emission quantification, data management, base year adjustments, management tools, and auditing/verification; and
- On-site IMP implementation review to ensure consistency of facility-level data collection, management, and reporting practices with corporate-level policies detailed in the IMP.

While these reviews do not generally reflect the level of detail examined in a full third-party verification conducted to a high level of rigor, they provide reasonable assurance to EPA that a well-implemented GHG data collection and management system is in place that is sufficient to track and evaluate progress towards a voluntary GHG reduction target.

Desktop reviews can be conducted on corporate-level data, facility-level data, and IMPs. A desktop review of corporate-level data might address the following questions:

- Are all emission source types within operational boundaries included?
- Are all significant differences in annual emission profiles explained?
- If structural or methodological changes are reported, do changes appear to be reflected in adjustments to base year emissions? Do changes appear to be consistent with changes in the annual inventory from the previous year's inventory?
- Are emissions of each GHG correctly converted to CO_2-equivalent?
- Are thorough descriptions of data collection, management, and review processes included?
- Does the inventory provide adequate data to track progress towards a reduction target (if applicable)?

A desktop review of facility-level data can address questions such as the following:

- Are all facilities included?
- Are emission source types at each facility consistent?
- Do emission totals appear consistent between facilities based on the magnitude and type of operations?
- Are calculations correctly completed for each emission type in each facility?
- Is the correct type of activity data used?
- Do facility subtotals sum to corporate totals?

A desktop review of an IMP in combination with corporate-level data can address issues related to boundary conditions, emission quantification, data management, base year, management tools, and auditing and verification in considerable depth and detail. US EPA (2005) provides detailed guidance on conducting desktop reviews of IMPs.

Even when resources or program design do not permit an in-depth review of corporate- and facility-level inventory data (as in PhilGARP), or when the program does not include an IMP (as in the Mexico GHG Program), a desktop review of a corporate-level GHG inventory report alone almost always identifies errors, exclusions, and areas for improvement.

SITE VISITS

The goal of a site visit is to establish confidence in the data reported to the program, as well as to identify opportunities to improve participants' GHG accounting and reporting procedures. A site visit might consist of meeting with key personnel on-site, sampling data, tracking data through the data management system, and checking calculations. Like desktop reviews, site visits can be conducted by program staff, contractors retained by the program, or, when done as part of a verification process, by the verifier.

It is helpful to select facilities for site visits with an eye towards risk and potential benefits to the participant. The ideal site visit candidate is a large emitter, has many of the participant's largest emission types, and represents its most common business activities, data management systems, and environment or quality management systems (USEPA 2005). Barbour (2005) provides detailed guidance on how to select facilities for site visits by analyzing the types of emission sources and management systems present within a company as well as the degree of homogeneity between facilities.

When site visits are conducted at the right facilities, and used in combination with an IMP and a thorough facility-level desktop review, they can provide a level of inventory quality assurance that is adequate for many applications.

VERIFICATION

Verification refers to the objective assessment of the accuracy and completeness of reported GHG information and of the conformity of this information to pre-established principles or standards such as the *Corporate Standard* or ISO 14064-1. It involves evaluating the risk of a material discrepancy in a participating company's GHG information and reporting process. A material discrepancy is an error (for example, from oversight, omission, or miscalculation) that results in a reported quantity or statement being significantly different from its true value or meaning. In the context of a GHG program, at what point a discrepancy becomes material depends on any materiality threshold the program has defined (see Decision 4.4).

Verification can be performed to varying degrees of rigor. Table 5.1 outlines three tiers of verification and suggests appropriate components and uses of each. These tiers are not rigid distinctions, but provide a framework that can help program designers think through the degree of assurance their quality control measures need to provide, and what types of activities can achieve it.

Programs that incorporate verification typically develop verification protocols that define the scope and frequency of verification, establish the materiality threshold, and clarify other aspects of the verification process, such as who is eligible to serve as a verifier. Programs may also choose to accredit specific verification firms or individuals according to their eligibility requirements. This can help minimize the risk of conflicts of interest and ensure that verifiers have the necessary technical expertise.

At its most rigorous, third-party verification establishes a level of credibility and assurance of information reported to a GHG program that the other quality management tools, used in isolation, cannot achieve. However, this can come at a relatively high cost and administrative burden. Box 5.2

TABLE 5.1 Notional Tiers of Verification

	TIER I	TIER II	TIER III
Relative level of assurance	• Low	• Intermediate	• High
Typical verification activities	• Desktop review	• Desktop review • Phone interviews • One or more site visits	• Desktop review • Phone interviews • Data system reviews • Facility visits
Typical uses supported	• Basic reporting; voluntary efforts with no expectation of baseline protection or GHG trading	• Basic reporting, including reporting to external stakeholders or reporting on voluntary reduction target commitments	• Demonstrating regulatory compliance • GHG trading

Adapted from Barbour (2005)

describes an innovative approach developed by the California Climate Action Registry to reduce the transaction costs of verifying inventories from non-GHG-intensive participants. Table 5.2 outlines the relative strengths and weaknesses of various inventory quality tools.

CONSIDERATIONS IN DEVELOPING AN APPROACH TO INVENTORY QUALITY MANAGEMENT

Building an appropriate portfolio of quality management tools depends on the goals and objectives of the GHG program, and the services that the program aims to provide to its participants and other stakeholders. For example, a program that plans to offer any of the following services may need to consider incorporating more intensive quality control measures, such as Tier II or III verification or comprehensive desktop and on-site reviews of corporate- and facility-level data:

Business education: A more comprehensive review, or detailed technical assistance, will provide more extensive information to companies regarding their inventories, which can be especially useful during the first year of participation, while data management systems are being developed.

Links with other registries: If a GHG program is intended to link to and recognize the data from other programs, program designers will need to consider a quality management system that can ensure that data collected under each program are of comparable quality.

Base year protection: To credibly promote base year protection for its participants, a GHG program will need to provide a very high level of assurance as to the quality of reported data.

BOX 5.2 Batch Certification in the California Climate Action Registry

The California Climate Action Registry (CCAR) requires third-party verification of certain elements of its participants' GHG inventories. Recognizing that the transaction costs of verification can be quite high, especially for smaller organizations, CCAR developed a batch certification (verification) process for its participants with relatively limited GHG emissions. Batch certification is available for participants with:

- Less than 200 metric tons of CO_2-equivalent emissions per year
- One or more of the following:
  - Indirect emissions from electricity consumption
  - Direct emissions from stationary combustion for heating or cooling
  - Direct emissions from passenger vehicles
- No process or fugitive emissions

Each year, CCAR waits until a sufficient number of eligible participants have expressed interest in participating in the batch certification, and then solicits bids for batch certification services from pre-approved certifiers. After selecting a batch certifier, CCAR works with the certifier to develop a standard contract for the certifier and each participant to sign, and to identify and collect the supporting documentation for certification. The certifier then completes the certification activities, which typically consist of desktop reviews and phone conversations but not site visits, and then prepares a certification report and opinion for each participant, discusses them with the participants, and completes the certification via CARROT, CCAR's registry software.

By standardizing the contract language and other elements of the certification process, CCAR is able to reduce the transaction costs of certification for small, office-based organizations.

Source: CCAR 2003.

Emission trading: In order to trade GHG allowances with other systems, data must be transparent and verifiable.

Programs that are focused on maximizing participation in voluntary GHG accounting and management initiatives may wish to minimize the burden to participants, leaving more comprehensive quality measures as an option for those participants for whom it is worth the cost.

In addition to the quality management approaches outlined above, quantification protocols and reporting platforms also play a role in inventory management. By creating a tiered quantification system, for example, which incorporates multiple quantification approaches with ascending levels of accuracy, GHG programs can make the accuracy of a given approach more transparent, helping participants evaluate their current relative accuracy and identify ways to improve. For stationary sources, Continuous Emission Monitoring Systems (CEMS), combined with automated reporting and clear guidance for estimating any missing

TABLE 5.2 Advantages and Disadvantages of Inventory Quality Tools

QUALITY MANAGEMENT APPROACH	ADVANTAGES	DISADVANTAGES
Direct Technical Assistance	• Helps participants establish a sound inventory process and avoid common errors • Provides technical capacity on GHG accounting, calculation, and reporting • Promotes consistency between participants	• Requires substantial program resources • Cannot attest to the accuracy of reported information
Inventory Management Plan	• Helps participants think through inventory process and avoid common errors • Helps participants institutionalize inventory preparation and maintenance process • Helps participants prepare for third-party verification and site visits • Provides a valuable complement to a desktop review of inventory data	• Cannot attest to the accuracy of reported information • Does not (on its own) provide external perspective on how to improve the inventory process
Desktop Review	• Can help determine whether all of the requirements have been adequately reported, whether inventory boundaries have been set correctly, whether any base year adjustments seem necessary, and whether the correct calculation methodologies have been applied • Can identify areas for improvement in quantifying and reporting emissions • Provides external perspective on inventory quality	• Does not (on its own) provide as high a level of assurance as a process that includes site visits in addition to desktop reviews • Can impose (usually minor) costs to participant or program (whomever compensates the reviewer)
Site Visit	• Provides a physical check on issues related to boundary conditions, emission quantification, data management, base year, management tools, and auditing and verification • Can identify areas for improvement in quantifying and reporting emissions • Risk-based site reviews can provide a degree of external assurance that a well-implemented GHG data collection and management system is in place	• Can impose more significant costs to participant or program (whomever compensates the site visitor) than a desktop review • Does not necessarily provide as detailed an examination of inventory management as does a rigorous form of third-party verification
Verification	• Provides feedback to participants, especially during their first year of GHG reporting, on managing data collection and inventory quality and on clarifying the procedures for presenting complete and sufficient data • Can establish a high level of quality assurance, when conducted to a high level of rigor • Can enhance the credibility of reported data with stakeholders without requiring that participants reveal their data inputs and methodologies	• Can impose a high cost to participant or program (whomever compensates the verifier), especially during the first year when verifiers must not only review data, but also review data collection and storage procedures, assess uncertainty risks, and make recommendations for improvement • Can create administrative burden for program, if verification protocols, accreditation measures, and reporting systems are included

data conservatively, can provide a high level of assurance. Likewise, a reporting platform that incorporates data entry, calculation, and storage can contribute to quality by reducing the possibility of transcription errors and ensuring data security (see Chapter 6).

6 Processes for Design, Implementation, and Review

In order to arrive at the decisions described in Chapters 2 through 5, it is helpful to develop and implement a systematic and inclusive process to solicit input from stakeholders and to carry out a pilot phase consisting of program design, implementation, and review. The involvement and buy-in of a wide range of actors is critical for the success of a GHG program – especially one in which participation is voluntary. This chapter describes a framework for engaging stakeholders in program design, implementation, and review, based on the experience of WRI, WBCSD, and their partners. These practices are meant as a guide; program designers may tailor these steps depending on the local context and program objectives. Box 6.1 describes how stakeholder input resulted in a customized approach to meet China's needs.

A stakeholder engagement process should underpin all phases of a GHG program. Described at the beginning of this chapter, the stakeholder process provides critical input during the pilot phase of program design, implementation, and review (see Figure 6.1). The design, implementation, and review phases, in turn, comprise eight steps that incorporate stakeholder input to carry out a successful program, as follows:

Phase I: Program Design

6.1 Establishing partnerships

6.2 Identifying program objectives and principles

6.3 Developing program structure and specifications

Phase II: Program Implementation

6.4 Building local capacity

6.5 Recruiting and training business participants

6.6 Collecting, reviewing, and publishing inventories

Phase III: Program Review

6.7 Conducting a structured feedback process

6.8 Identifying next steps

Developing and Implementing a Stakeholder Process

Gaining stakeholder input through an inclusive process ensures that the program will reflect a comprehensive range of interests and objectives to best secure maximum acceptability from the participants in addition to business, environment, community, and government agents who all have a stake in the program.

WHAT IS THE STAKEHOLDER PROCESS?

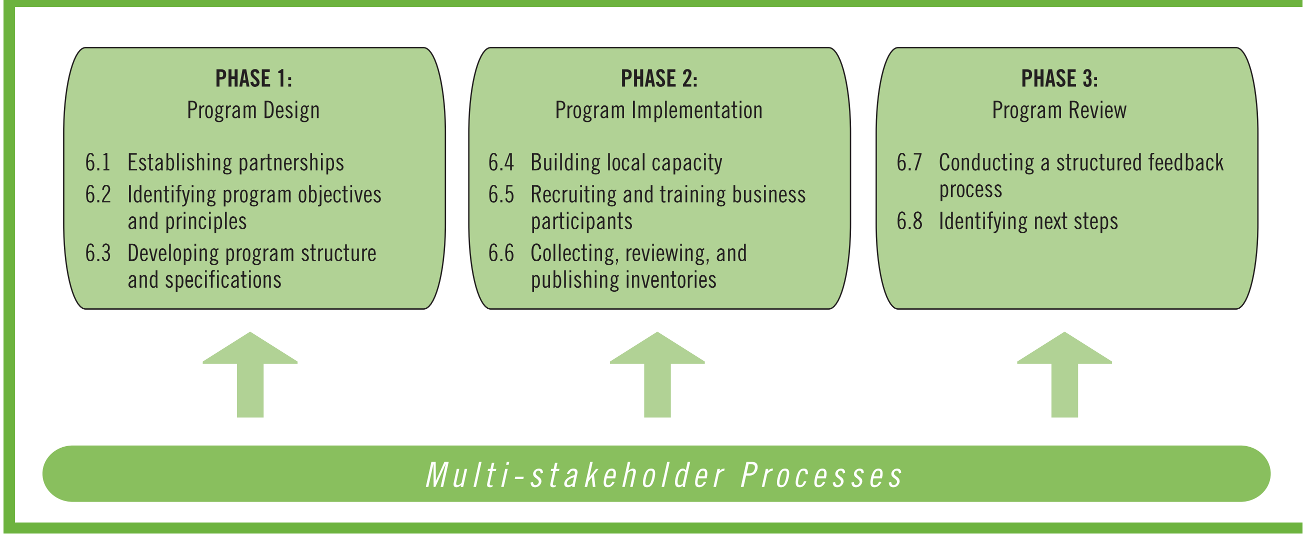
The stakeholder process is the organization of an open, transparent, and inclusive approach that engages multiple parties in the design, implementation, and review of a GHG

BOX 6.1 "Energy Conservation is GHG Emission Reduction" — Adapting a GHG Program to Suit Local Sustainable Development Goals in China

While a number of countries, regions, states, and provinces around the world have successfully pursued the development of accounting and reporting programs that focus exclusively on climate change and GHG management, China is following a different trajectory based on its national development priorities. Between 1980 and 2000, China experienced an unprecedented four-fold growth in GDP while only doubling energy use. To continue decoupling energy consumption and GDP, the Chinese government in 2000 announced ambitious energy intensity reduction targets of 20 percent by 2010 as part of the 11th 5-Year Plan. These goals place intense pressure on energy-intensive industries to increase productivity while decreasing energy use. Additionally, climate change has historically been a politically sensitive issue in China, as China is a non-Annex I country under the Kyoto Protocol (meaning it does not have limits on GHG emissions) despite being one of the world's largest GHG emitters. In this context, the challenge to convince Chinese enterprises of the value of GHG measurement and management became apparent during the initial scoping and partnership-building phase in December 2006.

Taking Chinese development goals and the political sensitivity surrounding climate change into consideration, WRI and WBCSD worked with the China Business Council for Sustainable Development (CBCSD), the local affiliate of the WBCSD, to design a program that factors in both energy conservation and GHG management to be attractive and practical for Chinese businesses. The program links energy conservation with GHG emission reductions under the motto "energy conservation is GHG emission reduction" (*jie neng shi jian pai),* coined by the CBCSD. The program strategy is built upon the basis that to meet energy reduction goals, enterprises will have to gather much of the same information that can then be used to measure GHG emissions. By developing GHG inventories as well as energy inventories, companies can gain additional understanding of their GHG-related risks and opportunities at little additional cost. Launched in June 2007, the China Energy and GHG Management Program was well received by an audience of government, multinational and national businesses, and other stakeholders. The launch coincided with the Chinese government's release of a National Strategy on Climate Change only days earlier. The program is being executed in two phases that target the most energy- and GHG-intensive industries in China: the cement, oil and gas, petrochemical, chemical, power generation, and iron and steel sectors. The first phase of the program aims to customize GHG calculation tools to Chinese conditions in each of the identified sectors and then to establish those tools and protocols as national standards. The second phase seeks to assist businesses in developing solutions to reduce energy consumption and GHG emissions.

FIGURE 6.1 The Stakeholder Process: A Basis for Program Design, Implementation, and Review



program. It has become the foundation upon which the GHG Protocol's standards, protocols, calculation tools, and accounting and reporting programs have been created and implemented throughout the world. If the stakeholder process is successful, the GHG program will reflect a number of positive outcomes, including:

- *Legitimacy among local and global agents:* Including multiple perspectives from key stakeholders will ensure that the GHG program is credible both locally and internationally. If stakeholders feel that a GHG program has undergone a thorough, visible, and comprehensive design process, the resulting program will have greater standing as a legitimate mechanism for responding to climate change. The stakeholder process ensures that actors with a vested interest in the GHG program have a voice in the program design, which increases the likelihood that the parties with the greatest impact on global climate within the program region will participate and develop GHG management and mitigation strategies. Undergoing the stakeholder process in the early design phases of the program adds long-term value to the GHG program for the partners and participants.

- *Customization to local needs and conditions:* One of the greatest advantages in using a stakeholder process to design a GHG program is the ability to fine-tune and tailor the model described in this guide to suit the program objectives and local context. As factors such as development goals, environmental and socioeconomic conditions all influence the needs and opportunities of a particular program, these differences should be accounted for in the program's design. The stakeholder process convenes diverse agents from a broad range of viewpoints to distill how these priorities and challenges might be best addressed in the development of the GHG program.
- *A sense of ownership:* Planning a GHG program through a stakeholder process imparts a strong sense of ownership to the parties involved. If significant priority is placed on soliciting and incorporating stakeholder input, the partners and eventual reporting entities will perceive that the program more accurately manifests their perspectives and motivations. A voluntary GHG program, in particular, cannot achieve its objectives without this sense of ownership on the part of the program partners and the willing participation of reporting businesses and organizations. The sense of ownership fostered throughout the stakeholder design process also helps guarantee the longevity of the program, as partners are more likely to invest long-term in the success of the GHG program if their sense of ownership is cultivated from the outset.

WHO ARE THE STAKEHOLDERS?

In the design of a GHG program or registry, there are three main groups of stakeholders (described further in Table 6.1) whose input and buy-in are critical:

- *Reporting businesses, corporations, and organizations:* These are the organizations that the GHG program targets as prospective program participants. Without the buy-in of the actual reporting organizations at the senior level, a voluntary GHG program would not be able to produce a critical mass of companies to participate.
- *Government:* Agencies such as the departments of environment, energy, or natural resources may be valuable stakeholders to engage, whether as program partners or as advisors in the design of a GHG program. While government agencies can play a very constructive role in developing and implementing GHG programs, in some cases, there is sensitivity surrounding government involvement. Some industrial stakeholders, in particular, may fear that a government-run voluntary accounting and reporting program will eventually lead to GHG

TABLE 6.1 Prospective Stakeholder Groups

STAKEHOLDER GROUP	STAKEHOLDER SUB-GROUPS	EXAMPLES
Industry and Potential Participants	Individual companies and sector-specific industry associations from GHG-intensive industrial sectors such as the power, cement, oil and gas, iron and steel, and aluminum sectors	Confederation of Industrial Chambers (CONCAMIN, Mexico), National Chamber of the Iron and Steel Industry (CANACERO, Mexico)
	Less GHG-intensive entities, which may also be keen to participate in order to become more familiar with GHG management or to "walk the talk" if environmental stewardship is part of their mission	Financial institutions, consulting groups
	Industry associations with a particular focus on sustainable development	Brazilian Business Council for Sustainable Development (CEBDS), China Business Council for Sustainable Development (CBCSD), Commission of Private Sector Studies for Sustainable Development (CESPEDES, Mexico), Confederation of Indian Industry (CII), Philippine Business for the Environment (PBE), WBCSD
Government Agencies	Environmental agencies	Secretariat of Environment and Natural Resources (SEMARNAT, Mexico) Environmental Protection Agency (EPA, United States), Department of Environment and Natural Resources (DENR, Philippines)
	Energy agencies	Department of Energy (DoE, Philippines)
	State and municipal agencies	Federal Secretariat of Environment of the Government of the State of Mexico, Central Municipal Government (Mexico)
Environmental Groups and Non-Government Organizations	Environmental groups with technical expertise and/or widespread public recognition and legitimacy	Fundação Getúlio Vargas (Brazil), klima Climate Change Center of the Manila Observatory (Philippines), The Energy and Resources Institute (TERI, India), WRI
Development and Aid Agencies	Bilateral agencies	Department for Environment, Food, and Rural Affairs (Defra, UK); GTZ (Germany); United States Agency for International Development (USAID)
	Multi-lateral agencies	United Nations Development Program (UNDP), the World Bank
Other Experts	Representatives from think tanks, national labs, research and development institutes	University of São Paulo (Brazil), National Institute of Ecology (INE, Mexico)

regulation, which they may oppose. On the other hand, government involvement can also create a sense of legitimacy surrounding the program. Regardless, it is critical to engage government stakeholders in some manner to preclude official opposition to the creation of a GHG program and to prevent any duplication of efforts that may be occurring in parallel.

- *Environmental organizations:* Environmental organizations and non-governmental organizations (NGOs) are natural allies in the creation of a GHG program. Furthermore, they will often have the technical capacity to act as an implementing agency for the GHG program. Environmental organizations and NGOs can also have connections to individuals or agencies within the government or private sector that could prove to be useful in establishing relationships with these other stakeholder groups. Additionally, environmental groups can help attract a critical mass of public support for a GHG program, which will improve the public image and acceptability of such an initiative.
- *Other experts:* Other experts typically include those with technical knowledge of GHG- or energy-related issues, environmental reporting, or related environmental programs, and might represent academic institutions, research groups, think tanks, or national laboratories.

Phase I Program Design

6.1. ESTABLISHING PARTNERSHIPS

While some GHG programs are implemented by a single group, such as a government agency, others are implemented by a consortium of organizations, which may include both public and private actors. The groups that implement the GHG program are the program partners, and it is critical to create strong partnerships that will support a nascent GHG program until it has taken root. Although program partners can mutually agree to initiate a stakeholder process to embark on the design of a GHG program, partnership building often begins as a series of informal discussions between organizations, agencies, and/or prospective funders interested in forming a GHG program. In many cases, these discussions will lead to the formation of a subset of groups that will become the program partners – those who host, coordinate, and implement the stakeholder process and eventually the GHG program. After the initial discussions have begun to identify common goals and objectives, and to clarify each organization's role, the groups may wish to formalize their partnership in a memorandum of understanding (MOU). An official statement such as an MOU provides the opportunity to delineate the responsibilities and expectations of each partner. Program partners may be selected based on criteria such as their ability to:

- Enhance the program's credibility among stakeholders;
- Provide technical expertise;
- Facilitate business participation; and
- Engage in future phases of the program (such as GHG reduction target setting or GHG trading).

6.2. IDENTIFYING AND SECURING CONSENSUS ON OBJECTIVES AND PRINCIPLES

As described in Chapter 2, the program objectives and principles will inform a series of decisions on program structure, technical specifications, and program implementation and operation. It is important to begin considering these objectives and principles early in the stakeholder process – preferably during the initial conversations between prospective program partners – and to seek feedback on them from stakeholders. Prospective GHG program designers should look toward the principles and objectives other GHG programs and registries have adopted based on the considerations elaborated in Chapter 2.

Additionally, program partners should carefully consider the local conditions and priorities within their respective national contexts to include other factors that may shape program aims and underlying tenets. The stakeholder process can be a valuable method of determining whether program partners have identified the right program objectives and principles. The program partners should draft objectives and principles and present them to stakeholders for feedback, for example, at a stakeholder forum as described in Box 6.2. Alternatively, they may use the discussions from such a forum to inform their draft objectives and principles, and then present them to a smaller subgroup of stakeholders for feedback. Either way, it is important to reach agreement on these key points before finalizing the operational rules and program specifications.

6.3. DESIGNING THE PROGRAM STRUCTURE, SPECIFICATIONS, AND QUALITY MANAGEMENT APPROACH

As described in Chapters 3, 4, and 5, program designers will need to reach a decision on several issues related to program structure, specifications, and the approach to quality management. Because of the highly technical nature of some of these decisions, they may require greater acquaintance with GHG accounting concepts and methodologies than can be imparted during a large stakeholder forum. Therefore, the program partners and a subset of stakeholders will need to acquire a strong familiarity with these issues, either by participating in a formal training program or by researching the issues on their own, using publications from the GHG Protocol and other initiatives as a guide.

It is helpful to conduct a workshop for all of the program partners and a small group of important stakeholders to bring them up to speed on accounting and reporting issues, and to make preliminary decisions regarding program structure and program specifications at the end of the workshop. It can also be helpful to build in a pilot phase of approximately one year for the program, and to agree that the structure and specifications will apply during the pilot

BOX 6.2 Conducting a Stakeholder Forum

A stakeholder forum is a highly effective and efficient means of convening targeted key groups and sectors to collect input for the design of a GHG program. Bringing together stakeholders in a single venue allows for open discussion and the exchange of ideas among parties that may not otherwise communicate directly. It also has the advantage of drawing to the surface issues for consideration that may have been overlooked by program partners. Furthermore, a stakeholder forum initiates dialogue on GHG measurement and management, placing these topics into the public domain and perhaps paving a smoother path for implementation. A forum typically includes presentations from the various stakeholder groups to include as broad a range of relevant perspectives as possible in the discussion of designing a GHG program. Additionally, the organizers may decide to present a preliminary framework of the GHG program for the audience's consideration and discussion. While the structure of the forum can vary depending upon the availability of speakers and participants, a stakeholder forum typically consists of the following:

- *High-level keynote addresses from representative government, business, or environmental organizations:* These are usually respected or reputable leaders in climate change who will act as "champions" for the creation of a GHG program.
- *Presentations from various stakeholders:* This could include sharing of experiences in GHG management or climate change from the different stakeholder groups, drawing upon industry or international best practices and lessons learned.
- *Introduction of the GHG program framework based on the GHG Protocol:* As a stakeholder forum is meant to gain input regarding the design of the program, it has been the experience of WRI, WBCSD, and their partners that presenting the proposed structure of the GHG program as a preliminary framework allows for stakeholders to feel more involved in the process, rather than as passive recipients of a predetermined model.
- *Open discussion:* Whether time is allotted for discussion after each presentation or reserved at the end of the forum, it is a crucial element that should not be overlooked in the planning process. A moderated panel format with an engaging, personable facilitator aids in discussion, especially in circumstances or cultural contexts where audiences may be reticent to openly share ideas.

phase, after which they may be re-evaluated based on the experience of the program partners, program participants, and other stakeholders. Box 6.3 describes the development of a technical working group designed to assist PhilGARP with decisions on program structure, specifications, and quality management.

BOX 6.3 PhilGARP Technical Working Group

To design the program specifications of the PhilGARP, the partners established a Technical Working Group to solicit expert input to decide whether guidance or requirements should be created regarding the technical options. The working group consists of professionals from the various sectors represented in the GHG program. They include engineers, environment, health and safety (EHS) managers from GHG-intensive sectors such as the cement and oil and gas sectors, and technical experts from various industry associations. They assisted the program partners in determining what operational rules should be instituted as additional requirements for reporting entities, such as mandating the control approach to consolidating organizational boundaries, requiring the reporting of relevant Scope 3 emissions (e.g. clinker inputs for the cement companies), among other clarifications. Additionally, the group serves as a support body for the program, providing continuous technical backing in training workshops, tool customization processes, and support for participating companies.

Phase II Program Implementation

6.4. BUILDING PROGRAM CAPACITY

Fostering the technical and institutional capacity to support program implementation is an imperative process for a GHG program. Typically, capacity building consists of founding a program office, developing technical expertise, and establishing a GHG reporting platform:

- *Founding a program office:* To centralize local capacity, a program office with expert staff trained in GHG accounting and reporting is a highly effective means of ensuring a reliable locus of support for companies participating in a GHG program. In the case of the Mexico GHG Program, a local office was created at SEMARNAT (the environmental secretariat) and staffed by a contracted individual who oversaw the implementation of the pilot phase of the program. Since the transition of the Mexico GHG Program from pilot to permanent status, SEMARNAT has incorporated the program management functions into the roles of full-time staff.
- *Developing technical expertise:* Program partners must have a strong working knowledge of the GHG Protocol's standards and calculation tools to train and assist businesses in the development of their inventories. A unique approach to local capacity building was trialed in the PhilGARP. Using a "training of trainers" model, representatives from various industrial sectors and associations were invited to participate in a program training corps. WRI then conducted a training-of-trainers workshop to create capacity within the core group of approximately 15 individuals. The training corps proved to be a beneficial resource in recruiting business to be members of the pilot group and also in training the

pilot participants on the GHG Protocol's standards and tools, providing continuous technical support to the local program partners, and training individuals within their own companies and others.

- *Establishing a GHG reporting platform:* GHG programs need a means to collect, store, and publish the corporate GHG inventories submitted to them. While some programs, particularly in their early stages, simply require participants to submit their inventories in PDF format and then (in programs with a public reporting component) make the reports available for download on a program website, a web-based GHG reporting software can integrate calculation, reporting, and database functions into one system with a user-friendly format. Prior to or in conjunction with the business recruitment and training process, GHG program designers should investigate GHG reporting platform options to determine which are consistent with their goals and objectives and can support their reporting specifications. Box 6.4 outlines some of the GHG reporting software options available to GHG programs.

6.5. RECRUITING AND TRAINING PARTICIPANTS

Recruiting and training a core group of companies to participate in a GHG program is a critical process in program development. It is helpful to identify a group of companies that will commit to joining the program during an initial pilot phase, testing the program specifications and reporting platform, and providing feedback on the program through a structured review process. There are two basic models for establishing the initial business group. The first is to open the group to 15 to 20 companies of various sizes and sectors, as has been done in Mexico and the Philippines. Casting a wide net can draw in a greater variety of participants, lead to a greater number of completed GHG inventories, and identify specific sectors where further attention is needed, for example with respect to the customization of quantification protocols. The second is to work with smaller, sector-specific groups to test and refine quantification protocols on a sector-by-sector basis before scaling up, as is being done in China. This approach allows for more hands-on, individualized guidance for participating companies, and can provide more in-depth feedback to the program. In either case, business recruitment can be facilitated by a national or sector-specific business association. While more executives are becoming aware of the value of GHG accounting and reporting, program designers may need to convince prospective participants of the value of joining a GHG program. The materials listed under *Making the Business Case* in the Resources section of this guide may be useful in this process.

Program designers should clarify the objectives and expectations with respect to companies' participation in the program by way of a contract, letter of intent, or terms of reference signed between the business participant and the program partners. While this does not have to be a formal

BOX 6.4 GHG Reporting Software Options

GHG program designers should consider developing or adopting a state-of-the-art, user-friendly reporting tool that can meet a range of current and prospective future needs, including collecting and storing emission data at the source, unit, facility, business unit and/or entity level, and aggregating or disaggregating data according to different geographical boundaries, including city, state, region, country, and global. In addition to serving the emission tracking functions identified above, the following capabilities will also ensure that the software serves as an effective GHG management tool:

- Collecting and storing data about discrete GHG emission reduction projects and reduction activities
- Providing a platform for participants to record and manage their emission data
- Permitting participants with independent emission calculation systems to report emission data without using any integrated calculation tools
- Serving as an interface with GHG transaction or trading programs
- Preserving data integrity in a secure environment
- Accommodating reporters in major industry sectors
- Tracking carbon intensity or performance metrics that allow comparisons across companies and across facilities
- Tracking changes in emission performance over time at a facility or entity level
- Tracking progress towards emission performance goals over time at a facility or entity level
- Permitting reporters to highlight information about their respective GHG management programs, goals, and projects
- Hosting documents (.pdf, .ppt, .doc, .xls) that provide additional information, attestations, or accounting methods relating to a reporter's GHG inventory
- Serving as a platform to support third-party review of GHG emissions inventories by independent verifiers, the GHG program, or the public

Two examples of GHG reporting software have been developed by the California Climate Action Registry, which provides the Climate Action Registry Online Reporting Tool (CARROT), and the former Eastern Climate Registry, which partnered with the U.S. Environmental Protection Agency to create the online Calculation, Reporting, and Verification Tool (CRAVe). CARROT is a web-based reporting program into which reporters enter GHG emission data, and the system automatically generates a report in .pdf format. CRAVe allows reporters to enter GHG emission data from multiple facilities across a range of sectors, which are then consolidated to provide facility-level and corporate-level aggregated reports. At the time of publication, WRI was working to customize CRAVe for certain GHG programs.

legal document, establishing the terms of participation in writing helps to clarify the participating businesses' role and expectations in the GHG program. It also creates accountability on the part of the businesses to encourage the timely completion and submission of inventories.

The GHG program will typically need to provide training for participants on the program accounting, quantification, and reporting specifications. This is best accomplished through a series of workshops to walk the participants through the steps of designing and compiling their GHG inventories, leaving several weeks in between for participants to implement the concepts they have learned. For example, a workshop series might include four workshops on the following topics:

- Introduction to the GHG program goals, objectives, and processes
- Designing a GHG inventory: organizational and operational boundaries and base years
- Identifying GHG sources, acquiring data, and calculating GHG emissions
- Compiling and reporting a GHG inventory

6.6. COLLECTING, REVIEWING, AND PUBLISHING GHG INVENTORIES

As described in 6.5, the GHG program should establish expectations regarding the collection, review, and publication of GHG inventories early in the business recruitment stage. Inventory collection and review is likely to be an iterative process, with the program providing feedback to participants on their draft inventories or inventory components prior to collecting and publishing the final inventories. Especially during a program's initial pilot phase, the program partners often need to follow up with participants and provide hands-on guidance on GHG quantification.

Conducting a public recognition event for program participants can be a powerful motivator to stimulate timely reporting in the context of voluntary GHG programs. The Mexico GHG Program has established an annual public recognition event for companies that submit their GHG inventory reports on time and maintain good environmental standing.

BOX 6.5 Adding a Goal-Setting Component: Climate Leaders

A GHG reduction target is a tangible, accountable action that helps communicate a company's climate strategy and commitment to stakeholders. Setting aggressive GHG reduction targets (also known as goals) can galvanize reduction efforts at a company, garner senior management attention, and increase funding for internal GHG reduction projects. Through the Climate Leaders program, the U.S. Environmental Protection Agency (EPA) works closely with each of its participants to set an individualized GHG reduction goal, because every company has a unique set of GHG emission sources and reduction opportunities. Each Climate Leaders goal must meet the following criteria:

- Corporate-wide (including at least all U.S. operations)
- Based on the most recent base year for which data are available
- Achieved over 5 to 10 years
- Expressed either as an absolute GHG reduction or as a decrease in GHG intensity
- Aggressive compared to the projected GHG performance for the participant's sector

What EPA considers an aggressive goal varies by sector and by company depending on a variety of factors, including historic capital stock turnover rates and activities undertaken prior to joining Climate Leaders. To address this variability, Climate Leaders conducts an iterative goal evaluation process based on a performance benchmarking methodology. EPA develops a sector-specific performance benchmark for each company using publicly available national energy and production data, which facilitates the comparison of expected business-as-usual emission performance of the sector(s) in which a company operates to a company's goal proposal. A Climate Leaders company thus distinguishes itself by announcing an aggressive GHG reduction goal compared to its sector performance benchmark. [1]

The typical steps in the goal-setting process are:

- The participant completes a corporate-wide inventory to identify risks and reduction opportunities from GHG emissions
- The participant completes an internal analysis to identify the range of potential internal reduction opportunities
- The participant presents an initial goal proposal to EPA for evaluation
- EPA calculates a sector performance benchmark, to identify an analytical basis for negotiating the reduction goal
- EPA and the participant work together to ensure that the proposed goal significantly exceeds the performance benchmark
- EPA senior management approves the goal for announcement as a Climate Leaders goal

EPA has used and refined this goal-setting process since 2002 and has negotiated many corporate-wide GHG reduction goals across a wide variety of industry sectors using objective benchmarking data.

Notes

[1] See Tonkonogy 2007.

Phase III Program Review

6.7. CONDUCTING A STRUCTURED FEEDBACK PROCESS

After concluding the pilot inventory collection, it is important to obtain feedback regarding the program design and implementation. A structured review process can provide a systematic process for the program partners to receive constructive recommendations on how to improve the program. This can come in the form of questionnaires, surveys, focus groups or individual interviews with companies, or an open forum. While surveys and questionnaires can provide a general overview of the issues of concern to participants, the most frank and useful feedback often comes from one-on-one discussions with individual stakeholders, so a combination of approaches may be the most effective. The feedback process should be designed to evaluate the program against its objectives and indicators as identified in Decision 2.1, as well as to elicit perspectives on issues the designers may not have considered. Program partners can then analyze the feedback and revise the program structure, specifications, and implementation processes accordingly. Feedback should be solicited from a range of stakeholders, including program participants, partners, and advisors.

The Mexico GHG Program made several changes to its specifications based on stakeholder feedback following its pilot phase. For example, the program had not initially specified which consolidation approach its participants should use to set their organizational boundaries. In reviewing the pilot phase, it became clear that most participants were selecting the operational control approach, so to improve consistency among participants, the program began recommending the operational control approach to all participants. Additionally, the government ministry charged with preparing Mexico's national inventory expressed that it could improve the national inventory if participants would disaggregate their emission data by the same categories as those used in the national inventory: stationary combustion, mobile combustion, industrial processes, and fugitive emissions. The revised program specifications now recommend this level of disaggregation.

6.8. NEXT STEPS

The structured feedback process should help program designers identify ways to improve or build on the GHG program going forward. Depending on the structure and objectives of the program, and the scope of activities during the initial implementation phase, next steps for a GHG program might include:

- *Transitioning from a pilot project to a permanent program:* If the program has been implemented initially as a pilot project, and received positive reviews from stakeholders during the structured feedback process, now is the time to plan a transition from pilot to permanent status. This may include modifying the program specifications based on user feedback, scaling up participation, ensuring that the program has adequate resources and a permanent institutional home, or exploring links to complementary strategies and programs.
- *Expanding participation and scope:* Having been through an initial round of inventory collection, the program is now in a position to incorporate additional sectors, or to phase in elements that may not have been implemented during the pilot phase, such as additional calculation protocols, an online reporting platform, or additional quality assurance processes.
- *Building on the GHG accounting and reporting platform:* In addition to facilitating GHG accounting and reporting, program designers may wish to consider incorporating additional functions, such as promoting the development of corporate climate change strategies, setting GHG reduction targets (see Box 6.5), or designing a cap-and-trade system (see Box 6.6).

BOX 6.6 An Example of Emission Reporting to Support a Cap-and-Trade Program: *The Regional Greenhouse Gas Initiative*

The Regional Greenhouse Gas Initiative (RGGI) is a CO_2 cap-and-trade program covering ten states in the northeastern United States that will become operational in 2009. The program applies to power plants only, covering all electric generating units with a nameplate capacity exceeding 25 megawatts, including fossil-fuel-fired boilers, combustion turbines, and combined cycle systems. Under RGGI, the point of regulation is the electric generating unit. The owner or operator of each combustion unit is required to submit quarterly emission data to the state regulatory agency. CO_2 emissions must be directly measured using continuous emission monitoring systems (CEMS), in accordance with rigorous and standardized monitoring regulations. The regulations are those used by U.S. EPA to collect sulfur dioxide emission data under the U.S. Acid Rain SO_2 trading program.

Key features of emission reporting under RGGI include:

- *Level of reporting:* Combustion unit level
- *Gases covered:* CO_2
- *Frequency of reporting:* Quarterly
- *Emission measurement:* Direct measurement (continuous emission monitoring)

Glossary

Absolute target	A target defined by reduction in absolute emissions over time, e.g., to reduce CO_2 emissions by 25% from 1994 levels by 2010.
Annex 1 countries	Defined in the UNFCCC as those countries taking on emission reduction obligations: Australia; Austria; Belgium; Belarus; Bulgaria; Canada; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Latvia; Liechtenstein; Lithuania; Luxembourg; Monaco; Netherlands; New Zealand; Norway; Poland; Portugal; Romania; Russian Federation; Slovakia; Slovenia; Spain; Sweden; Switzerland; Ukraine; United Kingdom; USA.
Associated/affiliated company	The parent company has significant influence over the operating and financial policies of the associated/affiliated company, but not financial control.
Base year	A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time.
Base year recalculation	Recalculation of emissions in the base year to reflect a change in the structure of the company, or to reflect a change in the accounting methodology used. This ensures data consistency over time, i.e., comparisons of like with like over time.
Baseline	A hypothetical scenario for what GHG emissions, removals or storage would have been in the absence of consideration of climate change mitigation.
Baseline protection	Recognition by a regulatory program of regulated entities' pre-regulatory, voluntary efforts to reduce GHG emissions, as established through a record of the entities' GHG inventories over time.
Biofuels	Fuel made from plant material, e.g. wood, straw and ethanol from plant matter.
Boundaries	GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, business unit, and target boundaries. The inventory boundary determines which emissions are accounted and reported by the company.
Cap-and-trade system	A system that sets an overall emission limit, allocates emission allowances to participants, and allows them to trade allowances and emission credits with each other.
Carbon sequestration	The uptake of CO_2 and storage of carbon in biological sinks.
Clean Development Mechanism (CDM)	A mechanism established by Article 12 of the Kyoto Protocol for project-based emission reduction activities in developing countries. The CDM is designed to meet two main objectives: to address the sustainability needs of the host country and to increase the opportunities available to Annex 1 Parties to meet their GHG reduction commitments. The CDM allows for the creation, acquisition and transfer of CERs from climate change mitigation projects undertaken in non-Annex 1 countries.
Consolidation	Combination of GHG emission data from separate operations that form part of one company or group of companies.
Control	The ability of a company to direct the policies of another operation. More specifically, it is defined as either operational control (the organization or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation) or financial control (the organization has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities).
CO_2-equivalent	The universal unit of measurement to indicate the global warming potential (GWP) of each of the six greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis.
Corporate inventory	A quantified list of a corporation's or other entity's GHG emissions and sources.

Desktop review An evaluation of reported GHG information, which may include GHG inventories, inventory management plans, activity data, and emission factors, that is completed remotely rather than on-site.

Direct GHG emissions Emissions from sources that are owned or controlled by the reporting company.

Direct monitoring Direct monitoring of exhaust stream contents in the form of continuous emission monitoring systems (CEMS) or periodic sampling.

Double counting Occurs when two or more reporting companies take ownership of the same emissions or reductions.

Emission factor A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g. tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions.

Emissions The release of GHGs into the atmosphere.

Equity share The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation, and equity share will normally be the same as the ownership percentage.

Fugitive emissions Emissions that are not physically controlled but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals, often through joints, seals, packing, gaskets, etc.

Greenhouse gases (GHGs) For the purposes of the GHG Protocol standards and tools, GHGs are the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF_6).

GHG accounting principle A generally accepted principle that guides the accounting and reporting of GHG emissions to ensure that reported information represents a faithful, true, and fair account of a company's GHG emissions. The *Corporate Standard*'s GHG accounting principles are relevance, completeness, consistency, transparency, and accuracy (Chapter 2).

GHG program A generic term used to refer to any voluntary or mandatory international, national, sub-national, government or non-governmental initiative that collects information on, registers, certifies, or regulates GHG emissions or removals from companies, project developers, or other entities. This guide pertains to GHG programs with a corporate GHG accounting and reporting component.

GHG program design principle A principle adopted by GHG program designers, based on input from stakeholders, to guide the development of GHG program structure, specifications, quality assurance, and implementation (Chapter 2).

GHG program objective Refers to a goal or aim of a GHG program, such as encouraging corporate GHG management and reduction, or improving the quality or consistency of GHG data (Chapter 2).

GHG project A specific project or activity designed to achieve GHG emission reductions, storage of carbon, or enhancement of GHG removals from the atmosphere. GHG projects may be stand-alone projects, or specific activities or elements within a larger non-GHG related project.

GHG Protocol calculation tools A number of cross-sector and sector-specific tools that calculate GHG emissions on the basis of activity data and emission factors (available at www.ghgprotocol.org).

GHG Protocol Initiative A multi-stakeholder collaboration convened by the World Resources Institute and World Business Council for Sustainable Development to design, develop and promote the use of accounting and reporting standards for business. It comprises of two separate but linked standards—the *GHG Protocol Corporate Accounting and Reporting Standard* and the *GHG Protocol for Project Accounting.*

GHG registry A public database of organizational GHG emissions and/or project reductions. For example, the California Climate Action Registry and The Climate Registry. Each registry has its own specifications for GHG accounting and reporting.

GHG report	Provides, among other details, the reporting company's physical emissions for its chosen inventory boundary.
GHG source	Any physical unit or process which releases GHG into the atmosphere.
Global warming potential (GWP)	A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of CO_2.
Group company / subsidiary	The parent company has the ability to direct the financial and operating policies of a group company/subsidiary with a view to gaining economic benefits from its activities.
Indirect GHG emissions	Emissions that are a consequence of the operations of the reporting company, but occur at sources owned or controlled by another company.
Insourcing	The administration of ancillary business activities, formally performed outside of the company, using resources within a company.
Intensity target	A target defined by reduction in the ratio of emissions and a business metric over time e.g., to reduce CO_2 per tonne of cement by 12% between 2000 and 2008.
Intergovernmental Panel on Climate Change (IPCC)	International body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change (www.ipcc.ch).
Inventory	A quantified list of an organization's GHG emissions and sources.
Inventory boundary	An imaginary line that encompasses the direct and indirect emissions that are included in the inventory. It results from the chosen organizational and operational boundaries.
Inventory Management Plan (IMP)	A document to help reporting companies institutionalize the completion of high-quality annual GHG inventories (Chapter 5).
Inventory quality	The extent to which an inventory provides a faithful, true and fair account of an organization's GHG emissions.
Kyoto Protocol	A protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Requires countries listed in its Annex B (developed nations) to meet reduction targets of GHG emissions relative to their 1990 levels during the period of 2008–12.
Letter of Intent (LOI)	A document that can aid the implementation of a GHG Program in which a company formally states its intention to participate (Chapter 6).
Material discrepancy	An error (for example from an oversight, omission, or miscalculation) that results in the reported quantity being significantly different to the true value to an extent that will influence performance or decisions. Also known as material misstatement.
Materiality threshold	A concept employed in the process of verification. It is often used to determine whether an error or omission is a material discrepancy or not. It should not be viewed as a de minimus for defining a complete inventory.
Memorandum of Understanding (MOU)	A formal agreement between parties that usually establishes cooperation to undertake an action (Chapter 6).
Mobile combustion	Burning of fuels by transportation devices such as cars, trucks, trains, airplanes, ships etc.
Non-Annex 1 countries	Countries that have ratified or acceded to the UNFCCC but are not listed under Annex 1 and are therefore not subject to any emission reduction obligation (see also Annex 1 countries).
Operational boundaries	The boundaries that determine the direct and indirect emissions associated with operations owned or controlled by the reporting company. This assessment allows a company to establish which operations and sources cause direct and indirect emissions, and to decide which indirect emissions to include that are a consequence of its operations.

Organizational boundaries	The boundaries that determine the operations owned or controlled by the reporting company depending on the consolidation approach taken (equity or control approach).
Outsourcing	The contracting out of activities to other businesses.
Process emissions	Emissions generated from manufacturing processes, such as the CO_2 that arises from the breakdown of calcium carbonate ($CaCO_3$) during cement manufacture.
Program specifications	Program requirements, recommendations, or guidance related to how program participants should account for, quantify, and report their GHG emissions.
Program structure	The collection of program design characteristics related to coverage of sectors, sources, and gases; geographical boundaries; and definition of the reporting entity.
Renewable energy	Energy taken from sources that are inexhaustible, e.g. wind, water, solar, and geothermal energy.
Renewable Energy Certificates (RECs)	The property rights to environmental benefits derived from electricity generation from renewable energy sources.
Reporting	Presenting data to internal management and external users such as regulators, shareholders, thegeneral public or specific stakeholder groups.
Reporting platform	A system (typically on-line) for collecting GHG emission information from participants and making it available to users.
Scope	Defines the operational boundaries in relation to indirect and direct GHG emissions.
Scope 1	Direct GHG emissions from sources owned or contolled by the reporting company.
Scope 2	Emissions associated with the generation of electricity, heating/ cooling, or steam purchased for the reporting entity's own consumption.
Scope 3	Indirect emissions other than those covered in Scope 2.
Significance threshold	A qualitative or quantitative criteria used to define a significant structural change. It is the responsibility of the company/ verifier to determine the "significance threshold" for considering base year emission recalculation. In most cases the "significance threshold" depends on the use of the information,the characteristics of the company, and the features of structural changes (Chapter 5).
Stakeholder process	An open, transparent, and inclusive approach that engages multiple parties with different interests in the design, implementation, and review of a GHG program (Chapter 6).
Stationary combustion	Burning of fuels to generate electricity, steam, heat, or power in stationary equipment such as boilers, furnaces, etc.
Structural change	A change in the organizational or operational boundaries of a company that result in the transfer of ownership or control of emissions from one company to another. Structural changes usually result from a transfer of ownership of emissions, such as mergers, acquisitions, divestitures, but can also include outsourcing/insourcing.
Structured feedback process	A systematic process for program partners to receive constructive recommendations on how to improve the program, usually through questionnaires, surveys, focus groups or individual interviews with companies, or an open forum (Chapter 6).
Uncertainty	1. Statistical definition: A parameter associated with the result of a measurement that characterizes the dispersion of the values that could be reasonably attributed to the measured quantity. (e.g., the sample variance or coefficient of variation). 2. Inventory definition: A general and imprecise term which refers to the lack of certainty in emissions-related data resulting from any causal factor, such as the application of non-representative factors or methods, incomplete data on sources and sinks, or lack of transparency. Reported uncertainty information typically specifies a quantitative estimate of the likely or perceived difference between a reported value and a qualitative description of the likely causes of the difference.

United Nations Framework Convention on Climate Change (UNFCCC)	Signed in 1992 at the Rio Earth Summit, the UNFCCC is a milestone Convention on Climate Change treaty that provides an overall framework for international efforts to mitigate climate change. The Kyoto Protocol is a protocol to the UNFCCC.
Value chain emissions	Emissions from the upstream and downstream activities associated with the operations of the reporting company.
Verification	An independent assessment of the reliability (considering completeness and accuracy) of a GHG inventory.

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- Emissions from employee commuting, version 2.0 (2006)

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This document has been designed to promote best practice GHG program design based on the GHG Protocol *Corporate Standard*. While WRI and WBCSD encourage the use of *Measuring to Manage: A Guide to Designing GHG Accounting and Reporting Programs*, its application and the design and implementation of programs based on it are the full responsibility of its users. Neither WRI and WBCSD, nor the individuals who contributed to the guide assume responsibility for any consequences or damages resulting directly or indirectly from its use and application.

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Our mission is to provide business leadership as a catalyst for change towards sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:

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- Policy Development—to participate in policy development to create the right framework conditions for business to make an effective contribution towards sustainable development.
- The Business Case—to develop and promote the business case for sustainable development.
- Best Practice—to demonstrate the business contribution to sustainable development solutions and share leading edge practices among members.
- Global Outreach—to contribute to a sustainable future for developing nations and nations in transition.

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World Resources Institute is an environmental research and policy organization that creates solutions to protect the Earth and improve people's lives. Our work is concentrated on achieving progress toward four key goals:

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- Increase access to information
- Create sustainable enterprise and opportunity
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Our strength is our ability to catalyze permanent change through partnerships that implement innovative, incentive-based solutions that are founded upon hard, objective data.We know that harnessing the power of markets will ensure real, not cosmetic change.

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ELECTRICAL EQUIPMENT LIST

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FOR

Lydian International

Amulsar FEED - Value Engineering and Optimization

Project Number: 15162-01

Orig./Lead Eng.:	J. Maas / J. Arnold	Date:	9/4/2015
Project Engineer Approval:		Date:	
Project Manager Approval:		Date:	

Rev. No.	By	Revisions	Approval	Date
A	JM	Issued For Bid	JJ	9/4/2015
B	JM	Issued For Bid	JA	9/10/2015
C	JA	Issued For Review	JA	11/4/2015

Client: Lydian International
Project: Amulsar FEED - Value Engineering and Optimization
Project Number: 15162-01

Electrical Equipment List
Rev. C
Date: 11/4/2015

Equipment Number	QTY	Description	Rating	Vendor/ Manufacturer	Spec #	Location	RFQ Number P.O. Number	Drawing Number		Comments	Rev. No
								One Line	Plan		
166 - MCC - 001	1	Low Voltage Motor Control Center	400 V, 400 A, 65 kA, 3-Phase, 3-Wire, 50 Hz.		16440						
166 - PDC - 001	1	Power Distribution Center (Kiosk)	16' X 20'		16300						
166 - XFMCC - 001	1	Unit Substation	75 / 84 kVA 35kV-400V, 3-Phase, 50 Hz.		16270						
210 - LVS - 001	1	Low Voltage Switchgear	400 V, 4000 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16361						
210 - PDC - 001	1	Power Distribution Center (Kiosk)	16' x 80'		16300						
210 - XFLVS - 001	1	Unit Substation	3 / 3.36 MVA 6kV-400V, 3-phase, 50 Hz.		16270						
215 - MCC - 001	1	Low Voltage Motor Control Center	400 V, 3000 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16440						
220 - MVC - 001	1	Medium Voltage Controller	6 kV, 1200 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16345						
220 - XFMVC - 001	1	Unit Substation	10 / 11.2 MVA 35kV-6kV, 3-phase, 50 Hz.		16270						
10/220/73 - MCC - 001	1	Low Voltage Motor Control Center	400 V, 2500 A, 65 kA, 3-phase, 3 wire, 50 Hz.		16440						
240 - MCC - 001	1	Low Voltage Motor Control Center	400 V, 800 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16440						
240 - PDC - 001	1	Power Distribution Center (Kiosk)	16 'x 20'		16300						
240 - XFMCC - 001	1	Unit Substation	500 / 560 kVA 35kV-400V, 3-phase, 50 Hz.		16270						
300 - MCC - 001	1	Low Voltage Motor Control Center	400 V, 400 A, 65 kA, 3phase, 3-wire, 50 Hz.		16440						
300 - MVC - 001	1	Medium Voltage Controller	6 kV, 1200 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16345						
300 - PDC - 001	1	Power Distribution Center (Kiosk)	16' x 40'		16300						
300 - XFMVC - 001	1	Unit Substation	2.5 / 2.8 MVA 35kV-6kV, 3-phase, 50 Hz.		16270						
300 - XFMCC - 001	1	Unit Substation	150 / 168 kVA 6kV-400V, 3-phase, 50 Hz.		16270						

Client: Lydian International

Project: Amulsar FEED - Value Engineering and Optimization

Project Number: 15162-01

Electrical Equipment List

Rev. C

Date: 11/4/2015

Equipment Number					QTY	Description	Rating	Vendor/ Manufacturer	Spec #	Location	RFQ Number P.O. Number	Drawing Number		Comments	Rev. No
												One Line	Plan		
410	-	LVS	-	001	1	Low Voltage Switchgear	400 V, 2000 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16361						
410	-	MVC	-	001	1	Medium Voltage Controller	6 kV, 1200 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16345						
410	-	PDC	-	001	1	Power Distribution Center (Kiosk)	16' x 60'		16300						
410	-	XFLVS	-	001	1	Unit Substation	1500 / 1680 kVA 6kV-400V, 3-phase, 50 Hz.		16270						
410	-	XFMVC	-	001	1	Unit Substation	5 / 5.6 MVA 35kV-6kV, 3-phase, 50 Hz.		16270						
410/411	-	MCC	-	001	1	Low Voltage Motor Control Center	400 V, 600 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16440						
412/735	-	MCC	-	001	1	Low Voltage Motor Control Center	400 V, 1600 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16440						
732	-	CS	-	001	1	Circuit Switcher (Substation)	35kV, 1200 A, 65 kAIC 3-phase, 3-wire, 50 Hz.		16321						
732	-	GE	-	001	1	Diesel Generator w/ Automaric Transfer Switch	1500kW, 6000V, 3 ph, 50 Hz								
732	-	MT	-	001	1	Metering Unit (Substation)	110kV, 65kAIC, 50 Hz.								
732	-	MVS	-	001	1	Medium Voltage Switchgear (Substation)	35kV, 1200 A, 65 kAIC 3-phase, 3-wire, 50 Hz.		16340						
732	-	PDC	-	001	1	Power Distribution Center (Kiosk) (Substation)	16' x 40'		16300						
732	-	PFCC	-	001	1	Power Factor Correction Capacitor (Substation)	3000 kVAR		16285						
732	-	XF	-	001	1	Substation Transformer (Substation)	15 / 16.8 / 18.8 MVA 110kV-35KV, 3-phase, 50Hz.		16275						
733	-	MCC	-	001	1	Low Voltage Motor Control Center	400 V, 400 A, 65 kA, 3-phase, 3-wire, 50 Hz.		16440						
733	-	PDC	-	001	1	Power Distribution Center (Kiosk)	16' x 20'		16300						
733	-	XFMCC	-	001	1	Unit Substation	225 /252 kVA 35kV-400V, 3-phase, 50 Hz.		16270						

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MECHANICAL EQUIPMENT LIST

E-ME-102-M
FOR

Lydian International, Ltd.

Amulsar FEED - Value Engineering and Optimization
Project Number: 15162-01

Originator/Lead Engineer:	M. Toso	Date:	11/3/2015
Project Engineer Approval:		Date:	
Project Manager Approval:	J. Kelly	Date:	11/3/2015

Rev. No.	By	Revisions	Approval	Date
A	MT	Issued for Study	JMK	11/3/2015

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
166 - PP - 550	Diesel Fuel Pump No. 1	Horizontal centrifugal solution pump, c/w pump cabinet, hose reel, filter and meter	35 m^3/hr				3.7	M-108	
166 - PP - 551	Diesel Fuel Pump No. 2	Horizontal centrifugal solution pump, c/w pump cabinet, hose reel, filter and meter	35 m^3/hr				3.7	M-108	
166 - PP - 552	Gasoline Fuel Pump	Horizontal centrifugal solution pump, c/w pump cabinet, hose reel, filter and meter	6 m^3/hr				1.5	M-108	
166 - TK - 555	Diesel Fuel Tank	9.1 m dia. x 9.8 m H, carbon steel	580 m^3				--	M-108	
166 - TK - 556	Gasoline Fuel Tank	4.0 m dia. x 4.9 m H, carbon steel	50 m^3				--	M-108	
210 - RB - 101	Rock Breaker	7.4 m horizontal reach, 8.9 m vertical reach		Metso	Metso	MB432	55	M-100	
210 - FE - 102	Vibrating Grizzly Feeder	900 mm width x 5.2 m length	316 dtph				18.5	M-103	
210 - FE - 104	Primary Crusher Apron Feeder	Apron type, 900 mm width x 7 m length	316 dtph	Metso	Metso	AF-5	55	M-119	
210 - CR - 107	Primary Crusher	Jaw crusher	300 dtph	Metso	Metso	C-150	225	M-100	
210 - DC - 110	Crushing Area Dust Collector						--	M-105	
210 - FA - 111	Crushing Area Dust Collector Fan						45	M-105	
210 - CN - 112	Crushing Area Crane	Overhead bridge crane	40 tonne				45	M-102	
210 - PK - 113	Crushing Area Plant Air Package	C/w compressor, filters, air receivers and dryer					75	M-109	
210 - CV - 115	Crushers Discharge Conveyor	1500 mm width x 80 m length, 10 m lift	4300 dtph				200	M-106	
210 - MA - 116	Tramp Iron Magnet						6	M-106	
215 - CV - 120	Coarse Ore Bin Feed Conveyor	1500 mm width x 240 m length, 25 m lift c/w tripper car	4300 dtph				400	M-106	
215 - BN - 125	Coarse Ore Storage Bin	8 m x 24 m x 8 m c/w 3 - 60 degree hopper bottoms	1600 tonne				--	Steel Fab.	
215 - CN - 127	Screening Area Crane	Overhead bridge crane	20 tonne				15	M-102	
215 - PK - 128	Screening Area Plant Air Package	C/w compressor, filters, air receivers and dryer					37.5	M-109	
215 - FE - 131	Belt Feeder No. 1	1800 mm width x 7.6 m length	1433 dtph				30	M-103	
215 - FE - 132	Belt Feeder No. 2	1800 mm width x 7.6 m length	1433 dtph				30	M-103	
215 - FE - 133	Belt Feeder No. 3	1800 mm width x 7.6 m length	1433 dtph				30	M-103	
215 - SC - 134	Vibrating Screen No. 1	Double deck, 3.65 m x 8.5 m vibrating	1433 dtph	Metso	Metso	MF3685-2	90	M-120	

Client:	Lydian International	Mechanical Equipment List (E-ME-102-M)
Project:	Amulsar FEED - Value Engineering and Optimization	Rev. A
Project Number:	15162-01	Date: 11/03/15

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
215 - SC - 135	Vibrating Screen No. 2	Double deck, 3.65 m x 8.5 m vibrating	1433 dtph	Metso	Metso	MF3685-2	90	M-120	
215 - SC - 136	Vibrating Screen No. 3	Double deck, 3.65 m x 8.5 m vibrating	1433 dtph	Metso	Metso	MF3685-2	90	M-120	
215 - DC - 140	Screening Area Dust Collector		30,000 cfm				--	M-105	
215 - FA - 141	Screening Area Dust Collector Fan						75	M-105	
215 - CV - 145	Vibrating Screen Oversize Conveyor	1200 mm width x 40 m length, 3.6 m lift	2685 dtph				50	M-106	
215 - CV - 146	Secondary Crushing Feed Conveyor	1200 mm width x 230 m length, 25 m lift	2685 dtph				250	M-106	
215 - CV - 147	Product Conveyor	900 mm width x 75 m length, 0 m lift c/w belt scale	1614 dtph				30	M-106	
220 - BN - 150	Secondary Crushing Feed Bin	8 m x 24 m x 8 m c/w 3 - 60 degree hopper bottoms	1600 tonne				--	Steel Fab.	
220 - FE - 151	Secondary Crusher Belt Feeder No. 1	1800 mm width x 6.6 m length	1343 dtph				30	M-103	
220 - FE - 152	Secondary Crusher Belt Feeder No. 2	1800 mm width x 6.6 m length	1343 dtph				30	M-103	
220 - CR - 153	Secondary Crusher No. 1	Cone crusher c/w hydraulic power unit, lubrication and cooling system	1343 dtph	Metso	Metso	MP1250	932, 37, 22.5 & 15	M-121	
220 - CR - 154	Secondary Crusher No. 2	Cone crusher c/w hydraulic power unit, lubrication and cooling system	1343 dtph	Metso	Metso	MP1250	932, 37, 22.5 & 15	M-121	
230 - SA - 159	Crushed Ore Sampler						--	M-110	
230 - CV - 160	Overland Conveyor	1050 mm width x 5587 m length, -705 m lift	1614 dtph	Thyssen Krupp	Thyssen Krupp		2 x 1500 kW Generator	M-122	
240 - XM - 163	Stockpile Cover	97 m dia x 37 m H					--	M-107	
240 - FE - 165	Reclaim Feeder No. 1	Vibrating pan feeder	538 dtph				30	M-104	
240 - FE - 166	Reclaim Feeder No. 2	Vibrating pan feeder	538 dtph				30	M-104	
240 - FE - 167	Reclaim Feeder No. 3	Vibrating pan feeder, spare	538 dtph				30	M-104	
240 - DC - 168	Reclaim Area Dust Collector						--	M-105	
240 - FA - 169	Reclaim Area Dust Collector Fan						30	M-105	
240 - CV - 170	Loadout Bin Feed Conveyor	1200 mm width x 200 m length, 15 m lift c/w belt scale	1618 dtph				125	M-106	
240 - BL - 175	Pneumatic Blower						15	M-111	
240 - SI - 176	Pebble Lime Silo	c/w bin activator	100 tonne				3.7	M-111	

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
240 - BV - 177	Lime Bin Vent						7.5	M-111	
240 - FE - 178	Screw Feeder						3.7	M-111	
240 - SL - 179	Truck Scale		40 tonne				--	M-123	
240 - BN - 185	Loadout Bin		100 tonne				--	M-117	
240 - GA - 186	Clam Shell Gate						--	M-117	
240 - GA - 187	Clam Shell Gate						--	M-117	
300 - PP - 201	Pregnant Solution Pump No. 1	200 mm x 150 mm, Self-priming horizontal centrifugal	330 m^3/hr				525	M-112	
300 - PP - 202	Pregnant Solution Pump No. 2	200 mm x 150 mm, Self-priming horizontal centrifugal	330 m^3/hr				525	M-112	
300 - PP - 203	Pregnant Solution Pump No. 3	200 mm x 150 mm, Self-priming horizontal centrifugal, spare	330 m^3/hr				525	M-112	
300 - PP - 204	Event Pond Pump No. 1	Self-priming horizontal centrifugal					37.5	M-112	
300 - PP - 205	Event Pond Pump No. 2	Self-priming horizontal centrifugal, spare					37.5	M-112	
400 - TK - 209	Heating Gas Storage Tank	Horizontal, 3.5 m dia x 11 m length	100 m^3				--	M-124	
410 - TK - 210	Adsorption Feed Head Tank	2.3 m dia x 2.3 m high, CS					--	M-116	
410 - SA - 212	Pregnant Solution Sampler	Wire sampler, 316SS, 2 L collector					--	M-110	
410 - CM - 215	Carbon Column No. 1	Flared design, 2.2/2.76 m dia (min/max) x 4.08 m high	4 mt carbon				--	M-114	Module 0
410 - CM - 216	Carbon Column No. 2	Flared design, 2.2/2.76 m dia (min/max) x 4.08 m high	4 mt carbon				--	M-114	Module 0
410 - CM - 217	Carbon Column No. 3	Flared design, 2.2/2.76 m dia (min/max) x 4.08 m high	4 mt carbon				--	M-114	Module 0
410 - CM - 218	Carbon Column No. 4	Flared design, 2.2/2.76 m dia (min/max) x 4.08 m high	4 mt carbon				--	M-114	Module 0
410 - CM - 219	Carbon Column No. 5	Flared design, 2.2/2.76 m dia (min/max) x 4.08 m high	4 mt carbon				--	M-114	Module 0
410 - PP - 220	Adsorption Column Carbon Advance Pump	20-30% solids, centrifugal screw type	35 m^3/hr @ 25 m TDH				7.5	M-112	
410 - SA - 222	Barren Solution Sampler	Wire sampler, 316SS, 2 L collector					--	M-110	
410 - SC - 225	Carbon Safety Screen	Single deck vibrating, 24 mesh, 1.83 m wide x 3.57 m long					7.5	M-127	
410 - PP - 226	Barren Solution Pump No. 1	Vertical turbine	412 m^3/hr				670	M-112	

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
410 - PP - 227	Barren Solution Pump No. 2	Vertical turbine	412 m^3/hr				670	M-112	
410 - PP - 228	Barren Solution Pump No. 3	Vertical turbine, spare	412 m^3/hr				670	M-112	
410 - PP - 233	Carbon Column Area Sump Pump	Vertical centrifugal	19 m^3/hr @ 15 m TDH				7.5	M-112	
411 - PV - 235	Elution Column No. 1	1.6 m dia x 4.4 m high, mild steel	9 m^3				--	M-114	Module 3
411 - PV - 236	Elution Column No. 2	1.6 m dia x 4.4 m high, mild steel	9 m^3				--		FUTURE
411 - FL - 237	Elution Safety Duplex Filter No. 1	In-line basket type, 316SS, 20 mesh					--	M-114	Module 3
411 - FL - 238	Elution Safety Duplex Filter No. 1	In-line basket type, 316SS, 20 mesh					--		FUTURE
411 - TK - 242	Strip Solution Tank	2.8 m dia x 3.3 m high, carbon steel	20 m^3				--	M-114	Module 3
411 - PP - 243	Strip Solution Pump	Horizontal centrifugal	16 m^3/hr @ 100 m TDH				9.2	M-114	Module 3
411 - HX - 245	Heat Recovery Exchanger	Plate type, w/EPDM gaskets	3.75 million Btu/hr				--	M-114	Module 3
411 - HE - 246	Gas Fired Heater	fuel fired	1170 kW thermal output				--	M-114	Module 3
411 - HX - 247	Cooling Heat Exchanger	Plate type, w/EPDM gaskets	438,000 Btu/hr				--	M-114	Module 3
411 - SA - 248	Pregnant Strip Solution Sampler	Wire sampler, 316SS, 2 L collector					--	M-110	
411 - TK - 250	Pregnant Strip Solution Tank	5.2 m dia x 5.7 m high, carbon steel	112 m^3				--	M-114	Module 4
411 - PP - 251	Pregnant Strip Solution Pump No. 1	Horizontal centrifugal	144 m^3/hr @ 35 m TDH				30	M-114	Module 4
411 - PP - 252	Sump Pump	Vertical centrifugal, 316SS	18 m^3/hr @ 25 m TDH				2.2	M-114	Module 3
411 - PP - 253	Pregnant Strip Solution Pump No. 2	Horizontal centrifugal	144 m^3/hr @ 35 m TDH				30	M-114	Module 4
411 - PP - 255	Elution Column Transfer Pump	Horizontal centrifugal, recessed type impeller	35 m^3/hr @ 30 m TDH				9.2	M-114	Module 3
411 - TK - 260	Steady Head Tank	1.5 m dia x 1.8 m high, carbon steel	2.65 m^3				--	M-114	Module 2
411 - TK - 261	Zinc Mixing Tank	1.5 m dia x 1.8 m high, FRP	2.65 m^3				--	M-126	
411 - AG - 262	Zinc Mixing Tank Agitator						2.2	M-130	
411 - FE - 263	Zinc Feeder						2.2	M-114	Module 4
411 - MX - 264	Zinc In-line Mixer	static mixer					--	M-131	

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Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
411 - MX - 265	Zinc In-line Mixer	static mixer					--	M-131	
411 - PP - 270	Acid Metering Pump	Close coupled mad drive gear pump, acid suitable	250 L/hr				2.2	M-114	Module 2
411 - TK - 271	Acid Mix Tank	2.2 m dia x 3.1 m high, FRP	10 m^3				--	M-114	Module 2
411 - AG - 272	Acid Mix Tank Agitator						0.75	M-114	Module 2
411 - PP - 273	Acid Circulation Pump	Horizontal centrifugal, 316SS, close coupled	16 m^3/hr @ 20 m TDH				4	M-114	Module 2
411 - PV - 275	Acid Wash Tank	2.2 m dia x 3.1 m high, FRP	10 m^3				--	M-114	Module 2
411 - PP - 276	Acid Wash Carbon Transfer Pump	20-30% solids, horizontal centrifugal recessed type	34 m^3/hr @ 30 m TDH				7.5	M-114	Module 2
411 - PP - 280	Acid Wash Area Sump Pump	Vertical centrifugal, 316SS	20 m^3/hr @ 25 m TDH				2.2	M-114	Module 2
411 - SC - 285	Regeneration Feed Dewatering Screen	Single deck vibrating, 20 mesh, 914 mm wide x 1.83 m long	35 m^3/hr @ 20% solids				2.2	M-114	Module 6
411 - FE - 286	Kiln Screw Feeder	C/w 2.8 m dia x 3.8 m and 1.4 m high cone hopper	833 kg/hr				1.8	M-114	Module 6
411 - KN - 287	Carbon Regeneration Kiln	Rotary kiln, induction	400 kg/hr				--	M-114	Module 6
411 - TK - 288	Carbon Quench Tank	Cone bottom, 45 degree cone, carbon steel	10 m^3				--	M-114	Module 6
411 - PP - 290	Regeneration Carbon Transfer Pump	Horizontal centrifugal recessed type	35 m^3/hr @ 30 m TDH				11.2	M-112	
411 - SC - 295	Carbon Dewatering Screen	Single deck vibrating, 20 mesh, 914 mm wide x 1.83 m long	35 m^3/hr @ 20% solids				1.2	M-114	Module 1
411 - TK - 296	Carbon Fines Tank	2.2 m dia x 3.1 m high	10 m^3				--	M-114	Module 6
411 - PP - 297	Carbon Fines Discharge Pump	Air diaphragm	55 m^3/hr @ 70 m TDH				--	M-112	
411 - TK - 298	Carbon Dewatering Tank	Cone bottom, 3.5 m dia x 4.8 m high, 45 degree cone, carbon steel	32.1 m^3				--	M-114	Module 1
411 - PP - 299	Carbon Feed Pump	20-30% solids, horizontal centrifugal recessed type	35 m^3/hr @ 30 m TDH				11.2	M-112	
411 - TK - 300	Carbon Attritioning Tank	Cone bottom, 2 m dia x 2.6 m high, 45 degree cone, carbon steel c/w hoist	5.1 m^3 2 tonne				0.4	M-114	Module 1
411 - AG - 301	Carbon Attritioning Tank Agitator	Single axial flow impeller					1.5	M-114	Module 1
411 - PP - 302	Carbon Attrition Transfer Pump	20-30% solids, horizontal centrifugal recessed type	35 m^3/hr @ 15 m TDH				11	M-114	Module 1
411 - PP - 305	Carbon Area Sump Pump	Vertical centrifugal	44 m^3/hr @ 20 m TDH				2.2	M-114	Module 6
411 - TK - 361	NaCN Solution Mix Tank	4.0 m dia x 4.0 m high, FRP, c/w internal eductor	43.7 m^3				--	M-126	

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
411 - PP - 363	NaCN Solution Transfer Pump	Horizontal centrifugal	82 m^3/hr @ 15 m TDH				7.5	M-112	
411 - HT - 364	NaCN Hoist		2 tonne				0.75	M-135	
411 - TK - 365	NaCN Solution Storage Tank	4.5 m dia x 4.5 m high, FRP	62 m^3				--	M-126	
411 - PP - 366	NaCN Solution Metering Pump No. 1						2.2	M-112	
411 - PP - 367	NaCN Solution Metering Pump No. 2						2.2	M-112	
411 - PP - 368	NaCN Solution Metering Pump No. 3						2.2	M-112	
411 - PP - 370	NaCN Area Sump Pump	Vertical centrifugal	10 m^3/hr @ 15 m TDH				5.6	M-112	
411 - PP - 375	Antiscalant Metering Pump No. 1						0.75	M-114	Module 3
411 - PP - 376	Antiscalant Metering Pump No. 2						0.75	M-112	
411 - PP - 377	Antiscalant Metering Pump No. 3						0.75	M-112	
411 - TK - 380	NaOH Mix Tank	1.6 m dia x 1.6 m high, FRP	2.2 m^3				--	M-114	Module 3
411 - AG - 381	NaOH Mix Tank Agitator	Single axial flow impeller					0.75	M-130	
411 - PP - 382	NaOH Transfer Pump	Horizontal centrifugal					2.2	M-114	Module 3
411 - HT - 383	NaOH Hoist		2 tonne				0.4	M-114	Module 6
411 - HX - 384	NaOH Mix Heat Exchanger	Plate type					--	M-134	
412 - FL - 320	Precipitation Filter No. 1	Recessed plate, 470 mm x 470 mm plates, 41 plates	150 L				7.5	M-114	Module 4
412 - FL - 321	Precipitation Filter No. 2	Recessed plate, 470 mm x 470 mm plates, 41 plates	150 L				7.5	M-129	
412 - PK - 322	Mercury Retort Package	C/w vacuum pump, air chiller, boats and transfer cart	415 kg/day				2@70.8	M-114	Module 5
412 - FA - 323	Mercury Retort Fan						3.7	M-114	Module 5
412 - FU - 324	Smelting Furnace	Tilting crucible type, manual tilt, Electrically heated					--	M-114	Module 5
412 - HD - 325	Smelting Furnace Fume Hood						--	M-114	Module 5
412 - DC - 326	Smelting Furnace Baghouse	121 m2 w/HEPA secondary filter	17,000 Am^3/hr @ 66 deg. C				44.8	M-114	Module 5

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
412 - FA - 327	Smelting Furnace Exhaust Fan	Stainless steel construction	17,000 Am^3/hr @ 100 mm H_2O				30	M-114	Module 5
412 - MX - 328	Flux Mixer						2.2	M-114	Module 5
412 - CR - 330	Slag Crusher						3.7	M-132	
412 - BN - 331	Slag Bin	1.4 m x 1.4 m x 1.0 m w/screened drain, polyethylene					--	M-133	
412 - SC - 332	Slag Screen	Sweco					7.5	M-128	
412 - PP - 335	Filter Area Sump Pump	Vertical centrifugal					3.7	M-114	Module 5
412 - SA - 339	Filtrate Sampler						--	M-110	
412 - TK - 340	Filtrate Holding Tank	2.9 m dia x 3.4 m high, carbon steel	20 m^3				--	M-114	Module 4
412 - PP - 341	Filtrate Pump	Horizontal centrifugal					3.7	M-114	Module 4
412 - PK - 345	ADR Area Plant Air Package	C/w compressor, filters, air receivers and dryer	58 m^3/hr @ 862 kPa				5.6	M-109	
412 - TK - 391	Diatomaceous Earth Mix Tank	2.3 m dia x 2.3 m high, CS					--	M-116	
412 - AG - 392	Diatomaceous Earth Mix Tank Agitator						2.2	M-130	
412 - PP - 393	Diatomaceous Earth Transfer Pump	Horizontal centrifugal					3.7	M-112	
610 - TK - 400	Heating Gas Storage Tank	Horizontal, 3.5 m dia x 11 m length	100 m^3				--	M-124	
732 - TK - 557	Diesel Fuel Tank	Horizontal	7500 liter				--	M-116	
733 - TK - 504	Raw Water Tank	14.9 m dia x 11.9 m high, CS	1935 m^3				--	M-125	
733 - PP - 505	Crushing Area Dust Suppression Pump	Horizontal centrifugal	250 m^3/hr				93	M-112	
733 - TK - 510	Contact Water Tank	16.5 m dia x 17 m high, CS					--	M-125	
733 - PP - 511	Fresh Water Pump	Horizontal centrifugal	25 m^3/hr				45	M-112	
733 - TK - 515	Fresh Water Tank	14.9 m dia x 11.9 m high, CS	1935 m^3				--	M-125	
733 - PP - 521	Fire Water Pump	Horizontal centrifugal					75	M-112	
733 - PP - 522	Fire Water Diesel Pump						--	M-112	
733 - PK - 532	ADR Area Fire Water Package	C/w electric and diesel driven fire water pump					75	M-112	

Equipment Number	Equipment Name	Equipment Description	Design Capacity	Supplier	Manufacturer	Model Number	Installed Power	Package Number	Notes
			Metric				kW		
734 - WP - 531	Water Treatment Package	C/w filters, tanks, pumps and controls					37.5	M-113	
734 - TK - 533	Potable Water Tank	Shop fabricated tank					--	M-116	
734 - PP - 534	Potable Water Pump	Horizontal centrifugal					25	M-112	
735 - PP - 501	Submersible Pump No. 1	Vertical turbine	250 m^3/hr				93	M-112	
735 - PP - 502	Submersible Pump No. 2	Vertical turbine	250 m^3/hr				93	M-112	
735 - PP - 503	Submersible Pump No. 3	Vertical turbine	250 m^3/hr				93	M-112	