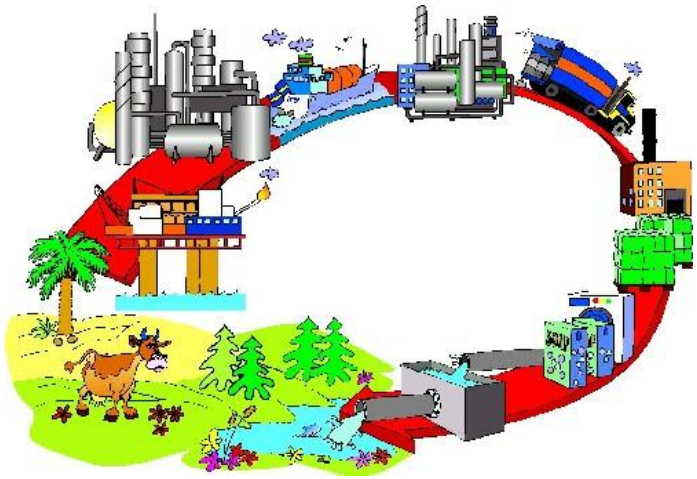
Environmental Life Cycle Assessment
PSE 476/WPS 576/WPS 595-005

Lecture 13: The GHG Protocol for Project Accounting

Richard Venditti



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The GHG Protocol for Project Accounting

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GHG Protocol for Project Accounting

- *WWW.ghgprotocol.org*

Introduction of GHG Protocol for Project Accounting, 1

- Provides specific principles, concepts, and methods for quantifying and reporting GHG reductions — i.e., the decreases in GHG emissions, or increases in removals and/or storage—from climate change mitigation projects (GHG projects).
- Objectives:
  - Provide a credible and transparent approach for quantifying and reporting GHG reductions from GHG projects
  - Enhance the credibility of GHG project accounting through the application of common accounting concepts, procedures, and principles;
  - Provide a platform for harmonization among different project-based GHG initiatives and programs.

Projects and activities

- A GHG project consists of a specific activity or set of activities intended to reduce GHG emissions, increase the storage of carbon, or enhance GHG removals from the atmosphere.
- A project activity is a specific action or intervention targeted at changing GHG emissions, removals, or storage.

Sources

- A GHG source is any process that releases GHG emissions into the atmosphere.

- Under the Project Protocol, there are five general GHG source categories:
  - combustion emissions from generating grid connected electricity
  - combustion emissions from generating energy or off-grid electricity, or from flaring
  - industrial process emissions—e.g., carbon dioxide (CO2) from the production of clinker for cement
  - fugitive emissions—e.g., GHG leaks from pipelines
  - waste emissions—e.g., GHG emissions from landfills.

Sinks

- A GHG sink is any process that removes and stores GHG emissions from the atmosphere.
- The Project Protocol identifies one GHG sink category: increases in storage or removals of CO_2 by biological processes.

GHG Effects

- GHG effects are changes in GHG emissions, removals, or storage caused by a *project activity*.
  - A primary effect is the intended change caused by a project activity in GHG emissions, removals, or storage associated with a *GHG source* or *sink.*
  - A secondary effect is an unintended change caused by a *project activity* in GHG emissions, removals, or storage associated with a *GHG source* or *sink*
    - *One time effects, construction for example*
    - *Up/down stream effects, recurring changes in GHG emissions associated with inputs or the products of an activity (example, market responses)*

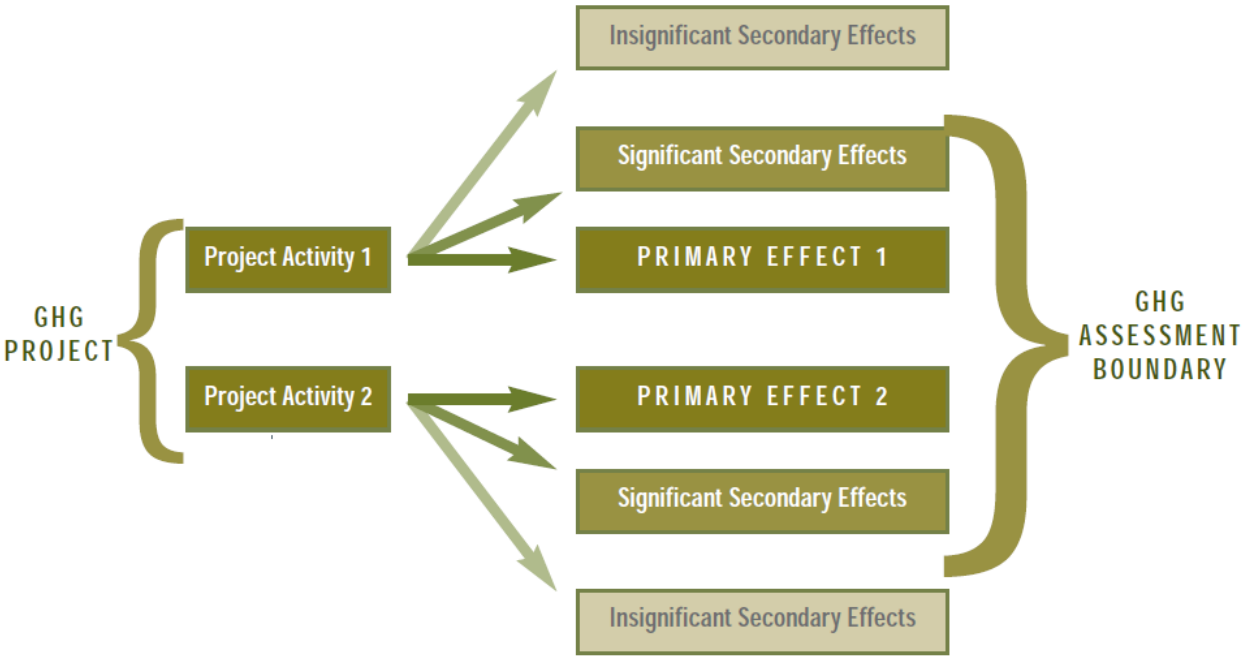
GHG Assessment Boundary

- GHG Assessment Boundary should encompass all *primary effects* and significant *secondary effects* associated with the *GHG project.*

Assessment Boundary, 5

- Define each activity in the project
- ID all primary effects
- Consider all secondary effects
- Estimate relative magnitude of all secondary effects
- Assess the significance of all secondary effects
- Justify "significance"

FIGURE 5.1 The GHG assessment boundary



The GHG assessment boundary includes all the primary effects and significant secondary effects associated with the GHG project, which can consist of multiple project activities (two project activities are depicted). Insignificant secondary effects are not included in the GHG assessment boundary.

Baseline candidates

- Baseline candidates are alternative technologies or practices, within a specified geographic area and temporal range, that could provide the same product or service as a *project activity*.

Identifying Baseline Candidates, 7

TABLE 7.1 Examples of the product or service and baseline candidates for some types of project activities

GHG PROJECT	PROJECT ACTIVITY	PRODUCT AND/OR SERVICE	PRIMARY EFFECT	EXAMPLES OF BASELINE CANDIDATE TYPES
Wind Power Project	Generate grid-connected electricity from wind turbines	Kilowatt-hours of electricity	Reduction in combustion emissions from generating grid-connected electricity	Other electricity-generating technologies on the grid, such as fossil fuel or other renewable energy technologies
Energy Efficiency Project	Improve energy efficiency of lighting by using energy-efficient light bulbs	Lighting (e.g., amount of illumination per square meter of floor space)	Reduction in combustion emissions from generating grid-connected electricity	• Incandescent light bulbs • Compact fluorescent light bulbs • Halogen light bulbs
Transportation Fuel Switch Project	Change from fossil fuel to biofuel in buses	Kilojoules of energy to power transportation	Reduction in combustion emissions from generating energy or off-grid electricity, or from flaring	• Diesel • Gasoline • Ethanol • Biodiesel • LNG
Industrial Fuel Switch Project	Fuel switch to natural gas at an off-grid stationary combustion plant	Tonnes of steam required for industrial processes	Reduction in combustion emissions from generating energy or off-grid electricity, or from flaring	• Other fossil fuels, such as coal or oil • Renewable energy sources
Afforestation Project	Change land-use to enhance carbon storage	Product/service changes depending on the land-use but the area of land is equivalent*	Increased storage or removals of CO_2 by biological processes	• Continuation of current land-use • Cropland growing different food crops • Pastureland
Forest Management Project	Change forest management to enhance carbon storage	Forestry commodities from a given area of land**	Increased storage or removals of CO_2 by biological processes	• Continuing current forest management • Variations in forest management, such as increasing thinning or fertilisation
Agricultural Tillage Project	Change tillage practices to enhance carbon storage	Agricultural commodities from a given area of land	Increased storage or removals of CO_2 by biological processes	• Continuing current tillage practices • No-till / zero tillage • Mouldboard ploughing • Conventional tillage • Ridge tillage
Landfill Gas (LFG) Project	a) Install equipment to capture methane b) Generate grid-connected electricity from captured methane	a) Collection and disposal of waste gases* b) Kilowatt-hours of electricity	a) Reduction in waste emissions b) Reduction in combustion emissions from generating grid-connected electricity	a) • Continuation of current activities • Flaring of LFG • Use of LFG for fuel b) Other electricity-generating technologies on the grid, such as fossil fuel or renewable energy technologies

Baseline scenario

- The baseline scenario is a reference case for the *project activity.* It is a hypothetical description of what would have most likely occurred in the absence of any considerations about climate change mitigation.
- The baseline scenario is used to estimate *baseline emissions.*
- *Three types:*
- implementation of the same technologies or practices used in the project activity (no additionality, see later);
- implementation of a *baseline candidate*;
- the continuation of current activities, technologies, or practices that, where relevant, provide the same type, quality, and quantity of product or service as the project activity.

- Example, we consider making plastic with chem B instead of chem A which is currently used
  - Replace chem A with chem B (proposed project)
  - Replace chem A with chem C (alternate solution)
  - Continue to use chem A in the product

Baseline emissions

- *GHG reductions* from a *project activity* are quantified relative to *baseline emissions*, which refers broadly to baseline GHG emissions, removals, or storage.
- Baseline emissions associated with *primary effects* are derived from either a *baseline scenario* (Chapter 8) or a *performance standard* (Chapter 9).
- Baseline emissions associated with *secondary effects* are estimated in Chapter 5 and will be linked to the project-specific baseline scenario.

Baseline procedures, two types

- Project-specific procedure—This procedure produces an estimate of baseline emissions through the identification of a *baseline scenario specific* to the proposed *project activity*.

- Performance standard procedure—This procedure produces an estimate of baseline emissions using a GHG emission rate derived from *a numerical analysis of the GHG emission rates of all baseline candidates*. It serves the same function as a baseline scenario, but avoids the need to identify an explicit baseline scenario for each project activity.

Additionality

- In the context of GHG programs, it is important to count only GHG reductions from project activities that differ from—or are additional to—their baseline scenarios (see Box 2.2).

- Distinguishing a project activity from its baseline scenario is often referred to as determining *additionality.*

- *A project that has additionality means that the project would not be done if there were no considerations for climate change mitigation*

- While the basic concept of additionality may be easy to understand, there is no common agreement about how to prove that a project activity and its baseline scenario are different.

Why is Additionality important?

- GHG emissions trading programs work by capping emissions of some individual sources.
- Offset credits allow these sources to go above their cap
- Offsets come from GHG reductions from outside the program
- Goal of trading programs: to achieve zero increase in GHG emissions
- Problem is that many projects to reduce GHG's would happen without regard to climate change mitigation (they don't have additionality, for instance they might have been done just to save money)
- IF a project would happen anyway, then the offset system actually allows a positive increase in GHG emissions
- Additionality is critical to the integrity of the program!!

GHG Reductions

- *GHG reduction* is either a reduction in GHG emissions or an increase in removals or storage of GHGs from the atmosphere, *relative* to baseline emissions.
- A *project activity's* total GHG reductions are quantified as the sum of its associated primary effect(s) and any significant secondary effects (which may involve decreases or countervailing increases in GHG emissions).

Estimating Baseline Emissions- Performance Standard Procedure, Requirements, 9

TABLE 9.2 Examples of performance metrics for different types of project activities

GHG PROJECT	PROJECT ACTIVITY	PRIMARY EFFECT	SAMPLE BASELINE CANDIDATES	POSSIBLE PERFORMANCE METRICS
PRODUCTION-BASED PERFORMANCE METRICS				
Wind Power Project	Generate grid-connected electricity from wind turbines	Reduction in combustion emissions from generating grid-connected electricity	Other electricity-generating technologies on the grid, such as fossil fuel or other renewable-energy technologies	• m^3 of gas consumed/kWh electricity generated • Tonnes coal/kWh electricity generated
Energy Efficiency Project	Improve energy efficiency of lighting by using energy-efficient light bulbs	Reduction in combustion emissions from generating grid-connected electricity	• Incandescent light bulbs • Compact fluorescent light bulbs • Halogen light bulbs	kWh electricity consumed/m^2 of lighted space
Transport-ation Fuel Switch Project	Change from fossil fuel to biofuel in buses	Reduction in combustion emissions from generating energy or off-grid electricity, or from flaring	• Diesel • Gasoline • Ethanol • Biodiesel • LNG	Litres of diesel fuel consumed/kilojoules of energy required for transportation
Industrial Fuel Switch Project	Fuel switch to natural gas at an off-grid stationary combustion plant	Reduction in combustion emissions from generating energy or off-grid electricity, or from flaring	• Other fossil fuels, such as coal or oil • Renewable energy sources	Tonnes of coal consumed/tonne of steam produced
TIME-BASED PERFORMANCE METRICS				
Afforestation Project	Change land-use to enhance carbon storage	Increased storage or removals of CO_2 by biological processes	• Continuation of current land-use • Cropland growing different food crops • Pastureland	Tonnes of CO_2eq sequestered/ha/yr
Forest Management Project	Change forest management to enhance carbon storage	Increased storage or removals of CO_2 by biologi-cal processes	• Continuing current forest management • Variations in forest management, such as increasing thinning or fertilisation	Tonnes of CO_2eq sequestered/ha/yr
Agricultural Tillage Project	Change tillage practices to enhance carbon storage	Increased storage or removals of CO_2 by biologi-cal processes	• Continuing current tillage practices • No-till or zero tillage • Mouldboard ploughing • Conventional tillage • Ridge tillage	Tonnes of CO_2eq sequestered/ha/yr
Landfill Gas (LFG) Project	a) Install equip-ment to capture methane b) Generate grid-connected electricity from captured methane	a) Reduction in waste emissions b) Reduction in combustion emissions from generating grid-connected electricity	a) • Continuation of current activity • Flaring of LFG • Use of LFG for fuel b) Other electricity-generating technologies on the grid, such as fossil fuel or renewable energy technologies	a) Tonnes of methane/m^3 landfill waste/month b) Tonnes coal/kWh electricity generated

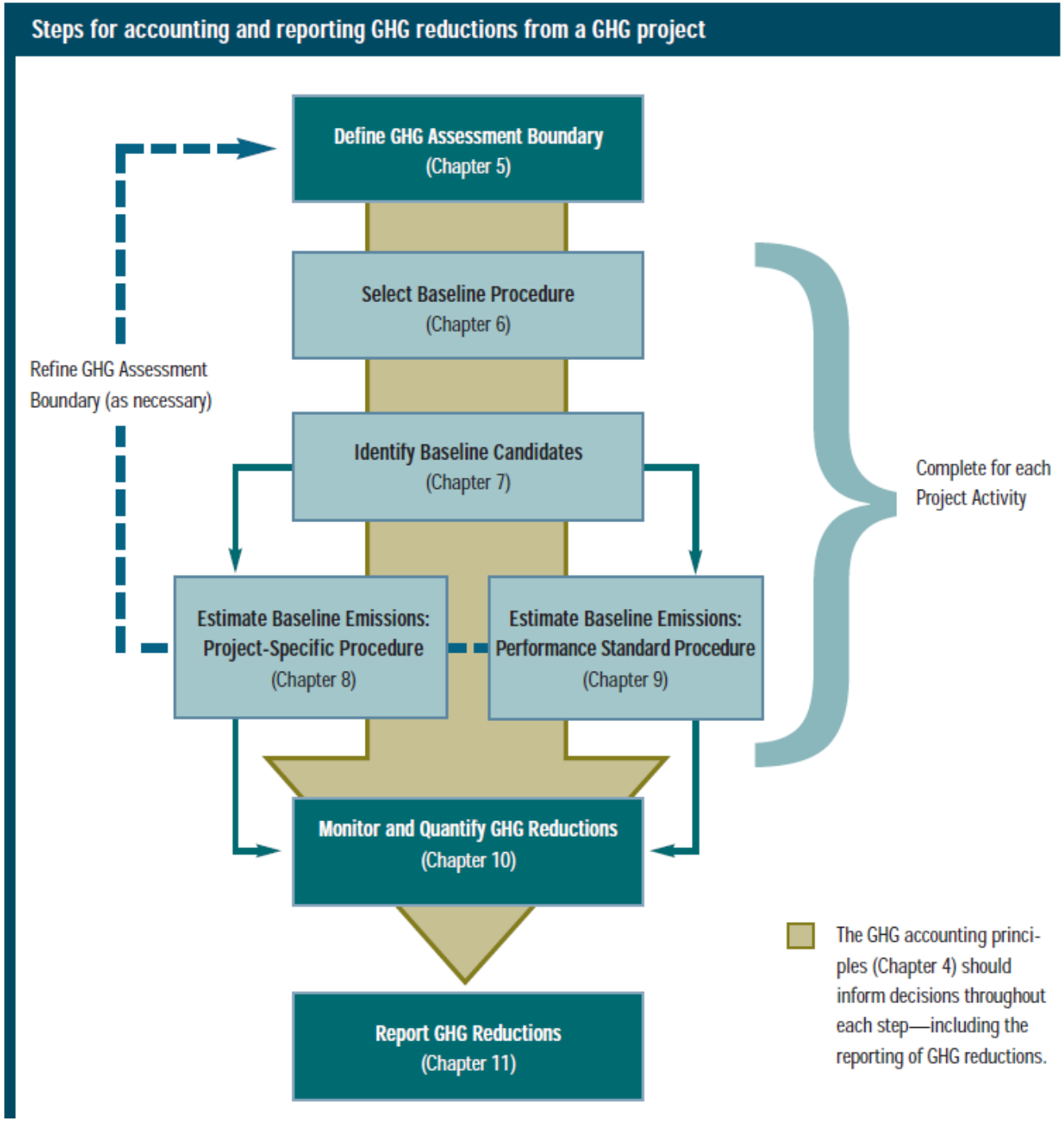
GHG Accounting Principles, 4

- Six principles are intended to underpin all aspects of the accounting, quantification, and reporting of project-based GHG reductions.
- Their purpose is to guide decisions where the Project Protocol affords *flexibility* or *discretion*, or where the requirements and guidance are *ambiguous* with respect to a particular situation.

GHG Accounting Principles, 4

- Six principles
  - Relevance
  - Completeness
  - Consistency, so meaningful comparisons are possible
  - Transparency, so reviewers can assess claims
  - Accuracy, reduce uncertainty
  - Conservatism, when uncertainty is high

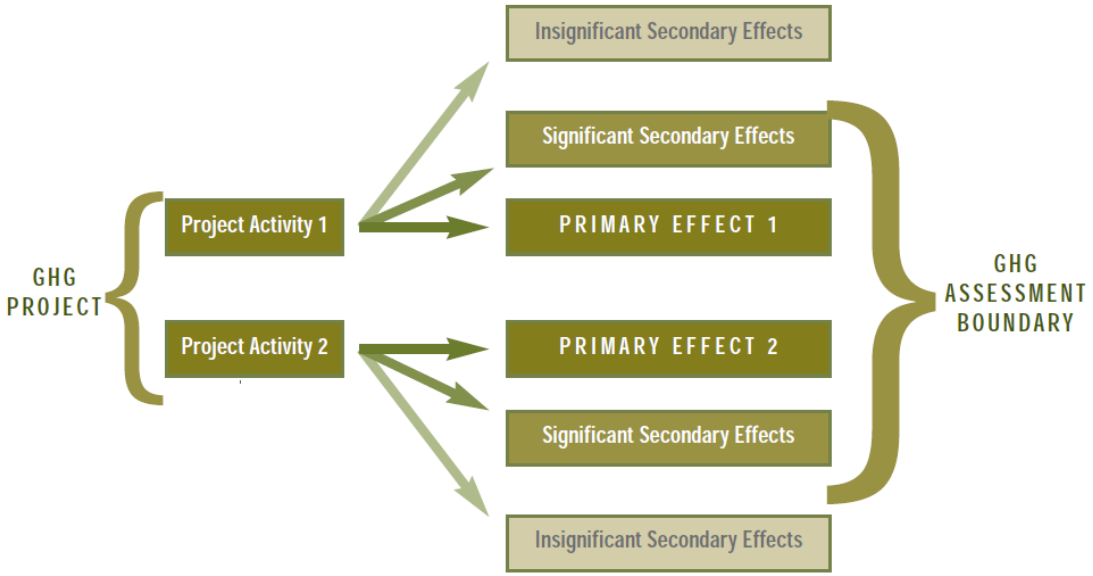
Steps for accounting and reporting GHG Reductions from a GHG project



Steps for accounting and reporting GHG Reductions from a GHG project

- Define the assessment boundary, 5

FIGURE 5.1 The GHG assessment boundary



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Assessment Boundary, 5

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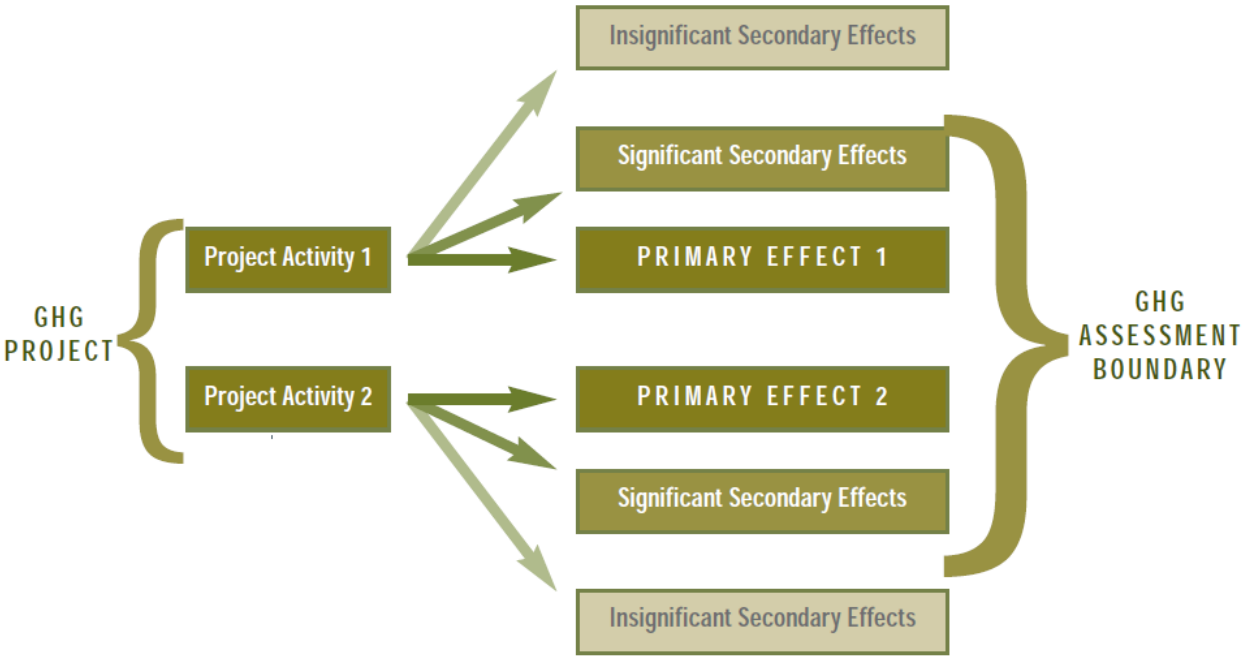

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Assessment Boundary, 5

TABLE 5.1 Examples of the relationship between GHG projects, project activities, and primary effects

GHG PROJECT	PROJECT ACTIVITY	PRIMARY EFFECT
Wind Power Project	Generate grid-connected electricity from wind turbines	Reduction in combustion emissions from generating grid-connected electricity
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Afforestation Project	Change land-use to enhance carbon storage	Increased storage or removals of CO_2 by biological processes
Forest Management Project	Change forest management to enhance carbon storage	Increased storage or removals of CO_2 by biological processes
Agricultural Tillage Project	Change tillage practices to enhance carbon storage	Increased storage or removals of CO_2 by biological processes
Landfill Gas Project	a) Install equipment to capture methane b) Generate grid-connected electricity from captured methane	a) Reduction in waste emissions b) Reduction in combustion emissions from generating grid-connected electricity

Select a baseline Procedure, 6

- Choosing whether project specific or performance standard procedure is preferred
- Standard procedure may be preferred if:
  - Number of similar projects
  - Verifiable data on project activity alternatives is difficult
  - Confidentiality issues
- Project specific if:
  - Baseline candidates information difficult to obtain

Identifying Baseline Candidates, 7

- Baseline candidates are alternative technologies or practices within a specified geographic area and temporal range that could provide the same product or service as the project activity.

Identifying Baseline Candidates, 7

- Requirements
  - **7.1 Define the product or service provided by the project activity.**
  - **7.2 Identify possible types of baseline candidates.**
  - **7.3 Define and justify the geographic area and the temporal range used to identify baseline candidates.**
  - **7.4 Define and justify any other criteria used to identify baseline candidates (legally possible).**
  - **7.5 Identify a final list of baseline candidates.**
  - **7.6 Identify baseline candidates that are representative of common practice (for the project-specific baseline procedure).**

Identifying Baseline Candidates, 7

TABLE 7.1 Examples of the product or service and baseline candidates for some types of project activities

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Estimating Baseline Emissions- Project Specific Procedure, 8

- The baseline scenario is a *reference case* for the project activity. It describes an activity or a set of activities that result in GHG emissions (referred to as “baseline emissions”), against which project activity emissions can be compared for the purpose of quantifying GHG reductions.
- Produces an estimate of baseline emissions for a project activity’s primary effect through the identification of a baseline scenario linked to the specific circumstances surrounding the project activity.
- The first component involves identifying the baseline scenario.
- The second component involves estimating the GHG emissions associated with the baseline scenario.

Estimating Baseline Emissions- Project Specific Procedure, Requirements, 8

- **Perform a comparative assessment of barriers. Identified barriers can bar baseline candidates.**
- **Identify and justify the baseline scenario** (what would have most likely occurred in the absence of any considerations about climate change mitigation.)
- **Estimate baseline emissions.** Use assumptions, calculations, and emission factors specific to the identified baseline scenario.

Three types of baseline scenarios:

- **Do nothing**
- The configuration, deployment, implementation, operation, and decommissioning of new technologies or practices described by one of the baseline candidates from Chapter 7.
- Continuation of current activities that, where relevant, provide the same type, quality, and quantity of product(s) or service(s) as the project activity.

Estimating Baseline Emissions- Performance Standard Procedure, 9

- The performance standard procedure analyses the GHG emission rates of all baseline candidates identified in Chapter 7 to construct a GHG emission performance standard against which project activity emissions can be compared.
- The performance standard is used to determine baseline emissions for the project activity's primary effect.
- Once a performance standard is developed, any number of similar project activities may be compared to it.

Estimating Baseline Emissions- Performance Standard Procedure, 9

- For energy efficiency, energy generation, and industrial process project activities, a GHG performance standard will generally be defined as a rate of GHG emissions per unit of a product or service produced by all the baseline candidates.
- For project activities involving storage or removals ofCO_2 by biological processes, fugitive emissions, or waste emissions—where there is no easily measured production of a product or service—the performance standard will usually be defined as a rate of GHG emissions (or removals) per unit of time and size or capacity of the baseline candidates.

TABLE 9.1 Types of performance standard emission rates

TYPES OF PERFORMANCE STANDARDS	RELEVANT TYPES OF PROJECT ACTIVITIES	PERFORMANCE STANDARD EXPRESSED AS:
Production-Based	Energy efficiency, energy generation, and industrial processes	$\frac{\text{GHG Emissions}}{\text{Unit of Product or Service}}$
Time-Based	Waste and fugitive emissions and storage or removals of CO_2 by biological processes	$\frac{\text{GHG Emissions}}{(\text{Unit of Time}) \cdot (\text{Unit of Baseline Candidate Size or Capacity})}$

Estimating Baseline Emissions- Performance Standard Procedure, Requirements, 9

- Specify appropriate performance metrics for all baseline candidates
- Calculate the GHG emission rate for each baseline candidate
- Calculate the GHG emission rate for different stringency
  - Most stringent
  - Weighted mean
  - Median
  - At least two better than average (eg, 10^{th} percentile)
- Select a stringency level
- Estimate baseline emissions

Estimating Baseline Emissions- Performance Standard Procedure, Requirements, 9

TABLE 9.2 Examples of performance metrics for different types of project activities

GHG PROJECT	PROJECT ACTIVITY	PRIMARY EFFECT	SAMPLE BASELINE CANDIDATES	POSSIBLE PERFORMANCE METRICS
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Industrial Fuel Switch Project	Fuel switch to natural gas at an off-grid stationary combustion plant	Reduction in combustion emissions from generating energy or off-grid electricity, or from flaring	• Other fossil fuels, such as coal or oil • Renewable energy sources	Tonnes of coal consumed/tonne of steam produced
TIME-BASED PERFORMANCE METRICS				
Afforestation Project	Change land-use to enhance carbon storage	Increased storage or removals of CO_2 by biological processes	• Continuation of current land-use • Cropland growing different food crops • Pastureland	Tonnes of CO_2eq sequestered/ha/yr
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Monitoring and quantifying GHG reductions, Requirements, 10

- **Create a plan for monitoring GHG emissions and baseline parameters related to each project activity's GHG effects.**
- **Quantify GHG reductions for the GHG project.**

Monitoring and quantifying GHG reductions, Requirements, 10

- **GHG Reduction**$_y$ (t CO_2eq) = Σ_z Project Activity Reduction$_{zy}$

  Where:

  Project Activity Reduction$_{zy}$ = Primary Effects$_{zy}$ + Secondary Effects$_{zy}$

  Primary Effects$_{zy}$ = Σ_p [Baseline Emissions$_{pzy}$ – Project Activity Emissions $_{pzy}$]

  Baseline Emissions$_{pzy}$ = Baseline GHG emissions related to the primary effect, p, for each project activity, z, in year y (in t CO_2eq)

  Project Activity Emissions$_{pyz}$ = GHG emissions related to primary effect, p, for each project activity, z, in year y (in t CO_2eq)

  Secondary Effects$_{zy}$ = Σ_s [Baseline Emissions$_{szy}$ – Project Activity Emissions$_{szy}$]

  Baseline Emissions$_{szy}$ = Baseline GHG emissions related to the secondary effect, s, for each project activity, z, in year y (in t CO_2eq)

  Project Activity Emissions$_{szy}$ = GHG emissions related to secondary effect, s, for each project activity, z, in year y (in t CO_2eq)

Monitoring and quantifying GHG reductions, Requirements, 10

Where GHG emission rates are used to quantify baseline and project activity emissions, use the following formulas:

- **Project Activity Emissions$_y$** = (Production Level$_y$) · (Project Activity Emission Rate$_y$)
- **Baseline Emissions$_y$** = (Production Level$_y$) · (Baseline Emission Rate$_y$)

Where:

Project Activity Emission Rate$_y$ = tonnes of CO_2eq per unit of production in year y for the project activity

Baseline Emission Rate$_y$ = tonnes of CO_2eq per unit of production in year y specified for the project activity's baseline scenario or performance standard

Production Level$_y$ = the amount produced in year y of the project activity's product or service (as defined in Chapter 7)

Monitoring and quantifying GHG reductions, Requirements, 10

The following formulas should be used to quantify the GHG reductions for all GHG projects involving biological GHG storage or removals as the primary effect:

- **GHG Reduction$_y$** (t CO_2eq) = Σ_z Project Activity Reduction$_{zy}$

Where:

Project Activity Reduction$_{zy}$ = Primary Effect$_{zy}$ + Secondary Effects$_{zy}$

Primary Effect$_{zy}$ (t CO_2eq) = Net Stocks$_{zy}$ · $\frac{44}{12}$ t CO_2/t carbon

Net Stocks$_{zy}$ (t carbon) = Σ_p [Project Activity Carbon Stocks$_{pzy}$ – Baseline Carbon Stocks$_{pzy}$]

Project Activity Carbon Stocks$_{pzy}$ = Σ_k carbon stocks from each biological carbon pool, k, related to each primary effect, p, for project activity, z, in year y (in t carbon)

Baseline Carbon Stocks$_{pzy}$ = Σ_k baseline carbon stocks from each biological carbon pool, k, related to each primary effect, p, for project activity, z, in year y (in t carbon)

Secondary Effects$_{zy}$ = Emissions Secondary Effects$_{zy}$ + Removals Secondary Effects$_{zy}$

Emissions Secondary Effects$_{zy}$ = Σ_s [Baseline Emissions$_{szy}$ – Project Activity Emissions$_{szy}$]

Baseline Emissions$_{szy}$ = Baseline GHG emissions related to the secondary effect, s, for each project activity, z, in year y (in t CO_2eq)

Project Activity Emissions$_{szy}$ = GHG emissions related to secondary effect, s, for each project activity, z, in year y (in t CO_2eq)

Removals Secondary Effects$_{zy}$ (t CO_2eq) = Net Stocks$_{zy}$ · $\frac{44}{12}$ t CO_2/t carbon

Net Stocks$_{zy}$ (t carbon) = Σ_s[Project Activity Carbon Stocks$_{szy}$ – Baseline Carbon Stocks$_{szy}$]

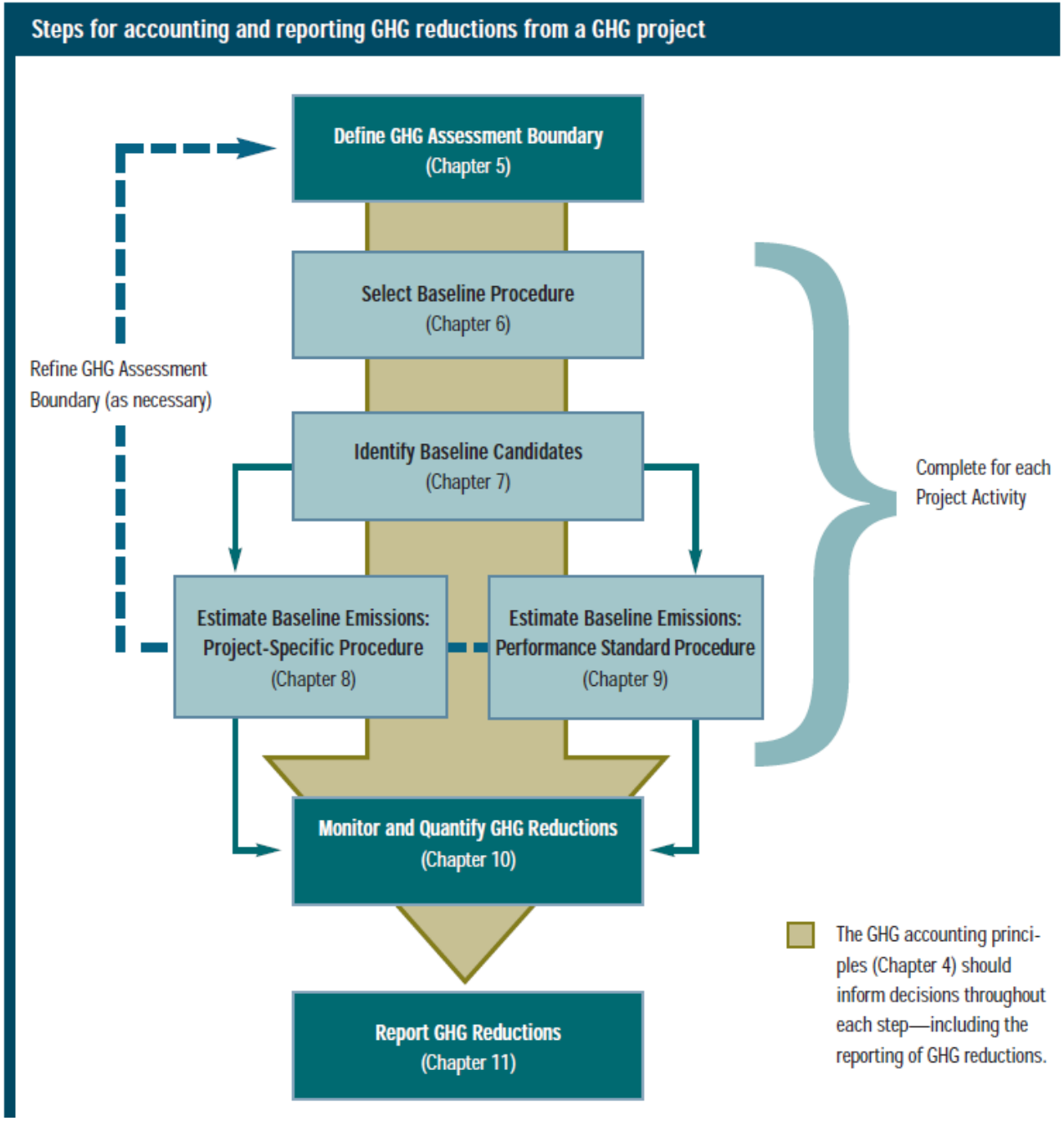
Project Activity Carbon Stocks$_{szy}$ = Σ_k carbon stocks from each biological carbon pool, k, related to each secondary effect, s, for project activity, z, in year y (in t carbon)

Baseline Carbon Stocks$_{szy}$ = Σ_k baseline carbon stocks from each biological carbon pool, k, related to each secondary effect, s, for project activity, z, in year y (in t carbon)

Reporting GHG reductions, Requirements, 11

- **Items required:**
  - **Description of the GHG Project**
  - **The GHG Assessment Boundary**
  - **Baseline Emissions for Each Project Activity and Primary Effect**
  - **Estimated GHG Reductions for the GHG Project**
  - **Monitoring Plan**
  - **Annual Monitoring and GHG Reduction Quantification Reports**

Questions???


Steps for accounting and reporting GHG reductions from a GHG project
Define GHG Assessment Boundary
(Chapter 5)
Select Baseline Procedure
(Chapter 6)
Refine GHG Assessment Boundary (as necessary)
Identify Baseline Candidates
(Chapter 7)
Complete for each Project Activity
Estimate Baseline Emissions: Project-Specific Procedure
(Chapter 8)
Estimate Baseline Emissions: Performance Standard Procedure
(Chapter 9)
Monitor and Quantify GHG Reductions
(Chapter 10)
Report GHG Reductions
(Chapter 11)
The GHG accounting principles (Chapter 4) should inform decisions throughout each step—including the reporting of GHG reductions.

Summary

- *GHG Protocol for Project Accounting*
- *GHG Activity*
- *GHG Source*
- *GHG Sink*
- *Primary Effect*
- *Secondary Effect*
- *Baseline Candidates*
- *Baseline Scenario*
- *Project Specific Procedure*
- *Performance Standard Procedure*
- *Additionality*
- *GHG Accounting Principles*