The GHG Protocol for Project Accounting: Example Using Project Specific Baseline Procedure

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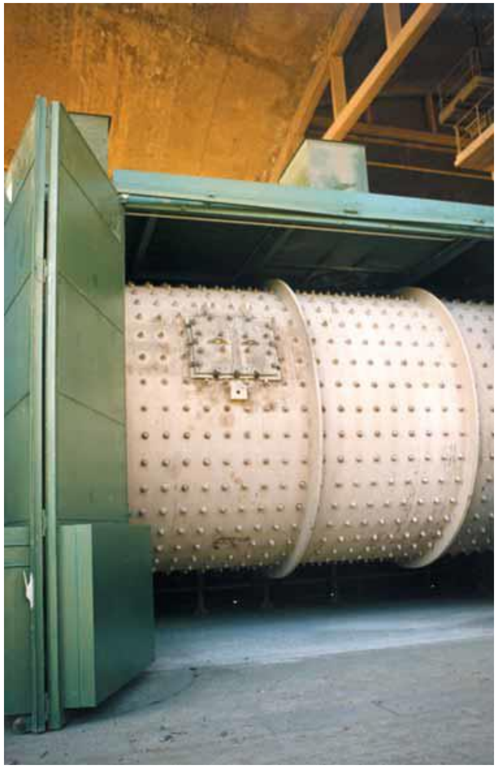
GHG Protocol for Project Accounting: *Cement Sector* Example Using Project Specific Baseline Procedure

- *Reference:*

WWW.ghgprotocol.org



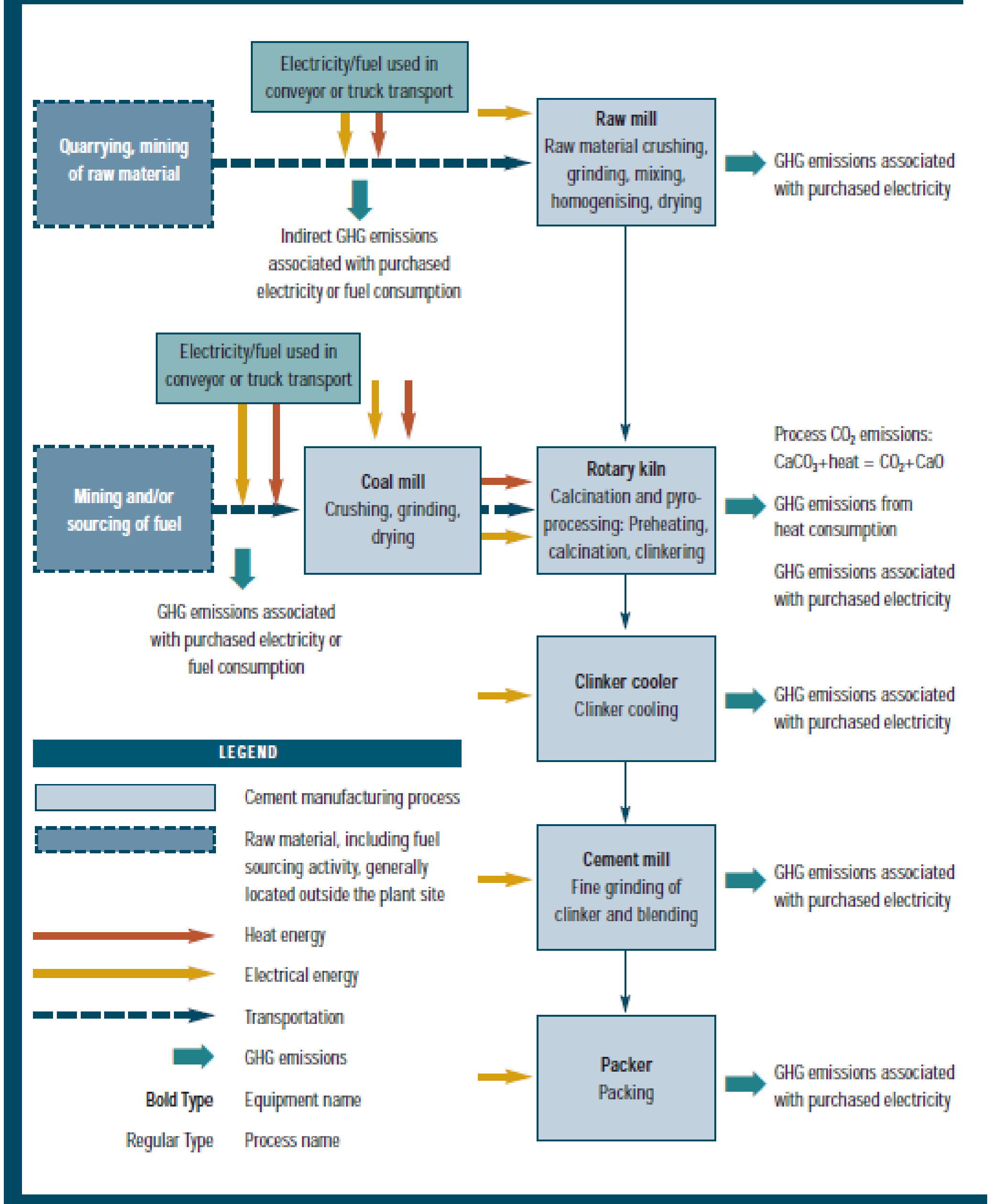
GHG Project: GHG Reductions in a Hypothetical Cement Manufacturing Plant

- *Company X produces Portland cement in three locations in Indonesia*
- *Reduce GHG emissions by*
  1. reducing emissions associated with the cement clinker production
  2. reducing GHG emissions associated with energy production and consumption.

Portland Cement Manufacturing

- Raw Materials, limestone silica sand, clay, blending materials are quarried and transported
- Raw materials are crushed, ground and homogenized
- Fuels are ground and dried
- In rotary kiln (2000 C), calcining and pyro-processing to form clinker nodules, burn fuels for heat
- Fuel used at about 3200-5500 MJ/tonne clinker
- Clinker is cooled, fine-ground, and blended with additives to make cement
- Ordinary Portland Cement (OPC)

FIGURE E1.1 Flow diagram of cement manufacturing process (dry process with rotary kiln), with energy consumption points and types of GHG emissions generated in a cement facility



GHG Project Description:

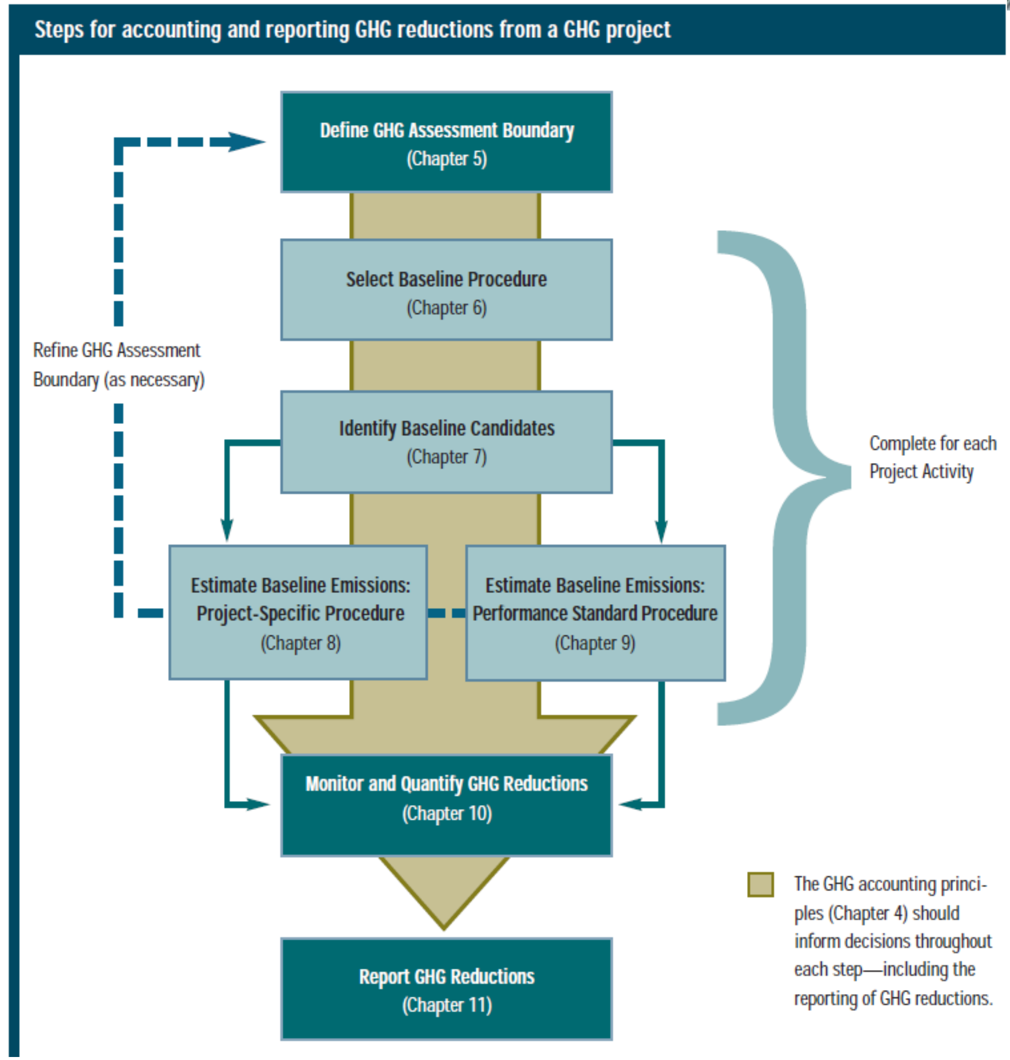
- Company X has 3 plants in Indonesia making OPC with cement kilns

- Project Activity 1.
  - Company X makes OPC with 95% clinker content
  - Proposal to manufacture blended cement, which uses increased proportions of limestone and pozzolan additives in the fine-grinding (after kilns) process. The result is cement with a lower clinker fraction (81 percent) but same physical properties.
  - Lowering the clinker-to-cement ratio reduces both process emissions (CO_2 from kiln reactions) and associated fuel-related GHG emissions.
  - Can reduce to clinker fraction of 91 % with existing equipment

- Project Activity 2.
  - Company X will replace a portion (15%) of the coal with biofuels found near its plants (palm kernel and rice husk), and consequently reduce GHG emissions.

Steps for accounting and reporting GHG Reductions from a GHG project: Boundary

- 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”



Defining the GHG Project Boundary (5):

- Identify the activities (5.1)
  - Reduce clinker content
  - Switch fuels to incorporate biomass fuels
- ID primary effects and consider secondary effects %. (5.2, 5.3)
- Estimate the relative magnitude and assess the significance of secondary effects (5.4, 5.5)
  - Should any secondary effects be included in the GHG boundary?

Estimate the relative magnitude and assess the significance of secondary effects (5.2-5.5)

- Project activity 1: (reduced clinker)
  - Primary effects
    - Reduced process emissions from calcination
    - Reduced combustion emissions from energy for pyro-processing
  - Secondary effects
    - Reduced combustion emissions from *reduced electricity* needed in clinker production, positive effect is smaller than primary effecs, to be conservative, not included in GHG boundary
    - *Reduced transportation* from reduced amt of raw materials, positive effect expected to be small, conservatively not included in GHG boundary
    - *Increased transportation of additives*, negative effect expected to be small, and counterbalanced by reduced transport of raw materials, not included in GHG boundary
    - *Increased combustion emissions from increased electricity used in preparation of additive materials*, negative effect expected to be small, and counterbalanced by reduced electricity of producing clinker, not included in GHG boundary
    - *Possible increase at other cement mfg sites that use additives due to a shortage of additives*, however, the additives are abundant and this is not included in GHG boundary

Estimate the relative magnitude and assess the significance of secondary effects (5.2-5.5)

- Project activity 2: (biofuels)
  - Primary effects
    - Reduced process emissions from calcination
    - Reduced combustion emissions from energy for pyro-processing
  - Secondary effects
    1. Increased transportation from biofuels, reduced amt of raw materials, positive effect expected to be small, conservatively not included in GHG boundary
    2. Reduced emmissions from coal transport
    3. Reduced waste emissions from disposal or decomposing in landfills of biofuel materials
    4. Reduced electricity use for coal preparation
    5. Increase in combustion emissions caused by reduced availability of biofuels
  - Estimation is that 2+3+4 is greater than 1 and they contribute to a 4% reduction in GHG, for conservatism, will not be included in the GHG boundary
  - Research indicates that rice husks and palm kernel shells are 1.5 times greater than the demand, 5 is not significant and is not included in GHG boundary

Selecting a Baseline Procedure (6)

- 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.

- The project-specific procedure was chosen to estimate baseline emissions for both project activities.
- The project-specific procedure was preferred over a performance standard approach because of difficulties in obtaining performance data on individual cement kilns in Indonesia.
- Further, the total number of comparable cement kilns in Indonesia is small, making it difficult to develop a robust statistical performance standard.

Identifying the Baseline Candidates: Define the service or product (7.1)

- Baseline candidates identified include representative types of plants, technologies, or practices that produce the same product or service as the project activities within a specified geographic area and temporal range.

- For Project Activity 1, the product is cement that is equally as strong as OPC.
- For Project Activity 2, the product is heat energy for kiln burning to create clinker.

Identifying the Baseline Candidates: Same service or product (7.2)

- Activity 1.
- The range of technical options to produce cement equal in strength to OPC
  1. Current OPC with 95% clinker
  2. Produce OPC with 91% clinker
  3. Portland Pozzolan Cement (PPC), strength develops slower
  4. Produce OPC with new equipment with 81% clinker

Identifying the Baseline Candidates: Same service or product (7.2)

- Activity 2.
- The range of possible fuels to provide energy to produce clinker
  1. Coal
  2. Natural gas
  3. Industrial diesel oil
  4. Non renewable resources, tires, waste oil, hazardous waste. But not available in Indonesia.
  5. Renewable energy fuels such as biomass

Identifying the Baseline Candidates: Define geographic area and time (7.3)

- Activity 1.
- Indonesia, cement must comply with local regulation, SNI 15-3500-1994
- Facilities must be close to cement demand locations
- 1997 to present, coincides with Asian economic crisis, in which most kilns were dry kilns

- Activity 2.
- Indonesia, all fuel is obtained domestically
- 1997 to present, coincides with Asian economic crisis

Identifying the Baseline Candidates: Other criteria (7.4)

- Activity 1.
- Cement must comply with local regulation, SNI 15-3500-1994, thus no other legal requirements are pertinent, no other criteria identified

- Activity 2.
- Indonesia does not have any legal requirements with respect to fuel used in clinker production, no other criteria identified

Identifying the Final List of Baseline Candidates (7.5)

- Activity 1.
    1. Current OPC with 95% clinker
    2. Produce OPC with 91% clinker
    3. ~~Portland Pozzolan Cement (PPC), strength develops slower and is thus eliminated~~ (not the same service, eliminated)
    4. Produce OPC with new equipment for a 81% clinker

- Activity 2.
    1. Coal, cheap
    2. Natural gas, since 1997 25% more expensive than coal
    3. Industrial diesel oil, 200 % more expensive than coal
    4. ~~Non renewable resources, tires, waste oil, hazardous waste.~~ But not available in Indonesia so eliminated.
    5. Renewable energy fuels such as biomass (Activity 2)

Identifying Baseline Candidates of Common Practice (7.6)

- Activity 1.
    1. Current OPC with 95% clinker, research determines that 82% of cement in Indonesia is OPC in 2002

- Activity 2.
    1. Clinker production utilizes coal nearly 100%

Estimating Baseline Emissions-Project Specific Procedure (8)

- The project-specific procedure estimates baseline emissions by identifying a baseline scenario for each project activity (8.2):

- The list of possible alternatives for each project activity—the baseline candidates—is evaluated using a comparative assessment of barriers.

Estimating Baseline Emissions-Project Specific Procedure (8)

- Identify barriers to the project activity and baseline candidates (8.1):

- Financial and budgetary
  - Investment risk
  - High cost
- Technology and Operation and Maintenance
- Infrastructure and Market Structure
- Institutional, Social, and Cultural
- Resources

Estimating Baseline Emissions-Project Specific Procedure (8)

- Identifying a baseline scenario: Activity 1 (8.2):
- The list of possible alternatives for each project activity—the baseline candidates—is evaluated using a comparative assessment of barriers.

TABLE E1.3 Rough ranking of baseline scenario alternatives by the cumulative importance of barriers

BASELINE SCENARIO ALTERNATIVES	BARRIER 1: INVESTMENT/BUDGETARY (H)*	BARRIER 2: TECHNOLOGY O&M (L)*	BARRIER 3: SOCIAL/CULTURAL (M)*	RANK BY CUMULATIVE IMPACT
Project Activity 1	High	High	High	Highest barriers
Baseline Candidate 1: Continuation of current activities	Not present	Not present	Not present	No barriers
Baseline Candidate 2: OPC production with 91% clinker-to-cement ratio	Low	Low	Low	Low barriers

*The relative importance of the barriers compared to each other: H = Significant barrier; M = Moderately significant barrier; L = Less significant barrier.

Estimating Baseline Emissions-Project Specific Procedure (8)

- Identifying a baseline scenario: Activity 1 (8.2):

- High barriers to Activity 1 prove additionality and reject it as the baseline scenario.
- This comparative assessment of barriers doesn’t unambiguously identify a baseline scenario
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TABLE E1.4 Results of comparative assessment of barriers

BASELINE SCENARIO ALTERNATIVES	RANK BY CUMULATIVE IMPACT OF BARRIERS	CONCLUSION
Project Activity 1	Highest barriers	Reject as baseline scenario
Baseline Candidate 1: Continuation of current activities	No barriers	Could be the baseline scenario
Baseline Candidate 2: OPC production with 91% clinker-to-cement ratio	Low barriers	Could be the baseline scenario

Estimating Baseline Emissions-Project Specific Procedure (8)

- Identifying a baseline scenario: Activity 1 (8.2):
- A net benefits assessment indicates that baseline candidate 2 should be selected as the baseline candidate
- It has low barriers and offers financially attractive net benefits to Company X
- It is also conservative

- Baseline candidate 2, 91% clinker is identified as the baseline scenario!!

TABLE E1.5 Incremental costs and net financial benefits for Project Activity 1 and associated baseline candidates

	INCREMENTAL COSTS	INCREMENTAL BENEFITS	NET FINANCIAL BENEFITS
Project Activity 1	Investment costs— • Equipment and human resources to improve clinker quality and QA/QC. Additional operating costs— • Additional cost of additive material to reduce clinker-to-cement ratio from 95 percent to 81 percent. • Additional cost of transporting the additive materials. • Additional electricity cost for preparing the additive materials. Market entry costs— To gain market entry there will be additional marketing costs for the first four years.	• Slight reduction in fuel costs from a reduction in clinker production. • Revenues from the sale of cement (same for other alternatives). • If the market for blended cement grows in Indonesia, Company X may benefit from this project activity in terms of gaining early entry into the market.	*Direct Financial:* A negative net income is expected. Incremental investment and the additional operating and marketing costs exceed the cost savings from reduced clinker use and sale of cement. Using the weighted average capital cost of 12 percent as the discount rate, the NPV for 20 years is: negative $ 3 million (U.S.). *Market Entry:* At this point such benefits are speculative and insufficient to justify the incremental costs. *Conclusion:* Negative net benefits.
Baseline Candidate 1: Continuation of current activities	Zero relative costs (no additional investment required or costs foreseen).	Zero relative benefits (no additional savings or revenues foreseen).	Zero net benefits.
Baseline Candidate 2: OPC production with a 91 percent clinker-to-cement ratio	Additional operating costs— • Additional cost of additive material to reduce clinker-to-cement ratio from 95 percent to 91 percent. • Additional cost of transporting additive materials. • Additional electricity cost for preparing the additive materials.	• Small reduction in fuel costs from a reduction in clinker production. • Revenues from the sales of cement (same for other alternatives).	Increase in income from the savings associated with a lower clinker usage. This gives a positive cash flow. Using the weighted average capital cost of 12 percent as the discount rate, the NPV for 20 years is $20 million (U.S.). *Conclusion:* Large positive net benefits.

Estimating Baseline Emissions-Project Specific Procedure (8)

- Identifying a baseline scenario: Activity 2 (8.2):
- The list of possible alternatives for each project activity—the baseline candidates—is evaluated using a comparative assessment of barriers.

TABLE E1.8 Assessment of financial and budgetary barriers for Project Activity 2 and its associated baseline candidates

BASELINE SCENARIO ALTERNATIVE	INVESTMENT COST	FUEL COST	CONCLUSION
Project Activity 2	U.S. $15 million	U.S. $0.007/Mcal*	Lower fuel costs but high up-front investment costs required, with limited access to capital due to the poor Indonesian investment climate.
Baseline Candidate 1: Continuation of current activities (coal)	None	U.S. $0.071/Mcal	Current activities have the least cost overall.
Baseline Candidate 2: Replacement of coal with natural gas	None	U.S. $0.089/Mcal	Significantly more expensive than using coal (U.S. $0.02/Mcal higher cost).
Baseline Candidate 3: Replacement of coal with fuel oil	None	U.S. $0.142/Mcal	More expensive than using coal or natural gas.

*Assuming weighted average of rice husk and palm kernel shell utilization. Utilization of renewable sources increases heat consumption per tonne of clinker produced. This heat consumption increase depends on the amount of biofuel used with the actual increase requiring monitoring.

Estimating Baseline Emissions-Project Specific Procedure (8)

- Identifying a baseline scenario: Activity 2 (8.2):
- Comparative assessment of barriers.
- Since Project activity 2 has high barriers, additionality is proven, and it is rejected as the baseline scenario
- Baseline candidates 2 and 3 have significant barriers
- Baseline candidate 1, continuation of coal firing involves no capital investment and faces no barriers and is identified as the baseline scenario.

TABLE E1.9 Rough ranking of baseline scenario alternatives by cumulative significance of barriers

BASELINE SCENARIO ALTERNATIVES	BARRIER 1: INVESTMENT/BUDGETARY (H)*	BARRIER 2: INFRASTRUCTURE (M)*	RANK BY CUMULATIVE IMPACT
Project Activity 2	High	High	Highest Barriers
Baseline Candidate 1: Continuation of current activities	Not present	Not present	No barriers
Baseline Candidate 2: Replacement of coal with natural gas	Medium	Not present	Medium barriers
Baseline Candidate 3: Replacement of coal with fuel oil	Medium/high	Not present	Medium/high barriers

*The relative importance of barriers compared to each other: H = Significant barrier; M = Moderately significant barrier.

EXAMPLES

Cement Sector GHG Project

TABLE E1.10 Results of comparative assessment of barriers

BASELINE SCENARIO ALTERNATIVES	RANK BY CUMULATIVE IMPACT	CONCLUSION
Project Activity 2	Highest barriers	Rejected as the baseline scenario.
Baseline Candidate 1: Continuation of current activities	No barriers	Identified as the baseline scenario.
Baseline Candidate 2: Replacement of coal with natural gas	Medium barriers	Rejected as the baseline scenario.
Baseline Candidate 3: Replacement of coal with fuel oil	Medium/high barriers	Rejected as the baseline scenario.

Estimating Baseline Emissions-Project Specific Procedure (8)

- Estimating baseline emissions (8.3)

- Baseline emissions are estimated for each primary effect, based on the identified baseline scenarios for each project activity.

Estimating Baseline Emissions-Project Specific Procedure (8)

- Estimating baseline emissions (8.3)

- Project Activity 1 Primary Effect 1: reduced process emissions
- NOTE, WE USE 91% CLINKER CONTENT AS THE BASELINE, NOT THE CURRENT PRACTICE
  - Emission factor for calcination 0.525 t CO2e/ 1 tonne clinker
  - (0.91 t clinker/t cement) . (0.525 t CO**2**/t clinker)
  - 0.478 tonnes of CO2eq for every tonne of cement produced by Company X

Estimating Baseline Emissions-Project Specific Procedure (8)

- Estimating baseline emissions (8.3)

- Project Activity 1 Primary Effect 2: reduced combustion emissions
- Coal from Indonesia has an emission factor of 0.402 kg CO_2eq/Megacalorie (CO_2/Mcal).
- Clinker requires an energy input of 755 Mcal/t of clinker.
- = (0.402 kg CO_2eq/Mcal) . (755 Mcal/t clinker)

  x (0.91 t clinker/t cement) / (1,000 kg CO_2 /t CO_2)
- **= 0.276 tonnes of CO_2eq for every tonne of cement produced by Company X**

Estimating Baseline Emissions-Project Specific Procedure (8)

- Estimating baseline emissions (8.3)

- Project Activity 2 Primary Effect 3: reduced emissions from biomass fuel
  - Must base calculations based on results of Activity 1, ie., premised on 81% clinker content
- = (0.402 kg CO_2eq/Mcal) . (755 Mcal/t clinker)

  x (0.81 t clinker/t cement) / (1,000 kg CO_2/t CO_2)
- **= 0.246 tonnes of CO_2eq for every tonne of cement produced by Company X**

Monitoring and Quantifying the GHG Reductions (10)

- A detailed monitoring plan will include provisions for monitoring frequency, record keeping, and methods used to measure, calculate, or estimate data on GHG emissions and baseline parameters.

Monitoring and Quantifying the GHG Reductions (10)

- Activity 1
- GHG emissions are monitored by indirect measurement and calculations

TABLE E1.11 Data requirements and uncertainty levels for monitoring Project Activity 1 emissions

GHG EFFECT / SOURCE	DATA	LEVEL OF UNCERTAINTY	UNCERTAINTY FACTORS	HOW UNCERTAINTIES ARE ADDRESSED
Primary Effect 1: Industrial process emissions	Clinker-to-cement ratio of blended cement	Low	N/A	N/A
	CO_2 emission factor due to calcination process	Low	MgO and CaO content of raw material and clinker	Conduct a laboratory analysis using x-ray analyser.
	Tonnes of cement produced by Company X	Low	N/A	N/A
Primary Effect 2: Combustion emissions from generating energy for pyro-processing	CO_2 emission factor for coal used in clinker production process (tonnes CO_2/Mcal)	Low	Heat values for coal used	• Conduct a laboratory analysis to test the heating values for coal used. • In the absence of laboratory analysis, use IPCC default emission factors.
	Energy content of coal used in clinker production process (Mcal/tonne)	Low	Heat values for coal used	• Conduct a laboratory analysis to test the heating values for coal used. • In the absence of laboratory analysis, use IPCC default emission factors.
	Amount of coal used in clinker production process (tonnes)	Low	N/A	N/A

Monitoring and Quantifying the GHG Reductions (10)

- Activity 1
- Also need to monitor baseline parameters
- If additive materials become scarce, there might be secondary effects (others finding other substitutes with different GWP) then must reevaluate the baseline emissions
- If blended (81% clinker) becomes the norm (>30% market penetration, then the baseline scenario is no longer valid (no additionality, this is what the company would do normally) and the GHG reductions would not be valid!!!
- Project Risk!!!

TABLE E1.12 Data requirements and uncertainty levels for monitoring baseline parameters related to Project Activity 1 (reducing clinker content)

BASELINE PARAMETER/ ASSUMPTION	DATA	LEVEL OF UNCERTAINTY	UNCERTAINTY FACTORS	HOW UNCERTAINTIES ARE ADDRESSED
Additive materials (fly ash, trass) remain abundantly available	Availability of unused additive materials	Medium	Displacement of other users of fly ash and trass	Regular surveys of other users of fly ash and trass to ascertain level of use.
Blended cement has limited market penetration in Indonesia	Total sales of OPC in Indonesia Total sales of blended cement in Indonesia Sales of non-OPC and non-blended cement in Indonesia Market share of blended cement in Indonesia	Low	Lack of records and available data on cement market	• Conduct a data assessment from the cement market association and existing market studies. • Conduct a regular survey and investigation of the OPC and blended cement market. • An independent expert should validate the data quality for the cement sector.
	Strength of blended cement and OPC cement	Low	N/A	Conduct a laboratory analysis to assess the OPC and blended cement strength.

Monitoring and Quantifying the GHG Reductions (10)

- Activity 2
- Also need to monitor baseline parameters
- If biofuel materials become scarce, rice husks and palm kernel shells available at less than 1.5 times amount currently demanded then possible secondary effects may arise (others finding other substitutes with different GWP)
- If true, then must reevaluate the baseline emissions, must estimate how other users of the biofuels will change their GWP emmissions and alter the baseline!!

TABLE E1.13 Data requirements and uncertainty levels for monitoring baseline parameters related to Project Activity 2 (switching fuels)

BASELINE PARAMETER/ ASSUMPTION	DATA	LEVEL OF UNCERTAINTY	UNCERTAINTY FACTORS	HOW UNCERTAINTIES ARE ADDRESSED
Energy input required to produce one tonne of clinker	Specific heat consumption using coal fuel only	Low	N/A	Pre-project documentation of specific heat consumption of coal used for clinker production.
Biofuels remain abundantly available	Availability of unused rice husks and palm kernel shells	Medium .	Quantity of unused rice husks and palm kernel shells	Regular surveys of sources for rice husks and palm kernel shells to ascertain level of availability.
	Biofuels used by other users	Medium	Quantity of biofuel used by other users	Regular surveys of other users of rice husks and palm kernel shells to ascertain level of use.

Monitoring and Quantifying the GHG Reductions (10)

- Identifying time period
- Activity 1:
  - Estimated at 5 years
  - Based on expectation that blended cement penetration in Indonesian market would be 30% in 5 yrs
  - India blended cement is 47% of market, took about 5 years (1999-2003)
- Activity 2:
  - Estimated at 15 years
  - Coal is available, cheap and used at almost 100%
  - Biomass collection is not common nor will it be in near future
- GHG Project overall time period is I5 yrs, shortest valid baseline scenario time length

Monitoring and Quantifying the GHG Reductions (10)

- Calculations for quantifying GHG reductions
- Project Activity 1, Primary Effect 1 (reduced clinker content)
  - = (0.81 t clinker/t cement) (0.525 t CO_2/t clinker)
  - **= 0.425 tonnes of CO_2eq for every tonne of cement produced by Company X**
- Baseline emissions, Primary Effect 1
  - 0.478 t CO**2**/t of cement
- GHG reductions will therefore be:
- = 0.478 – 0.425 **= 0.053 t CO2eq/t cement produced**

Monitoring and Quantifying the GHG Reductions (10)

- Calculations for quantifying GHG reductions
- Project Activity 1, Primary Effect 2 (reduction in combustion emissions from reduced clinker content)
- GHG emissions from Project Activity 1, Primary Effect 2 are:
  - = (0.402 kg CO_2eq/Mcal) . (755 Mcal/t clinker)(0.81 t clinker/t cement) / (1,000 kg CO_2/t CO_2)
  - = 0.246 tonnes of CO2eq for every tonne of cement produced by Co. X
- Baseline emissions for Primary Effect 2 were estimated as 0.276 t CO_2eq/t of cement.
- GHG reductions will therefore be:
  - = 0.276 – 0.246 = **0.03 t CO_2eq/t cement produced**

Monitoring and Quantifying the GHG Reductions (10)

- Calculations for quantifying GHG reductions
- Project Activity 2, Primary Effect 3 (reduction in combustion emissions from switch from coal to biofuels)
  - Will substitute 15% of the coal with biofuels (zero emission factor)
- GHG emissions from Project Activity 2, Primary Effect 3 are:
- = (0.246 t CO_2eq/t cement) . (0.85) **= 0.209 t CO_2eq/t cement**
- **(NOTE, 0.246 IS BASED ON RESULTS FROM ACTIVITY 1, NOT BASELINE)**
- Baseline emissions for Project Activity 2 were estimated as 0.246 t CO2eq/t of cement.
- GHG reductions will therefore be:

  = 0.246 – 0.209 **= 0.037 t CO_2eq/t cement produced**

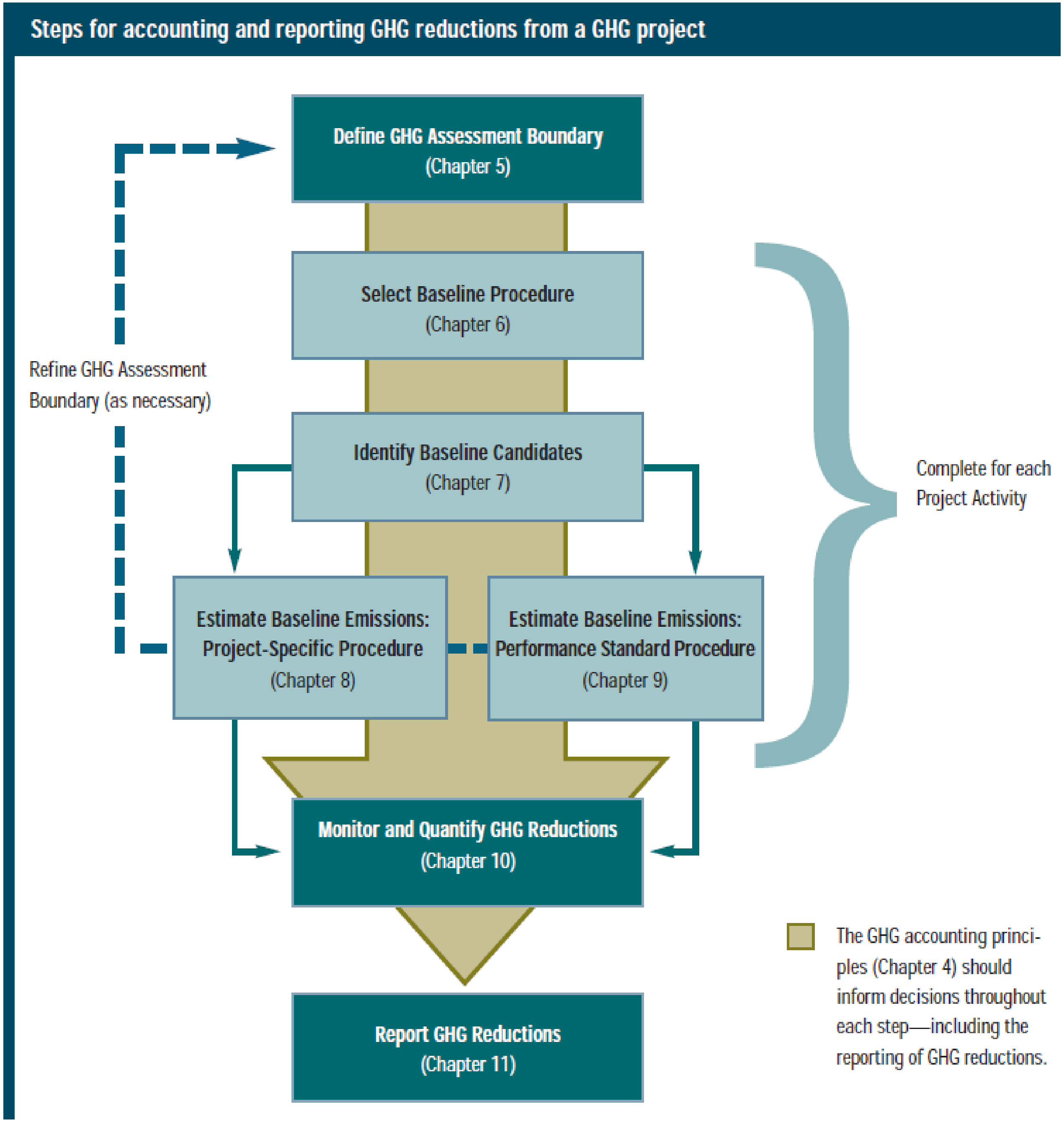
Monitoring and Quantifying the GHG Reductions (10)

- Calculations for quantifying GHG reductions
- Aggregating the GHG reductions associated with each primary effect together, total GHG reductions related to primary effects will be:
  - = 0.053 + 0.03 + 0.037 = **0.12 t CO2eq/t cement produced**
- Company X expected to have an avg annual cement production of 2 million tonnes
- = (2 million t) . (0.12 t CO_2eq/t cement) **= 240,000 t CO_2eq.**
- This is estimated before the project occurs, must also check the results during and after the project.

Monitoring and Quantifying the GHG Reductions (10), *ex post*

- Must quantify the GHG reductions during and after the project
- R = BE – PE
  - R = Annual GHG reductions for the entire GHG project
  - BE = Total annual baseline emissions for all three GHG project primary effects
  - PE = Total annual GHG project emissions
- $R = [C_y \cdot CF_b \cdot EF_p] + [C_y \cdot CF_b \cdot E \cdot EF_c] - [C_y \cdot CF_p \cdot EF_p] + [F_y \cdot EC_c \cdot EF_c]$
- C_y = Quantity of cement produced in year *y*, in tonnes
- CF_b = Fraction of clinker in cement, baseline scenario = 0.91
- EF_p = Emission factor for process emissions from clinker production = 0.525 t CO_2/t clinker (WBCSD Cement Protocol 2001).
- E = Energy input from coal required to produce a tonne of clinker = 755 Mcal/tonne of clinker (as determined through pre-implementation monitoring)
- EF_c = Emission factor for coal combustion = 0.402 kg CO_2eq/Mcal (as determined under the monitoring plan)
- CF_p = Fraction of clinker in cement, GHG project = 0.81
- F_y = Amount of coal consumed in year *y*, in tonnes
- EC_c = Energy content of coal in units of Mcal/tonne, as determined under the monitoring plan

Questions???



Steps for accounting and reporting GHG reductions from a GHG project
Define GHG Assessment Boundary (Chapter 5)
Select Baseline Procedure (Chapter 6)
Identify Baseline Candidates (Chapter 7)
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)
Refine GHG Assessment Boundary (as necessary)
Complete for each Project Activity
The GHG accounting principles (Chapter 4) should inform decisions throughout each step—including the reporting of GHG reductions.