Presentation on GHG Inventorization

for

Bengal Chamber of Commerce & Industry

by

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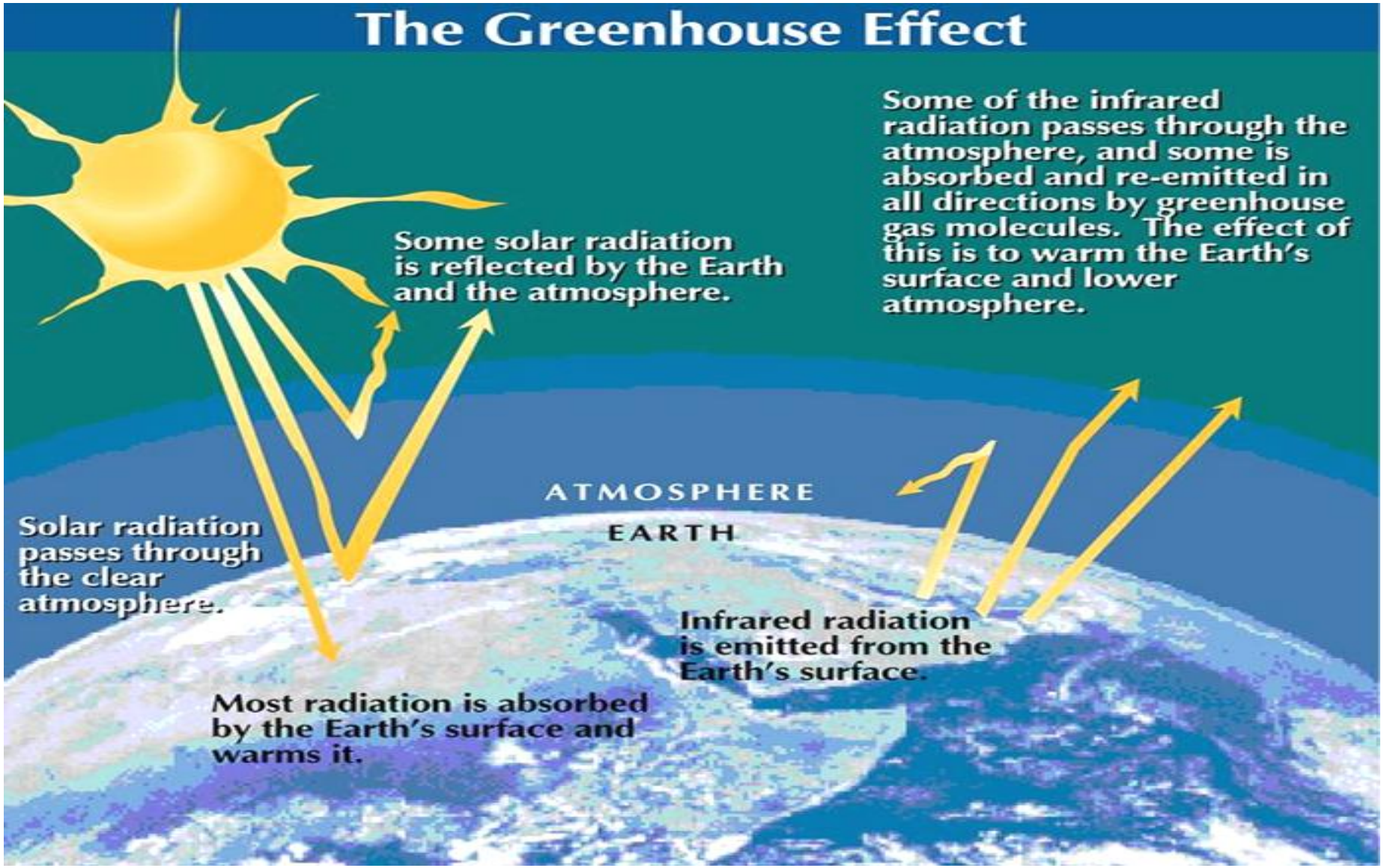
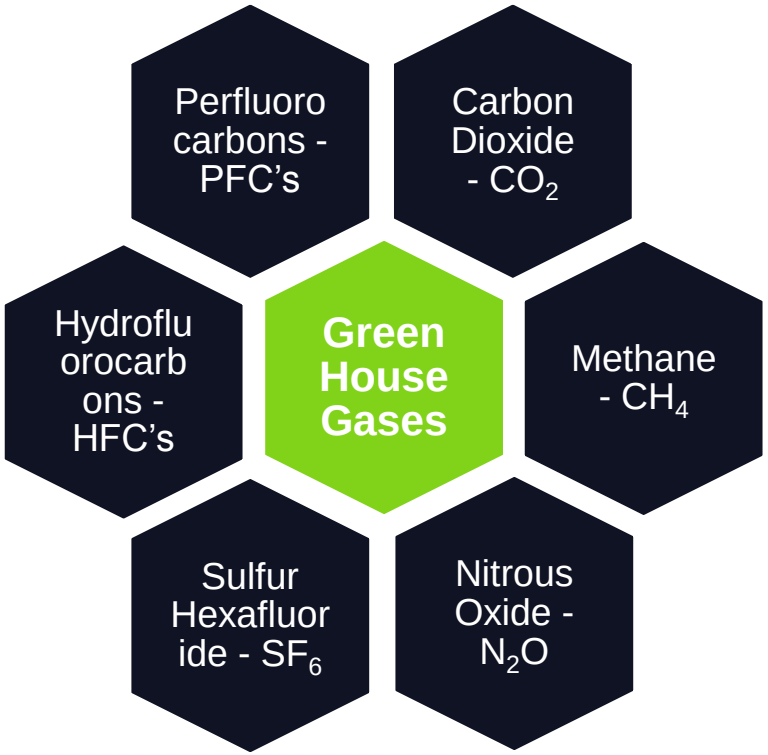
The Greenhouse Effect



Introduction - Greenhouse Gases

Six Green House Gases Typically Covered by Existing Regulations / Protocols:



Green house gas (GHG)	Global Warming Potential
Carbon-di-oxide (CO_2)	**1**
Methane (CH_4)	**21**
Nitrous oxide (N_2O)	**310**
Per fluoro carbons (PFCs)	**560 ~ 9200**
Hydro fluoro carbons (HFCs)	**140 to 11700**
Sulphur hexa fluoride (SF_6)	**Above 10,000**

'The total set of greenhouse gas emissions caused directly and indirectly by an [individual, event, organization, product] expressed as CO2e.'

Or

"Measure of the impact human activities have on the environment in terms of the amount of green house gases produced*, measured in units of Carbon Dioxide"*

GHG Concentration Levels

GHG listed in Annex A of Kyoto Protocol					
s no	GHG	unit	1750	2007	GWP
1	CO_2	ppm	280	384	1
2	CH_4	ppb	700	1857	25
3	N_2O	ppb	270	321	298
4	CFC 12	ppt	0	541	10900
5	HFC 134a	ppt	0	49	1430
6	SF_6	ppt	0	6.4	22800

Conceptual Framework: Greenhouse Gas Accounting and Carbon Footprint

The term "Carbon Footprinting" is almost synonymous with the term "GHG Accounting", as the exercise of accounting GHG emissions of an organization reveals its GHG intensity in "Carbon" terms, i.e., its Carbon Footprint.

Greenhouse Gas (GHG) Accounting

- GHG accounting encompasses all activities associated with measuring, reporting, and verifying an organization's emissions (i.e., from sources) and removals (i.e., from sinks) any kind of greenhouse gases (GHG)
- Its the first step towards understanding the impacts of an organization to climate change

Carbon Footprinting

- Carbon Footprint is the "measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide"
- Subset of ecological footprint, including all human demands on biosphere

Characteristics

- Encompasses all possible causes that giving rise to GHG emissions:
  - Direct (on-site, internal)
  - Indirect emissions (off-site, external, embodied, upstream, & downstream)
- Critical building block in an effective corporate strategy to address climate change
- Provides insight into the efficiency of material, energy and service flows across corporate operations

Characteristics

- Measure of impact of human activities on environment measured in carbon dioxide (CO_2) equivalent units or in other words mapping the organization wide GHG emissions over a specific period
- Total amount of CO_2 emitted over full life cycle of a product or service (product carbon footprint or carbon labeling).
- Total amount of CO_2 attributable to actions of an individual/ organization (mainly through energy use) over the period
- Provides basis for **"Emission Benchmarking"**
- Provides directions for Emission reduction opportunities and ways & means to offset emissions

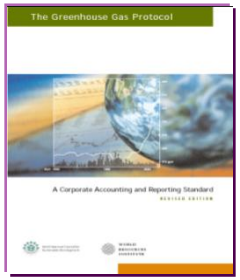
Why GHG Inventorization/Accounting?

- Enhance the environmental integrity of GHG quantification
- Enhance the credibility, consistency and transparency of GHG quantification, monitoring and reporting, including GHG project emission reductions and removal enhancements
- Facilitate development and implementation of organization GHG management strategies and plans
- Facilitate development and implementation of GHG projects
- Facilitate ability to track performance and progress in reduction of GHG emissions and/or increase in GHG removals
- Assist in identifying GHG risks and liabilities
- Facilitate the crediting and trade of GHG emission reductions or removal enhancements

Prevalent Standards for GHG Accounting

1

General Standards provided by the ***International Organization for Standardization (ISO)*** for GHG Inventory Accounting & Verification
- Greenhouse gas emissions at organization level **(ISO 14064 – 1)**
- Greenhouse gas emissions at project level **(ISO 14064 - 2).**
- Specifications to validate and verify relevant accountings **(ISO 14064 - 3)**



2

"The Greenhouse Gas Protocol" for GHG Inventory Reporting by
- *World Business Council for Sustainable Development* (WBCSD), Geneva-based coalition of 170 international companies
- *World Resources Institute* (WRI), U.S.-based environmental NGO

Out of the 335 Global FT500 companies studied by the Corporate Climate Communications Report 2007, 63% aligned with the GHG Protocol

ISO International Organization for Standardization

ISO, WRI and WBCSD have signed a Memorandum of Understanding (MoU) under which they have agreed to jointly promote the ISO 14064 standards and the WRI and WBCSD GHG Protocol standards. This would ensure to consistency and mutually support. For corporate accounting, requirements and guidance contained in ISO and GHG Protocol standards are consistent and are designed to be used in a complementary manner. **ISO 14064 considered as the "what to do" and GHG Protocol considered as the "how to do it"**

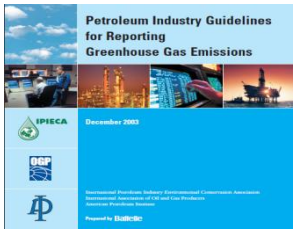
3

Sectoral and National GHG inventories
- *Intergovernmental Panel on Climate Change (IPCC)* – Methodology reports
- *Kyoto Protocol:* Rules for annual inventories of all anthropogenic GHG emissions from sources and removals from sinks
- *EU Emissions Trading Scheme:* Standardized CO_2 accounting per regulation; applies to power generation, energy-intensive industries and (from 2012) aviation

4

"Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions" by
- *International Petroleum Industry Environment Conservation Association (IPIECA)*
- *American Petroleum*
- *International Association of Oil & Gas Producers (OGP)*

Consistently used by major players in the global Oil & Gas industry to report GHG emission performance



Standards and calculation methodology preferred by companies reporting in the Carbon Disclosure Project India:
GHG Protocol – 37.3 %, ISO – 2 %, Others *(International Iron & Steel Institute tools based on the carbon calculations tools developed by WRI as GHG protocol,ACM0004 ver. 2, Central Electricity Authority in India and Chicago Carbon Exchange) –* ***21 %***

Categorization of GHG Emission Sources

GHG EMISSION SOURCES

Direct Emissions

Emissions from sources that owned or controlled by the company

Indirect Emissions

Emissions that are a consequence of the activities of the company but occur at sources owned or controlled by another company

Scope – I Emissions

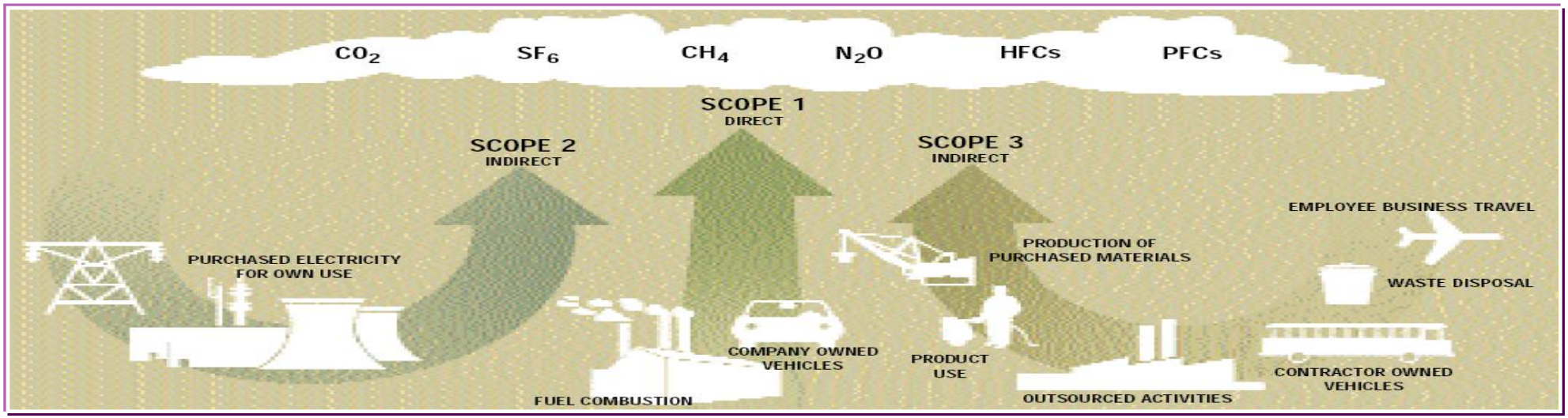
- Stationary combustion (boilers, evaporators, furnaces, flame reactors)
- Process emissions (oxidation/ reduction of substrates, impurity removal, byproducts, and catalytic reactions, myriad other emissions individual to each process)
- Mobile combustion (transportation of raw materials/products/waste)
- Fugitive emissions (storage tank leakage)

Scope – II Emissions

Stationary combustion (consumption of purchased electricity, heat or steam)

Scope – III Emissions

- An optional reporting category that allows for the treatment of all other indirect emissions
- These are a consequence of the activities of the company, but occur from sources not owned or controlled by the company
- Examples are extraction and production of purchased materials, transportation of purchased fuels and use of sold products and services



Source: Figure & description as per the "The Greenhouse Gas Protocol" by WBCSD & WRI

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

Step – I: Defining the Boundary…. (Cont.)

- **Establishing operational boundaries:** After an organization has determined its organizational boundaries, it shall establish its operational boundaries. The establishment of operational boundaries includes identifying GHG emissions and removals associated with the organization's operations. **Categorizing GHG emissions and removals into direct, energy indirect and other indirect and** choosing which of the other indirect emissions will be quantified, monitored and reported.
- **Direct GHG emissions and removals:** The organization shall quantify all direct GHG emissions from facilities within its organizational boundaries. The organization should quantify all direct GHG removals from facilities within its organizational boundaries.
- Direct GHG emissions from generated and exported electricity, heat and steam may be reported separately, but shall not be deducted from the organization's total direct GHG emissions.
- **Energy indirect GHG emissions:** The organization shall quantify indirect GHG emissions from the generation of imported electricity, heat or steam consumed by the organization.
- **Other indirect GHG emissions:** The organization should quantify indirect GHG emissions, other than energy indirect GHG emissions, that are a consequence of the organization's activities, but occur from GHG sources that are owned or controlled by another organization, based on requirements of the GHG program in which they are operating, internal reporting needs or the intended use for the GHG inventory.

Approach for determination of Organizational Boundary

Equity share approach:

In this approach, a company accounts for GHG emissions from operations according to its share of equity in the operation. The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation.

Control approach:

In this 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

Operational Control:

A company has operational control over an operation if the former or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation. It is expected that except in very rare circumstances, if the company or one of its subsidiaries is the operator of a facility, it will have the full authority to introduce and implement its operating policies and thus has operational control.

Financial Control:

The company has financial control over the operation if the former has the ability to direct the financial and operating policies of the latter with a view to gaining economic benefits from its activities. For example, financial control usually exists if the company has the right to the majority of benefits of the operation, however these rights are conveyed. Similarly, a company is considered to financially control an operation if it retains the majority risks and rewards of ownership of the operation's assets.

Organizational activities to reduce GHG emissions or increase GHG removals

Continuous improvement activities: The organization may attribute GHG emission or removal differences over time in its GHG inventory to the implementation of specific activities, such as policy or program initiatives.

Directed actions: The organization may plan and implement specific directed actions to reduce [or avoid] GHG emissions or increase GHG removals. The organization may quantify GHG emission or removals differences attributable to the implementation of directed actions. GHG emission or removal differences resulting from directed actions will usually be reflected in the organization's GHG inventory, but may also result in GHG emissions or removal differences outside of inventory boundaries. If reported, the organization shall report directed actions and associated GHG emission or removal differences separately and shall describe the:

a) Directed action;

b) Spatial and temporal boundaries of the directed action;

c) Quantification approach used to quantify GHG emission or removal differences;

d) Determination and classification of GHG emission or removal differences attributable to directed actions as direct, indirect or other types of GHG emissions or removals;

e) Portion of GHG emission or removal differences occurring within the organizational boundary and outside the organizational boundary.

Principles of GHG Accounting

To ensure that reported data, information & related disclosures provide a faithful, true, fair account of GHG emissions, removals, emission reductions, removal enhancements, GHG quantification, monitoring, reporting, validation, verification shall be based on the following principles.

- **Completeness:** All GHG emissions and removals within the chosen boundaries are included. Any GHG emissions or removals not quantified and/or monitored are disclosed and explained/justified.
- **Consistency:** Consistent methodologies are used to permit meaningful comparisons. Any changes to the methodologies, procedures or any other relevant factors are disclosed and explained/justified.
- **Accuracy:** Sufficient accuracy is achieved to enable users to make decisions with reasonable assurance as to the integrity of quantification & of reported information. Uncertainties are reduced as far as practical.
- **Transparency:** All relevant issues are documented [and disclosed] in a factual and coherent manner [based on an audit trail] [that allows users to judge its reliability]. Any relevant assumptions made and appropriate references to the quantification methodologies and data sources used are disclosed.
- **Relevance:** GHG quantification, monitoring and reporting methodologies are appropriately selected to reflect GHG emissions/ removals and to serve the decision-making needs of users.
- **Conservativeness:** In selecting baseline scenarios, and in other cases that lack transparency, completeness or certainty, conservative assumptions, values and procedures are used to help ensure that GHG emission reductions and removal enhancements are not overestimated.

Few Definitions

- **Carbon dioxide equivalent (CO_2e):** Unit for comparing the radiative forcing of a GHG to carbon dioxide. Generally calculated using the quantity of a given GHG multiplied by its global warming potential.
- **Directed actions:** Specific activity or initiative implemented by an organization to reduce [or avoid] GHG emissions or increase GHG removals. GHG emission or removal differences that result from directed actions may occur within or outside of organizational boundaries.
- **Facility:** Single installation, set of installations, or production processes, stationary or mobile, which can be defined within a single geographical boundary, organizational unit or production process
- **Greenhouse gas (GHG):** Gaseous constituent of the atmosphere that absorbs and re-emits infrared radiation. Common GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).
- **GHG source:** Physical unit or process which releases a GHG into the atmosphere
- **GHG sink:** Physical unit or process that absorbs a GHG from the atmosphere
- **GHG emission:** Release of a GHG to the atmosphere by a GHG source
- **GHG removal**: Absorption of a GHG from the atmosphere by a GHG sink
- **GHG activity data:** Quantitative measure of activity that results in GHG emission or removal. Examples include the amount of energy, fuels or electricity consumed, material produced, service provided or biomass accumulated.

Few Definitions

- **GHG emission or removal factor**: Factor relating activity data to GHG emissions or removals
- **Direct GHG emission:** GHG emission from GHG sources that are owned or controlled by the organization
- **Energy indirect GHG emission**: GHG emission from the generation of imported electricity, heat or steam consumed by the organization
- **Other indirect GHG emission:** GHG emission, other than energy indirect GHG emissions, which are a consequence of an organization's activities, but arise from GHG sources that are owned or controlled by another organization
- **GHG inventory**: Detailed list of an organization's GHG sources, sinks, emissions and removals
- **GHG program:** International, national, sub-national governmental or non-governmental authority that registers, accounts or manages GHG emissions, removals, emission reduction or removal enhancements. A GHG program may be voluntary or mandatory.
- **GHG report**: Self-contained document intended to communicate the organization's or project's GHG emissions, removals, emission reductions or removal enhancements during a specified period of time and other related issues to its intended users
- **Global warming potential**: Factor describing the radiative forcing impact of one unit of a given GHG relative to one unit of carbon dioxide

Few Definitions

- **Monitoring:** Assessment of GHG emissions and removals. Assessments can be continuous or periodic and could include assessment of inputs or outputs of GHG sources and sinks or the general conditions that may influence GHG emissions and removals.

- **Organization:** Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration. For organizations with more than one operating unit, a single operating unit may be defined as an organization.

- **Uncertainty:** Parameter, associated with the result of quantification, which characterizes the dispersion of the values that could be reasonably attributed to the quantified amount. Dispersion is often expressed as a standard deviation or as a range with a given level of confidence.

Why GHG Inventorization?

- Inventorisation of emission and setting targets in accordance with globally acceptable standards
  - Direct reduction in energy consumption
  - Reduction in energy costs – power, fuel & transport
- Proactive approach to establish GHG baseline and reduction
- Gearing for Voluntary Emission Reduction (VER) Markets
- Fulfilling its social commitment of being an environmentally conscious company and working towards sustainable development

Steps in GHG Accounting

Levels of Inventorization

➢ Corporate Level:

Overall emission levels including corporate office, marketing offices, all factories, warehouse, R & D Facilities, Colony (if applicable), etc.

➢Plant Level:

Specific plant and its associated operation

Stationary Sources

Energy Industries

- Extraction, production and transformation
- Electricity generation, petroleum refining
- Autoproduction of electricity

Manufacturing Industries and Construction

- Iron and steel production
- Non-ferrous metal production
- Chemical manufacturing
- Pulp, paper and print
- Food processing, beverages and tobacco

Commercial/Institutional

Residential

Agriculture/Forestry/Fisheries

Mobile Sources

- **Civil Aviation**
- **Road Transportation**
  - Cars
  - Light duty trucks
  - Heavy duty trucks and buses
  - Motorcycles
- **Railways**
- **Navigation**
- **International Bunker Fuels are reported separately**

Methods of estimating CO_2

Reference Approach (Tier 1)

- Estimates based on national energy balance (production + imports - exports) by fuel type without information on activities
- Performed quickly if basic energy balance sheet is available
- Way of cross-checking emission estimates of CO_2 with the Sectoral Approach

Sectoral Approach (Tier 1)

- Estimates based on fuel consumption data by sectoral activity

Bottom-Up Approaches (Tier 2 or 3)

- More detailed activity and fuel data

Fundamental Equation

carbon emissions

=

$\sum$ fuel consumption expressed in energy units (TJ) for each sector

x carbon emission factor

- carbon stored

x fraction oxidised

Six Basic Steps

1. Collect fuel consumption data
2. Convert fuel data to a common energy unit
3. Select carbon content factors for each fossil fuel/product type and estimate the total carbon content of fuels consumed
4. Subtract the amount of carbon stored in products for long periods of time
5. Multiply by an oxidation factor
6. Convert carbon to full molecular weight of CO_2 and sum across all fuels

1. Consumption Data

- Reference Approach
  - Estimate apparent consumption of fuels within the country

- Sectoral Approach
  - Collect actual consumption statistics by fuel type and economic sector

- Tier 2 or 3
  - Collect actual fuel consumption statistics by fuel type, economic sector and combustion technology type

2. Common Energy Unit

- Convert fuel data to a common energy unit
- Production and consumption of solid and liquid fuels in tonnes
- Gaseous fuels in cubic meters
- Original units converted into energy units using calorific values (i.e. heating values)
- Reference approach: use different calorific values for production, imports and exports
- Calorific values used should be reported

3. Estimate total carbon content of fuels consumed

- Natural gas
  - Depends on composition (methane, ethane, propane, butane and heavier hydrocarbons)
  - Natural gas flared at the production site will usually be “wet’’ – its carbon content factor will be different
  - Typical: 15 to 17 tonnes C/TJ
- Oil
  - Lower carbon content for light refined petroleum products such as gasoline
  - Higher for heavier products such as residual fuel oil
  - Typical for crude oil is 20 tonnes C/TJ
- Coal
  - Depend on coal's rank and composition of hydrogen, sulfur, ash, oxygen and nitrogen
  - Typical ranges from 25 to 28 tonnes C/TJ

4. Subtract non-energy uses

- Oil refineries: asphalt and bitumen for road construction, naphthas, lubricants and plastics
- Natural gas: for ammonia production
- Liquid petroleum gas (LPG): solvents and synthetic rubber
- Coking: metals industry

Attempt to use country-specific data instead of IPCC default carbon storage factors.

Total Carbon Stored (Gg C) =
Non-Energy Use (10^3 t)
x Conversion Factor (TJ/10^3 t)
x Emission Factor (t C/TJ)
x Fraction Carbon Stored
x 10^{-3}

5. Oxidation Factor

- Multiply by an oxidation factor to account for the small amount of unoxidized carbon that is left in ash or soot.
- Amount of carbon remaining unoxidized should be low for oil and natural gas combustion…
- …but can be larger and more variable for coal combustion
- When national oxidation factors are not available, use IPCC default factors

TABLE 1-6 FRACTION OF CARBON OXIDISED (RECOMMENDED DEFAULT ASSUMPTIONS)	
Coal[a]	0.98
Oil and Oil Products	0.99
Gas	0.995
Peat for electricity generation[b]	0.99

(a) This figure is a global average but varies for different types of coal, and can be as low as 0.91.

(b) The fraction for peat used in households may be much lower.

6. Convert to full molecular weight and sum

- Convert carbon to full molecular weight of CO_2 and add across all fuels
- To express the results as CO_2, multiply the quantity of carbon oxidized by the molecular weight ratio of CO_2 to C (44:12)

Methods for non-CO_2 emissions

Tier 1

- Multiply fuel consumed by an average emission factor
- Does not require detailed activity data
- Rely on widely available fuel supply data that assume an average combustion technology is used

Tiers 2/3

- Multiply fuel consumed by detailed fuel type and technology-specific emission factors
- Tier 2 methods use data that are disaggregated according to technology types
- Tier 3 methods estimate emissions according to activity types (km traveled or tonne-km carried) and specific fuel efficiency or fuel rates

Use most disaggregated technology-specific and country-specific emission factors available

Fundamental equation

Emissions =

$\Sigma(\text{Emission Factor}_{abc} \bullet \text{Fuel Consumption}_{abc})$

Where,

a = fuel type

b = sector activity

c = technology type including emissions controls

Quality control and completeness checks

- All gases (CO_2, CH_4 and N_2O)
- All source and sub-source categories
- All national territories addressed
- Bunker fuels and military operations
- All fossil-fuel-fired electric power stations
- Blast furnaces and coke production
- Waste combustion with energy recovery
- Black market fuels
- Non-metered fuel use for pipelines by compressor stations

Uncertainty

- Uncertainty in carbon content and calorific values for fuels is related to the variability in fuel composition and frequency of actual measurements. Likely to be small for all countries.
- For most non-Annex I Parties the uncertainty in activity data (i.e. fuel consumption data) will be the dominant issue!
  - Effort should focus on collection of fuel consumption data
  - Country-specific carbon content factors are unlikely to improve CO_2 estimates significantly
- It is important to document the likely causes of uncertainty and discuss steps taken to reduce uncertainties.

CASE STUDY:

A CEMENT PLANT

GHG for 1MMTPA Cement Plant

Basis of Calculation

- 43 % Blended Cement (PPC)
- 22 % Fly ash Addition in PPC
- Specific heat consumption – 800 Kcal / kg Clinker
- Specific power consumption – 88 kWh / MT Cement

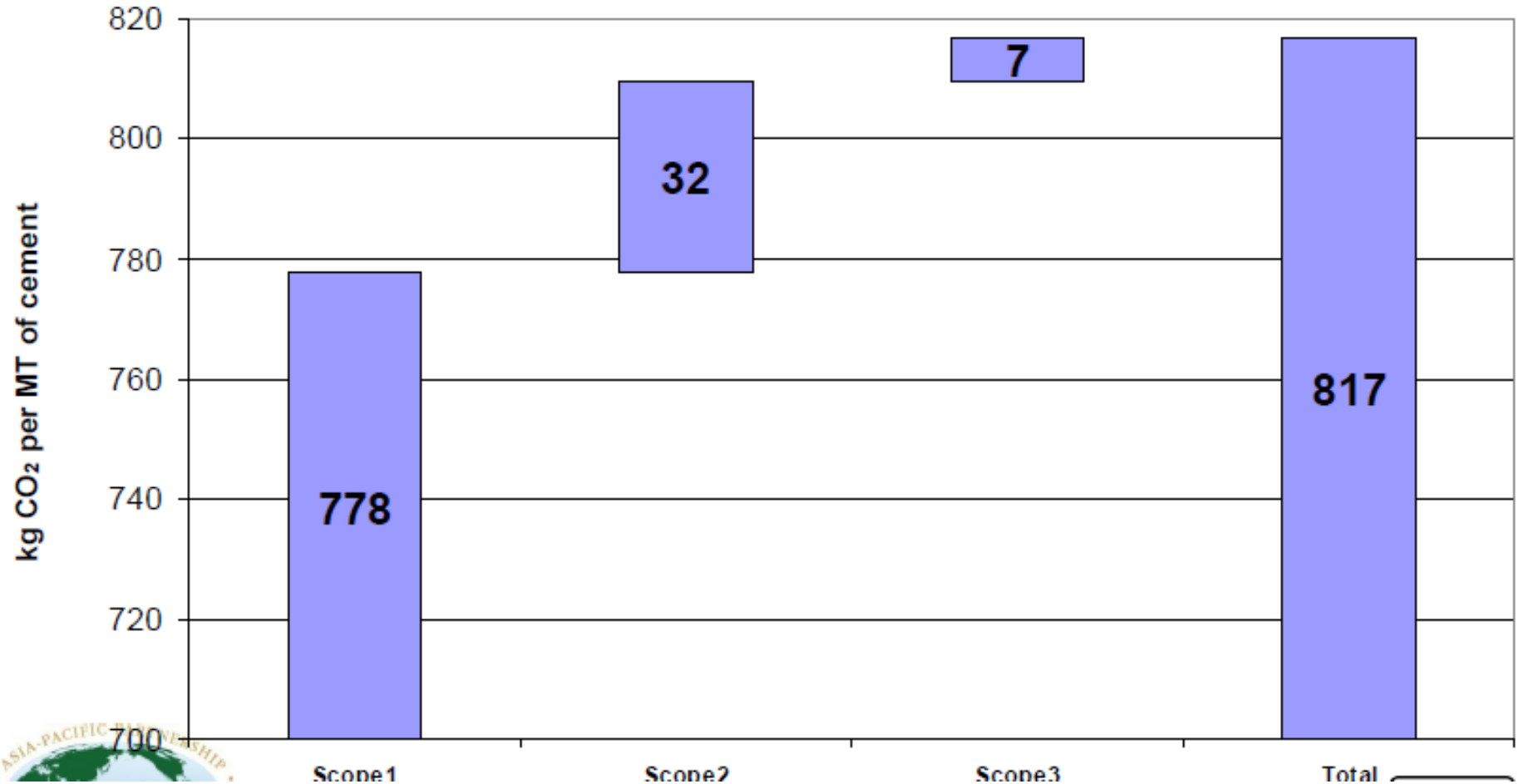
GHG Emissions Break Up for a particular year

Sl no	Source of emissions	% share of Total Emissions
A	**Scope 1 Emissions**	**95.2**
1	Calcination	55.0
2	Fuel for kiln	33.5
3	Fuel for CPP	6.7
4	Others	0.1
B	**Scope 2 Emissions**	**3.9**
C	**Scope 3 Emissions**	**0.8**
D	**Overall Emissions**	**100.0**

Specific Emission Factors

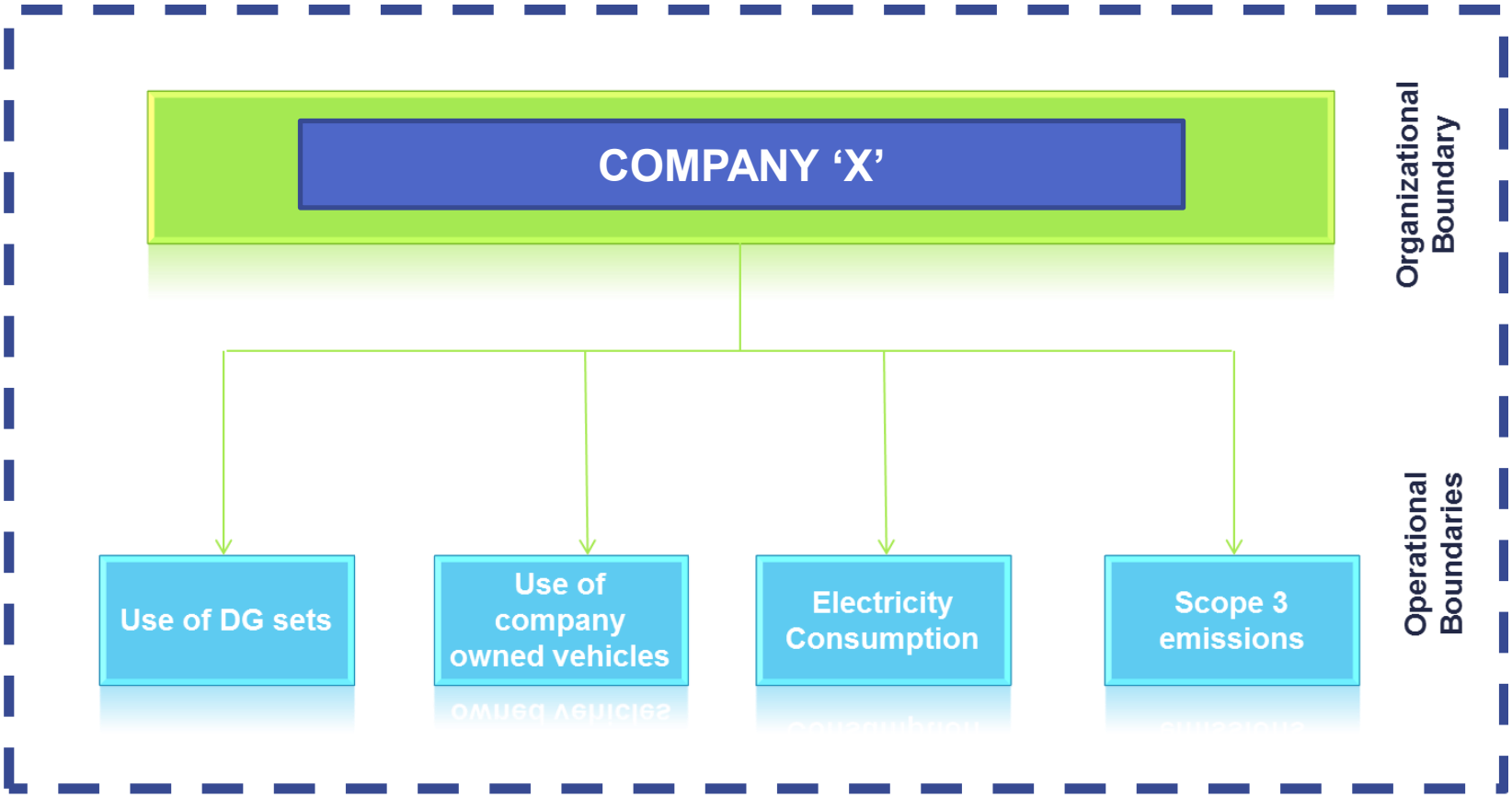
Details	unit	Value
Specific emission factor	kg CO_2/ MT Clinker	955
Specific emission factor (estimated)	kg CO_2/ MT Cement	817

Typical GHG Emission Data – Scope Wise



Step – I: Defining the Boundary

Organizational Boundary: In setting organizational boundaries, a company selects an approach for consolidating GHG emissions and then consistently applies the selected approach to define those businesses and operations that constitute the company for the purpose of accounting and reporting GHG emissions.



Step – I: Defining the Boundary…. (Cont.)

Illustrations of an organization's activities that may result in other indirect GHG emissions may include

- Employee business travel and commuting to work;
- Transportation of an organization's products, materials, people, or waste by another organization;
- Outsourced activities, contract manufacturing and franchises;
- Emissions from waste generated by the organization but managed by another organization;
- Emissions from the use and end-of-life phases of organization's products and services;
- Emissions arising from the production and distribution of energy products, other than electricity steam and heat.

Overview of the emission inventory to be reported

No	Type of GHG emission
1.	Direct (Scope 1) emissions
	Petrol use
	Diesel use
	LPG use
	Natural gas use
	Coal use
	Electricity use
	Other fuels (Petcoke/Fuel oil etc)
	Total Direct (Scope 1) Emissions

+

No	Type of GHG emission
2.	Indirect (Scope 2) Emissions
	All purchased electricity in owned buildings and leased buildings where the agency is the sole tenant
	Purchased electricity for lighting and utility/appliance power in leased space where the agency is not the sole tenant
	Purchased electricity for base building power in leased buildings where the agency is not the sole tenant
	Total Indirect (Scope 2) Emissions
3.	Indirect (Scope 3) Emissions
	Transmission and distribution line losses for all purchased electricity
	Air travel
	Business travel in Rental cars / taxis
	Waste to landfill
	Business Travel employee owned cars
	Total Indirect (Scope 3) Emissions
4.	**Total GHG Emissions**

Note 1: The scope 1 & scope 2 emissions are as per the definition of emission sources mentioned in WBCSD protocol

Note 2: GHG emissions include the emissions of CO_2, CH_4, N_2O, PFCs, HFCs and SF_6 all converted to CO2 (equivalent) terms

Default CO_2 Emission Factor for Combustion

Fuel Type		Default Emission Factor(TJ/Gg))
Crude Oil		73300
Orimulsion		77000
Natural Gas Liquids		64200
Gasoline	Motor Gasoline	69300
	Aviation Gasoline	70000
	Jet Gasoline	70000
Jet Kerosene		71500
Other Kerosene		71900
Shale Oil		73000
Gas/Diesel Oil		74100
Residual Fuel Oil		77400
Liquefied Petroleum Gases		63100
Bitumen		80700
Lubricants		73330
Petroleum Coke		97300
Refinery Feed Stock's		73300

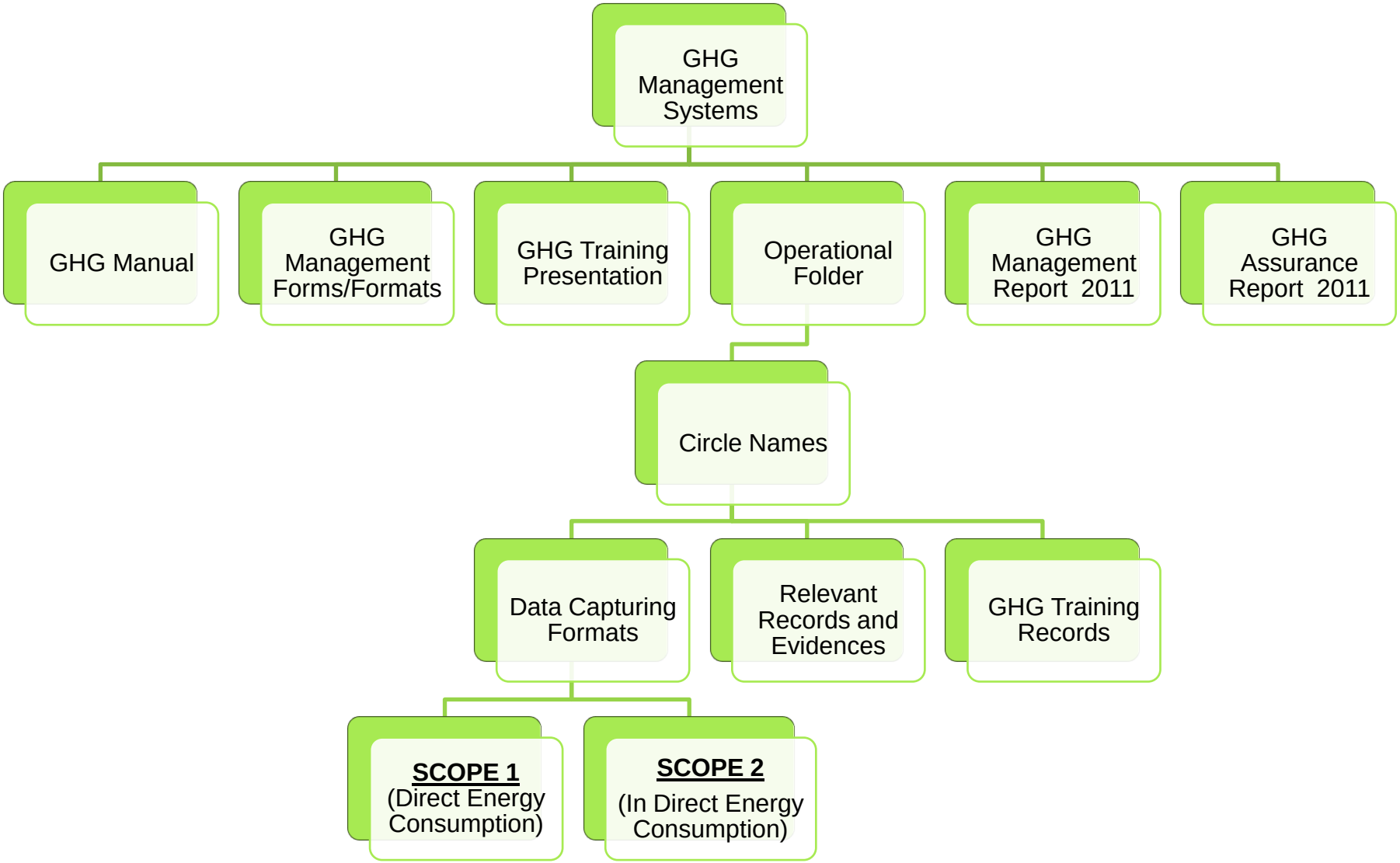
Default CO_2 Emission Factor for Combustion

Fuel Type		Default Emission factor (TJ/Gg)
Other Oil	Refinery Gas	57600
	Paraffin Wax	73300
	White Spirit & SBP	73300
Other Petroleum Products		73300
Anthracite		98300
Coking Oil		94600
Other Bituminous Coal		94600
Lignite		101000
Patent Fuel		97500
Coke	Coke oven coke	107000
	Gas coke	107000
Derived Gases	Gas work gas	44400
	Coke oven Gas	44400
	Blast Furnace Gas	260000
	Oxygen steel Furnace Gas	182000

Default CO_2 Emission Factor for Combustion

Fuel Type		Default Emission Factor (TJ/Gg)
Natural gas		56100
Municipal Solid Waste		91700
Industrial waste		143000
Peat		106000
Solid Bio-fuel	Wood Waste	112000
	Charcoal	112000
	Other Preliminary Solid Bio-mass	100000
Liquid Bio-fuel	Bio Gasoline	70800
	Other liquid bio-fuel	79600
Gas Bio-mass	Land fill Gas	54600
	Other Bio-Gas	54600
Other non-fossil fuels	Municipal Waste (Bio-mass Fraction)	100000

GHG Information Management Systems



Relevant Forms to be used for Data Collection

DG Set Owned by HTIPL							
Month	Monthly Fuel Consumtion	Density	Monthly Fuel Consumtion	NCV of diesel	Energy content of diesel utilized	Emission Factor	Monthly Emmisions
	ltr	kg/ltr	kg	kcal/kg	TJ	Kg CO_2 /TJ	tonnes CO_2
	A	B	C	D	E = C*D*4.1868/1000000000	F	G=(A*B)/1000
April		0.89	0	10294	0	74100	0
May		0.89	0	10294	0	74100	0
June		0.89	0	10294	0	74100	0
July		0.89	0	10294	0	74100	0
August		0.89	0	10294	0	74100	0
September		0.89	0	10294	0	74100	0
October		0.89	0	10294	0	74100	0
November		0.89	0	10294	0	74100	0
December		0.89	0	10294	0	74100	0
January		0.89	0	10294	0	74100	0
February		0.89	0	10294	0	74100	0
March		0.89	0	10294	0	74100	0

Relevant Forms to be used for Data Collection

Diesel Vehicles Owned by HTIPL									
Month	Monthly Expenses	Price of Diesel per litre	Monthly Fuel Consumtion	Density of Diesel	Monthly Fuel Consumption	NCV of diesel	Energy content of diesel utilized	Emission Factor	Monthly Emmisions
	Rs (INR)	Rs./ltr	ltr	kg/ltr.	kg	kcal/kg	TJ	Kg CO_2 /TJ	tonnes CO_2
	A	B	C=A/B	D	E = C*D	F	G= E*F*4.1868/1000000000	H	I=G*H/1000
April		45	0	0.89	0	10294	0	74100	0
May		45	0	0.89	0	10294	0	74100	0
June		45	0	0.89	0	10294	0	74100	0
July		45	0	0.89	0	10294	0	74100	0
August		45	0	0.89	0	10294	0	74100	0
September		45	0	0.89	0	10294	0	74100	0
October		45	0	0.89	0	10294	0	74100	0
November		45	0	0.89	0	10294	0	74100	0
December		45	0	0.89	0	10294	0	74100	0
January		45	0	0.89	0	10294	0	74100	0
February		45	0	0.89	0	10294	0	74100	0
March		45	0	0.89	0	10294	0	74100	0
								Total	0

Relevant Forms to be used for Data Collection

Circle Office/Site Office

	A	B	C	D
Month	Monthly Electricity Consumption	Monthly Electricity Consumption	CO_2 emission factor (NEWNE Grid)	Indirect CO_2 emissions
		B=A/1000		D=B*C
	kWh	MWh	t CO_2 / MWh	tonnes CO_2
April		0	0.823	0.00
May		0	0.823	0.00
June		0	0.823	0.00
July		0	0.823	0.00
August		0	0.823	0.00
September		0	0.823	0.00
October		0	0.823	0.00
November		0	0.823	0.00
December		0	0.823	0.00
January		0	0.823	0.00
February		0	0.823	0.00
March		0	0.823	0.00
Total				0

Guidance: On how to Maintain/Gathering Evidences

- **Physical evidence :** refers to something that can be seen or touched, such as fuel or utility meters, emission monitors or calibration equipment. Physical evidence is gathered by direct observation of equipment or processes, and is persuasive because it demonstrates that the organization being verified is in the practice of collecting relevant data.

- **Documentary evidence:** is written on paper or recorded electronically, and includes operating and control procedures, log books, inspection sheets, invoices and analytical results

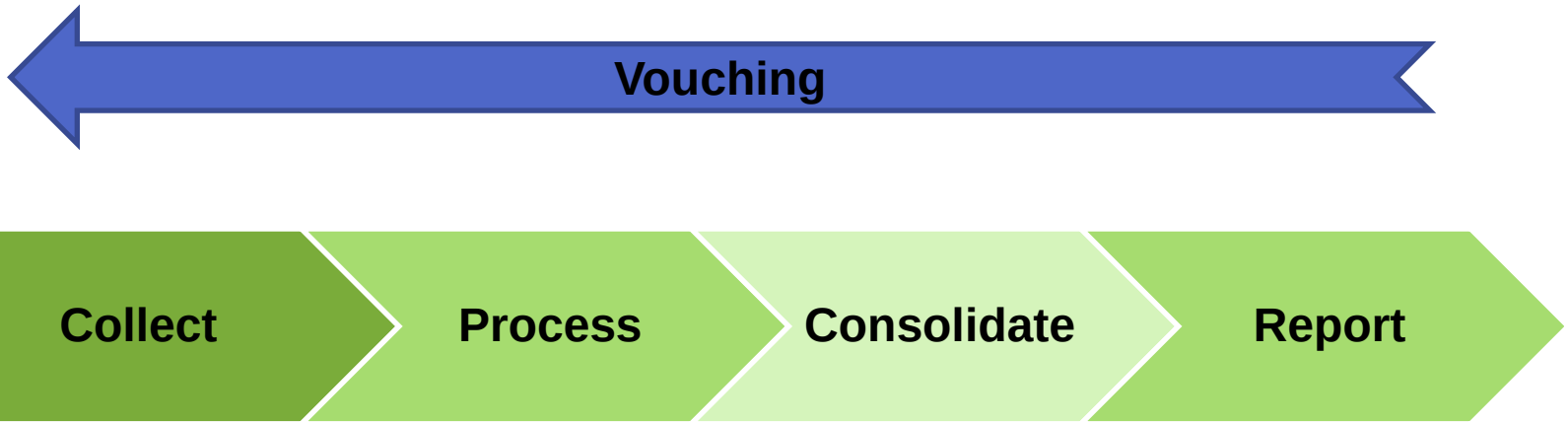
- **Testimonial evidence:** is gathered from interviews with technical, operating, administrative or managerial personnel. It provides a context for understanding physical and documentary information, but its reliability depends on the knowledge and objectivity of the interviewees

Guidance: Process to be followed

Verification Testing – Vouching :

- Uncovers errors in reported GHG information
- Involves following the paper trail back to the raw data

E.g.: reported quantities of purchased fuel oil used to calculate CO2 emissions would be traced back to the accounts payable department to check invoices from the fuel supplier. This process verifies that all reported information is supported.

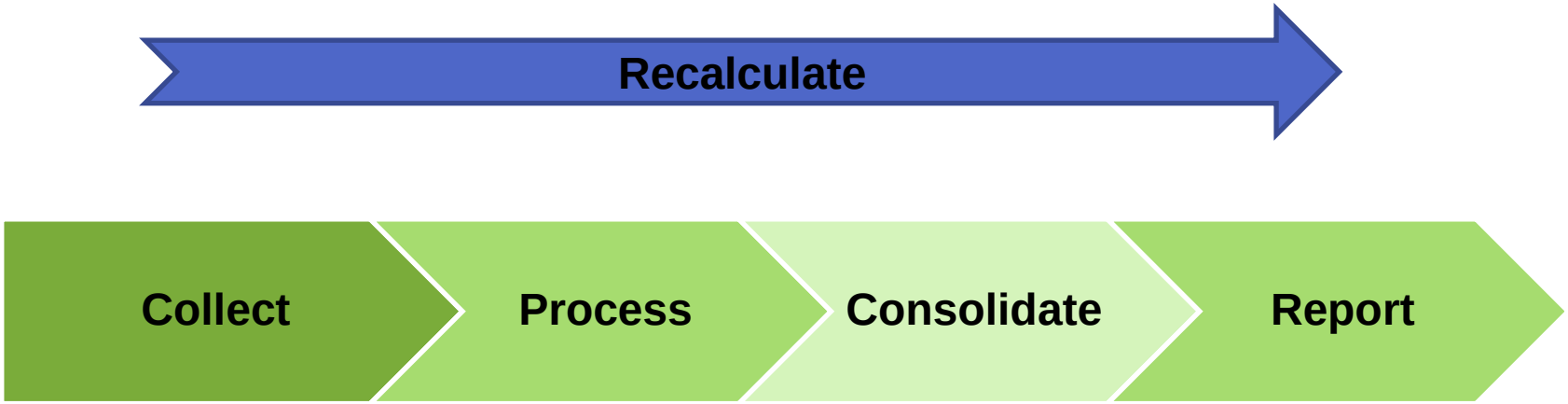


Guidance: Process to be followed (Cont….)

Verification Testing - Re Computation

- Checks for the accuracy of arithmetic calculations
- Involves re-performing the calculations to ensure that the same results are attained

E.g. using combustion emission factors to calculate emissions from a flare or any emission source

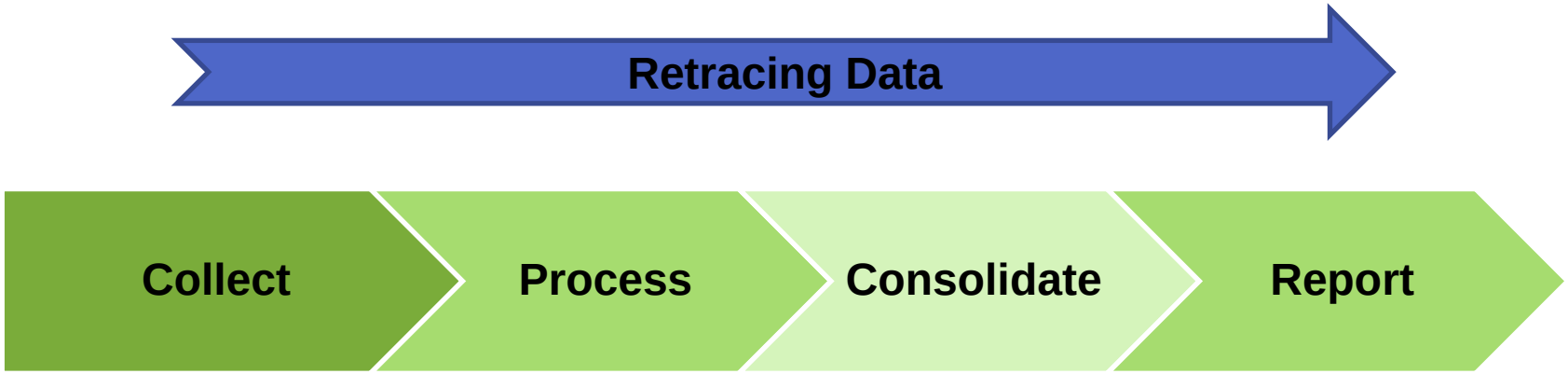


Guidance: Process to be followed (Cont….)

Verification Testing – Retracing Data

- Uncovers omissions in reported information
- Involves reviewing the original data records

E.g. review of raw data from continuous emissions monitors to ensure that all data is reflected in GHG report

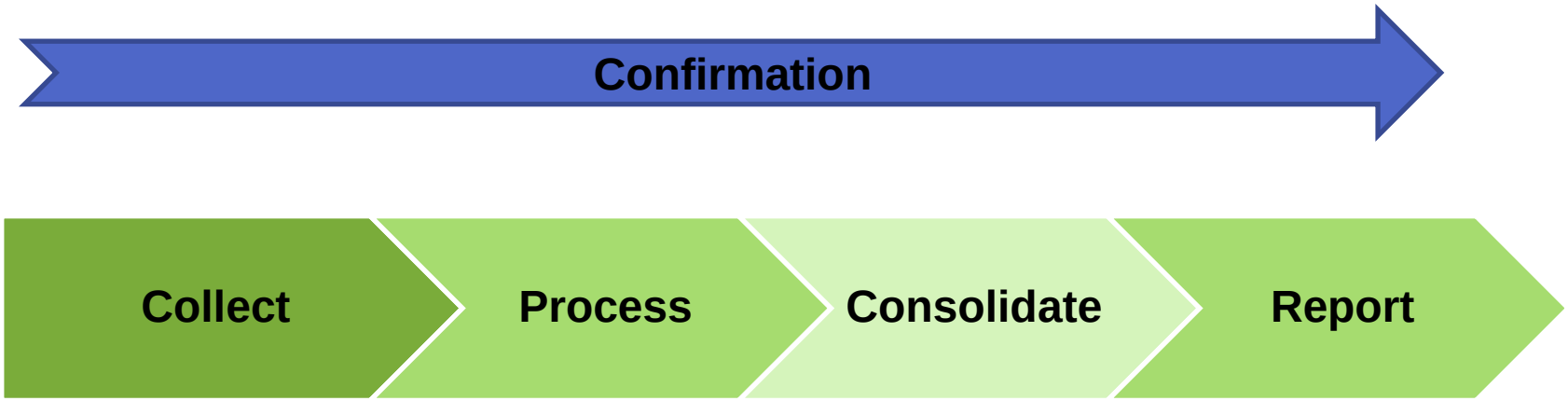


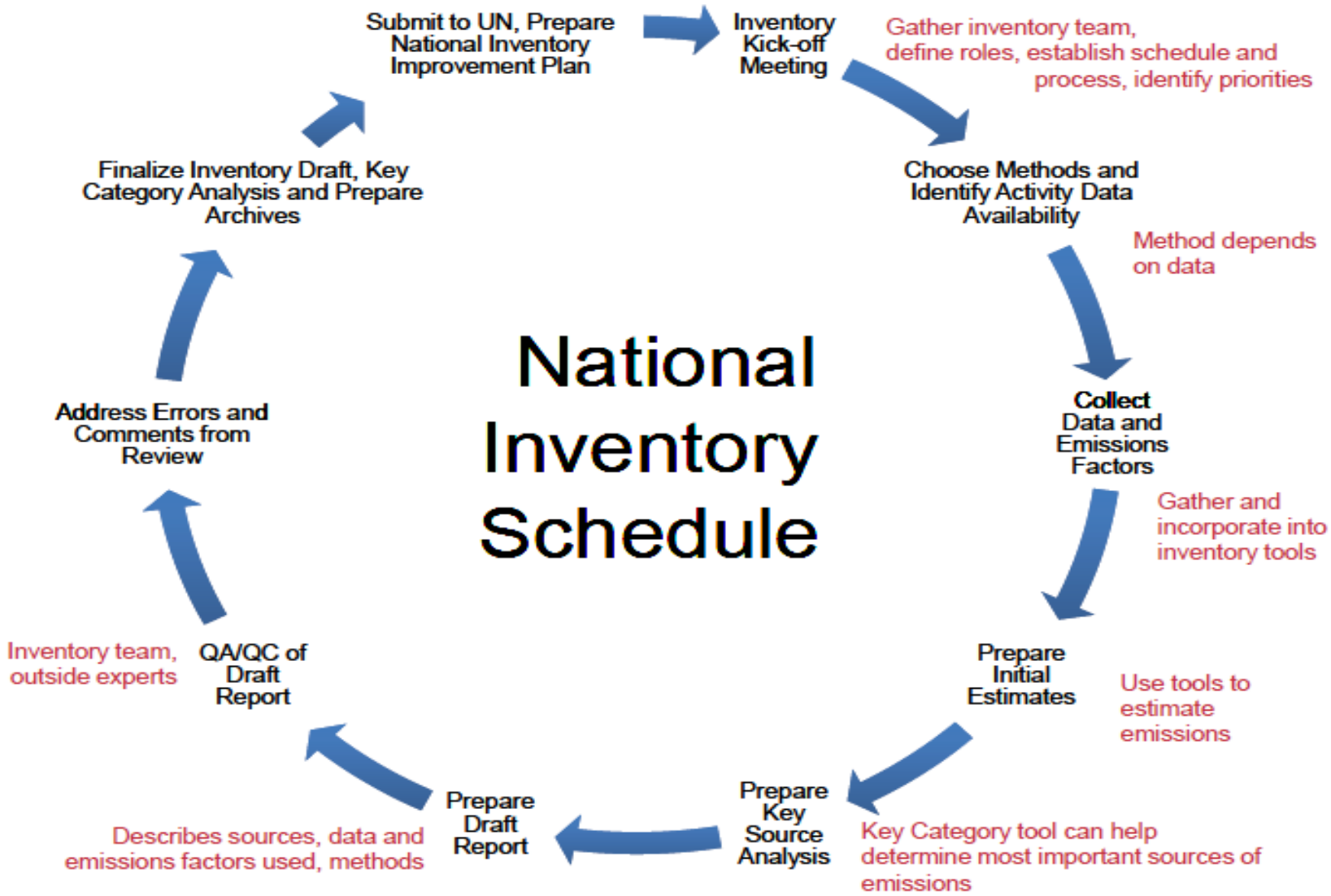
Guidance: Process to be followed (Cont….)

Verification Testing – Confirmation

- Seeks written confirmation from objective 3rd parties
- Can be used when the audit team cannot physically observe a condition

E.g. Seek confirmation that flow meter was appropriately calibrated




National Inventory Schedule
Inventory Kick-off Meeting
Gather inventory team, define roles, establish schedule and process, identify priorities
Choose Methods and Identify Activity Data Availability
Method depends on data
Collect Data and Emissions Factors
Gather and incorporate into inventory tools
Prepare Initial Estimates
Use tools to estimate emissions
Prepare Key Source Analysis
Key Category tool can help determine most important sources of emissions
Prepare Draft Report
Describes sources, data and emissions factors used, methods
QA/QC of Draft Report
Inventory team, outside experts
Address Errors and Comments from Review
Finalize Inventory Draft, Key Category Analysis and Prepare Archives
Submit to UN, Prepare National Inventory Improvement Plan

GHG Inventorization benefits

- Inventorization of emission and setting targets in accordance with globally acceptable standards
- Direct reduction in energy consumption
- Reduction in energy costs – power, fuel & transport
- Proactive approach to establish GHG baseline and reduction
- Gearing for Voluntary Emission Reduction (VER) Markets
- Fulfilling its social commitment of being an environmentally conscious company and working towards sustainable development

GHG Reduction targets……

- **Global companies' GHG Targets**
  - **GE – 1% yearly from 2004 to 2012**
  - **California Portland Cement – 9% per production index from 2003 to 2012**
  - **Holcim – US emissions reduction by 12% from 2000 to 2008**
  - **Dupont – 15% reduction from 2004 to 2015**
  - **General Motors – total North American emissions reduction by 40% from 2000 to 2010**
- **National companies**
  - **Ambuja Cement – 20% reduction in 2012 compared to 1990 levels**
  - **Mahindra & Mahindra – 5% by 2013-14 compared to 2008-09**


Thank You