CAMBODIA CLIMATE CHANGE ALLIANCE

The Project: Demonstration of
RECP, EMS, and GHG Mitigation and
Adaptation In Industrial and Handicraft Sectors

TRAINING MANUAL FOR GHG INVENTORY IN THE INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR

Prepared by: **The Ministry of Industry and Handicraft**

Phnom Penh, May 2018

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Abbreviation

AFOLU	Agriculture, Forestry, and Land Use
ASEANs	Association of South East Asia Nations
BaU	Business As Usual
CCCSP	Cambodia Climate Change Strategic Plan
CIDP	Cambodia Industrial Development Policy
GDP	Gross Domestic Product
GHG	Green House Gas
IPCC	Inter-governmental Panel on Climate Change
INDC	Intended Nationally Determined Contribution
IPPU	Industrial Process and Industrial Use
M&E	Monitoring and Evaluation
MIH	Ministry of Industry and Handicraft
MoE	Ministry of Environment
MME	Ministry of Mines and Energy
RGC	Royal Government of Cambodia

Chemical Compound

$BaCO_3$	Barium Carbonate
$CaCO_3$	Calcium Carbonate
CaC_2	Calcium carbide
CaO	Calcium Oxide
C_2H_4O	Ethylene Oxide
CO_2	Carbon Dioxide
CH_4	Methane
HNO_3	Nitric Acid
K_2CO_3	Potassium Carbonate
Li_2CO_3	Lithium Carbonate
N_2O	Nitrous Oxide
NH_3	Ammonia
$NaHCO_3$	Sodium Bicarbonate
NH_4NO_3	Ammonium Nitrate
PFCs	Perfluorocarbon
$SrCO_3$	Strontium Carbonate

Unit

GWh	Gigawatt Hour
Gg	Gigagram
$GtCO_2$	Gigatonne of Carbon Dioxide
$MtCO_2$	Metric tons of Carbon Dioxide
tCO_2	Ton of Carbon Dioxide
kgoe	Kilogram of Oil Equivalent
kWh	Kilowatt hour
$ktCO_2$	Kilotonne of Carbon Dioxide
$ktCO_2eq.$	Kilotonne of Carbon Dioxide Equivalent
ktoe	Kilotonne of Oil Equivalent
Mtoe	Megatonne of Oil Equivalent
MWh	Megawatt-hour
t	Tonne

Conversion:

GWh	10^3 MWh
MWh	10^3 KWh
Gg	10^9 Grams
Gg	10^3 t
Mtoe	10^3 ktoe
ktoe	10^3 toe
toe	10^3 Kgoe
$GtCO_2$	10^3 $MtCO_2$
$MtCO_2$	10^3 $ktCO_2$
$ktCO_2$	10^3 tCO_2
tCO_2	10^3 $kgCO_2$
$kgCO_2$	10^3 gCO_2

1. Introduction

Climate change has become one of the greatest risks facing humanity and a high priority of global concern in the 21st century. The earth continues to heat up, the severity of climate change impacts on global socioeconomic development and environmental sustainability continue to intensify and amplify (IPCC, 2014). The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of GHGs have increased (IPCC, 2013). Among the total world Greenhouse Gases (GHG) emissions of 49GtCO_2eq./year in 2010, the energy sector contributed by about 35.0%, the Agriculture, Forestry, and Land Use (AFOLU) sector by 24.0%, industry by 21.0%, transportation by 14.0%, and buildings by 6.4% (IPCC, 2013). Countries in the Association of South East Asia Nations (ASEANs), including Cambodia are facing adverse impacts of climate change, causing a number of human and animal mortalities, damaging physical infrastructures and natural resources and, seriously affecting to social-economic development. The temperature in Cambodia has increased and this trend is predicted to continue with mean temperatures increase between 0.013^oC to 0.036^oC per year by 2099 (MoE, 2015).

Cambodia is regionally and globally insignificant with emissions per capita of about 0.2tCO_2eq./year in 2000 (MoE, 2015); however, it is expected to increase to 1.1 and 5.5 tCO_2eq./year in 2030 and 2050, respectively. GHG emissions from the industrial sector in 2000 was insignificant (MoE, 2002); however, it increased its share of 28.0% in 2010 and is expected to increase to 32.0% by 2030 (Mao et al., 2016). In response to impacts of climate change, the RGC prepared the first ever Cambodia Climate Change Strategic Plan (CCCSP) (2014-2023), aiming to develop Cambodia towards a green, low-carbon, climate resilient, equitable, sustainable, and knowledge-based society (MoE, 2013). Also the country developed her Intended Nationally Determined Contribution (INDC), which is expected to be a maximum reduction of 27.0% of GHG emissions by 2030 compared to the Business As Usual (BaU) level (RGC, 2015).

It has been observed that Cambodia's emissions from the Industrial Process and Industrial Use (IPPU) have not been reported (MoE, 2002 and 2015) because the production of construction materials, electronics, engines and machineries, chemical products, motorbike, and car assemblies, plastic products, and other consumption materials are still at their early stage, and their productions are used very minimally as import substitution. However, The Royal Government of Cambodia (RGC) considers the industrial sector as a growth strategy priority, aimed at promoting economic diversification, effectuating profound structural change and improving competitiveness. It played an important role for the Cambodia's economy with its share to the GDP increased from 12.6% and 29.9% in 1993 and 2013, respectively; and is expected to increase to 30.0% by 2025 with the manufacturing sector growing from 15.5% in 2013 to 20.0% in 2025 (RGC, 2015a). It is going to be a major economic pillar for many years to come. Therefore, carbon emissions from this sector is expected to increase significantly in the long-run.

2. Objective

The training manual has the following objectives:

- Introduce the basic concept of climate change impacts and responsive measures;
- Introduce and build capacity on methodology to estimate GHG emissions;
- Introduce data requirement and collection techniques;
- Challenges and solution for effective data collection; and
- Enhance coordination, cooperation, and dialogue among Government's agencies and other relevant institutions for data management and GHG emissions inventory.

3. Data collection and requirement

Most of data primarily collected from the relevant international reports (IPCC assessment reports, international agreements, research papers, etc.), Government documents, and discussions with key Government officers and involved institutions to make the information more reliable and acceptable. To estimate GHG emissions from the IPPU sector, a number of data are required including amount of cement product per year (ton/year), amount of clinker product per year (ton/year), amount of beer/coca product per year (ton/year), amount of glass per year (ton/year), etc. Types and sources of data are shown in Table 1. Generally, there are two types of data to be collected:

1) Primary data are collected through interview with relevant stakeholders and researchers; and
2) Secondary data are collected from secondary sources. They refer to any information retrieved from book, research thesis, article, research paper, government document and file report, web information, etc.

Table 1: Types and sources of data

Type of industrial products	Total production (ton/year)	Year	Sources of data
Cement			
Food and Drink Production			
Beers			
Coca			
Soft drinks			
Clinker			
Glass			
Coke			
Ammonia			
Methanol			
Graphite and carbon black			
Pig iron			
Primary aluminum			
Lead			
SMEs			
Others*			

*Other industrial processes and products where data are available in the country

4. GHG emissions estimation methodology

The following formula is used in order to estimate GHG emissions from the IPPU sector. When emissions source is not CO_2 the conversion to CO_2 equivalent is required. The detail information on global warming potential is shown in Table 2. We will use excel spreadsheet to estimate GHG emissions as shown in Figure 1.

Total Emission = Activity Data x Emission Factor

Where:

- Total Emission = Process emission (tonne) from the industrial sector
- Activity Data = Amount of activity or production of process material in the industrial sector
- Emission Factor = Emission factor associated with gas per unit of activity in the industrial sector (tonne/year)

Table 2: Global warming potential

Industrial designation or common name	Chemical formule	GWP values for 100-year time horizon		
		Second Assessment Report (SAR)	Fourth Assessment Report (AR4)	Fifth Assessment Report (AR5)
Carbon dioxide	CO2	1	1	1
Methane	CH4	21	25	28
Nitrous oxide	N2O	310	298	265
Substances controlled by the Montreal Protocol				
CFC-11	CCl3F	3,800	4,750	4,660
CFC-12	CCl2F2	8,100	10,900	10,200
CFC-13	CCl2F2		14,400	13,900
CFC-113	CCl2FCClF2	4,800	6,130	5,820
CFC-114	CClF2CClF2		10,000	8,590
CFC-115	CClF2CF3		7,370	7,670
Halon-1301	CBrF3	5,400	7,140	6,290
Halon-1211	CBrClF2		1,890	1,750
Halon-2402	CBrF2CBrF2		1,640	1,470
Carbon tetrachloride	CCl4	1,400	1,400	1,730
Methyl bromide	CH3Br		5	2
Methyl chloroform	CH3CCl3	100	146	2
HCFC-21	CHCl2F			148
HCFC-22	CHCLF2	1,500	1,810	1,760
HCFC-123	CHCl2CF3	90	77	79
HCFC-124	CHClFCF3	470	609	527
HCFC-141b	CH3CCl2F	600	725	782
HCFC-142b	CH3CClF2	1,800	2,310	1,980
HCFC-225ca	CHCl2CF2CF3		122	127
HCFC-225cb	CHClFCF2CClF2		595	525
Hydrofluorocarbons (HFCs)				
HFC-23	CHF3	11,700	14,800	12,400
HFC-32	CH2F2	650	675	677
HFC-41	CH3F2	150		116
HFC-125	CHF2CF3	2,800	3,500	3,170
HFC-134	CHF2CHF2	1000		1,120
HFC-134a	CH2FCF3	1,300	1,430	1,300
HFC-143	CH2FCHF2	300		328
HFC-143a	CH3CF3	3,800	4,470	4,800
HFC-152	CH2FCH2F			16
HFC-152a	CH3CHF2	140	124	138
HFC-161	CH3CH2F			4
HFC-227ea	CF3CHFCF3	2,900	3,220	3,350
HFC-236cb	CH2FCF2CF3			1,210
HFC-236ea	CHF2CHFCF3			1,330
HFC-236fa	CF3CH2CF3	6,300	9,810	8,060
HFC-245ca	CH2FCF2CHF2	560		716
HFC-245fa	CHF2CH2CF3		1,030	858
HFC-365mfc	CH3CF2CH2CF3		794	804
HFC-43-10mee	CF3CHFCHFCF2CF3	1,300	1,640	1,650

Perfluorinated compounds Sulfur hexafluoride	SF6	23,900	22,800	23,500
Nitrogen trifluoride	NF3		17,200	16,100
PFC-14	CF4	6,500	7,390	6,630
PFC-116	C2F6	9,200	12,200	11,100
PFC-218	C3F8	7,000	8,830	8,900
PFC-318	c-C4F8	8,700	10,300	9,540
PFC-31-10	C4F10	7,000	8,860	9,200
PFC-41-12	C5F12	7,500	9,160	8,550
PFC-51-14	C6F14	7,400	9,300	7,910
PCF-91-18	C10F18		>7,500	7,190
Trifluoromethyl sulfur pentafluoride	SF5CF3		17,700	17,400
Perfluorocyclopropane	c-C3F6			9,200
Fluorinated ethers				
HFE-125	CHF2OCF3		14,900	12,400
HFE-134	CHF2OCHF2		6,320	5,560
HFE-143a	CH3OCF3		756	523
HCFE-235da2	CHF2OCHClCF3		350	491
HFE-245cb2	CH3OCF2CF3		708	654
HFE-245fa2	CHF2OCH2CF3		659	812
HFE-347mcc3	CH3OCF2CF2CF3		575	530
HFE-347pcf2	CHF2CF2OCH2CF3		580	889
HFE-356pcc3	CH3OCF2CF2CHF2		110	413
HFE-449sl (HFE-7100)	C4F9OCH3		297	421
HFE-569sf2 (HFE-7200)	C4F9OC2H5		59	57
HFE-43-10pccc124 (H-Galden 1040x)	CHF2OCF2OC2F4OCHF2		1,870	2,820
HFE-236ca12 (HG-10)	CHF2OCF2OCHF2		2,800	5,350
HFE-338pcc13 (HG-01)	CHF2OCF2CF2OCHF2		1,500	2,910
HFE-227ea	CF3CHFOCF3			6,450
HFE-236ea2	CHF2OCHFCF3			1,790
HFE-236fa	CF3CH2OCF3			979
HFE-245fa1	CHF2CH2OCF3			828
HFE 263fb2	CF3CH2OCH3			1
HFE-329mcc2	CHF2CF2OCF2CF3			3,070
HFE-338mcf2	CF3CH2OCF2CF3			929
HFE-347mcf2	CHF2CH2OCF2CF3			854
HFE-356mec3	CH3OCF2CHFCF3			387
HFE-356pcf2	CHF2CH2OCF2CHF2			719
HFE-356pcf3	CHF2OCH2CF2CHF2			446
HFE 365mcf3	CF3CF2CH2OCH3			<1
HFE-374pc2	CHF2CF2OCH2CH3			627
Perfluoropolyethers				
PFPMIE	CF3OCF(CF3)CF2OCF2OCF3		10,300	9,710
Hydrocarbons and other compounds - direct effects				
Chloroform	CHCl3	4		16
Methylene chloride	CH2Cl2	9		9
Methyl chloride	CH3Cl		8.7	12
Halon-1201	CHBrF2		13	376

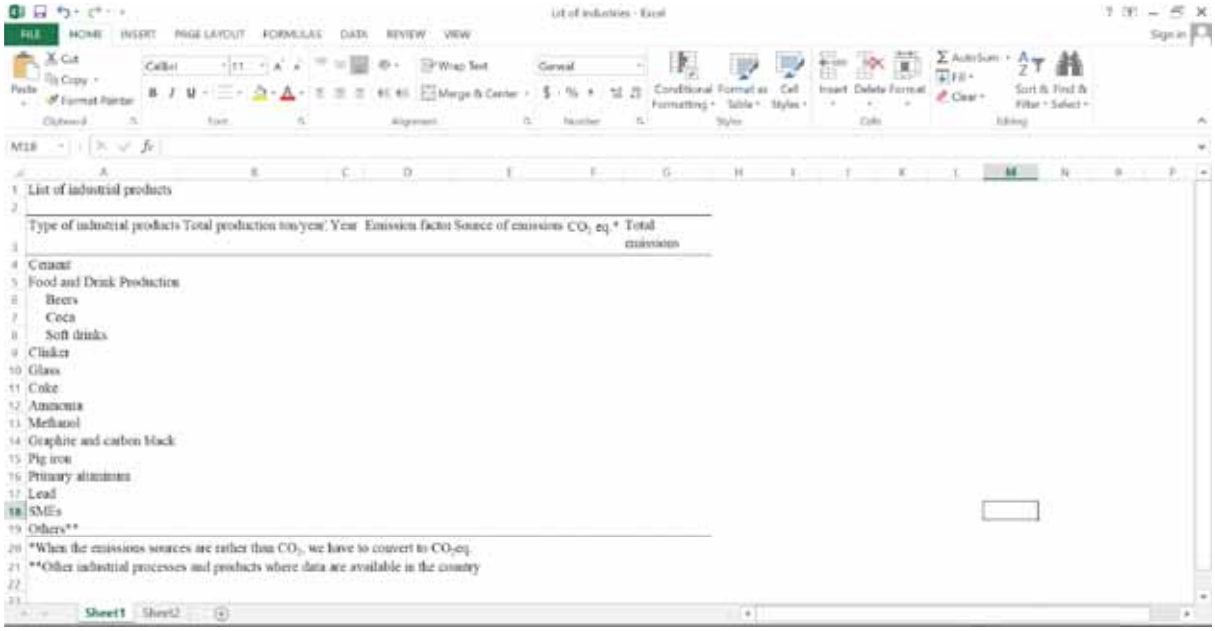

Figure 1: Excel spreadsheet used to estimate GHG emissions from the IPPU sector

5. Industrial Process and Product Use

5.1 Definition of Industrial Processes

Industrial processes are procedures, involving chemical, physical, electrical, or mechanical steps to aid in the manufacturing of an item or items, usually carried out on a very large scale. GHG emissions from industrial processes and product use are primarily by products of production. The level of emissions is a factor of the process technology used and the level of industrial output. Industrial processes and product use emissions are non-energy related, while energy-related emissions are accounted for in the stationary energy sector (Liu, 2016).

5.2 GHG emissions from Industrial Process and Production Use

GHG emissions can be generated by fossil fuel combustion, industrial production processes, waste treatment, and land use change (IPCC, 2006). It is invested that fossil fuel combustion and cement production are the most significant sources of human-induced carbon emissions (Le Quere, et al., 2013; Levin, 2012; Boden et al., 2013; Oliver et al., 2014). Industrial emissions also result from the processing of materials to manufacture items, including mineral aggregate products, chemicals, metals, refrigerants, electronics, and other consumer goods such as paper and food items (David, 2008). During these processes, many different GHGs, including CO_2, CH_4, N_2O, and PFCs, can be released (IPCC, 1996).

Total GHG emissions of the industrial production is mainly composed of two parts: energy related emissions, which are mainly from energy consumption, for example, direct emissions from combustion of fossil fuel and indirect emissions from consumption of electricity and heat (Liu et al., 2014); and process related emissions, which result from the following processes (DCCEE, 2010):

- **Metal production:** CO_2 and PFCs emissions from aluminum smelting; and carbon dioxide, methane, and nitrous oxide emissions from iron and steel production;
- **Chemical industry:** N_2O emissions from the production of Nitric Acid (HNO_3) (largely used in production of Ammonium Nitrate-NH_4NO_3); CO_2 emissions from Ammonia (NH_3) production; and CH_4 emissions from the production of organic polymers and other chemicals;
- **Mineral products:** CO_2 emissions from cement clinker and lime production, the use of limestone and dolomite in industrial smelting processes, soda ash use and production, magnesia production, and the use of other carbonates (Sodium Bicarbonate-$NaHCO_3$, Potassium Carbonate-K_2CO_3, Barium Carbonate- $BaCO_3$, Lithium Carbonate-Li_2CO_3, and Strontium Carbonate- $SrCO_3$); and
- **Food and drink production:** CO_2 emissions from Ammonia (NH_3) production, CO_2 wells, Ethylene Oxide (C_2H_4O) production, and Sodium Bicarbonate ($NaHCO_3$) use.

5.3 Direct Carbon Emissions in Cement Factories

Direct emissions are emanations from sources that are possessed or controlled by the reporting organization. Direct CO_2 emissions result from the accompanying sources; for instance, calcination of limestone in the raw materials, conventional fossil kiln fuels, alternative fossil based kiln fuels, biomass kiln fuels, and non-kiln fuels in cement plants (Vanderborght and Brodmann, 2001).

Cement is known as the **"glue"** that holds the concrete and is utilized extensively in construction globally (IEA, 2007). Cement production is an energy-escalated process and energy consistently addresses to 20-40% of total production costs. The most extensively used is Portland cement type that contains 95% cement clinker.

5.4 Indirect Carbon Emissions in Cement Factories

Indirect emissions are emissions caused by the activities of the reporting company; however, it happens at sources possessed or controlled by another corporation. For instance, emissions from the generation of network electricity ran through by a cement company will qualify as indirect (WBCSD, 2011).

Cement production uses much electricity for raw materials preparation, cement grinding, and catering for other electrical instrumentations (Ke et al., 2013). Amid the cement production process, CO_2 is emitted by four different sources. Mahasenan et al. (2003) argued that the most noteworthy proportion of emissions of about 50% is discharged in the decomposition of $CaCO_3$ (Calcium Carbonate) and $MgCO_3$ (Magnesium carbonate) to produce CaO and MgO. CO_2 outflows in cement industry mostly from ignition of fossil fills and calcination of the limestone into calcium oxide.

5.5 Training Approach

The training/capacity building approach is more "practitioner-oriented", challenging our traditional notions of expert-delivered, didactic lecture-style classroom approaches. And, rather than the content and style of training being dictated by the trainers, as is common in training and capacity-development initiatives, the needs and desires of the delegates should largely drive the style and content of the courses. That is, change from 'training experts' to 'delegate-led' training design.

The following training/capacity-building approaches would be employed individually, or in some combination, to achieve learning needs with respect to the traditional learning styles and the current needs of the participants:

- Lectures (overall information on climate change and GHG emissions, types and sources of data, methodology to estimate GHG emission, etc.);
- Individual or group works (capacity assessment);
- Role playing exercises;
- Field visits to sites (if any); and
- Inter-changes among those with and without experience (follow-up trainings).

5.6 Expected Outcomes

The training will provide significant outcomes as follows:

- The trainees learned more on general information of climate change impacts and responsive measures;
- The trainees understood data requirement and methodology to estimate GHG emissions from the IPPU sector; and
- Improved and built coordinating mechanism among key participants for future cooperation.

5.7 Training process

Three capacity building trainings will be held. The first training will be more focused on the conceptual framework of climate change impacts, GHG emissions estimation methodology, and data requirement, while the second training will more be focused on "practice-oriented", the trainees are required to practice the methodology to estimate GHG emissions from the IPPU sectors and primary results of GHG emissions can be estimated. The last training will be focused on "practice-oriented and in-depth review", the results of GHG emissions estimation need to be intensively discussed among the participants so that they can be used to discuss during the consultative meeting to validate the results. The detail information on training process is shown in Annex 1.

5.8 Trainees

The trainees will mainly be focused on the staff of the Ministry of Industry and Handicraft (MHI), who are working in industrial sectors and the private sectors both in Phnom Penh city and provinces. In addition, relevant stakeholders will be invited for this training. The following list shows relevant government agencies and private sectors:

1) Ministry of Industry and Handicraft (MHI);
2) National Council for Sustainable Development (NCSD);
3) Ministry of Mines and Energy (MME) (Mining sector);
4) Ministry of Commerce (MoC) (Export data of industrial products, etc.);
5) Food and drinks companies (Angkor beer, Cambodia beer, Coca, etc.);
6) Cement factories; and
7) Others.

5.9 Relevant Documents

Two PPTs (***overview of climate change impacts and responsive measures and conceptual framework for GHG emissions and estimation in the IPPU sector***) will be provided and distributed during the first training. The second training will be presented about ***"the review of GHG emissions and estimation in the IPPU sector and using excel spreadsheet to estimate GHG emissions from the IPPU sector"***. The last training will be covered ***"the brief results of the second training and continue to estimate GHG emissions from the IPPU sector using excel spreadsheet"***. The following documents are used as sources for developing the training materials:

1) A review on emission analysis in cement industries;
2) A Review on Carbon Emissions in Malaysian Cement Industry;
3) Global, Regional, and National Fossil-Fuel CO_2 Emissions;
4) An Analysis of Regional Emissions and Strategies to Achieve AB 32 Targets;
5) Industrial Process Emissions Projections 2010;
6) Tracking Industrial Energy Efficiency and CO_2 Emissions;
7) The Science of Climate Change of the Second Assessment Report of the Intergovernmental Panel on Climate Change;
8) Climate Change 2001: The Scientific Basis of the Third Assessment Report of the Intergovernmental Panel on Climate Change;
9) IPCC Guidelines 2006 for National Greenhouse Gas Inventories of Industrial Process and Product Use;
10) Estimation of CO_2 emissions from China's cement production;
11) National Carbon Emissions from the Industry Process: Production of Glass, Soda Ash, Ammonia, Calcium Carbide, and Alumina;
12) Insight into the Regional Greenhouse Gas Emission of Industrial Processes: A Case Study of Shenyang, China;
13) A Design of Low Carbon Development Plan towards 2050 in Cambodia;

14) The cement industry and global climate change: Current and potential future cement industry CO_2 emissions;
15) Initial National Communication;
16) Cambodia Climate Change Strategic Plan (2014-2023);
17) Second National Communication;
18) Trends in Global CO_2 Emissions;
19) Cambodia Industrial Development Policy 2015-2025;
20) Intended Nationally Determined Contribution;
21) CO_2 Abatement in the Cement Industry;
22) National Strategic development plan (2014-2018);
23) Rectangular Strategy Phase III;
24) Energy statistics of Cambodia;
25) Annual report from the MHI;
26) Annual report from the MME; and
27) Others.

6. Monitoring and Evaluation

The Monitoring and Evaluation (M&E) is a systematic process of gathering, processing, analyzing, interpreting, and storing data and information thereby setting into motion a series of managerial actions for the purpose of ascertaining the realization of training's objective and targets. The M&E process will be conducted after the individual training (each training course) by using questionnaire list as shown in Annex 2. The results of the M&E can be included in the training report. The adaptive training tools/methodologies have to be taken into account when the feedback from the trainees can't reach the training's objectives. Subsequent observation and assessment of the trainees' capacity can be conducted by the project manager/director of the MHI (it is applied after the project ended).

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ANNEX 1:

FIRST TRAINING ON GREENHOUSE GAS INVENTORY IN THE IPPU SECTOR

a. Objectives:

- To provide overview of climate change impacts and responsive measures;
- To introduce GHG calculation methodology for industrial process and product use; and
- To provide conceptual framework for data collection and requirement.

b. Participants:

- IPPU sector's GHG inventory working group;
- Representatives from the MHI;
- Representatives from the NCSD;
- Representatives from the MME (Mining sector);
- Representatives from the MoC;
- Cement factories;
- Private companies (Angkor beer, Cambodia beer, Coca, etc.);
- Private sectors in Siemreap and Battambang province; and
- Others.

c. Venue:

- Hotel in Sieamreap

d. Date:

- ***Fourth week of April 2018***

e. Material:

- Overview of climate change impacts and responsive measures; and
- Conceptual framework for GHG emissions and estimation in the IPPU sector.

f. Agenda

Tentative Agenda		
Time	**Description**	**Responsible**
08:00 - 08:30	Registration	Admin officer
08:30 - 08:35	National Anthem	All Participants
08:35 - 08:50	Welcome speech	**H.E. Dr. TUNG Ciny,** Under Secretary State of the MIH and Project Director
08:50 - 09:00	**Photo Session**	All Participants
09:00 - 10:00	**Session I:** Global and National Information on	**National Consultant**

	Climate Change and Responsive Measures (Q&A)	
10:00 - 10:20	**Coffee and Tea break**	
10:20 - 12:00	**Session II:** Initial framework for GHG emissions calculation methodology for industrial process and production use (Q&A)	**National Consultant**
12:00-13:30	**Lunch Break**	All Participants
13:30 - 15:00	Conceptual framework for data collection and requirement (Q&A)	**National Consultant**
15:00 - 15:15	**Coffee and Tea break**	
15:15-16:00	Group discussion	All Participants
16:00-16:30	Group presentation	Group leader
16:30-16:45	Wrap-up	**Mr. VEN Keahak**, Deputy Director General of Industry and Project Manager
16:45-16:55	Closing remarks	**H.E. Dr. TUNG Ciny,** Under Secretary State of the MIH and Project Director

SECOND TRAINING ON GREENHOUSE GAS INVENTORY IN THE IPPU SECTOR

a. Objectives:

- To enhance capacity of relevant stakeholders for GHG emissions estimation methodology;
- To collect further data to qualify the results of GHG emissions estimation; and
- To verify and validate the results of GHG emissions estimation.

b. Participants:

- IPPU sector's GHG inventory working group;
- Representatives from the MHI;
- Representatives from the NCSD;
- Representatives from the MME (Mining sector);
- Representatives from the MoC;
- Cement factories;
- Private sectors in Battambang and Siemreap province; and
- Others.

c. Venue:

- Hotel in Siemreap

d. Date:

- ***Second week of May 2018***

e. Material:

- Review of GHG emissions and estimation in the IPPU sector; and
- Excel spreadsheet (computer is needed).

f. Agenda

Tentative Agenda		
Time	**Description**	**Responsible**
08:00 - 08:30	Registration	Admin officer
08:30 - 08:35	National Anthem	All Participants
08:35 - 08:50	Welcome speech	**H.E. Dr. TUNG Ciny,** Under Secretary State of the MIH and Project Director
08:50 - 09:00	**Photo Session**	All Participants
09:00 - 10:00	**Session I:** Review of GHG emissions and estimation in the IPPU sector (Q&A)	**National Consultant**
10:00 - 10:20	**Coffee and Tea break**	

10:20 - 12:00	**Session II:** Exercise on GHG emission estimations: Excel spreadsheet (computer)	**National Consultant**
12:00-13:30	**Lunch Break**	
13:30 - 15:00	Continue from Session II	**National Consultant**
15:00 - 15:15	**Coffee and Tea break**	
15:15-16:00	Group discussion	All Participants
16:00-16:30	Group presentation	Group leader
16:30-16:45	Wrap-up	**Mr. VEN Keahak**, Deputy Director General of Industry and Project Manager
16:45-16:55	Closing remarks	**H.E. Dr. TUNG Ciny,** Under Secretary State of the MIH and Project Director

THIRD TRAINING ON GREENHOUSE GAS INVENTORY IN THE IPPU SECTOR

a. Objectives:

- To conduct intensive review of the results of GHG emissions estimation;
- To final data inputs from the industrial processes and products; and
- To finalize the results of GHG emissions estimation.

b. Participants:

- IPPU sector's GHG inventory working group;
- Representatives from the MHI;
- Staff of CCCA
- Representatives from the NCSD;
- Representatives from the MME (Mining sector);
- Relevant private sectors; and
- Others.

c. Venue:

- Hotel in Phnom Penh

d. Date:

- ***First week of June 2018***

e. Material:

- Review of GHG emissions and estimation in the IPPU sector; and
- Excel spreadsheet (computer is needed).

f. Agenda:

Tentative Agenda		
Time	**Description**	**Responsible**
08:00 - 08:30	Registration	Admin officer
08:30 - 08:35	National Anthem	All Participants
08:35 - 08:50	Welcome speech	**H.E. Dr. TUNG Ciny,** Under Secretary State of the MIH and Project Director
08:50 - 09:00	**Photo Session**	All Participants
09:00 - 10:00	**Session I:** Brief results of the second training and continue to estimate GHG emissions from the IPPU sector (Q&A)	**National Consultant**
10:00 - 10:20	**Coffee and Tea break**	
10:20 - 12:00	**Session II:** Exercise on GHG emission estimations	**National Consultant**

	(final results): Excel spreadsheet (computer)	
12:00-13:30		All Participants
13:30 - 15:00	Continue from Session II	**National Consultant**
15:00 - 15:15	**Coffee and Tea break**	
15:15-16:00	Group discussion	All Participants
16:00-16:30	Group presentation	Group leader
16:30-16:45	Wrap-up	**Mr. VEN Keahak**, Deputy Director General of Industry and Project Manager
16:45-16:55	Closing remarks	**H.E. Dr. TUNG Ciny,** Under Secretary State of the MIH and Project Director

ANNEX 2: TRAINING EVALUATION QUESTIONNAIRE

Duration:…….. Venue ……

Title/Aim/Objective of the training (*write in your own word/understanding*):

Evaluation Questions	**Ratings Scale 1-5** ***(please circle a number, as you feel appropriate)***	
1. How much do you feel the training course meet your learning objectives?	1. Not met 2. 3. 4. 5. Fully met	1 2 3 4 5
2. How was the duration of the course?	1. Too short. Couldn't learn enough in such a short time. 2. A little too short 3. Just fine 4. A little too long 5. Definitely too long. The concepts could be learned in much less time.	1 2 3 4 5
3. How helpful were the course materials? *List below the key materials you received:*	1. Not helpful. Made things more difficult to learn and understand. 2. 3. 4. 5. Really made things easy	1 2 3 4 5
4. Did the instructor add value to the materials?	1. No added value to reading the materials. 2. 3. 4. 5. Yes. The instructor really made very useful oral explanations.	1 2 3 4 5
5. How well did the instructor explain or answer questions from the audience?	1. Poorly. Didn't try to understand the questions well or rarely managed to find useful answers. 2. 3. 4. 5. Answered very well to questions from the	1 2 3 4 5

Evaluation Questions	Ratings Scale 1-5 *(please circle a number, as you feel appropriate)*	
	audience.	
6. Was the instructor helpful with practical individual/group works (if any)?	1. No, not enough available and helpful during the group/individual works. 2. 3. 4. 5. Yes. Definitely helped to make the individual/group works a learning opportunity.	1 2 3 4 5
7. How difficult were the practical group/individual works (if any)?	1. Too difficult. Didn't help or even discouraged a beginner to get more familiar with the tools and concepts. 2. A bit too difficult. Would be better if the instructions were a bit more details and explanations. 3. Just fine. Prompted me to look for answers, get my own experience and find my own solutions. 4. Too easy for my own technical level. 5. Too easy for everyone. Should challenge participants more and help everyone to practice on real.	1 2 3 4 5
8. Was enough time dedicated to the practical group/individual works (if any)?	1. No. More practice is needed 2. A little bit more time would help. 3. Just fine 4. A little bit less time would be enough. 5. Don't need to spend so much time on practice. On-the-job practice is needed anyway.	1 2 3 4 5
9. How do you rate training conditions (room size, equipment, environment...)?	1. Poor. 2. 3. 4. 5. Very good.	1 2 3 4 5
10. How well the sessions were organized (registration, schedule, breaks, refreshments...)?	1. Not well. 2. 3. 4. 5. Very well	1 2 3 4 5

Evaluation Questions	Ratings Scale 1-5 *(please circle a number, as you feel appropriate)*	
11. How useful should this training be in your daily job?	1. Not useful. 2. 3. 4. 5. Very useful. Will make my job easier and more productive.	1 2 3 4 5
12. Overall rating on the event (from your own perception)	1. Disappointing 2. Nearly OK 3. Good 4. Very good 5. Excellent	1 2 3 4 5
Comment (if any):		
Please answer the following questions		
What is climate change and its impacts?		
What are sources of Greenhouse Gas (GHG) emissions?		
How is the importance of the industrial sector to contribute to GHG emissions?		
Why is the world community worry about climate change?		
Can you estimate GHG emissions from the industrial process and product use?. (if no, give reasons?)		

Evaluation Questions	Ratings Scale 1-5 *(please circle a number, as you feel appropriate)*
What is impact factor?	
What is activity data?	
What is input data?	
What do you want to do next? (please explain)	
Signature	
Name	
Position	
Organization	