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Proceedings of the 16th Workshop on Greenhouse Gas Inventories in Asia (WGIA16)

- Capacity Building for Measurement, Reporting and Verification -

10th-13th July 2018, New Delhi, India

Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES

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Foreword

The international community now recognizes increases in anthropogenic emissions of greenhouse gases (GHGs) as the primary cause of climate change and its impacts. The 5th Assessment Report published by the Intergovernmental Panel on Climate Change (IPCC) in 2013 stated that "the atmospheric concentrations of the greenhouse gases carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have all increased since 1750 due to human activity." Moreover, many GHG observatories including Mauna Loa Observatory in Hawaii have detected that the yearly mean concentration of CO_2 had surpassed 400 ppm since 2015. In order to address mitigation and adaptation to climate change, all of us on the globe must make more efforts than ever in each of our respective fields.

"Measurement, Reporting and Verification", abbreviated as MRV, and transparency of mitigation actions is becoming increasingly important, and in this respect, national GHG inventories, which provide information on GHG emissions and their trends over time, play a critical role as a basis for decision makers to design and implement strategies of their countries' mitigation actions for reducing GHG emissions.

In order to support the enhancement of capacities for national GHG inventories in Asian countries, the National Institute for Environmental Studies (NIES) has been organizing the "Workshop on GHG Inventories in Asia" (WGIA) annually since November 2003 with the support of the Ministry of the Environment of Japan (MOEJ). This workshop supports government officials, compilers, and researchers in the Asian countries to develop and improve their GHG inventories through enhancing regional information exchange. The Greenhouse Gas Inventory Office of Japan (GIO), affiliated with the Center for Global Environmental Research (CGER), NIES, has functioned as the Secretariat for this workshop since its first session.

This CGER report serves as the proceedings of the 16th WGIA, which was held from July 10th to 13th, 2018, in New Delhi, India. We hope that this report will be useful for all those who work in the field of GHG inventories as well as climate change and will contribute to the further progress of inventory development in Asia.

Nobuko Saigusa

Director
Center for Global Environmental Research
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Preface

An important lesson that we have learned from the history of the UNFCCC is the importance of "measurement, reporting and verification" (MRV) and transparency. This includes measuring the effects of emissions reduction initiatives; reporting the results of the measurements on the international stage; and verifying the status of reductions. MRV ensures the transparency and accuracy of reports on each country's mitigation actions.

For steady implementation of MRV and transparency, it is essential to develop national systems for preparation of national greenhouse gas (GHG) inventories and to improve the accuracy of the inventories. In the Paris Agreement, the importance of establishing an enhanced transparency framework in order to build mutual trust and confidence and to promote effective implementation, is stated. The purpose of the framework for transparency of actions is to provide a clear understanding of climate change actions, including clarity and tracking of progress towards achieving Parties' individual nationally determined contributions (NDCs) and Parties' adaptation actions to inform the global stocktake. Each Party shall regularly provide a national inventory report and information necessary to track progress made in implementing and achieving its NDC under the Paris Agreement. Against this background, GHG inventories are being accepted more and more as being valuable because they support the transparency and accuracy of implementation of the national mitigation actions.

Since its first session in 2003, WGIAs have contributed significantly to the construction and consolidation of a network of officials involved in GHG inventory preparation in Asian countries and other institutes, and to the identification and solution of common issues of relevant to the inventories.

This time, the 16th WGIA (WGIA16) was held from 10th to 13th July, 2018 in New Delhi, India. The topics set out for this workshop were based on consideration of the current situation of the member countries, and we hope that this workshop contributes to the improvement of their inventories.

The outcomes of the WGIA16 are summarized in this report as Proceedings. It is our hope that this report will be found useful and will contribute to the further improvement of the GHG inventories of the WGIA-member countries.

In conclusion, we would like to thank all the attendees for their participation and active contribution to the workshop.

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List of Acronyms and Abbreviations

AB	WGIA Advisory Board
AD	Activity Data
AFOLU	Agriculture, Forestry and Other Land Use
BR	Biennial Report
BUR	Biennial Update Report
CDM	Clean Development Mechanism
CGE	Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention
CGER	Center for Global Environmental Research
COP	Conference of the Parties
CS	Country-Specific
EF	Emission Factor
EFDB	IPCC Emission Factor Database
ETF	Enhanced Transparency Framework
FAO	Food and Agriculture Organization of the United Nations
FSV	Facilitative Sharing of Views
FY	Fiscal year
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GIO	Greenhouse Gas Inventory Office of Japan
GPG	Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry
GWP	Global Warming Potential
IAR	International Assessment and Review
ICA	International Consultation and Analysis
IGES	Institute for Global Environmental Strategies, Japan
INC	Initial National Communication
INDC	Intended Nationally Determined Contribution
IP	Industrial Processes
IPCC	Intergovernmental Panel on Climate Change
IPCC AR4	IPCC Fourth Assessment Report
IPCC SAR	IPCC Second Assessment Report
IPCC TFI	IPCC, Task Force on National Greenhouse Gas Inventories,
IPCC TFI TSU	Technical Support Unit of the IPCC Task Force on National Greenhouse Gas Inventories
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
LUCF	Land-Use Change and Forestry
LULUCF	Land Use, Land-Use Change and Forestry
ML	Mutual Learning
MOEJ	The Ministry of the Environment, Japan
MRV	Measurement, Reporting and Verification Measurable, Reportable, and Verifiable
MPG	Modalities, procedures and guidelines
NAI	Non-Annex I

NAMA	Nationally Appropriate Mitigation Action
NC	National Communication
NDC	Nationally Determined Contribution
NIES	National Institute for Environmental Studies, Japan
NIR	National Inventory Report
PA	Paris Agreement
QA	Quality Assurance
QC	Quality Control
RAC	Refrigeration and Air Conditioning
REDD	Reducing Emissions from Deforestation and forest Degradation in developing countries
REDD+	Reducing Emissions from Deforestation and forest Degradation, and the Role of Conservation, Sustainable Management of Forests, and Enhancement of Forest Carbon Stocks
SBI	Subsidiary Body for Implementation
SLCF	Short-Lived Climate Forcer
SNC	Second National Communication
TA	Technical Analysis
TACCC	Transparency, Accuracy, Completeness, Comparability and Consistency
TNC	Third National Communication
TTE	Team of Technical Experts
UNFCCC	United Nations Framework Convention on Climate Change
WGIA	Workshop on Greenhouse Gas Inventories in Asia
1996 IPCC GLs	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
2006 IPCC GLs	2006 IPCC Guidelines for National Greenhouse Gas Inventories
2019 Refinement	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Chemical terms

CO_2	Carbon dioxide
CH_4	Methane
N_2O	Nitrous oxide
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulfur hexafluoride
NF_3	Nitrogen trifluoride
NO_X	Sum of nitrogen oxide and nitrogen dioxide
CO	Carbon monoxide
NMVOCs	Non-methane volatile organic compounds
SO_X	Sulfur oxide
CFCs	Chlorofluorocarbons
HCFCs	Hydrochlorofluorocarbons
ODS	Ozone Depleting Substance
BC	Black Carbon
Gg	Giga gram (10^9 g)
Mt	Million tonnes

Photos of the Workshop

Inaugural Address

Dr. Harsh Vardhan, Minister of Environment, Forest and Climate Change, India

Special Address

Mr. Hideki Asari, Charge d'affaires ad interim of Japan, Embassy of Japan in India

VIPs of Opening session

Co-Chairpersons for the Plenary Sessions

Session I

Mr. Kiyoto Tanabe (IPCC/ TFI) and Prof. Amit Garg (IIMA)

Session II

Dr. Sumana Bhattacharya (Iora Ecological Solutions Pvt ltd) and Dr. Atul Bagai (UNEP)

Session III

Dr. Sirintornthep Towprayoon (King Mongkut's University of Technology Thonburi) and Prof. Kirit Parikh (IRADe)

Session IV

Mr. Takahiko Hiraishi (IGES)

Wrap-up Session

Prof. Yukihiro Nojiri (Manager of GIO, Japan)

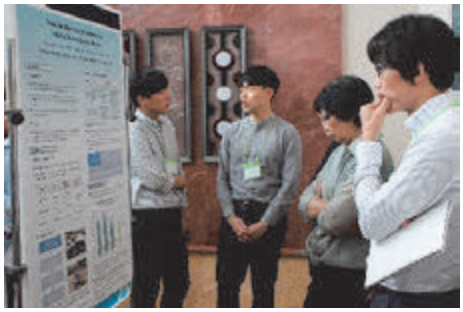
Mutual Learning Sessions

Waste sector: Lao PDR - Japan

Energy sector: India - Vietnam

Hands-on Training in Using the IPCC Inventory Software (IPCC TFI)

Discussions in the Plenary Sessions



Discussions in the Poster Session

Information Exchanges in Tea Breaks & during Reception

1. Executive Summary of WGIA16

1 Executive Summary of WGIA16

The Ministry of the Environment of Japan (MOEJ) and the National Institute for Environmental Studies (NIES) convened, together with the Ministry of Environment, Forest and Climate Change (MoEFCC) of India, the "16th Workshop on Greenhouse Gas (GHG) Inventories in Asia (WGIA16)" from July 10 (Tuesday) to 13 (Friday), 2018, in New Delhi, India.

The annual workshops have been held since 2003 in order to support non-Annex I (NAI) Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Asia to develop and improve their GHG inventories and to facilitate the enhancement of cooperative relationships towards the improvement of the accuracy of national GHG inventories in the Asian region. This year, in total, 116 participants attended WGIA16, including government officials and researchers from fifteen member countries (Brunei, Cambodia, China, India, Indonesia, Japan, Lao P.D.R., Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, and Vietnam), in addition to representatives of the Intergovernmental Panel on Climate Change Task Force on National Greenhouse Gas Inventories (IPCC/TFI), Ministry of Economic Affairs of Bhutan, Papua New Guinea Climate Change & Development Authority, World Resource Institute (WRI), and the Department of the Environment of Australia.

Opening Session

India and Japan individually made welcome addresses. The Greenhouse Gas Inventory Office of Japan (GIO) gave an overview of WGIAs. Then, India overviewed the institutional arrangement for its Biennial Update Report (BUR) and explained that higher tiers were used for many categories. Japan made a presentation on Japan's achievements in the field of climate change after the Great East Japan Earthquake in March 2011.

Additional Secretary of MoEFCC, Charge d'affaires ad interim of Japan of Embassy of Japan in India, and Director General of Forest and Special Secretary of MoEFCC gave welcome addresses, finally, the Minister of Environment, Forest and Climate Change, India made an inaugural address.

Updates on NCs and BURs from Non-Annex I Parties and Preparation for the Enhanced Transparency Framework

Mongolia, Papua New Guinea, and Korea gave presentations on their submitted National Communications (NCs) or BURs and reported the most updated information on their emission amount, mitigation activities, and relevant data. Japan also gave a presentation on the Current Status of Negotiations and Prospects for the Transparency Framework under the Paris Agreement (PA).

The information/experience sharing in this session is important. International Consultation and Analysis (ICA), especially Technical Analysis (TA) which involves interaction with international technical experts, is useful to identify areas for the improvement of BUR/NC. Compilers are encouraged to follow the negotiations on the Enhanced Transparency Framework (ETF) under the PA to better understand the modalities, procedures and guidelines (MPGs).

Fluorinated Gas Emissions from non-Annex I Parties

GIO made a presentation on the Kigali Amendment to the Montreal Protocol and the status of reporting by WGIA countries of fluorinated gases. Thailand, Malaysia and Singapore introduced their current methods of estimation or plans for estimation of fluorinated gas emissions.

With the Kigali Amendment entering into force, a closer collaboration between climate change and ozone experts is imperative, and the consistency between reported HFC production/consumption and emissions, and the consistency of global warming potentials (GWPs) between Montreal Protocol and UNFCCC will be useful.

Data Collection and Archiving

Bhutan, Indonesia, Korea and Japan introduced their institutional arrangement and data collection systems. Korea focused on energy statistics and Japan focused on forestry statistics.

It is important to improve the data collection policy and the quality of tools as well as to improve primary statistics, for the improvement of the accuracy of the national GHG inventory. The continuity of monitoring and tracking data, as well as that of inventory teams and QA/QC (Quality Assurance and Quality Control) systems are important as well.

GHG Inventories, Projections and Related Activities

IPCC/TFI/Technical Support Unit (TSU) explained the recent activities of IPCC/TFI, such as the development of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas inventories (2019 Refinement). Australia introduced its national system for GHG inventory compilation. Then, NIES presented the emissions projections of GHGs and air pollutants in the transport sector and stressed the importance of improving national GHG inventories. NIES also presented the use of GHG observations by satellites for estimating surface emissions. The National Institute of Polar Research explained a new observation methodology of Black Carbon (BC), a Short-Lived Climate Forcer (SLCF).

It is important to be aware of scientific advancements surrounding GHG inventories and to learn from advanced systems, and inventory compilers are encouraged to not only wait for inputs from science but to think about how they can contribute to science.

Mutual Learning of each sector's GHG inventories

The participants exchanged materials and questions to learn about the inventory and institutional arrangements of the counterpart country. For each session, two countries engaged with each other, by following-up on the Q&A which had taken place over the course of two months preceding the Workshop. In this WGIA, the mutual learning was held on the following two GHG inventory sectors: Energy sector (India and Vietnam), and Waste sector (Lao PDR and Japan).

Countries applied partly the 2006 IPCC Guidelines, and continuously improved their own GHG inventories. Methodology of the partner country and suggestions for improvement of the status of institutional arrangement including data collection system and QA/QC system were learned, and these were referred for future improvement of their own inventories.

Poster Session

This session was held to share information on institutional arrangements and latest research results and to deepen the discussion on specific issues. In one-to-one informal discussions, detailed information on reforming institutional arrangements were exchanged.

Hands-on Training

WGIA16 participants took hands-on training provided by IPCC/TFI on how to use the IPCC Inventory Software, focusing on Agriculture sector and F-gas sector.

2. Workshop Report

2 Workshop Report

Please note that all presentation materials can be downloaded from the website of Greenhouse Gas Inventory Office of Japan (GIO):
http://www-gio.nies.go.jp/wgia/wg16/wg16index-e.html

2.1 Opening Session

The opening session was moderated by Prof. Yukihiro Nojiri (GIO), and the rapporteur was Ms. Atsuko Hayashi (GIO).

The welcome address was delivered by Dr. J. R. Bhatt (Advisor of Ministry of Environment, Forest and Climate Change, India (MoEFCC)), followed by the welcome address delivered by Mr. Nobuhiro Kino (Director of the Low-Carbon Society Promotion Office, Ministry of the Environment, Japan (MOEJ)).

Mr. Hiroshi Ito (GIO) gave an overview of WGIAs. He introduced the historical progress of WGIA and its participants, agenda and expected outcomes. The expected outcomes of WGIA16 were:

- Capacity building of GHG inventory preparation of Asian counties
- Enhanced GHG inventories quality for the submission of National Communications and Biennial Update Reports
- Improved understanding of Fluorinated gases emissions from non-Annex I Parties
- Improved transparency of data collection and archiving
- Better understanding of the importance of GHG inventories, through the discussion of relationship among GHG inventories, projections, and so on.

Mr. Ito emphasized that an accurate inventory of NCs and BURs will contribute to planning and assessment of the emission reduction target in Nationally Determined Contribution.

Prof. Amit Garg (IIM Ahmedabad, India) made a presentation on preparation of Indian GHG Inventory. He overviewed the institutional arrangement for Biennial Update Report (BUR) in India and showed that India's national greenhouse gas emissions in 2010 were 2136.8 Mt CO_2eq. He also explained that higher tiers were used for many categories.

Mr. Takumi Ichikawa (MOEJ) made a presentation on Japan's Achievement for Climate Change after the Great East Japan Earthquake. He reported that Japan succeeded in reducing greenhouse gas emissions for three consecutive years. Japan's GHG emissions were 1,307 MtCO_2 eq. in FY2016. In 2015, Japan set an emission reduction target to reduce its GHG emissions by 26.0% below the FY2013 levels by FY2030 in INDC and will continue to make further efforts to achieve the 2030 target.

Dr. A.K. Mehta (Additional Secretary, MoEFCC), Mr. Hideki Asari (Charge d'affaires ad interim of Japan, Embassy of Japan in India), and Mr. Siddanta Das (Director General of Forest and Special Secretary, MoEFCC) gave welcome addresses, followed by Dr. Harsh Vardhan (Minister of Environment, Forest and Climate Change, India) who made an inaugural address. He expressed his appreciation for Japan to hold this workshop. He mentioned that the Prime Minister of India, Mr. Modi, initiated the Solar Alliance, Mission Innovation and others projects at COP21 and India will achieve the emission reduction target in 2030 before the target year.

2.2 Hands-on Training on Using the IPCC Inventory Software

Hands-on Training in Using the IPCC Inventory Software was implemented in two break-out groups: one on Agriculture sector and the other on F-gas sector. Dr. Baasansuren Jamsranjav (IPCC/TFI/TSU) lectured on Agriculture sector, and Mr. Kiyoto Tanabe (IPCC/TFI) lectured on F-gas sector.

2.3 Session I: Updates on the National Communications (NCs) and Biennial Update Reports (BURs) from Non-Annex I Parties and Preparing for the Enhanced Transparency Framework

This session was co-chaired by Mr. Kiyoto Tanabe (IPCC/TFI) and Prof. Amit Garg (IIMA) and the rapporteur was Ms. Atsuko Hayashi (GIO).

Non-Annex I Parties shall, as per COP 16 decision, submit national GHG inventories as a part of their BURs or NCs every two years. Under such circumstances, the WGIA member countries have submitted their BURs and/or NCs. In this session, Mongolia, Papua New Guinea (PNG) and Korea gave presentations about their latest BUR and NCs. In addition, there was a report on the current status of negotiations and prospects for the transparency framework under the Paris Agreement (PA).

Ms. Sanaa Enkhtaivan (Mongolia) gave a presentation on Mongolia's BUR1 and Third NC (TNC). Mongolia's BUR1 and TNC updated the information contained in the Second NC (SNC) and the first National Inventory Report (NIR). In these latest submissions, emissions/removals of GHGs from various source and sink categories have been estimated using methodologies that are consistent with the 2006 IPCC Guidelines.

Mr. Erick Immanuel Sarut (PNG) gave a presentation on PNG's SNC, BUR1, and TNC. He showed GHG emissions in SNC, methodology for GHG inventory in BUR1 and TNC, and PNG's challenges. PNG's BUR1 will be submitted in October 2018 and their TNC will be submitted in 2019. The 2006 IPCC Guidelines were used to estimate emissions and removals for the BUR1.

Dr. Hyung-Wook Choi (Korea) gave a presentation on Korea's BUR2. Korea submitted its BUR2 in November 2017. In order to improve the transparency of GHG inventory chapter, Korea provided more information than that contained in the BUR1 as follows: (1) information on estimation methodologies such as applied IPCC GLs for specific categories, emission factors including the list of country-specific emission factors in annex, and Global Warming Potentials (GWPs); (2) GHG emission trends from 1990 to 2014; (3) GHG emissions by gas; and (4) GHG emissions per capita and GHG emissions per GDP. The technical analysis took place in March 2018. Korea received 18 questions and comments for the inventory chapter regarding confirmation of categories which used the 1996 IPCC GLs, activity data information, the MRV process and timeline, indirect emissions, international bunkers, and uncertainty analysis.

Mr. Takashi Morimoto (MURC) gave a presentation: the Current Status of Negotiations and Prospects for the Transparency Framework under the Paris Agreement (PA). He showed that the Enhanced Transparency Framework (ETF) under the PA would build on the existing transparency arrangements under the Convention while integrating the differentiated arrangements between developed and developing countries. He offered his perspective that the general structure of transparency and reporting would not change so drastically from the existing arrangements, but the details would be enhanced and elaborated.

Discussions in this session were as follows:

In the first discussion, regarding Mongolia's presentation, it was recognized that experience of the International Consultation and Analysis (ICA) process was useful for further improvement towards the next submission, e.g., Mongolia took note of the importance of notation keys and 'not estimated' categories. In the second discussion, Korea's MRV process on BUR was clarified. The Greenhouse Gas Inventory & Research Center of Korea conducted MRV for sectoral data and made internal guidelines for MRV. In addition, improvement from Korea's BUR1 to BUR2 was shared. Korea reflected the comments from ICA/BUR1 and from internal experts to strengthen transparency.

In the last discussion, as a future prospect, it was mentioned that timing for applying the new modalities, procedures and guidelines (MPG) under the PA would probably be in 2024 or later.

In this session, the following conclusions were shared with the participants. First, the information/experience sharing in this session is important because it helps WGIA countries improve their capacities to meet the reporting requirements under the UNFCCC. Then, ICA, especially Technical Analysis (TA) which involves interaction with international technical experts, is useful to identify areas for improvement of BUR/NC. Finally, compilers are encouraged to follow the negotiations on the ETF under the PA to better understand the MPGs. It would be useful to share the information on how each country is planning to follow the MPGs at WGIA next year and onwards.

2.4 Session II: Fluorinated Gas Emissions from Non-Annex I Parties

This session was co-chaired by Dr. Sumana Bhattacharya (AB/Iora Ecological Solutions Pvt ltd.) and Dr. Atul Bagai (UNEP), and the rapporteur was Ms. Atsuko Hayashi (GIO).

The session focused on the new requirements under the Kigali Amendment to the Montreal Protocol, estimation methodology for fluorinated gases, and challenges/good practices in reporting. A wide range of national officials/experts gave presentations and participants exchanged views on how to estimate and report F-gas emissions.

Ms. Elsa Hatanaka (GIO) made a presentation on the Kigali Amendment and the status of reporting by WGIA countries of fluorinated gases under the UNFCCC. Although the reporting of F-gases such as HFCs, PFCs, and SF6 is not mandatory for Non-Annex I (NAI) countries, roughly half of WGIA countries are reporting such gases. The Kigali Amendment will newly be controlling HFCs, but its mission is to “phase down” production and consumption. Therefore, reducing emissions during the use of HFC devices, etc. will still be the actions under UNFCCC. It is important to further develop each country's F-gas inventory.

Dr. Kraichat Tantakarnapa (Thailand) talked about a case study conducted to develop F-gas emission estimations in Thailand. Although Thailand did not include F-gas emissions in its BUR2, they are currently analyzing what sources of data might be available. Information from importers/exporters seem achievable, but challenges are faced with information at the manufactures and end-users of F-gas devices. Promoting understanding is a priority.

Dr. Elizabeth Philip (Malaysia) gave an overview on the estimation of F-gases emitted from the IPPU sector in Malaysia. For the TNC, Malaysia is starting to collect data for aluminium production, semiconductors and PVs, mobile air conditioning, and electrical equipment, using the 2006 IPCC Guidelines/1996 IPCC Guidelines.

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Mr. Pitt Yu Zhe (Singapore) explained how F-gas emissions from the semiconductor industry in Singapore are estimated. This industry is the main source for PFC emissions. Companies report through the online system called the Emissions Data Monitoring and Analysis System (EDMA) which has the 2006 IPCC Tier 2a methodology built into it to estimate emissions. Robustness/completeness of data is checked through inter-agency cooperation mechanisms.

Following the above presentations, some comments were given and questions were raised. Mr. Takahiko Hiraishi (IGES) called for attention to the fact that under the Montreal Protocol, it is the production and consumption amounts that need to be reported and not the emissions data. He commented that close collaboration among inventory officers and ozone officers was becoming increasingly important.

Prof. Mingshan Su (China) raised the issue of what GWPs should be used under the different reporting schemes, since the Kigali Amendment required countries to use the IPCC-AR4 GWPs for estimation, but the UNFCCC reporting for NAI countries required the use of IPCC-SAR GWP values. In response to this, Ms. Hatanaka (GIO) suggested to use IPCC-AR4 GWPs, if possible, to avoid confusion during compilation.

Regarding Singapore's inventory, a question was posed from Dr. Tatsuya Hanaoka (NIES) whether they collected stock and flow data for refrigeration and air conditioning (RACs) as well, and Mr. Zhe (Singapore) responded that a study was currently being conducted on how to estimate emissions from RACs using IPCC 2006 Tier 1 methodology. Dr. Philip (Malaysia) explained that in their case, they were starting to collect RAC data to move to Tier 2 in the future.

Regarding Singapore's online reporting system for companies, EDMA, Dr. Bhattacharya sought clarification on how company-specific EFs were verified. Mr. Zhe (Singapore) responded that companies were required to provide documents that substantiate the EFs, or could, otherwise, use factors from e.g. international semiconductor organizations or IPCC defaults.

The participants, led by Dr. Bagai and Dr. Bhattacharya, concluded that with the Kigali Amendment entering into force, a closer collaboration between climate change and ozone experts was imperative, and that consistency between reported HFC production/consumption and emissions, and GWPs would be useful.

2.5 Session III: Data Collection and Archiving

This session was co-chaired by Dr. Sirintornthep Towpryoon (King Mongkut's University of Technology Thonburi) and Prof. Kirit Parikh (IRADe), and the rapporteur was Ms. Atsuko Hayashi (GIO).

"Data collection" is an integral part of developing and updating a greenhouse gas inventory. So, it is important to improve the technique of data collection, as it can make the inventory work sustainable and it can strengthen the accuracy of inventory.

This session was held with the aim of sharing the latest approaches and tools for data collection to be chosen and developed according to each county's circumstances.

The first speaker, Mr. Dawa Chogyal (Bhutan) started off the session with a presentation about Bhutan's commitment in GHG emissions and laws and policies to support the commitment. He reported that the total emissions for year 2010 in Bhutan didn't exceed the total sink from forest land, and he also told that the minimum coverage of forest was regulated by the law.

The second speaker of Bhutan, Mr. Rinzin Namgay (Bhutan) explained, however, Bhutan's rapid economic development with its industrialization and urbanization, which had led to an increase in GHG emissions in the country. The emission trends since 1999 by sector were shown and the data collection process for TNC was also introduced. He also mentioned that the online submission and data archival system enabled activity data to be reviewed once every year, which was seen as one of the benefits using online data systems.

Dr. Joko Prihatno (Indonesia) gave a presentation on Indonesia's national GHG data registration & collection system, called SIGN SMART, which was introduced as one of Indonesia's strategies for achieving its NDC's emission target. He also explained how the system worked. It can simplify the calculation process and improve the inventory archive system.

Dr. Sung-Kyun Kim (Korea Energy Economic Institute / KEEI) introduced GHG inventory Management System (GIMS) as well as the compilation process and data sources for Energy statistics in Korea. He explained how they collected and compiled energy data. He also shared some difficulties in gathering data appropriate for compiling needs. These included the fact that data provided voluntarily were at times beyond their control in terms of the raw data collection process and different criteria used for the raw data. The second part of his presentation was focusing on "GIMS". He differentiated "GIMS" from Indonesia's system, in that "GIMS" was developed to ensure the compiling process and to make the compiling work sustainable. He described the system with the word "platform" and the functions of the system were introduced, such as automatic calculation and verification function, generating CRF files and tracking revision in data changes.

The last speaker, Mr. Masaya Nishimura (Forestry Agency of Japan / FAJ) explained how they developed Japan's data for the national forest inventory, and emphasized the importance of establishing good statistics based on the bottom-up data from the forest register. He also explained each methodology for collecting different kinds of data, such as detection method for land conversion, method for developing parameters for calculating living biomass and models for estimating carbon stock changes in pools of dead wood, litter and mineral soils.

Following the presentations, some comments were given, and questions were raised.

Through the first discussion, Indonesia's online data registration and collection system was explained as it applied the methodology of FGD (Focus Group Discussion) to verify data by sector or subsector before data were imported to the system. Furthermore, activity data they were using were usually nationally integrated data even if the data were provided in province-base form, which was integrated to national statistical data. Mr. Kiyoto Tanabe (IPCC/TFI) and Dr. Towpryoon pointed out that further continuous development would be needed for data collection systems to have flexibility to be able to adapt to future EF or methodology changes and incorporate QA/QC.

In the second discussion over Korea's energy data, Dr. Kim clarified that the KEEI was the institute that provided national energy statistics and submitted them to the Bureau of Statistics. He also explained that no gaps were currently identified in the energy data, since there were vigorous efforts to work with voluntary providers, although only part of the data provision from energy importers and producers were legally bound, and the remaining was voluntarily provided by associations.

In the last discussion, Mr. Nishimura emphasized that the methodology/model should be selected based on the data availability.

Dr. Towpryoon, one of the co-chairs of this session, concluded that it was important to improve the quality of data collection policy and tools as well as to improve primary statistics, for the improvement of the accuracy of the national GHG inventory. She also emphasized that continuity in monitoring and tracking data, as well as inventory teams and QA/QC systems were important.

2.6 Session IV: GHG Inventories, Projections, and Related Activities

This session was chaired by Mr. Takahiko Hiraishi (IGES) and the rapporteur was Ms. Atsuko Hayashi (GIO).

A wide range of experts gave presentations and participants exchanged views on the interlinkages between GHG inventories, projections, and related activities.

At the outset, Mr. Hiraishi made a brief introduction of the topics taken up in the presentations and the agenda.

Mr. Andrej Kranjc (IPCC/TFI/TSU) explained IPCC/TFI's recent activities. Their main focus now is preparing the "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories" (2019 Refinement). It is to be completed in May 2019 and is about half way through. He also introduced recent activities regarding the IPCC Emission Factor Database (EFDB), the IPCC Inventory Software, and support for inventory-related capacity building programmes. EFDB was upgraded to a new version and released in May 2018. The work to incorporate Tier 2 methods into the IPCC Inventory Software is expected to be completed for all sectors by March 2019.

Ms. Monami Das Gupta (Australia) presented Australia's National Inventory System for GHG inventory reporting. She first explained Australia's IT data management system named Australian Greenhouse Emission Information System (AGEIS) which has built-in emission, QA/QC and CRF populating functions. The AGEIS has also an archiving function and the data back to 1990 is archived as one set after submission to UNFCCC each year. She next explained about the National Greenhouse and Energy Reporting scheme (NGER) for Australia which is an important mandatory reporting system for greenhouse gas emitting companies. Emission projection activities and inventory work for

F-gases were presented as well.

Dr. Tatsuya Hanaoka (NIES) presented the emissions projections of GHG and air pollutants in the transport sector and the importance of improving national GHG inventories. He firstly emphasized that all efforts for all gases and sectors are needed to achieve the 2-degree target under the PA. He also stressed the importance of the quality enhancement of statistical data for national GHG inventories for the improvement of emissions projections for CO_2 and air pollutants, and also elaborated on possible methodologies for emission projections.

Dr. Shamil Maksyutov (NIES) presented the use of GHG observations by satellites for estimating surface emissions. He introduced several specific research results of atmospheric observations by satellites and models for independent emission estimations and explained their usefulness for comparison with national inventories. He also mentioned that the use of atmospheric observation data by satellite is one of the ways to complement sparse surface observation networks.

Dr. Yutaka Kondo (National Institute of Polar Research: NIPR) gave a presentation titled "Black Carbon in the atmosphere: the importance, emission estimates and monitoring". He explained that Black Carbon (BC), a Short-Lived Climate Forcer (SLCF), is estimated to be one of the significant global warming agents, however, there are still large uncertainties in the estimate of its direct radiative forcing, because the estimates of BC emissions, transportation process of BC, and its impacts are not fully understood. He introduced instruments developed for long-term and automated measurements of BC.

Regarding the presentation of IPCC/TFI recent activities, Mr. Hiraishi, informed the period for the government and expert review of the 2019 Refinement and recommended participants of WGIA16 to register to review.

Mr. Hiraishi and Mr. Ajay (India) raised questions about Australia's NGER scheme, especially about the scope of the mandatory reporting. Ms. Gupta explained that the NGER was based on legislation that required companies that emit over a certain threshold to report their GHG emissions every year. She additionally commented that the reported data were confidential and that the emissions were aggregated to UNFCCC classification.

Dr. Philip (Malaysia) asked Dr. Hanaoka to introduce Japanese experiences on data collection when sufficient data are unavailable for projection. Dr. Hanaoka recommended to attempt referring to data from neighboring countries or modifying the methodologies based on the available dataset. To another question from Mr. Patino (Philippines) on how to develop and improve their own emissions projections, Dr. Hanaoka mentioned that methodologies and datasets of projection models could be improved by comparing them with other models. Mr. Hiraishi provided information that it might be advisable to refer to Clean Development Mechanism (CDM) experiences of road-traffic-related project proposals to generate traffic activity data and their projection and also commented that "projection" was an important key word for WGIA.

In terms of atmospheric observation by satellite, Mr. Ajay raised questions about the experience of comparison between the satellite data and the actual observation data. Another participant asked about the satellite detection level and the treatment of the transboundary emissions. Dr. Maksyutov explained that a wide range of scientific research was still required to alleviate uncertainties of GHG observation by satellites, including those related to inverse modelling, transport models and observation instruments and practices because this research field was still in the developing stage.

Prior to the discussion on BC after the presentation by Dr. Kondo, Mr. Tanabe (IPCC/TFI) shared a brief summary of the IPCC expert meeting on SLCFs held in May 2018 as follows:

- ✓ SLCF emission inventories are useful to enhance scientific understanding and assessment of their role in climate change as well as to inform climate policy at the national and international levels.
- ✓ There exist methodologies for emission inventories of most SLCF species which have been

developed and used by international/regional organizations, but they are not applicable globally. The need to do some work to fill gaps in existing methodologies was recognized.

- ✓ There are some issues that require careful consideration in future work to integrate inventories of GHG and SLCF, such as required spatial/temporal resolution, and the use of metrics to calculate emissions in CO_2 equivalent units.

Prof. Su and Mr. Ajay raised questions about the GWP or global warming impact of Black Carbon and those issues were discussed with comments by Dr. Kondo and Mr. Hiraishi. It was, however, confirmed through the discussion that the metrics of SLCFs including BC, as radiative forcing agents, were still under discussion in the climate science area due to their complexity, although mitigation had started in some places.

Following the questions and answers, Mr. Hiraishi concluded the session by commenting that it was important to be aware of scientific advancements surrounding GHG inventories and to learn from advanced systems, and that inventory compilers should not only wait for inputs from science but must think how they can contribute to science.

2.7 Wrap-up Session

This session was co-chaired by Prof. Yukihiro Nojiri (GIO) and Dr. A K Mehta (MoEFCC). In this session, the rapporteurs from the Mutual Learning session and plenary sessions provided summaries of the discussions including findings and conclusions, followed by the final discussion to conclude the workshop.

Summary of the Mutual Learning

Dr. Takefumi Oda (GIO) presented the background and objectives of the Mutual Learning (ML) programme as well as the outcomes of past MLs. He also summarized the ML held in this workshop.

After his report, some participants of ML expressed their appreciation. They said that the ML was informative and beneficial because they could share problems and knowledge to bring back home and receive feed back to their own inventory. They also remarked that the ML helped participants find differences in counterparts' inventory system from those of their own and learn from them.

It was suggested that ML would be more effective and more useful for improvement of inventory if experiences of development of country-specific emission factors could be shared among participating countries. Those who had not yet participated in the ML sessions expressed eagerly their intention to participate in future ML. Furthermore, participants hoped that future WGIAs would provide further opportunities to learn about other countries' inventories through this programme.

Generally, it was concluded that the ML should be continued.

Summary of the Plenary Sessions

Ms. Atsuko Hayashi (GIO), the rapporteur of the Plenary Sessions, reported a summary of the presentations, discussions and conclusions of Session I through Session IV.

The discussion after her report is summarized as follows.

Mr. Kiyoto Tanabe (IPCC/TFI) praised WGIA participating countries for the high ratio of submissions of BURs compared to the total submission ratio in all the NAI countries, which could be owing to the continuous effort of WGIA and networking in WGIA member countries.

For session II, Prof. Yukihiro Nojiri (GIO), the chair of the session, pointed out that many of the participating countries included or had been preparing for F-gas emissions although F-gas reporting wasn't obligated in NAI countries. Following this, Dr. Javiardhan Ramanlal Bhatt (MoEFCC) emphasized that close collaboration between climate change and ozone expert was needed.

Looking back at session III, Ms. Elsa Hatanaka (GIO) commented that it was important to start to be aware of keeping the deadlines for the products, e.g. BUR, NC or annual inventories in the case of AI countries. She stressed the need for close collaboration with relevant agencies that provide the

background data in order to achieve this. Following this, Mr. Larsen Daboyan (PNG) expressed his gratitude for the invitation to WGIA16 and told that PNG needed to do something to prepare integrated data management systems, as he was impressed that some of the presenters' countries already had developed their data management systems.

Closing Remarks

The closing remarks were delivered by Dr. A K Mehta (MoEFCC) and Prof. Yukihiro Nojiri (GIO). They thanked all for their active participation. They expressed their hope for the continuity of this workshop and development of a good networking within the countries.

3. Abstracts

3 Abstracts

In this section, the abstracts of the presentations are compiled. The abstracts are attached in an unedited form, as they were received from the presenters.

3.1 Opening Session

Overview of WGIA 16

Hiroshi Ito
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Abstract

Non-Annex I (NAI) Parties under the United Nations Framework Convention on Climate Change (UNFCCC) are required to prepare Greenhouse Gas (GHG) inventories as a part of National Communications (NCs) and/or Biennial Update Report (BURs) to be periodically submitted to the Conference of the Parties (COP) under the UNFCCC. It becomes important to develop reliable GHG inventory of NAI countries and to enhance its further improvement.

To support developing and improving GHG Inventories of NAI Parties in Asia, the Workshop on GHG Inventories in Asia (WGIA) was organized by the Ministry of the Environment of Japan (MOEJ) and the National Institute for Environmental Studies (NIES) and has been held on annually since 2003. The participating countries are 15 countries (Brunei, Cambodia, China, India, Indonesia, Japan, Republic of Korea, Lao P.D.R., Malaysia, Mongolia, Myanmar, Philippines, Singapore, Thailand and Vietnam). So far, WGIA achieved to strengthen a network of regional government officials and experts and to make website and proceedings.

The upcoming 16th Workshop on GHG Inventories in Asia (WGIA16) is to be held 10-13 July 2018 in New Delhi, India. The WGIA16 aims:

1) To enhance sector-specific capacity for inventory compilation,
2) To share the information of national GHG inventory for NCs and BURs,
3) To enhance the understandings of requirements of F-gas inventories,
4) To share the data collection and archiving systems for GHG inventory of BUR, and
5) To promote the relationship among GHG inventory, Projections and related activities.

Approximately 100 participants are expected to be present in this 16th workshop. Participants are government officials and researchers from 15 countries in Asia (the participating countries) and experts from international organizations (the IPCC Task Force on National GHG Inventories (IPCC/TFI), and others.

Access to relevant information

http://www-gio.nies.go.jp/wgia/wgiaindex-e.html

Japan's Achievement for Climate Change after the Great East Japan Earthquake

Takumi Ichikawa
Ministry of the Environment, Japan

Abstract

Japan overcame the Great East Japan Earthquake and succeeded in reducing greenhouse gas emissions for three consecutive years. In FY 2016, Japan's GHG emissions were 1,307 million tons of carbon dioxide equivalent ($MtCO_2$ eq.). Japan has set an emission reduction target to reduce its GHG emissions 26.0% below FY 2013 levels by FY2030 and will continue to work toward achieving this target.

The Great East Japan Earthquake that occurred in March 2011 caused enormous damage to Japan as well as changes in its energy structure. Greenhouse gas emissions in Japan greatly increased due to increase of electricity generation from thermal power plants caused by the shutdown of nuclear power plants.

In spite of the great impact of the earthquake, Japan has continued to work on climate change countermeasures. In 2015, Japan set an emission reductions target (INDC) to reduce GHG emissions 26.0% below FY 2013 levels by FY 2030. In 2016, Japan formulated the Plan for Global Warming Countermeasures to achieve this target. Based on this plan, Japan conducts global warming countermeasures such as expanding the introduction of renewable energy and supporting the promotion of energy conservation.

The implementation of these measures has resulted in increase of power generation from renewable energy, decrease of greenhouse gas emissions, and the development of a low-carbon society, etc.

Japan will continue to make further efforts to achieve the 2030 target.

References/ Publications

National Communication 7 (December 2017)
National Greenhouse Gas Inventory Report of Japan (April 2018)
General Energy Statistics of Japan (April 2018)
Plan for Global Warming Countermeasures (May 2016)

Access to relevant information

National Communication 7 (December 2017)
<http://unfccc.int/files/national_reports/annex_i_natcom_/application/pdf/79481053_japan-nc7-1-japan_nc7.pdf>

3.2 Session I

Updates on the Third National Communication (TNC) and Initial Biennial Update Report (iBUR) of the Mongolia

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Climate Change Project Implementing Unit
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Abstract

Mongolia has submitted the First National Communication (FNC) on 1st November 2001 and the Second National Communication (SNC) has been submitted on 10th December 2010. The most recently submitted the Initial Biennial Update Report (iBUR) and the Third National Communication (TNC) are officially launched on UNFCCC website on 30th August 2017 and 23rd April 2018, respectively.

The iBUR and TNC have updated the information contained in SNC and the first National Inventory Report (NIR) is being developed. In these latest submissions, emissions/removals of GHGs from various sources and sink categories between 1990 and 2014 have been estimated using methodologies that are consistent with the IPCC 2006 Guidelines.

Total GHG emissions in Mongolia in 2014 were 34,482.73 Gg CO_2e (excluding LULUCF). Net GHG emissions in 2014 were 10,030.80 Gg CO_2e (including LULUCF). The energy sector is the most significant source of the GHG emissions with 50.08% and the second major source was agriculture sector accounted for 48.51%, followed by IPPU (0.95%) and waste (0.46%) share of the national total emissions (without LULUCF) in 2014.

The technical analysis of the Mongolia's initial BUR took place from 4 to 8 December 2017 in Bonn, Germany. During the technical analysis, in addition to the written exchange, through the secretariat, to provide technical clarifications on the information reported in the BUR, the Teams of Technical Experts (TTEs) and Mongolia engaged in video conferencing consultation on the identification of capacity-building needs for the preparation of BURs and participation in the ICA process. Following the technical analysis of Mongolia's first BUR, the TTE prepared and shared a draft summary report with Mongolia on 1 March 2018 for its review and comment. Mongolia, in turn, provided its feedback on the draft summary report on 25 May 2018. The TTE responded to and incorporated the Party's comments and finalized the summary report in consultation with Mongolia on 6 June 2018.

Access to relevant information

https://unfccc.int/sites/default/files/resource/2018%20Mongolia%20TNC%20EN.pdf

https://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/application/pdf/mongolia_bur1_resubmission_and_annexnir.pdf

Sharing the Experience of the Second BUR and ICA in the Republic of Korea

Hyung-Wook Choi, Kyeongah Ahn
Greenhouse gas Inventory and Research Center, Republic of Korea

Abstract

The Republic of Korea (ROK) has submitted the second Biennial Update Report (BUR) to UNFCCC on 16 November 2017 as a non-annex I Party in accordance with the decision of the 17th Conference of the Parties in Durban. The second BUR of ROK was prepared by Greenhouse gas Inventory and Research Center (GIR) and the relevant ministries. The second BUR contains four chapters: (1) National Circumstances; (2) National Greenhouse Gas Inventory; (3) Mitigation Actions; and (4) International Support and Cooperation. National GHG inventory between 1990 and 2014 was estimated based on 1996 IPCC GL (energy, industrial process, agriculture and waste sector), GPG 2000 and GPG-LULUCF (LULUCF sector) for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

In order to improve transparency of GHG inventory chapter, ROK provided more information than the first BUR as follows: (1) information of estimation methodologies such as applied IPCC GL for specific categories, emission factors including the list of country-specific emission factors in annex, and Global Warming Potentials (GWPs); (2) GHG emission trends from 1990 to 2014; (3) GHG emissions by gas; and (4) GHG emissions per capita and GHG emissions per GDP.

The technical analysis of ROK's the Second BUR which is the first step of international consultation and analysis (ICA) took place from 5 to 9 March 2018 in Bonn, Germany. ROK received 18 questions and comments for inventory chapter regarding confirmation of categories which used 1996 IPCC GL, activity data information, MRV process and timeline, indirect emissions, international bunkers, and uncertainty analysis. During the conference call for the technical analysis, ROK received generally favorable comments by a team of technical experts (TTE) due to the improvements from the first BUR. The limitation for key category analysis, uncertainty analysis, and specific information of activity data were also discussed. Since the uncertainty analysis is difficult to estimate due to the limited data for activity data and emission factors, ROK gave feedback to TTE that it is necessary to provide the practical guidance and seminar for the uncertainty analysis. ROK will prepare the Facilitative Sharing of Views (FSV) for the second BUR.

References

Decision 17/CP.8 "Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention"

The Second Biennial Update Report of the Republic of Korea to UNFCCC

Current Status of Negotiation and Prospects for the Transparency Framework under the Paris Agreement

Takashi Morimoto
Mitsubishi UFJ Research and Consulting Co., Ltd., Japan

Abstract

The enhanced transparency framework for action and support (ETF) was established in Article 13 of the Paris Agreement, which builds on and enhances the existing transparency arrangements under the Convention. The Paris Agreement and decision 1/CP.21 requests the Ad Hoc Working Group on the Paris Agreement (APA) to develop and adopt the modalities, procedures and guidelines (MPGs) for the ETF at the COP24 to be held this year, and the work on the development of the MPGs is currently ongoing under the agenda item 5 of the APA. Parties will use the MPGs for their future reporting including greenhouse gas (GHG) inventories and tracking progress made in implementing and achieving nationally determined contributions (NDCs) under Article 4 of the Paris Agreement under the ETF in the near future. It would be helpful for national report compilers to follow the negotiations and the outcomes on the MPGs in preparation for the future reporting and review activities.

This presentation provides the summary of current status of the ongoing negotiations on the development of the MPGs for the ETF under the APA agenda item 5 and prospects the possible outcome based on personal views, especially focusing on the sections of GHG inventories, tracking progress made in implementing and achieving NDCs, and review process. The co-facilitators of the agenda item 5 have prepared the informal note at APA 1-5 held in May 2018 which includes diverse possible approaches and options for each component in the MPGs based on many views raised by Parties through past negotiations and submissions.

The critical viewpoints of the development of the MPGs are “continuous improvement” and “flexibility”. The MPGs to be adopted need to ensure an appropriate balance between the robustness to enable accurate assessment of achievement of NDCs and applicability to Parties with diverse capacities and starting points by incorporating these viewpoints. The more in-depth discussions and negotiations are expected at the next and subsequent APA sessions to explore the most appropriate option for each component included in the informal note and finalize the MPGs at the COP24.

References/ Publications

Paris Agreement
Decision 1/CP.21 “Adoption of the Paris Agreement”
Decision 2/CP.17 “Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention”
Draft elements for APA agenda item 5, Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement, Informal note by the co-facilitators – Final iteration

Access to relevant information

https://unfccc.int/process/bodies/subsidiary-bodies/ad-hoc-working-group-on-the-paris-agreement-apa/information-on-apa-agenda-item-5

3.3 Session II

The Kigali Amendment and the Status of Reporting of Fluorinated Gases under the UNFCCC: Emissions, Methods, and Gaps

Elsa Hatanaka
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National Institute for Environmental Studies (NIES)

Abstract

With the Montreal Protocol taking effect, CFCs have been replaced by HCFCs overtime, and HFCs have in turn replaced HCFCs. The inclusion of HFCs in the Montreal Protocol from the viewpoint of global warming countermeasures was under discussion since 2009. It culminated in an adoption of an amendment to newly include HFCs in the Protocol (the Kigali Amendment) in October of 2016. Three groups of countries now have different phase-down schedules set out for HFCs. Although the reporting of F-gases such as HFCs, PFCs, and SF_6 are not mandatory for UNFCCC Non-Annex I countries, the F-gas emissions are expected to keep rising, and dealing with these gases are becoming increasingly important.

Roughly half of WGIA countries are currently reporting such F-gases. The attempt to do so is similar across the three gases. Of those, some at least partially cover a time-series of data - more so for PFCs, followed by HFCs and SF_6.

Regarding estimation methodology, where available, reports indicated HFC methodology to be partly *Revised 1996 IPCC Guidelines/GPG*-based, and partly *2006 IPCC Guidelines*-based. This was similar for PFCs, but for SF_6 methodology, more countries based estimations on the *Revised 1996 IPCC Guidelines/GPG*. However, we would need to be mindful that the sample size of WGIA countries reporting F-gases is very small.

F-gases occur from various sources. For reference, on the last year when Japan was applying the *Revised 1996 IPCC Guidelines/GPG*, the main source for HFCs were refrigeration and air conditioning. The electronics industry was the main source for PFCs and electrical equipment was the main source for SF_6. HFC emissions were over and above the largest of the three F-gases, and PFC emissions and SF_6 emissions followed behind.

Here, the emissions for HFCs, PFCs, and SF_6 for WGIA countries were compiled, and several observations were made. It was noted that there were isolated peaks in emissions for certain years when reporting took place, following reporting requirements. It was also noted that the size of emissions were quite different between the gases, with HFCs being over and above the largest, with PFC emissions and SF_6 emissions following behind. It was also noted that it was difficult to evaluate consistency across years within one country's reporting when there was no time-series data.

However, it was observed that comparison between HFC/PFC/SF_6 emissions within one country, during one reporting, and comparison across countries for the same inventory year might be useful. It was also noted that comparison with other estimates might also be useful, while bearing in mind that various assumptions are made to prepare the estimates.

The Kigali Amendment to the Montreal Protocol will be controlling HFCs as well from now on, however, its mission is to phase down production and consumption. Therefore, reducing emissions during the use of HFC devices, etc. will still be the job of UNFCCC. With this overlap, it may be efficient to plan to deal with the Montreal Protocol and UNFCCC matters together, where appropriate. It is also important to further develop each country's F-gas inventory under the UNFCCC (including PFCs and SF_6, etc.), while keeping in mind that CFCs and HCFCs are still also potent global warming substances.

Development of F-gas emissions estimation from non-Annex I Parties: A case Study of Thailand

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Abstract

Thailand is classified as non-annex I parties according to the UNFCCC category and located in the heart of mainland Southeast Asia. However, Thailand has cooperated with the international community to address the global issue. We submitted the National Communication (NC) Reports and also Biennial Update Report (BUR). The last version of NC is the third report and the second report of BUR. Office of Natural Resources and Environmental Policy and Planning (ONEP) is a focal point to conduct both reports. At the first stage, the ONEP requested the professor from university to carry out the GHG estimation, however the participation of related and responsible organization was the key factor. Therefore, ONEP set up and announced the steering committee from the designed organizations. The steering committee has worked together to get the GHG estimation for Thailand report. We estimated GHG emissions by following the guideline of IPCC 1996 including IPPU sector. The F-gas emission estimation was not reported in the BUR since there were limitation of available data. Currently, we have developed Thailand's Greenhouse Gas Emissions Inventory System (TGEIS) by following the IPCC guideline version 2006 for all sectors. The estimation of GHG for IPPU sector has been developed by the coordination and cooperation of Department Industrial Work (DIW), Ministry of Industry that is the organization who take responsible about the industrial work. However, ONEP and DIW also have collaborate with other related organizations. If the Greenhouse Gas Emissions Inventory system was completed, it would be tested for the validation of the system by the working team. The orientation and distribution would be the next step for the involved and responsible organization. However, our country has to create and launch the project for the organizations by setting the regulation or any agreement. In addition, the MRV (Measurement Reporting and Verification) system should be also prepared. In order to achieve the purposes, the capacity building is also required for the understanding the GHG estimation, TGEIS, and MRV system and other related issues. The next step would be the validation of TGEIS, the orientation of TGEIS and strengthen the capacity in other related issues for development of the next national communication report and biennial update report

Estimating Fluorinated Gas from Industrial Processes and Product Used (IPPU) Sector

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Abstract

Malaysia estimate fluorinated gas emissions from two sub categories, within the substitutes for ozone depleting substances (2F) in the BUR. In the 3rd National Communication, Malaysia started collecting data for other categories such as metal industry (2C3), electronics industry (2E), products use as substitutes for ozone depleting substances (2F) and other product manufacture and use (2G).

Tier 1 method as described in 2006 IPCC Guidelines were used to estimate the emissions of F gases. Two PFCs, are emitted from the primary aluminum smelting process. The simplest method for accounting PFCs is to multiply the default emission factors by aluminum production. Total aluminum produced was sourced from Minerals Yearbook published by Minerals and Geoscience Department Malaysia. Default emission factors by technology-type are available in the 2006 IPCC Guidelines. Since, Malaysia has only one aluminum plant operating since 2011, the Center Worked Prebake (CWPB) technology as used as reported in by the company.

For electronics industry, F gas emissions are basically from the silicon process in the semiconductor and photovoltaic production. activity data for the electronics industry consists of data on gas sales and use or the annual amount of electronics substrate processed. Silicon consumption may be estimated using an appropriate edition of the World Fab Watch (WFW) database, published quarterly by Semiconductor Equipment & Materials International (SEMI).

Current application of HFCs in Malaysia is mainly confined to road transport air conditioning. The Department of Environment (DOE) reported that the only halocarbon actively being used in Malaysia is HFC 134a for mobile air-conditioning in vehicles. All new non-commercial vehicles assembled are considered to be HFC-134a fitted air conditioning at factory. Based on the accessibility of data, the Tier 2 method (bottom-up approach) was used for the calculation of HFC 134a emissions from automobiles. The accuracy of the result of the calculation was based on the data availability for the refrigerated transport including mobile air conditioners used to cool passengers' compartment of automobiles. Data were obtained from Ministry of Transport, the Ministry of Transport (MOT), Department of Road Transport (JPJ), local Mobile Air Conditioning (MAC) system manufacturers and Malaysia Automotive Association (MAA).

Revised 1996 IPCC guideline was used to estimate the emission of SF_6 due to data availability from data providers.

3.4 Session III

Bhutan Carbon Neutral (Greenhouse Gas Institutional Arrangements)

Dawa Chogyel, Rinzin Namgay
Bhutan

Abstract

The Kingdom of Bhutan is a small landlocked country (India in the south/east/west and China in the north) with a total area of 38,394 sqkm and is characterized by rugged mountainous terrain with elevations ranging from around 160 meters to more than 7000 meters above sea level. The population is around 735,553 with about 55% of the total engaged in agriculture and forestry.

As a landlocked least developed country located in a fragile mountainous environment, Bhutan remains highly vulnerable to the impacts of climate change and will disproportionately bear the impacts of climate change. As reported in the Second National Communication (2011), the most vulnerable sectors due to climate change are water resources, agriculture, forests & biodiversity and hydropower sectors.

Bhutan made the commitment to remain carbon neutral in 2009 despite our status as a small, mountainous country with many other pressing social and economic development needs and priorities. This commitment was made with the view that there is no need greater, or more important, than keeping the planet safe for life to continue. Bhutan submitted the Intended Nationally Determined Contribution and re-communicated our resolve to remain carbon neutral by ensuring that our emission of GHGs does not exceed the sink capacity of our forests.

According to the second national GHG inventory (2013), Bhutan is a net sink for greenhouse gases. Forests currently cover 70.46% of the land area of Bhutan and sequestration by forests is estimated at 6.3 million tons of CO_2 and emissions in 2013 are estimated at 2.2 million tons of CO_2 equivalent.

Although the highest emissions are from the agriculture sector they have more or less remained constant, but emissions from sectors such as industrial processes and transport are showing a rapidly increasing trend. During the period 2000-2013, emissions from the energy sector increased by 191.6% from 0.270 million tons of CO_2e in 2000 to 0.79million tons of CO_2e in 2013. During the same period, emissions from industrial processes increased by 154.3% from 0.24 million tons of CO_2e to 0.6 million tons of CO_2e. Emission from waste management also increased by 247.54% from 0.047 million tons of CO_2e to 0.16 million tons CO_2e.

The country is in the process of preparing the Third National Communication. The project is coordinated by the National Environment Commission Secretariat (NECS). There is no separate GHG Inventory Institution, however the NECS coordinates the task with the formation of Taskforce and Thematic Working group members for various relevant government and private sector agencies.

References/ Publications

1. Statistical yearbook of Bhutan 2017
2. Second National Communication from Bhutan UNFCCC 2011
3. Intended Nationally Determined Contribution Document as submitted to UNFCCC
4. Land Cover Mapping Project, 2010, National Soil Service Center

Access to relevant information

1. Website of National Environment Commission Secretariat (NECS) – www.nec.gov.bt
2. Website of National Statistical Bureau (NSB) – www.nsb.gov.bt
3. Website of Ministry of Agriculture and Forests – www.moaf.gov.bt

ONE GHG EMISSION DATA POLICY OF INDONESIA

Joko Prihatno
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Abstract

Indonesia as an archipelagic country, consists of 34 provinces, 416 district areas and 98 cities, is having a great challenge in facing climate change. Indonesia has put on strategy in combating climate change issue at national and sub-national level to implement National Determined Contribution and conducting reporting on implementation progress. It takes great effort in providing transparent, accurate, consistent, continuous yet comparable data in order to produced systematic documentation and archiving based on IPCC guideline 2006. There is a need to have single GHG emission reduction's data base policy in order to gain compatible emission data profile in five main sectors to be stored in SIGN SMART and national public registry.

Indonesia commits to reduce GHG emission 29% (conditional) up to 38% (unconditional) by 2030 compared with the recent baseline. The higher GHG emission target comes from two main sectors i.e. forestry (17.2%) and energy (11%). The rest come from waste, industry and agriculture. There are 9 strategies in implementing NDC in order to achieve emission reduction targets, one of them is a national single GHG emission data base policy.

A single GHG emission data base policy is aimed to ensure accountability, integrity, effectiveness in reporting GHG emission at national and international level. The strategy has been put in place by building agreement from related stakeholders and strengthening regulation; facilitated related sectors in integrating and managing data in each sector as well as developing documentation system and archiving through SIGN SMART and SRN.

Documentation and archive GHG inventory have been conducted as well as developing improvement plan through MDA Programme: CGE Training Material from UNFCCC Secretariat, there are 7 steps in documenting and inventorying process of GHG emission and 3 steps in archiving process. Current condition shows that all the meta data are well stored in SIGN SMART and hard copy of the data are well stored by SIGN SMART data operator. Methodology is documented in the GHG Inventory reports such as Natcom and BUR, activities data are well stored in each focal point for each sector. Future planning for GHG emission data management is all the data including activities, emission factors, uncertainty and key category analysis will be all integrated in SIGN SMART.

Archive system is still in the form of hard copy/manual. At this moment digital archives are only consisted of activities data and emission factors which are used to conduct emission accounting and have been input in SIGN SMART. Emission factors application system is being developed as archive emission factor database in PDF format. In the future digital archive GHG inventory system will be improved by integrating in single system in SIGN SMART.

A single GHG emission data base system reflects Indonesian commitment in implementing NDC in order to reduce GHG emission at national level which will give contribution to international GHG emission reduction. Using IPCC Guideline 2006 supported by SIGN SMART application helps the GHG inventory process.

Reference:

1. CGE Handbook on Building Sustainable National GHG Inventory Management Systems, Secretariat UNFCCC. WGIA 15 in Myanmar, 2017.

2. GHG Inventory and penurunan emisi terverifikasi Indonesia sampai dengan tahun 2016. Kementerian LHK, 2017.

Access to relevant information:

1. http://signsmart.menlhk.go.id/signsmart_new/web/home/
2. http://ditjenppi.menlhk.go.id/srn/

Developing GHG inventory management system for Korean energy sector

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Abstract

Korea Energy Economics Institute(KEEI) compiles national energy statistics and also energy sector GHG inventory. Korea's national energy statistics is compiled mostly based on reports by energy importers and producers. KEEI verifies these raw data using data from other sources and socio-economic data. However, there remain limitations because it depends on voluntary cooperation of reporters. KEEI cannot control raw data collection while reporters use different criteria on energy type and sector category. This suggests possibility of systematic and human error in integrating and converting data.

Republic of Korea ranks in top ten GHG emitters in the world. Korea's energy sector emitted about 600 million tCO2e in 2014(KESIS, 2018), and it occupies about 1% of world GHG emissions (IEA, 2017). Energy industry, mostly power generation sector, is the major source of GHG emissions. It results in that use of coal is the major source of emissions among fuel types.

KEEI has compiled energy sector inventory for years and has experienced diverse difficulties in managing input and output inventory data, and also in making this work sustainable. In order to improve accuracy and transparency of GHG inventory in energy sector, KEEI-GHG inventory team has carried out a project to develop GHG Inventory Management System(GIMS) since 2011.

Improvement efforts started from analyzing data characteristics and searching for optimal way in organizing the data. Required functions of inventory work were identified and presented in computer programs: (1) data calculation and verification, (2) result table and graph production, (3) CRF generation, and (4) record keeping. Once plugged in input data, GIMS calculates GHG emissions, produces tables and graphs for NIR, and generates CRF files, while all processes are recorded. At each step, one can easily check errors for QA/QC.

GIMS project also made a couple of improvements including reducing total number of files to six, standardizing variable names, using color code, using network drive and so on. This project has been proved successful so far by peer groups and evaluated to make inventory work more efficient and sustainable. The experience of developing GIMS would be helpful to inventory compilers in other sectors as well.

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Korea Energy Statistical Information System(KESIS). (2018).
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Data Development Approach for National Forest Inventory in Japan

Masaya Nishimura
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Abstract

1. Back ground information

On the basis of Article 4 and 12 of the UNFCCC (United Nations Framework Convention on Climate Change), all Parties to the Convention are required to submit national inventories of greenhouse gas emissions and removals. As it is widely known, LULUCF (Land Use, Land Use Change and Forestry) sector has specific aspects such as covering both emissions and removals. In this session, the Japanese way of data development approach for estimating national forest inventory in LULUCF sector will be introduced.

2. Japanese definitions of forest

Forests are classified in following subcategories. Their definitions are set by tree crown cover rate etc.

A) Forest with standing trees:
   i. Intensively managed forest; and
   ii. Semi-natural forest.
B) Forest with less standing trees
C) Bamboo

3. Development of NFRDB (National Forest Resource Database)

National Forest Resource Database has been developed to calculate carbon stock and to store necessary information

- Time frame: 2003 - 2006
- Costs: JPY 400 million (equivalent to USD 3.6 million)
- Data stored: forest registers, satellite imageries, forest planning maps etc.

4. Parameters development approach for estimating carbon stock change

A) Living biomass

Trunk volume is calculated based on forest registers and other parameters (BEF (Biomass Expansion Factor), density and carbon fraction) are set based on the results from biomass sampling surveys on dominant tree species and existing research reports. Remote sensing technology has been also used to detect land use conversions.

B) DOM (Dissolved Organic Matter) and soil

The 'Century' was applied as the basic model to estimate the carbon stock. The model has been modified to adapt to Japan and a country specific model the 'Century-jfos' has been developed. The carbon stock changes are estimated by multiplying the data from the Century-jfos and NFRDB

5. Conclusion

Each country needs to adapt the most appropriate approach to develop the inventories depending on their data availability and national circumstances, however development of the first statistics data is very important to improve accuracy of the national GHG inventory.

3.5 Session IV

IPCC TFI: Recent Activities

Andrej Kranjc
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Abstract

The two main objectives of the IPCC TFI are:

- to develop and refine an internationally-agreed methodology and software for the calculation and reporting of national GHG emissions and removals;
- to encourage the widespread use of this methodology by countries participating in the IPCC and by signatories of the United Nations Framework Convention on Climate Change (UNFCCC).

On the basis of the decision (IPCC/XLIV-5) taken at 44th Session of the IPCC (October 2016, Bangkok, Thailand), the IPCC Task Force on National Greenhouse Gas Inventories (TFI) started its work on production of the Methodology Report titled the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement)* to be completed in May 2019. From among 328 nominations received from governments, observer organizations and Bureau members, 190 experts were selected as Authors and Review Editors by the Task Force Bureau (TFB) in accordance with the Principles Governing IPCC Work. Three Lead Author meetings have already taken place (in June 2017, September 2017 and April 2018), and the fourth and final one will take place next October. Authors have prepared the First Order Draft which was submitted to the Expert Review in the period 4 December 2017 – 11 February 2018, and the Second Order Draft which is open for Government and Expert Review from 2 July to 9 September.

The overall aim of the *2019 Refinement* is to provide an updated and sound scientific basis for supporting the preparation and continuous improvement of national greenhouse gas (GHG) inventories. It will have the same structure as the *2006 IPCC Guidelines*. The refinement work does not revise the *2006 IPCC Guidelines*, but will update, supplement and/or elaborate the *2006 IPCC Guidelines* where gaps or out-of-date science have been identified. The *2019 Refinement* will not replace, but will be used in conjunction with, the *2006 IPCC Guidelines*.

The activities to maintain and improve the IPCC Emission Factor Database (EFDB) are permanently taking place. Around 600 new data were accepted for inclusion into the database by the EFDB Editorial Board at its 15th meeting held in December 2017 at IEA in Paris.

The work to incorporate Tier 2 methods in the software was completed in 2017 for the sectors Energy, Industrial Processes and Product Use, and Waste; the work on AFOLU has already started (completed for Livestock), and it is planned to be completed for other parts of AFOLU in the first quarter of 2019.

The IPCC TFI continues with other activities for supporting users of the IPCC Guidelines (e.g. organizing expert meetings, producing supporting materials) and collaboration with other organizations contributing to inventory-related capacity building programmes/activities (e.g. regional workshops organized by UNFCCC).

Access to relevant information

http://www.ipcc-nggip.iges.or.jp/

Australia's National Inventory System for GHG Inventory Reporting

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Abstract

The Australian Government has invested for nearly 30 years in institutional arrangements to that sustain the development of a comprehensive and efficient inventory system that successfully supports evolving climate policy and international reporting obligations.

There is a shared understanding that effective domestic emissions policies rely on emissions estimates which is clearly an outcome of an efficient inventory system that is aligned with IPCC and UNFCCC reporting rules and emission estimation guidance. Australia has demonstrated that centralising institutional arrangements as much as possible will help guarantee estimates are accurate, comparable and transparent.

Australia's National Inventory System (NIS) is at the core of the government's response to climate change. The NIS allows the government to:

- fulfil international reporting obligations under the Paris Agreement, the UNFCCC and Kyoto Protocol,
- support the design, implementation and independent monitoring of domestic emission reduction policies,
- track Australia's progress towards international emission reduction commitments; and
- provide a fundamental and strategic input into emissions projections that inform decisions on future emission reduction commitments.

The NIS's success is because of significant investments in data collection and centralised data management systems. Australia centralises its inventory preparation in the Department of the Environment and Energy. Data collection is underpinned by legislation. The main legislative tool is Australia's mandatory National Greenhouse and Energy Reporting Scheme (NGERS). All major companies that emit emissions or produce or consume energy over a certain threshold must report annually, and in accordance with approaches based in national inventory methods. This essential principle of NGERS has been vital to ensuring data collected helps maintain complete and accurate national inventory reporting.

Investment in data management is ongoing. In particular, the Australian Greenhouse Emissions Information System (AGEIS) supports a high quality and transparent inventory consistent with requirements of the IPCC inventory guidelines. Building on inventory estimates, the Australian Government produces emissions projections to inform domestic policy debate and national emission targets. The projections demonstrate Australia's progress towards meeting its emissions reduction targets, illustrating where emissions arise in the economy and the drivers behind long-term trends. The projections therefore form a key input into policy development and evaluation for the Australian government and stakeholders. Reporting emissions projections also fulfils one of Australia's reporting requirements under the UNFCCC.

Access to relevant information

http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/tracking-emissions
http://ageis.climatechange.gov.au/
http://www.cleanenergyregulator.gov.au/NGER
http://www.environment.gov.au/climate-change/climate-science-data/emissions-projections

Emissions Projections of GHGs and Air Pollutants in the Transport Sector and Importance of Improving National GHG Inventories

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Abstract

In the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Paris in 2015, policy-makers have agreed decisions that nations take climate mitigation actions for achieving the mid- to long-term global greenhouse (GHG) emissions pathways consistent with a global temperature change limit below two degree compared to the pre-industrial level (i.e. the 2℃ target). In order to achieve the 2℃ targets, it is required to accelerate introduction of energy efficient technologies on both the demand side and the supply side. At the same time, it is important to reduce SLCPs (Short-Lived Climate Pollutants) such as CH_4, BC (black carbon) and tropospheric O_3 in order to help achieving the 2℃ targets.

As for emissions and atmospheric concentrations of air pollutants, the road transport is one of major sectors of emitting air pollutants of NOx, NMVOC and CO which are also precursor substances of tropospheric O_3 as one of SLCPs. If we deploy more energy efficient technologies and also promote energy shifting from fossil fuels (gasoline and diesel) to electricity in the road transport, we can find cobenefits of reducing air pollutants emissions due to effects of low carbon mitigation measures. Thus, this presentation will focus on the transport sector and introduce the following topics;

1) how important to enhance quality of required statistical data for improving national GHG inventories, in order to estimate future emissions projections about not only CO_2 but also air pollutants such as NOx, $PM_{2.5}$, BC etc.
2) methodologies how to estimate the future road transport volumes, develop emissions scenarios, and evaluate future emissions projections
3) methodologies how to analyze mitigation measures and evaluate effects of synergies and tradeoffs of combinations of decarbonization measures and air pollutants control measures.

References/ Publications

- Mittal, E., Hanaoka, T., Shukla, P.R., Masui, T. (2015) Air pollution co-benefits of low carbon policies in road transport: a sub-national assessment for India. *Environmental Research Letters*, 10(8), DOI: 10.1088/1748-9326/10/8/085006
- Mittal, S., Dai, H., Fujimori, S., Hanaoka, T., Zhang, R. (2017) Key factors influencing the global passenger transport dynamics using the AIM/Transport model. *Transport Research Part D,* 55:373-388, DOI: https://doi.org/10.1016/j.trd.2016.10.006
- Hanaoka, T., Masui, T. (2017) Global Emissions Scenarios on SLCPs, GHGs, and Air Pollutants – Evaluation on Cobenefits and Tradeoffs of Mitigation Measures -, *International Workshop on SLCP emissions and impacts in East Asia*

Use of GHG observations by satellites for estimating surface emissions

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Abstract

The Paris Agreement, which entered into force in 2016, requires each country to report its greenhouse gas (GHG) emission inventory under a highly transparent framework. To secure the transparency of the inventory, it is advised to compare and evaluate the inventories by independent ways. A number of countries, such as Switzerland, UK and Australia implemented ground-based monitoring networks and include the emission estimates based on atmospheric GHG measurements into national inventory reporting. One of the ways to complement sparse surface observation networks is GHG observations using satellite remote sensing techniques. Several satellites to monitor GHGs are in operation, including Greenhouse gases Observing SATellite (GOSAT) launched by Japan in 2009, the Orbiting Carbon Observatory 2 (OCO-2) by the US in 2014, TanSAT by China in 2016 and Sentinel-5p by the European Space Agency in 2017. Several studies used satellite data for estimating national emissions.

Turner et al., (2015) used GOSAT data and transport modeling to estimate methane emissions in USA, pointing out that the upward correction to bottom up inventory is needed, likely due to oil and gas sector emissions. A study by Univ. of Bristol (Ganesan et al., 2017) inferred India's CH_4 emissions for the period 2010–2015 using a combination of GOSAT satellite, surface and aircraft data. They applied a high-resolution atmospheric transport model to simulate data from these platforms to infer fluxes at sub-national scales and to quantify changes in rice emissions, and found that average emissions over this period are 22±3 Tg yr^{-1}, consistent with the emissions reported by India to the UNFCCC.

More examples of using satellite observations for estimating national GHG emissions are presented, based on a Guidebook on use of greenhouse gas (GHG) observations by satellites for estimating surface emissions (Matsunaga and Maksyutov, 2018). The purpose of the Guidebook is to facilitate use of satellite GHG concentration observations for estimating the emissions, at a city to national scale, for applications such as national emission inventory improvement and verification in support of implementation of the Paris agreement on the gradual reductions of the GHG emissions. Guidebook include overview, introduction to satellite GHG data analysis methodology and a number of case studies, based on published research papers.

References/ Publications

Ganesan A.L., et al. (2017) Atmospheric observations show accurate reporting and little growth in India's methane emissions. Nature Communications 8: 836

Matsunaga T. and Maksyutov S., Editors, (2018) A Guidebook on the use of satellite greenhouse gases observation data for verification of greenhouse gases emission inventories, SOC, NIES, Tsukuba, 131 pp. Online document: https://www.nies.go.jp/soc/en/documents/guidebook

Turner A., et al. (2015) Estimating global and North American methane emissions with high spatial resolution using GOSAT satellite data. Atmospheric Chemistry and Physics 15: 7049-7069.

Black carbon in the atmosphere: Importance, emission estimates, and monitoring

Yutaka Kondo[1)], Makoto Koike[2)], Satoru Chatani[3)]
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[3)]National Institute for Environmental Studies, Japan

Abstract

Black carbon (BC) aerosols are light-absorbing carbonaceous particles emitted by incomplete combustion of fossil fuels, open biomass burning, and biofuel burning. Climate model calculations indicate that the emissions of BC contribute to global warming through heating in the atmosphere. In addition to its effects on climate, it is harmful to human health. BC is estimated to be the third largest global warming agent, after CO_2 and CH_4. BC and CH_4 are the most important short-lived climate forcers (SLCFs). BC direct radiative forcing (DRF) has been estimated to be about 0.6 W m^{-2} (IPCC AR5). However, there are large uncertainties in the estimate of the BC DRF, because the estimates of BC emissions are uncertain and the processes that control BC distributions are not fully understood. Currently, it is not required to submit BC emission inventories to the UNFCCC. However, Expert Meeting on Short-Lived Climate Forcers (EM-SLCF) organized by IPCC Task Force on National Greenhouse Gas Inventories (TFI) will make a recommendation that IPCC TFI will take a lead to make a guideline to compile emission inventories of SLCFs in a consistent manner with those for GHGs (May 2018, tentative information). Apart from this activity, ambitious reductions of BC emission are recommended by the Expert Group on Black Carbon and Methane (EGBCM) of the Arctic Council (AC) for partially mitigating the warming caused by the increases in the long-lived GHGs. EGBCM is also taking an initiative to compile BC emission inventories for AC and observer countries. Measurements of the changes of BC concentrations are needed to evaluate the effects of future regulations on BC (and PM2.5) emissions. We have developed COSMOS (Continuous soot monitoring system) instrument for long-term and automated measurements of BC with a high accuracy. We have shown that BC concentrations decreased to 1/3 in Tokyo over 7 years, soon after stringent regulations on vehicular emissions. The data obtained by COSMOS played a critical role for this study.

References

Kondo, Y. (2015), Effects of black carbon on climate: Advances in measurement and modeling, *Monogr. Environ. Earth Planets*, *3*, 1-85, doi:10.5047/meep.2015.00301.0001.

3.6 Poster Session

Introduction of GHG data information system in Korea

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Abstract

Framework Act and its Enforcement Decree on Low Carbon and Green Growth are the foundation of Korea's movement towards sustainable development. According to them, Korea established the institutional arrangements, including GIR as an organization for overall statistics management, and developed the Measurement, Report and Verification (MRV) process.

Roughly speaking, Korean MRV process starts from the revision of MRV Guidelines every year, and they are distributed to sectoral agencies to estimate emissions/removals. After reviews from their responsible ministries, statistics, draft NIR, and other relevant materials are submitted to GIR by June. Then GIR verifies all the information thoroughly and asks for modifications or supplementary explanations. Finally, annual GHG inventory is confirmed by December through deliberation from the national GHG Management Committee.

There are more than fifteen responsible ministries and agencies involved in this MRV process. Furthermore, a lot of data are produced and compiled up each year. As the need arose to manage and archive a large amount of complicated data systematically, GIR established a platform called National GHG Inventory Report System (NIRS) in 2013.

Through NIRS, sectoral agencies submit draft CRF, NIR, QA/QC report, and other materials used for estimating GHG emissions, and all of them are archived in it. In addition, questions and opinions from GIR and subsequent responses from agencies during a period of verification are exchanged and archived in NIRS. As a result of verification, final CRF, simple figures and tables that represent emission trends are produced for preparing NIR.

Currently, these are the main use of NIRS; to submit statistics, exchange opinions in the verification process, and produce results. However, there has been an ongoing project to improve its performance particularly in terms of producing more accurate and elaborate statistics results. In doing so, GIR expects this system to enhance the accuracy and transparency of Korea's national GHG Inventory.

References

Framework Act and Enforcement Decree on Low Carbon and Green Growth

Access to relevant information

www.law.go.kr>english

PNG's Intuitional Arrangement for Greenhouse Gas Inventories and enhanced management in data and statistics.

Larsen Daboyan
Papua New Guinea

Abstract

As a Non-Annex I party to the Paris Agreement under the UNFCCC, Papua New Guinea (PNG) has submitted Nationally Determined Contributions (NDC) to help keep climate change below a global rise of two degrees Celsius. As part of the ETF, PNG has committed to certain protocols for MRV regarding progress toward its NDC targets.

As a seminal proponent of the program for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD; now REDD+), PNG signed the UNFCCC 13 June 1992 and ratified it 16 March 1993. PNG signed the Kyoto Protocol 2 March 1999 and ratified it 28 March 2002. Likewise, PNG has been at the forefront of the process to draft, adopt, ratify, and operationalize the Paris Agreement. ***On 29 March 2016, PNG became the first country to submit NDCs under the agreement***. PNG signed the Paris Agreement at the earliest opportunity, 22 April 2016, and ratified the agreement 21 September 2016. The agreement as it pertains to developing countries was afforded force of law in PNG by the United Nations Paris Agreement (Implementation) Act of 2016, which is further supported by the Climate Change (Management) Act of 2015.

PNG submitted its 1st National Communication under the UNFCCC (NC1) 27 February 2002 and its 2nd National Communication (NC2) 15 December 2015. PNG is currently drafting its 3rd National Communication (NC3), which it expects to submit in 2019. PNG aims to submit its 1st Biennial Update Report under the UNFCCC (BUR1) by 30 June 2018. By the end of 2020—near the conclusion of this project—PNG aims to submit its revised NDC (NDC2) for the 2026-2030 reporting period. This project is critical to ensuring that the deliberations shaping NDC2 are well informed and that relevant stakeholders are fully engaged.

Priorities in PNG's NDC to UNFCCC in 2015:

PNG's NDC indicates the national priorities for mitigating and adapting to climate change, as well as the anticipated benefits of addressing those priorities.

Mitigation.

PNG's primary opportunities for climate-change mitigation pertain to the electricity-supply sector, energy efficiency, transport, and forestry. PNG aims to achieve its forest-related mitigation targets through implementation of REDD+ activities. As noted in the NDC, "PNG will implement REDD+ activities under the UNFCCC to reduce emissions and enhance removals from this important sector, which PNG has set as a priority, as can be seen from its creation of a REDD+ Directorate within the Office for Climate Change and Development (OCCD) [now CCDA]. Extensive capacity building, technology transfer and technical assistance is required to implement effective actions and ensure the collection of accurate data. "The policies and measures will aim to reduce emission from deforestation and forest degradation, as well as support sustainable management, conservation and enhancement of forest carbon stocks, thereby leading to enhanced removals from the forestry sector. A key current shortcoming is the lack of data on forestry emissions and removals. ***To accomplish these aims, PNG requires improved data-gathering and capacities***. As noted in the NDC, "PNG would like to vigorously pursue mitigation options in the future; however, considerable assistance will be needed in terms of ***capacity building and technology transfer for emissions data collection and***

tracking mitigation progress. Without improving national capacities in this area there is a high likelihood that regulation of the government and the private sector in terms of emissions will not be effective.

Adaptation.

Whereas the agricultural and land-use sub-sectors have limited direct roles in the NDC's mitigation-related priorities, the AFOLU sector has a prominent role in PNG's adaptation-related priorities. PNG has (i) high exposure/ vulnerability to climatic changes and disasters, (ii) high sensitivity to such events, and (iii) low adaptive capacity. As noted in the NDC, "The natural environment already poses significant risks to Papua New Guinea today; hazards like coastal flooding, inland flooding and droughts take a severe toll on the people and the economy. Climate change[s] are predicted to exacerbate some of these event-driven hazards and may also introduces new hazards due to gradual shifts in climatic conditions.PNG has prioritized nine hazards for adaptation-related initiatives:

1. coastal flooding and sea-level rise;
2. inland flooding;
3. food insecurity caused by crop failures due to droughts and inland frosts;
4. cities and climate change;
5. climate-induced migration;
6. damage to coral reefs;
7. malaria and vector-borne diseases;
8. water and sanitation; and
9. landslides.

In order to achieve these initiatives highlighted in the NDC of Papua New Guinea in terms of mitigation and adaptation areas of climate change, it needs to have a very robust and strong intuitional arrangement in order to effectively coordinate policies and guidelines to enhance collaboration among key stakeholders and development partners to realize what PNG as a country hopes to achieve in contributing towards the global effort to combat climate change in the world.

All in all, PNG's NDC is conditional and requires technical and financial support from outside development partners and also ***requires support to strengthen its intuitional arrangement for GHG Inventory***, MRV work and other important requirements in order to fully enable PNG to achieve its goal to be carbon neutral by 2015.

References/ Publications

1. PNG's INDC 2015
2. PNG's SNC 2015

Access to relevant information

Nb: (The above documents are already on UNFCCC's website)

China's institutional Arrangement for National GHG Inventory Preparation

Su Mingshan, Zhu Songli, Ma Cuimei
National Center for Climate Change Strategy and International Cooperation, Energy Research Institute of National Development and Reform Commission, China

Abstract

Since the preparation of the Initial National Communication on Climate Change, China has initially established a national system for greenhouse gas inventory development, forming a relatively stable national greenhouse gas inventory team. Ministry of Ecology and Environment (MEE)_is mainly responsible for the preparation of national GHG inventory-which has been transferred from National Development and Reform Commission (NDRC) on April 2018 according to the institutional reform program-collaborating with the National Bureau of Statistics (NBS) to provide basic statistical data for the inventory, coordinating of industrial associations and typical businesses to provide related data, and establishing the National Greenhouse Gas Inventory Database to support the preparation and data management of the inventory. Industry associations, including China Petroleum and Chemical Industry Federation, China National Coal Association, China Electricity Council, China Iron and Steel Association, China Cement Association, China Lime Association and China Carbide Industry Association etc., provide related data for the preparation of national greenhouse gas inventory participate in seminars and peer review meetings. MEE submits final inventory reports to the National Leading Group on Climate Change, Energy Conservation and Emissions Reduction for discussion and approval. After approval they are formally submitted to the UNFCCC.

The new MEE is established from the former Ministry of Environment Protection (MEP) , integrating environmental related functions from six other ministries, to promote ecological civilization from an overarching perspective. Data from pollution source survey and terminal monitoring will be better applied to the preparation of inventory, thus improving the quality of national greenhouse gas inventory.

References/ Publications

The People's Republic of China First Biennial Update Report on Climate Change

Access to relevant information

https://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/application/pdf/pr_china-_bur-chinese+en.pdf

Seasonal methane emissions and recoveries from landfill sites of Republic of Korea

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Abstract

As of 2015 in Korea, GHG emissions from the SWDS (Solid Waste Disposal Sites) account for about 47% of the waste sector. Considering only the amount of CH_4 generated, that is approximately 30% of the annual emission of the entire country. And also, environmental changes are evident depending on the season, which is expected a lot affect the CH_4 generation mechanism in the landfill. Therefore, this study is carried out to improve the reliability and uncertainty of the estimation of CH_4 emissions from disposal sites.

In Korea, according to 'National GHG statistical Measurement, Reporting and Verification Guidelines (2017, GIR)', FOD (First Order Decay) model in the IPCC GPG 2000 is stipulated as the method of measuring the emissions from the landfill sites. As the activity data, on-site measurement and recovery data from 2012 to 2017 were applied.

As a result, CH_4 emissions from the venting wells are 19.9% higher in spring, 37.7% in summer than in autumn. Considering only methane in the recovered landfill gas, it is 2.1% higher in spring, 10.6% in summer than in autumn, but 14.8% less in winter.

There is some gap between emissions and recoveries, but the seasonal trend is recognized. It is important to consider that the recovered amount in winter is considerably lower than the other seasons, even though it is impossible to carry out the field measurement in winter due to the environmental constraints.

In additional studies, as well as securing more measurement data taking account of winter seasons, we need to take into account the other factors such as the differences in compaction and covering soil, weather, and the surrounding environment. Furthermore, as the DOC of the disposed waste decomposes over time, reduced emissions should be considered.

A Study on the emission characteristics of GHGs according to waste characteristics (Fluidized bed incinerating facility)

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Abstract

The IPCC recommends the use of emission factor to apply decision tree. To improve the reliability of the national greenhouse gas inventory, accuracy of emission factors is important. Most advanced countries apply national emission factor to major emission sources. The development and application of national emission factor is necessary, to increase accuracy of domestic greenhouse gas emissions.

In this study, the characteristics of GHGs studied and emission factors calculated in industrial waste incinerating facility (Waste Paper, Wood industry) (Fluidized bed). Using the NDIR, which is a continuous measurement, 4 incineration facilities were measured about 2~3 months.

As a result, 1. In paper industry, the average concentration of CH_4 is 0.79~2.08 ppm and emission factor is calculated 0~3.52 gCH_4/ton-waste. The average concentration of N_2O is 4.05~5.18 ppm. And emission factor is calculated 23.41~30.71 gN_2O/ton-waste. 2. In wood industry, the average concentration of CH_4 is 0.74~1.86 ppm and emission factor is calculated 0.00 gCH_4/ton-waste. The average concentration of N_2O is 6.13~15.63 ppm. And emission factor is calculated 153.6 ~ 254.0 gN_2O/ton-waste.

We know that CH_4 has a similar concentration of GHGs according to waste characteristics. But N_2O was found to have higher concentration characteristics in wood than paper industry.

Space based GHG monitoring with GOSAT satellite

Shamil Maksyutov, Tsuneo Matsunaga
National Institute for Environmental Studies, Japan

Abstract

Monitoring greenhouse gases (GHG) emissions from human activities is essential for verifying the efficiency of emission reduction efforts. The present estimates of the emissions of anthropogenic greenhouse gases are primarily based on bottom-up inventories based on statistical data. Inconsistencies between underlying country-level statistics of energy use and inaccuracies in the use of these data cause poorly quantified errors in bottom-up emission inventories. To quantify their errors, emission inventories need verification against independent data, which is made in several cases with atmospheric GHG observation network and modeling. While ground-based observation networks are often too sparse for monitoring these emissions, satellite observations can alleviate this limitation. We employed an atmospheric transport model to attribute column-averaged CO_2 mixing ratios (called X_{CO2}) observed by Greenhouse gases Observing SATellite (GOSAT) to emissions due to large sources such as megacities and power plants (Janardanan et al, 2016). X_{CO2} enhancements estimated from observations were compared to model simulations implemented at the spatial resolution of the satellite observation footprint (0.1° × 0.1°). We found that the simulated X_{CO2} enhancements agree with the observed over several continental regions across the globe, for example, for North America with an observation to simulation ratio of 1.05 ± 0.38 ($p < 0.1$), but with a larger ratio over East Asia (1.22 ± 0.32; $p < 0.05$). The obtained observation-model discrepancy (22%) for East Asia is comparable to the uncertainties in emission inventories (~15%) suggested by recent reports. To evaluate anthropogenic methane emission inventory in various regions over the globe, we extract emission signatures from column-average methane observations (X_{CH4}) by GOSAT using high-resolution atmospheric transport model simulations (Janardanan et al., 2017). Reduction of observation error, which is large compared to local enhancements, is achieved by binning the observations over large region according to model-simulated enhancements. We found that the local enhancements observed by GOSAT scale linearly with inventory based simulations of X_{CH4} for the globe, East Asia and North America. Weighted linear regression of observation derived and inventory-based X_{CH4} anomalies was carried out to find a scale factor by which the inventory agrees with the observations. Over East Asia, the observed enhancements are 30% lower than suggested by EDGAR v4.2 emission inventory, implying a potential overestimation in the inventory. On the contrary, in North America, the observations are approximately 28% higher than model predictions, indicating an underestimation in emission inventory. Our results concur with several recent studies using other analysis methodologies, and thus confirm that satellite observations provide an additional tool for bottom-up emission inventory verification.

References/ Publications

Janardanan, R., S. Maksyutov, T. Oda, and coauthors, (2016), Comparing GOSAT

observations of localized CO_2 enhancements by large emitters with inventory-based estimates, Geophys. Res. Lett., 43, doi:10.1002/2016GL067843.

Janardanan, R., S. Maksyutov, A. Ito, and coauthors, (2017), Assessment of Anthropogenic Methane Emissions over Large Regions Based on GOSAT Observations and High Resolution Transport Modeling, Remote Sensing, 9(9), 941.

Institutional Arrangement for GHG Inventory

Mr. Leang Sophal
Cambodia

Abstract

The Kingdom of Cambodia ratified, as a Non-Annex I Party, the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and acceded to the Kyoto Protocol in 2002. The Initial National Communication (INC) was officially submitted after the ratification in 2002. Currently, we are preparing the Second National Communication (SNC) in Cambodia in following with first Biennial Update Report (BUR) that plan to submit mid-June 2019.

Cambodia does not have the permanent GHG Inventory team so far. In 2015, Department of Climate Change, General Secretariat of National Council for Sustainable Development and as secretariat of national focal point entity of the United Nations Framework Convention on Climate Change has set up the national GHG inventory team combined from line ministries/institutions/academies to join this team.

Once again, Cambodia's GHG emissions were estimated at 47,709 GgCO2-eq in 2000 from Energy, agriculture, land use change and forestry and waste sector, and removal at 48,383 GgCO2-eq. The net removal was estimated at 674 GgCO2-eq. Hence, Cambodia remained a net sink in the year 2000. In 1994, Cambodia was a net sink country able to offset approximately 5,142 GgCO2-eq.

Each sector and fuel type a list of mitigation options was formulated based on previously successful projects, pilot projects, feasibility studies, literature reviews and expert opinion. These mitigation options were screened based on UNFCCC documentation (UNFCCC 2004) to determine the most viable options for Cambodia. Related to strategies and policy, we used four short to long term strategies, namely: short-term win-win strategy; extended short-term win-win finance strategy includes carbon finance; medium-term green growth support strategy; and long-term green growth planning strategy.

Thanks!

Preparation of Japan's National Greenhouse Gas Inventory and Trends in GHG Emissions

the Greenhouse Gas Inventory Office of Japan (GIO), Japan

Abstract

Under Article 4 and 12 of the United Nations Framework Convention on Climate Change (hereinafter, Convention) and relevant decisions adopted by the Conference of the Parties, the Annex I parties including Japan (i.e. developed countries) are required to prepare national greenhouse gas (GHG) inventories and submit them to the Secretariat of the Convention. Moreover, Article 7 of the Act on Promotion of Global Warming Countermeasures, which provides for domestic measures under the Convention, requires the Government of Japan to annually estimate and make public Japan's GHG emissions and removals.

In accordance with these Articles, the Greenhouse Gas Inventory Office of Japan (GIO) develops the GHG inventory in cooperation with private consultant companies under a contract with the Ministry of the Environment. Before preparing GHG inventories, GIO collects data from relevant ministries, agencies and organizations to estimate emissions and removals. Based on these data together with other data from different publications, GIO then compiles the GHG inventory.

Japan's total GHG emissions in FY2016 were 1,307 million tonnes of carbon dioxide (CO_2) equivalents (Mt CO_2 eq.; the same shall apply hereafter).

This is a decrease of 1.2% (16 Mt CO_2 eq.) and 7.3% (103 Mt CO_2 eq.) when compared to the FY2015 and FY2013 emissions (1,323 Mt CO_2 eq. and 1,410 Mt CO_2 eq.), respectively, mainly because of the decrease in energy-related CO_2 emissions due to the decrease in energy consumption through energy conservation, and the increase in the share of non-fossil fuels within the domestic energy supply brought by the wider adoption of solar and wind power and resumption of nuclear power plant operation, despite the increase in hydrofluorocarbon emissions from refrigerants that substitute for ozone-depleting substances.

This is also a decrease of 5.2% (72 Mt CO_2 eq.) when compared to the FY2005 emissions (1,379 Mt CO_2 eq.), mainly due to the decrease in energy-related CO_2 emissions owing to the decrease in energy consumption through energy conservation, despite the increase in hydrofluorocarbon emissions from refrigerants that substitute for ozone-depleting substances.

Access to relevant information

http://www-gio.nies.go.jp/index-j.html

Bridging the Data Gap: A National Disaggregation Effort to Support Sub-National GHG Estimates

Chirag Gajjar, Subrata Chakrabarty
WRI India, India

Abstract

With the Paris Agreement, the importance of frequent reporting of GHG emissions is now more crucial than ever to design robust climate actions. In the case of India, official GHG inventories are available for the year 1990, 2000, 2007 and 2010. These inventories, however, do not provide in-depth details of activity data and emission factor corresponding to the methodologies followed to arrive at the emissions estimate. To establish a trend and identify emission hotspots to drive robust climate actions a time-series of emissions estimates are necessary. A recent economy-wide GHG emissions would be a prerequisite.

With this background, WRI India along with other civil society organizations in India collaborated to develop time-series of GHG estimates. This is a humongous task and therefore, different research organizations took sectoral responsibilities to determine GHG emissions from key economic sectors like energy, industrial energy use and industrial process and product use (IPPU), waste and agriculture, forestry and other land use (AFOLU).

A system was designed with formation of secretariat and sectoral partners with pre-defined roles and responsibilities. To enhance confidence for intended users of these GHG estimates, peer review was integrated into the system. WRI India developed the guidance framework based on IPCC good practice guidance. This new framework aligns with internationally followed reporting of GHG estimates and allows for national datasets to be disaggregated to the subnational level estimates.

Disaggregation to City Level

In order to accelerate climate action at the city level, there is also a need to make activity data and emission factors available at city level in an open and transparent manner. WRI is developing a new platform which provides cities with some of the estimates cities need for city level strategies and prioritizing local actions. The platform will make use of community-scale GPC guidelines to develop methodology for scaling down national and sub-national estimates to city level.

The poster will highlight the system developed by WRI in three key economic sectors using India as an example at the sub-national level. It will also showcase the platform focused on time-scaling national and state level emissions data. The methodology and data collection and analysis can be used to inform national inventory development, data improvement, and policy planning.

References

http://www.ghgplatform-india.org/

Access to relevant information

http://www.ghgplatform-india.org/

NC Preparation of Myanmar (Data Collection and Archiving)

Ms.Thin Thuzar Win
Environmental Conservation Department
Ministry of Natural Resource and Environmental Conservation, Myanmar

Abstract

The Union of the Republic of Myanmar rectified UNFCCC at 1994 and Kyoto protocol at 2004. And also rectified Paris Agreement at 19th Sept,2017. According with the UNFCCC frame work as a Non Annex – 1 party, we submitted Intended Nationally Determined Contribution (INDC) on 2015 and now revised into its nationally determined contributions (NDC). In Our NDC Mitigation focus on Forestry, Energy, Transportation and Waste sectors. Adaptation mainly focus on Agriculture, Forestry, Early warning System, Public Health, Water Resource Management, Costal zone Protection and Biodiversity Preservation.

Initial National Communication INC submitted at 2012 and base line inventory year is 2000. Myanmar is one of agriculture country, main GHGs emissions are from Agricultural sector. Because of 40% of land area is cover with forest, carbon removal amount is more than emission amount, so Myanmar submitted carbon sink country in year 2000 of INC.

Now, we prepare Second National Communication and First Biannual Update Report. We plan to submit SNC at the end of 2019 and BUR-1 is at 2020. There are five Thematic Working Group for SNC preparation. Environmental Conservation Department (from Ministry of Natural Resource and Environmental Conservation) is the focal and other relevant ministries are coordinated. Project activities of national GHGs inventory are Institutional arrangement, capacity building of the working task force, Development of Data Archiving for activity data and emission factor and update of GHG Inventory from year 2000 to 2010 .Software and Tools for GHG Inventory are UNFCCC Inventory software, IPCC 2006 Guide line (Version 2.54) and Emission Factor Data Base and ALU software. We collect data from relevant ministries and also international agencies (IEA, FAO, UN – Sat, REDD+).

Due to active participation of government agencies, NGHGI – Myanmar will be able to sit upon existing institutional structure and will strengthen its capacities in GHG inventory as well as mitigation to achieve UNFCCC reporting requirement to submit NC and BUR in timely manner.

References/ Publications

Myanmar's Intended Nationally Determined Contribution 2015
Myanmar Initial National Communication under 2012

Access to relevant information

The above documents are already on UNFCCC's website

4. Report on Mutual Learning Session

4 Report on Mutual Learning Session

4.1 Overview of the Mutual Learning

Mutual Learning (ML) is an activity to improve the individual countries' inventories through the following series of processes: 1) exchanging inventories between two countries; 2) learning from a partner's inventory; and 3) exchanging comments on each other's inventories. The primary purpose of the ML is to improve GHG inventories by providing details of methods and data for GHG emission/removal estimation between two countries and exchanging comments on the methods and data. The ML is also expected to foster and strengthen a cooperative relationship among GHG inventory experts. Since the aim of the ML is not criticism or audit, participants can conduct a two-way communication, not a one-way communication like an examiner versus an examinee.

The first Mutual Learning was held on the Waste sector between GIO and Korea Environment Corporation (KECO) in the annual workshop in 2008. The Secretariat of WGIA introduced this activity in WGIA8 held in 2010. With the participants' agreement, ML has been held in the following WGIAs as one of the sessions.

Table 4.1.1 History of Mutual Learning

		General	Energy	IP	Agriculture	LULUCF	Waste
2008-2010		Trial implementation Japan- Korea					
2010	**WGIA8**	Introduction to ML (with hands-on training)					
2011	**WGIA9**	-	Indonesia-Mongolia	-	-	Japan-Lao PDR	Indonesia-Cambodia-Korea
2012	**WGIA10**	-	Cambodia-Thailand	Indonesia-Japan	Indonesia-Vietnam	-	China-Korea
2013	**WGIA11**	-	Lao PDR-Thailand	-	China-Myanmar	-	Malaysia-Vietnam
2014	**WGIA12**	-	Indonesia-Myanmar	-	China-Mongolia	Vietnam*	-
2015	**WGIA13**	Japan-Vietnam	-	-	Indonesia-Lao PDR	Cambodia-Mongolia	Korea-Myanmar
2016	**WGIA14**	-	Brunei-Korea	Myanmar-Malaysia	-	Indonesia-Lao PDR	Mongolia-Thailand
2017	**WGIA15**	-	Mongolia-Vietnam	-	-	Lao PDR - Myanmar	China-Philippines
2018	**WGIA16**	-	India-Vietnam	-	-	-	Japan-Lao PDR

*Reporting from Vietnam with comments from experts

Participants

In December 2017, the WGIA Secretariat advertised the ML to the participants of WGIA, and received applications from 7 parties. Considering the requirements of the applicants, an appropriate balance among sectors, and the feasibility of implementation, the WGIA Secretariat set up two pairs (India and Vietnam on Energy sector, and Lao PDR and Japan on Waste sector) in April 2018.

Preparation

A few months before WGIA16, the chosen participants in the ML submitted the materials of their inventories to the WGIA Secretariat, including worksheets used for estimating emissions and reports describing details of methodologies, and exchanged the materials with their partner countries through the Secretariat. Through studying the materials provided by the partner country, the participants found good points as well as issues to improve in the partner's inventory. They also found issues to clarify

by questions. Thus, participants wrote such comments and questions to their partner countries onto "Question and Answer Sheets". After that, the "Question and Answer Sheets" were shared with the partner countries through the Secretariat. The partner countries responded to these comments and questions before WGIA16 took place.

Table 4.1.2 Preparation Process of Mutual Learning

Process	Schedule
Material submission	May 2018
Material exchange	May 2018
Studying the materials	May 2018
Comment exchange	June 2018
Answers to comments	June 2018
Sessions	10th July 2018

Table 4.1.3 Submitted Materials for the MLs

Sector	Country	Inventory
Energy	India	BUR1 in 2016, SNC in 2012
	Vietnam	BUR2 in 2017
Waste	Lao PDR	First draft report on GHG inventory for BUR1
	Japan	GHG inventory in 2018

Discussions

In the WGIA16, the ML participants were divided into two sessions (Energy and Waste) to discuss sector-specific issues based on preliminary comment exchanges. In order to encourage a frank discussion and to ensure confidence, these sessions were held as closed-door discussions.

In these sessions, participants discussed their counterpart's inventory and national system, sharing their own technical issues (e.g., data collection, adoption of emission factors, national system, etc.) with the partner to overcome the obstacles, and clarifying matters in their own inventory which should be improved. Through the discussions, they recognized that the inventories of participant countries have been continuously improved by adopting the methodologies of the 2006 IPCC Guidelines. Closely studying the improvement of not only methodology of the counterpart countries' inventories but also their national system for data collection and quality assurance/quality control, participants found hints for improvements of their own inventories. To enhance further opportunities to learn from other countries' inventory, participants expressed their hope for continuous implementation of the ML programme in future WGIAs.

The points of discussions and outcomes of each individual ML session are summarized in the following sections (4.2 - 4.5).

4.2 Energy Sector

Sector Overview

India and Vietnam participated in an ML session on the Energy sector. General information of the two countries is shown in Table 4.2.1 below.

Table 4.2.1 Sector Overview for the ML on Energy Sector

	India	Vietnam
National total GHG emissions (kt-CO_2 eq., with LULUCF)	1,884,309 (in 2010, BUR2016)	259,024 (in 2013, BUR2017)
GHG emissions in the Energy sector (kt-CO_2 eq.)	1,510,121 (in 2010, BUR2016)	151,403 (in 2013, BUR2017)
Responsible agency for the inventory	Ministry of Environment, Forest and Climate Change (MoEFCC)	Ministry of Natural Resources and Environment (MONRE)
Estimation methodology	Revised 1996 IPCC Guidelines and partially 2006 IPCC Guidelines	Revised 1996 IPCC Guidelines and partially 2006 IPCC Guidelines
Source of emission factors	In principle, IPCC default values and partially country-specific values	In principle, IPCC default values and partially country-specific values
Source of activity data	National Statistics	Energy Balance Table in Vietnam and National Statistics

Materials Used

In order to prepare for the ML session in WGIA16, both countries exchanged their documents relevant to the Energy sector two and a half months before the workshop. The exchanged documents were as follows:

India
- Second National Communication submitted in 2012
- First Biennial Update Report submitted in 2016
- Excel files with estimation worksheets of mobile combustion from 2008 to 2010
- Excel files with estimation worksheets of stationary combustion in 2010

Vietnam
- Second Biennial Update Report submitted in 2017
- Excel files with estimation worksheets of energy sector in 2013

Questions and Answers

After receiving the materials described above, both countries studied them and provided questions and comments to their partner country approximately 2 weeks before the workshop. The classification and the number of questions are summarized in Table 4.2.2.

Table 4.2.2 Classification of Questions and Comments in the ML on Energy Sector

Classification of questions	Number of questions	
	from Vietnam to India	from India to Vietnam
Acquisition of activity data	3	1
Adoption of emission factors or parameters	2	3
Estimation methods	3	1
Institutional arrangement	1	1
Others	1	1

Outcomes of the Mutual Learning Session

Through the ML session, several issues and good practices in the participating countries' preparation of GHG inventory were identified.

➢Issues and Solutions

Some issues were pointed out through the ML as follows:

India

1) India has decentralized system among ministries, with MoEFCC as the nodal Ministry.
2) There is already a system of data collection in place, which helps build a more country-specific (CS) inventory, but the CS data do not necessarily fit international data (e.g. International Energy Agency).

Vietnam

1) Vietnam has currently centralized system, but in the near future, line ministries will prepare the inventory for the energy sector with more detail (maybe Tier 3) that will help the implementation and MRV of the nationally determined contribution (NDC).
2) It is better to provide an uncertainty range for CS EF of fugitive emissions from underground coal mines to justify the factor that is significantly different from the default value.

➢Good Practices

Some good practices were pointed out through the ML as follows:

India

1) At each submission, some part of the inventory is improved– e.g. raising the Tier for a category, etc.
2) Quality assurance/quality control (QA/QC) plan is in place.
3) India is slowly moving to the 2006 IPCC Guidelines.
4) National research institutions are involved in the respective areas - e.g. improving EFs.
5) National experts are involved in IPCC and UNFCCC processes – understanding of methodology/reporting is enhanced.
6) Rigorous review is undergone‐ including compiler peer review, review by ministries (data providers), top governmental level review, and review by civil society.

Vietnam

1) A legal document defining the national inventory system (NIS) is in place ‐ a network is created to work with stakeholders such as data providers
2) Improvement is made at each inventory cycle – e.g. recalculation and uncertainty analysis added in the most recent cycle
3) Vietnam plans to move to the 2006 IPCC Guidelines
4) Vietnam closely contacts with technical analysis (TA) team – e.g. integrating suggestions from

the TA into the next report

5) AD for BUR2 is much more transparent– the national inventory report and data collection report (the latter for the internal consideration process only)

➢ **Follow-up Activities**

The following were pointed out as possible follow-up activities:

1) Improving inventory compilers' skill through various training
2) Developing NIS and data collection systems/formats – Provision of Japanese examples/input might be useful
3) Developing a common format – being in line with the guidelines but also making it fit each country's needs

Table 4.2.3 Participants in the ML on Energy Sector

Parties	Name	Organization
India	Dr. J R Bhatt	MoEFCC
	Mr. Ajay Raghava	MoEFCC
	Mr. Lokesh Chandra Dube	MoEFCC
	Dr. Nayanika Singh	MoEFCC
	Dr. Abhijit Basu	MoEFCC
	Dr. Himangana Gupta	MoEFCC
	Dr. Pinaki Sarkar	Central Institute for Mining and Fuel Research (CIMFR)
	Dr. Ajay Kumar Singh	CIMFR
	Dr. D Mohanty	CIMFR
	Dr. Amit Garg	Indian Institute of Management Ahmedabad (IIMA)
	Dr. Sunil Pathak	Indian Institute of Petroleum (IIP)
	Dr. Sumana Bhattacharya	IORA Ecological Solutions
	Dr. M Karthik	National Environmental Engineering Research Institute (NEERI)
	Mr. Iranna Gogeri	CSIR-IIP Dehradun
	Mr. Prakash Lakhchora	Forest Survey of India (FSI), Dehradun
	Dr. G Mondal	National Dairy Research Institute
Vietnam	Ms. Ngoc Thi Bich Tran	MONRE, Department of Climate Change, Greenhouse Gases Emission Reduction and Ozone layer protection
	Ms. Hue Thi Minh Nguyen	MONRE, Vietnam Department of Climate Change, Centre for Responding to Climate Change
	Mr. Hoa Xuan Vuong	Viet Nam Institute of Meteorology, Hydrology and Climate Change, Journal of Climate Change Science
Facilitators and Resource persons	Mr. Naofumi Kosaka (Facilitator)	Greenhouse Gas Inventory Office of Japan (GIO)
	Ms. Akiko Tanaka (Facilitator)	GIO
	Mr. Takashi Morimoto (Resource person)	Mitsubishi UFJ Research and Consulting Co., Ltd. (MURC)
	Mr. Masaaki Nakamura (Resource person)	MURC

	Dr. Tatsuya Hanaoka (Resource person)	National Institute for Environmental Studies (NIES)
Observers	Mr. Nobuhiro Kino (Workshop organizer)	Ministry of the Environment, Government of Japan (MOEJ)
	Mr. Takumi Ichikawa (Workshop organizer)	MOEJ
	Prof. Yukihiro Nojiri (WGIA Secretariat)	GIO
	Ms. Elsa Hatanaka (WGIA Secretariat)	GIO

4.3 Waste Sector

Sector Overview

Japan and Lao PDR participated in a ML session for the Waste sector. The general information of the two countries is shown in Table 4.3.1 .

Table 4.3.1 Sector Overview for the ML on Waste Sector

	Japan	Lao PDR
National total GHG emissions (kt-CO_2 eq., with LULUCF)	1,269,900 (in 2016, GHG Inventory 2018)	50,743 (in 2000, SNC2013)
GHG emissions in the Waste sector (kt-CO_2 eq.)	21,640 (in 2016, GHG Inventory 2018)	132 (in 2000, SNC2013)
Responsible agency for the inventory	Ministry of the Environment	Ministry of National Natural Resources and Environment
Estimation methodology	Country-specific methodology, Tier 2 and Tier 3 of the 2006 IPCC Guidelines	Tier 1 of the 2006 IPCC Guidelines
Source of emission factors	Country-specific emission factors and IPCC default values	IPCC default values
Source of activity data	National statistics	National statistics and Estimations from population statistics

Materials Used

In order to prepare for the ML session in WGIA16, both countries exchanged their documents relevant to GHG emission estimation of the sector with each other two months before the workshop. The exchanged documents were as follows:

Lao PDR:
- Waste Sector-GHG Inventory 2014 (First draft report on GHG inventory for BUR1)

Japan:
- National Greenhouse Gas Inventory Report (NIR) of Japan 2018
- Common reporting format (CRF) of Japan 2018

Questions and Answers

After receiving the materials described above, both countries studied them and provided questions and comments to their partner country approximately one month before the workshop. The classification and the number of the questions are shown in Table 4.3.2.

Table 4.3.2 Classification of Questions and Comments in the ML on Waste Sector

Classification of question	Number of questions	
	from the Lao PDR to Japan	from Japan to Lao PDR
Acquisition of activity data	1	6
Adoption of emission factors or parameters	0	2
Estimation methods	2	3
Institutional arrangement	1	2
Waste management	2	1

Outcomes of the Mutual Learning Session

Through the ML, several issues and good practices in the participating countries' preparation of GHG inventory were identified.

➢Issues and solutions / Outstanding issues

Main issues discussed in the session were as follows:

<Activity data>

1. Importance of cooperating with line Ministries for collecting AD
2. Importance of regular update of AD (amount of waste and waste composition) in order to reflect rapid economic growth
3. Importance of estimating historical waste data for First Order Decay (FOD) method by using an appropriate driver

<Improvement of GHG inventory>

1. Separation of calculation files of Laos' inventory based on different methane conversion factors (MCF) for unmanaged solid waste disposal site (SWDS) for Vientiane capital and other provinces based on the depth of SWDS
2. Use of country-specific data for Key categories based on research in the country

< Mitigation>

1. Consideration of capacity of incinerator as one of the key criteria when considering the installation of power generation at waste incinerator

<Challenges>

1. Necessity of further efforts to ensure the consistency among data from different data sources

➢Good Practices

Good practices of participant countries' inventories were pointed out as follows.

Lao PDR:

1. Application of methodologies of the 2006 IPCC GLs including the FOD method
2. Establishment of organizational arrangements for waste data collection

Japan:

1. Transparent explanation and accurate GHG calculation
2. Cooperation with private sectors for collecting AD and developing EFs

➢Follow-up activity

The following was pointed out as a possible follow-up activity:

1. After finalizing the GHG inventory with updating EFs and AD of Lao PDR, the revised results would be shared with Japan

➢**Suggestions for future ML**

Suggestions for future ML from participants were as follows.

- Inclusion of topics for mitigation, projection and MRV
- Inclusion of some case studies related to GHG inventory
- Consideration for collaboration activities between participating countries for EF development.

Table 4.3.3 Participants in the ML on Waste Sector

Parties	Name	Organization	Title
Lao PDR	Mr. Immala Inthaboualy	Ministry of Natural Resources and Environment (MONRE), GHC inventory and Mitigation Division	Director of Division
	Mr. Boun Eua Khamphilavanh		Deputy Director of Division
	Mr. Mone Nouansyvong	Ministry of Natural Resources and Environment (MONRE), Department of Climate Change	Consultant
Japan	Mr. Hiroyuki Ueda (Facilitator)	Mitsubishi UFJ Research and Consulting Co., Ltd.	Senior Analyst
	Ms. Yui Ogawa		Analyst
	Dr. Takefumi Oda	GHG Inventory Office of Japan (GIO), National Institute for Environmental Studies (NIES)	GHG Inventory Expert
	Ms. Atsuko Hayashi		GHG Inventory Expert
	Mr. Tetsuhiro Tanaka (Workshop organizer)	Ministry of the Environment, Government of Japan	Official

Annex I: Agenda

Annex I: Agenda

The 16th Workshop on GHG Inventories in Asia (WGIA16)

- Capacity Building for Measurement, Reporting and Verification -

Period: 10th – 13th July 2018,

Venue: The Lalit New Delhi (India)

Day 1: Morning, 10th July 2018		
8:30 - 9:00	**Registration**	
9:00-12:30	**Mutual Learning (Closed session: open only for countries participating in the session, facilitators, resource persons, and the WGIA Secretariat)**	
Sector	Energy	Waste
Combination of Participating Countries	**India – Vietnam**	**Lao PDR – Japan**
Room	Regency III	Regency IV
Facilitators	Mr. Naofumi Kosaka (GIO)	Mr. Hiroyuki Ueda (MURC)
Rapporteurs	Dr. Takefumi Oda (GIO), Dr Himangana Gupta, Dr Abhijit Basu and Dr Nayanika Singh (MoEFCC)	
Note: Mutual learning sessions are closed sessions in order to secure confidentiality of information so that countries participating in each mutual learning session can provide unpublished information. Therefore, only participating countries in each session, facilitators, resource persons and the WGIA Secretariat can enter each of the rooms. In addition, facilitators and resource persons will be registered in advance and receive confirmation of participation from the countries engaging in mutual learning and the WGIA Secretariat.		
12:30-14:00	*Lunch*	
Day 1: Afternoon, 10th July		
14:00-17:30	**Hands-on Training on Using the IPCC Inventory Software (IPCC TFI)**	
Sector	Agriculture	F gases
Room	Regency I	Regal
19:30 – 22:00	*Welcome Reception hosted by India*	

Annex I

Day 2: Morning, 11th July, 2018			
8:30 - 9:00	**Registration**		
9:00 – 11:00	**Opening Session**		
	Room: Crystal Ballroom	**MC: Prof. Yukihiro Nojiri**	**Rapporteur: Ms. Atsuko Hayashi (GIO)**
9:00 – 9:10	Welcome Address		Dr. J. R. Bhatt, Advisor of MoEFCC
9:10 – 9:15	Welcome Address		Mr. Nobuhiro Kino, Director of Low Carbon Society Promotion Office, MOEJ
9:15 – 9:25	Overview of WGIA16		Mr. Hiroshi Ito (GIO)
9:25 – 9:40	Presentation on India's GHG preparation		Prof. Amit Garg (IIM Ahmedabad)
9:40 – 9:55	Presentation on Japan's Achievement on Climate Change		Mr. Takumi Ichikawa, Chief official, Low Carbon Society Office, Ministry of Environment, Japan
9:55- 10:00	Key Note Address		Dr. A.K. Mehta, Additional Secretary, MoEFCC
10:00- 10:05	Special Address		Mr. Hideki Asari, Charge d'affaires ad interim of Japan, Embassy of Japan in India
10:05- 10:10	Special Address		Mr. Siddanta Das, Director General of Forest and Special Secretary, MoEFCC
10:10- 10:25	Inaugural Address		Dr. Harsh Vardhan, Minister of Environment, Forest and Climate Change, India
10:25- 10:35	**Questions and Answers**		**All**
10:35 – 11:00	*Group Photo & Tea Break*		
11:00 – 12:30	**Session I: Updates on the National Communications (NCs) and Biennial Update Reports (BURs) from non-Annex I Parties and Preparing for the Enhanced Transparency Framework**		
	Room: Crystal Ballroom	**Co-Chairs: Mr. Kiyoto Tanabe (IPCC/ TFI) and Prof. Amit Garg (IIM A)**	**Rapporteur: Ms. Atsuko Hayashi (GIO)**
11:00 – 11:15	Updates on the Third National Communication (TNC) and initial Biennial Update Report (iBUR) of the Mongolia		Ms. Sanaa Enkhtaivan/ Ms. Gerelmaa Shaariibuu (Mongolia)
11:15 – 11:30	Papua New Guinea's Second National Communications Report		Mr. Erick Immanuel Sarut (PNG)
11:30 – 11:45	Sharing the Experience of the Second BUR and ICA of the Republic of Korea		Dr. Hyung-Wook Choi (ROK)
11:45 – 12:00	Current Status of Negotiations and Prospects for the Transparency Framework under the Paris Agreement		Mr. Takashi Morimoto (MURC)

12:00 – 12:30	**Questions and Answers**		**All**
12:30 – 14:00	*Lunch*		
14:00 – 15:50	**Session II: Fluorinated Gas Emissions from non-Annex I Parties**		
	Room: Crystal Ballroom	**Co-Chairs: Sumana Bhattacharya (AB/ IORA Ecological Solutions) and Dr. Atul Bagai (UNEP)**	**Rapporteur: Ms. Atsuko Hayashi (GIO)**
14:00 – 14:20	The Kigali Amendment and the Status of Reporting of Fluorinated Gases under the UNFCCC Emissions, Methods, and Gaps		Ms. Elsa Hatanaka (GIO)
14:20 – 14:35	Development of F-gas Emissions Estimation from non-Annex I Parties: A Case Study of Thailand		Dr. Kraichat Tantakarnapa (Thailand)
14:35 – 15:00	**Questions and Answers, Discussion**		**All**
15:00 – 15:15	Estimating Fluorinated Gas from the Industrial Processes and Product Use Sector		Dr. Elizabeth Philip (Malaysia)
15:15 – 15:30	Estimation of Fluorinated Gases Emission from Semiconductor Industry		Mr. Pitt Yu Zhe (Singapore)
15:30 – 15:50	**Questions and Answers, Discussion**		**All**
15:50 – 16:20	*Tea Break*		
16:20 – 18:00	**Session III: Data Collection and Archiving**		
	Room: Crystal Ballroom	**Co-Chairs: Dr. Sirintornthep Towprayoon (AB/ King Mongkut's University of Technology Thonburi) and Prof. Kirit Parikh (IRADe)**	**Rapporteur: Ms. Atsuko Hayashi (GIO)**
16:20 – 16:35	Bhutan Carbon Neutral (Greenhouse Gas Inventory Institutional Arrangements)		Mr. Dawa Chogyel/ Mr. Rinzin Namgay (Bhutan)
16:35 – 16:50	One GHG Emission Data Policy of Indonesia		Dr. Joko Prihatno (Indonesia)
16:50 – 17:10	**Questions and Answers, Discussion**		**All**
17:10 – 17:25	Developing a GHG Inventory Management System for Korean Energy Sector		Dr. Sung-kyun Kim (RoK)
17:25 – 17:40	Data Development Approach for National Forest Inventory in Japan		Mr. Masaya Nishimura (FAJ)
17:40 – 18:00	**Questions and Answers, Discussion**		**All**

Annex I

Day 3 Morning, 12th July 2018			
9:00 – 12:00	**Session IV: GHG Inventories, Projections, and Related Activities**		
	Room: Crystal Ballroom	**Co-Chairs: Mr. Takahiko Hiraishi (IGES) and Dr. K. J. Ramesh (IMD)**	**Rapporteur: Ms. Atsuko Hayashi (GIO)**
9:00 – 9:15	IPCC TFI: Recent Activities		Mr. Andrej Kranjc (IPCC/TFI/TSU)
9:15 – 9:30	Australia's National System for GHG Inventory Reporting		Ms. Monami Das Gupta (Australia)
9:30 – 9:45	Emissions Projections of GHGs and Air Pollutants in the Transport Sector and Importance of Improving National GHG Inventories		Dr. Tatsuya Hanaoka (NIES)
9:45 – 10:15	**Questions and Answers, Discussion**		**All**
10:15– 11:00	*Tea Break*		
11:00 – 11:15	Use of GHG Observations by Satellites for Estimating Surface Emissions		Dr. Shamil Maksyutov (NIES)
11:15 – 11:30	Black Carbon in the Atmosphere: Importance, Emission Estimates, and Monitoring		Dr. Yutaka Kondo (NIPR)
11:30 – 12:00	**Questions and Answers, Discussion**		**All**
12:00 – 13:30	*Lunch*		
Day 3 Afternoon, 12th July			
13:30 – 15:00	**Poster Session**		
15:00 – 16:30	**Wrap-up Session**		
	Room: Crystal Ballroom	**Co-chairs: Dr. A K Mehta (MoEFCC) and Prof. Yukihiro Nojiri (GIO)**	
15:00 – 15:15	Summary of the Mutual Learning Sessions		Dr. Takefumi Oda (GIO)
15:15 – 15:30	**Discussion**		**All**
15:30– 15:45	*Tea Break*		
15:45 – 16:00	Summary of the Plenary Sessions		Ms. Atsuko Hayashi (GIO)
16:00 – 16:10	**Discussion**		**All**
Closing Remarks			
16:10 – 16:20	Closing Remarks		Dr. A K Mehta (MoEFCC)
16:20 – 16:30	Closing Remarks		Dr. Yukihiro Nojiri (GIO)

Day 3 Evening, 12th July		
17:00 – 18:00	**Joint Meeting of the WGIA Organizing Committee and Advisory Board (Members of the OC and AB, and the WGIA Secretariat are required to attend)**	
	Chair: Mr. Hiroshi Ito (GIO)	
17:00 – 17:30	Review of Activities in WGIA16	All
17:30 – 18:00	Discussion on Topics for WGIA17	All

Study Tour, 13th July 2018	
8:30 – 14:00	**Site visit to International Solar Alliance and National Institute of Solar Energy**

Poster Sessions			
13:30 – 15:00			
Number	**Topic**	**Title**	**Name, Organization**
P-1	3	Introduction of GHG data information system in Korea	Kyeongah Ahn *Greenhouse gas Inventory and Research center of Korea*
P-2	3	PNG's Institutional Arrangement for the Development of its National Greenhouse Gas Inventory data and statistics	Larsen Daboyan *Papua New Guinea Climate Change & Development Authority*
P-3	3, 7	China's Institutional Arrangement for National GHG Inventory Preparation	Su Mingshan, Zhu Songli, Ma Cuimei *National Center for Climate Change Strategy and International Cooperation (NCSC)*
P-4	1	Seasonal methane emissions from landfill sites of Republic of Korea	Myoung-seok Lee *Korea Environment Corporation(K-eco)*
P-5	1	A study on the emission characteristics of GHGs according to waste characteristics (Fluidized bed incinerating facility)	Byeong-guk Jeon *Korea Environment Corporation(K-eco)*
P-6	2	Space based GHG monitoring with GOSAT satellite	Shamil Maksyutov, Tsuneo Matsunaga *National Institute for Environmental Studies, Japan*
P-7	7	Cambodia's Institutional Arrangement for National GHG Inventory	Leang Sophal, Sum Cheat *Department of Climate Change, General Secretariat of National Council for Sustainable Development/Ministry of Environment*
P-8	7	Preparation of Japan's National Greenhouse Gas Inventory and Trends in GHG Emissions	GIO of Japan
P-9	7	Bridging the Data Gap: A National Disaggregation Effort to Support Sub-National GHG Estimates	Chirag Gajjar, Subrata Chakrabarty *World Resource Institute India, India*
P-10	6	Bhutan Carbon Neutral (Greenhouse Gas Inventory Institutional Arrangements)	Dawa Chogyel, Rinzin Namgay (Bhutan)

Annex II: List of Participants

Annex II: List of Participants

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(Alphabetical order by family name)

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