The 2nd Workshop on Greenhouse Gas Inventories in Asia Region
7-8 February 2005, Shanghai, China

Proceedings

Ministry of the Environment, Japan
National Institute for Environmental Studies (NIES), Japan
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PREFACE

This month of February 2005 marks one important milestone as the Kyoto Protocol enters into force. To help guide policies and strategies of countries around the world in their efforts to reduce emissions and enhance sinks of atmospheric greenhouse gases, accurate GHG inventories will continue to be critically important.

Over a year has passed since the First Workshop on GHG Inventories in the Asia Region was held in Phuket, Thailand, in November 2003. During this time, many countries in Asia have made progress with their GHG inventories. Some non-Annex countries have submitted their first National Communications under the UN Framework Convention on Climate Change and gained valuable experience in the process. Many have improved the accuracy of their inventories through work on locally relevant emission factors.

It is clear that neighboring countries and the entire region can benefit by cooperating and sharing information and experience. In this context, this Second Workshop on Greenhouse Gas (GHG) Inventories in Asia Region (WGIA) was held in Shanghai, China, on 7 and 8 February 2005, with participation by scientific experts and governmental representatives responsible for GHG inventories in their countries. The workshop was held back-to-back with the Contact Group of Experts, Hands-on Training Workshop on National Greenhouse Gas Inventories for the Asian Region. The aims of this workshop were to (1) to hear updates on GHG inventories of countries in Asia, (2) to share useful information and experiences in GHG inventory preparation, and (3) to discuss future activities of this Asian network.

Through discussions at the workshop, participants gained an up-to-date understanding of common issues and challenges, and developed some ideas on how cooperation can help countries in Asia produce more accurate GHG inventories in the most efficient way in the future. We hope that the momentum will continue to build in this direction.

Lastly, we would like to extend our sincere thanks to our host country China for its generous support. We would also like to thank the UNFCCC Secretariat, Asia-Pacific Network for Global Change Research CAPaBLE Programme and IPCC Technical Support Unit for the National GHG Inventories Programme for their great contributions to the workshop.

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Opening Remarks

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Mr. Aimin Ma (China)

Prof. Zhang Yutian (China)
Chair & Co-Chairs

Ms. Mimi Nameki (Japan)

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Mr. Syamphone Sengchandala (Lao P.D.R)

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Dr. Damasa Macandog (Philippines)

Mr. Dominique Revet (UNFCCC)
Dr. Sirintornthep Towprayoon (Thailand)
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Executive Summary
EXECUTIVE SUMMARY

The Second Workshop on Greenhouse Gas (GHG) Inventories in Asia Region (WGIA) was attended by governmental officials and scientists from 10 countries and representatives of three international organizations.\(^1\) It was organized by the Ministry of the Environment, Japan and the National Institute for Environmental Studies (Japan) and hosted by the Chinese Research Academy of Environmental Science. Objectives of the meeting were to (1) update each other on the most up-to-date situation of GHG inventories in Asia, (2) share useful information and experiences in GHG inventory preparation, and (3) discuss future activities of the Asian network.

During updates on the status of GHG inventories, participants received information on the Intergovernmental Panel on Climate Change (IPCC) work for GHG inventory guidelines and resources available for UNFCCC National Communications from non-Annex I Parties. Some resources that were mentioned include the (1) UNFCCC User Manual for the guidelines on national communications from non-Annex I Parties,\(^2\) (2) various documents of the IPCC National Greenhouse Gas Inventory Programme (NGGIP),\(^3\) and (3) the IPCC’s Emission Factor Database.\(^4\) Work is under way to produce 2006 IPCC GHG inventory guidelines. Also, the UNFCCC website provides some useful materials, particularly a plain-language description (“User Manual”) of the latest UNFCCC guidelines for national communications (decision 17/CP.8), as well as the “NAI Update,”\(^5\) a brief newsletter on issues relevant for non-Annex I Parties which is released shortly after each Subsidiary Body (SB) meeting.

China, India and Viet Nam reported on their submission of Initial National Communications to the UNFCCC Secretariat (in Nov. 2004, June 2004, and Nov. 2003, respectively). Of the participating countries in the WGIA, all countries have now submitted their Initial National Communications, while Korea has submitted its Second, and Japan has submitted its Third.

A presentation was made on the GHG Inventory Project (Capacity Building for GHG Inventory Development in Asia-Pacific Developing Countries) supported by the APN CAPaBLE Programme.\(^6\) It includes pilot studies in Cambodia and Thailand aiming to improve GHG

\(^{1}\) Countries that participated in the 1st and/or 2nd WGIA meetings include Cambodia, China, India, Indonesia, Japan, Korea, Lao PDR, Mongolia, Philippines, Thailand, Viet Nam (Mongolia was unable to attend this time).
\(^{3}\) www.ipcc-nggip.iges.or.jp
\(^{4}\) www.ipcc-nggip.iges.or.jp/EFDB/main.php
\(^{5}\) http://unfccc.int/national_reports/non-annex_i_natcom/NAI_update/items/347txt.php
\(^{6}\) APN=“Asia-Pacific Network for Global Change Research (APN),” CAPaBLE=“Scientific Capacity Building and
inventories, establish sustainable systems for GHG inventories, provide more realistic emission factors reflecting country and regional conditions, and exchange information with other developing countries for better GHG inventories.

Participants in the WGIA summarized constraints and problems that countries have experienced in GHG inventory compilation in the following four categories: (1) activity data for all five sectors\(^7\) (data is not being collected in some sectors; data has been collected but may not be readily accessible; data is accessible but there are problems with format and conversion; and data is available but there are problems with reliability), (2) emission factors (local EFs are needed that specifically reflect local conditions; more research is needed to improve EF quality); (3) capacity building (needed for experts responsible for GHG inventories) and (4) institutional arrangements (need to be improved, particularly at the national level, in order to facilitate greater efficiency and sustainability in preparing GHG inventories).

The meeting discussed approaches to address these difficulties. The discussion concluded with a recommendation that countries encourage the following actions in the Asian region: (1) promote more sharing of experience among Asian countries regarding collection of activity data, updating of emission estimation methods, and refinement of emission factors; (2) put more effort into emission factors for the Asian region (compile relevant information on EFs that could be useful for other countries in the region that have similar environmental conditions; and submit locally-developed EFs to the IPCC’s Emission Factor Database to share with others); (3) share successful practices in each country regarding activity data and EFs, (4) strengthen the WGIA network, promote active use of the network’s mailing list, and participate in ongoing discussions on GHG inventories in Asia, and (5) compile reports; publish findings (e.g., related to research for GHG inventories, methodologies, local EFs, source/sink category analysis, etc.); and enhance the visibility of the activities of the WGIA.

Participants welcomed a kind offer from the Philippines to host a third workshop in early 2006. In preparation for the workshop, participants will strive to have active communications between now and then.

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\(^7\) Energy; industrial processes; agriculture; land use, land-use change and forestry (LULUCF); and waste.

Enhancement for Sustainable Development in Developing Countries.” See www.apn.gr.jp
Chairpersons’ Summary

Attachment I: Agenda
Attachment II: List of Participants
The 2nd Workshop on GHG Inventories in Asia Region
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Chairpersons’ Summary

Background

1. The Second Workshop on Greenhouse Gas (GHG) Inventories in Asia Region (WGIA) was held in Shanghai, China on 7–8 February 2005 (one and a half days). It was organized by the Ministry of the Environment, Japan and the National Institute for Environmental Studies (Japan) and hosted by the Chinese Research Academy of Environmental Science. The workshop was held back-to-back with the Consultative Group of Experts (CGE) Hands-on Training Workshop on National GHG Inventories for the Asia-Pacific Region organized by the Secretariat of the UN Framework Convention on Climate Change (UNFCCC) from 8 to 12 February.

2. The workshop was attended by participants from 10 countries (Cambodia, China, India, Indonesia, Japan, Korea, Lao PDR, Philippines, Thailand, Viet Nam), and representatives of three international organizations (the UNFCCC Secretariat, the Technical Support Unit of the IPCC National Greenhouse Gas Inventories Programme, and the Asia-Pacific Network for Global Change Research).

Opening Session

3. The opening session was chaired by Ms. Mimi Nameki of the Ministry of the Environment, Japan who opened by pointing out that as the Kyoto Protocol will enter into force this month, the role of GHG inventories will become even more important as a basis of climate change policies. Dr. Shuzo Nishioka of the National Institute for Environmental Studies welcomed participants to the workshop and invited participants to consider future activities of this group as a network in Asia to improve GHG inventories. Mr. Aimin Ma of the Office to the National Coordination Committee on Climate Change (China) on behalf of the host country, welcomed participants to China and expressed his view that it is important for neighboring countries to learn from each other and share experiences relating to GHG inventories. Prof. Zhang Yutian of the Chinese Research Academy of Environmental Science also welcomed participants to China and expressed his hope for a fruitful workshop. He said that China had recently submitted its Initial National Communication (INC) to the UNFCCC Secretariat and he hoped that regional cooperation would benefit all countries in future GHG inventory work. Dr. Hideaki Nakane of the Greenhouse Gas Inventory Office of
Japan (GIO) described the objectives of the meeting as being (1) to update each other on the most up-to-date situation of GHG inventories in Asia, (2) to share useful information and experiences in GHG inventory preparation, and (3) to discuss future activities of the Asian network.

Session I: Update on the Status of Asian Inventories

4. Session 1 was co-chaired by Dr. Rizaldi Boer of Bogor Agricultural University in Indonesia and Mr. Syamphone Sengchandala of Prime Minister’s Office of Lao PDR. In this session, presenters provided updates on activities since the first workshop, held in Phuket in 2003.

5. Mr. Taka Hiraishi of the Institute for Global Environmental Strategies (IGES) in Japan presented information on the Intergovernmental Panel on Climate Change (IPCC) work for GHG inventory guidelines and resources available for UNFCCC National Communications from non-Annex I Parties. He referred participants to the UNFCCC User Manual for the guidelines on national communications from non-Annex I Parties, various documents of the IPCC National Greenhouse Gas Inventory Programme (NGGIP), and the IPCC’s Emission Factor Database. He pointed out that work is now under way to produce 2006 IPCC GHG inventory guidelines. In a comment, Mr. Dominique Revet of the UNFCCC Secretariat pointed out that the UNFCCC website provides some useful materials, particularly a plain-language description (“User Manual”) of the latest UNFCCC guidelines for national communications (decision 17/CP.8), as well as the “NAI Update,” a brief newsletter on issues relevant for non-Annex I Parties which is released shortly after each Subsidiary Body (SB) meeting.

6. Next, three countries reported on their submission of Initial National Communications (INC) to the UNFCCC Secretariat (see workshop proceedings for greater detail). First, Mr. Hoang Manh Hoa of the Ministry of Natural Resources and Environment of Viet Nam reported that his country had submitted its INC in November 2003 and gave a detailed description of its contents, including adaptation and mitigation efforts. Next steps are developing climate change scenarios in Viet Nam for 2010 to 2070, collecting data for the Second National Communication, continuing to study adaptation measures, and developing climate change project portfolio including potential Clean Development Mechanism.

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2. [www.ipcc-nggip.iges.or.jp](http://www.ipcc-nggip.iges.or.jp)
4. [www.unfccc.int](http://www.unfccc.int)
7. Next, Dr. Subodh Sharma of India’s Ministry of Environment and Forests reported that India had submitted its INC in June 2004. He gave a detailed presentation of the main contents of the INC and explained the national institutional arrangements and the extensive work that had gone into the report. India had found that most of the IPCC default emission coefficients were not representative of India’s specific coefficients, and had to use a combination of indigenously-developed and the IPCC’s default emission factors. The shares of levels of inventory estimations in the INC were 23%, 70% and 7% for Tier 1, Tier 2, and Tier 3, respectively, and India desired to move to a higher tier in the future in many emission categories. Sectors requiring improvement in GHG emission estimates included energy, industrial processes, agriculture, LULUCF, and waste management.

8. Third, Dr. Qingxian Gao of the Chinese Research Academy of Environmental Science reported that China had submitted its INC in November 2004. He described the development process and main contents of the INC. China’s experiences in preparing the INC including the following: some obstacles arose due to a lack of activity data; there were challenges in dealing with reliability and quality of data; much of the IPCC’s default data could not be applied directly to China; many models used for assessing the impacts of climate change were still introduced from abroad; the assessments of impacts were preliminary; and many uncertainties still existed. Dr. Gao reported that capacity building had been an important part of the entire INC exercise.

9. Then, Ms. Nameki of the Ministry of the Environment, Japan reported on the current status of Japan’s GHG inventory at the national and local levels. At the national level, Japan started annual submission of its GHG inventory in 1996 and had now established the infrastructure and a routine for annual submissions, which allowed it to accurately track trends in overall emissions in each sector. At the local level, Japan had introduced the “Area Promotion Plan” which encourages local governments to plan local projects to tackle climate change. Japan’s National Policy Programme on Climate Change includes a step-by-step process (in three phases, 2002-04, 2005-07, 2008-12) and fiscal 2004 marked the end of the first phase of implementation.

10. Finally, Prof. Seungdo Kim of Korea’s Hallym University made a presentation on his country’s progress with procedures for estimating CH₄ emissions from landfills using Tier

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6 Land Use, Land-Use Change and Forestry
2 methodology. A comparison of this more rigorous Tier 2 (applying a specially developed Fortran code) with the IPCC’s Tier 1 methodology resulted in significantly different estimates for year-by-year emissions from a landfill. Some participants indicated their desire to obtain more details of the methodology in English.

11. The Co-Chairs summarized the session, saying that it was clear non-Annex I countries face a number of challenges in preparing National Communications, and that capacity-building is still required. They said that GHG inventories could be enhanced by (1) improving institutional arrangements to make GHG inventory preparation a continuous process, (2) improving emission factors and sharing these with other countries that have similar characteristics, and (3) improving the methodologies for GHG emission estimates. Above all, it is clear that countries could benefit by sharing the information and experience that they gain through their respective work with GHG inventories and National Communications.

Session II: Sharing Useful Information and Experiences in GHG Inventory Preparation

12. Session II was co-chaired by Mr. Dominique Revet of the UNFCCC Secretariat and Dr. Sirintornthep Towprayoon of King Mongkut’s University of Technology Thonburi in Thailand.

13. Mr. Leandro Buendia of the IPCC-Technical Support Unit for the National Greenhouse Gas Inventories Programme made a presentation on the IPCC’s Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF), an extensive guide published in 2003 to support the development of good inventories. It also helps countries produce reliable estimates of the magnitude of uncertainties in GHG inventories, and describes how these uncertainties may be best managed to be acceptable for the UNFCCC. Default emission factors in the GPG-LULUCF are now accessible from the Emission Factor Database and many other materials are available from the main website.

14. Dr. Linda Stevenson of the Asia-Pacific Network for Global Change Research (APN) presented the APN CAPaBLE Program (Scientific Capacity Building and Enhancement for Sustainable Development in Developing Countries). One project the APN is currently funding (approximately US$120,000 over three years) is the APN CAPaBLE GHG

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7 www.ipcc-nggip.iges.or.jp/EFDB/main.php
8 www.apn.gr.jp
Inventory Project (Capacity Building for GHG Inventory Development in Asia-Pacific Developing Countries). Dr. Hideaki Nakane of the Greenhouse Gas Inventory Office of Japan, as the APN Project Leader for this project, introduced the project which includes pilot studies in Cambodia and Thailand. Among the project’s top aims are (1) to improve GHG inventories, (2) to establish sustainable systems for GHG inventories, (3) to provide more realistic emission factors reflecting country and regional conditions, and (4) to exchange information with other developing countries for better GHG inventories.

For Cambodia, Mr. Thy Sum of the Ministry of the Environment presented its work under the APN CAPaBLE GHG Inventory Project to improve GHG inventories for LULUCF, through trainings in Japan and field work in Cambodia to measure aboveground biomass and biomass growth rates of deciduous, evergreen and secondary forests.

For Thailand, Dr. Amnat Chidthaisong of King Mongkut’s University of Technology Thonburi made a presentation on a new instrument, developed by NIES and assembled under the APN CAPaBLE GHG Inventory Project, a semiconductor-based sensor that can measure methane flux in various situations, including rice paddies. The new sensor can replace the gas chromatographic measurement of sampling air from a chamber which is commonly used for this purpose, as the sensor is mobile (fits in a suitcase), makes quick measurements, is reliable and accurate, offers lower cost per measurement, and is relatively easy to operate. Under the APN CAPaBLE GHG Inventory Project, he has received training in Japan to use this instrument, plans to put it to use soon in methane emission measurements in various rice cultivation schemes in order to develop an emission factor database for methane emissions in Thailand, and hopes to share his experiences in the future with other countries in the region.

15. Ms. Chisa Umemiya of the Greenhouse Gas Inventory Office of Japan identified the regionally-significant source/sink categories in Asia by applying the key category analysis method by nation and found that the characteristics of those categories differ across regions. She suggested one of the future activities of the region would be improving the accuracy of emission factors and activity data of those identified categories. Dr. Qingxian Gao said that differences in regional characteristics of key categories in the waste sector in her analysis might originate from different waste management practices used in different regions. Mr. Hiraishi mentioned that the methodology of her analysis should be discussed further in order to identify the regionally-significant categories where participating countries need real improvement in quality of GHG emissions estimations.
16. The Co-Chairs summarized the discussions of this session, saying that participants had gained useful information. The discussion on the regionally-significant source/sink categories had stimulated thinking on these topics and deserves further discussion in the future. Also, there is an obvious link between the technical work being done, for example, at the IPCC level with regard to methodologies, on one hand, and the need for in-country capacity building, on the other.

Session III: Future Activities of the WGIA Community
17. Session 3 was co-chaired by Dr. Shuzo Nishioka and Dr. Damasa Macandog of the University of the Philippines Los Banos. To begin with, Dr. Gao, as rapporteur, presented a summary of the previous day of discussions.

18. The meeting then discussed the constraints and problems that participants’ countries have experienced in GHG inventory compilation. Common issues included the following:
(a) Activity Data (for all five sectors)\(^9\)
   - Data is not being collected in some sectors.
   - Data has been collected but may not be readily accessible.
   - Data is accessible but there are problems with format and conversion.
   - Data is available but there are problems with its reliability.
(b) Emission Factors
   - Local emission factors that specifically reflect local conditions need to be developed.
   - More research studies are needed to improve quality of emission factors.
(c) Capacity Building
   - Capabilities of experts responsible for GHG inventories need to be enhanced.
(d) Institutional Arrangements
   - Institutional arrangements need to be improved, particularly at the national level, in order to facilitate greater efficiency and sustainability in preparing GHG inventories.

19. The meeting then discussed approaches to address these difficulties. The discussion concluded with a recommendation for countries to encourage the following actions in the Asian region:

\(^9\) Energy; industrial processes; agriculture; land use, land-use change and forestry (LULUCF); and waste.
(a) Promote greater sharing of experience among Asian countries regarding collection of activity data, updating of emission estimation methods, and refinement of emission factors.

(b) Emission factors for the Asian region
   - Compile relevant information on emission factors that could be useful for other countries in the region that have similar environmental conditions.
   - Submit locally-developed emission factors to the IPCC’s Emission Factor Database to share with others.

(c) Share experience of successful practices in each country regarding activity data and emission factors.

(d) Strengthen the WGIA network, promote active use of the network’s mailing list, and participate in ongoing discussions on GHG inventories in Asia.

(e) Compile reports (including proceedings of this workshop); publish findings (e.g., related to research for GHG inventories, methodologies, local emission factors, source/sink category analysis, etc.); and enhance the visibility of the activities of the WGIA in the IPCC, CDM and CGE communities, for the benefit of all in their GHG inventory work.

20. Finally, the meeting discussed plans for a third WGIA workshop. Participants welcomed a kind offer from the Philippines (University of the Philippines Los Banos, Department of Environment and Natural Resources, and the Manila Observatory) to host the meeting in early 2006. In preparation for the workshop, participants will strive to have active communications between now and then.

Closing Session
21. Dr. Nishioka wrapped up the workshop, thanking everyone for their contributions. Dr. Gao thanked participants for coming to Shanghai and expressed his hopes that everyone had enjoyed their time here. Ms. Nameki reviewed the main topics of discussions and mentioned that many issues still remain to be discussed and addressed. Limited time and resources mean that countries need to find the most efficient way to enhance the accuracy of GHG inventories so that they reflect the local conditions of the Asian region. She urged everyone to keep working together and was confident that the network established through this workshop would be of great help for that purpose. The participants thanked the Japanese organizers for organizing the workshop, and expressed special appreciation to the host organization in China for the warm hospitality and fine venue.
The 2nd Workshop on GHG Inventories in Asia Region (WGIA)
7-8 February 2005, Shanghai, China

Agenda

Day 1, Monday 7th February

9:00~9:30  Participant Registration

9:30~10:30  Opening Session (60 min.)
Chair: Ms. Mimi Nameki, Japan

9:30~ 9:35  Dr. Shuzo Nishioka, Japan  Welcome address (5 min.)
9:35~ 9:40  Mr. Aimin Ma, China  Welcome speech from host country (5 min.)
9:40~9:45  Prof. Zhang Yutian, China  Welcome speech from host country (5 min.)
9:45~ 10:05  All  Introduction of participants (20 min.)
10:05~10:20  Dr. Hideaki Nakane, Japan  Overview of workshop and explanation of schedule (13 min. + 2 min.)
10:20~10:30  All  Questions (10 min.)

10:30~10:45  Tea Break (15 min.)

10:45~12:55  Session I : Update on the status of the Asian inventories (130 min.)
Co-chairs: Dr. Rizaldi Boer, Indonesia & Mr. Syamphone Sengchandala, LAO P.D.R

10:45~11:05  Mr. Taka Hiraishi, Japan  IPCC’s work for GHG inventory guidelines and national communications from non-Annex I Parties (15 min. + 5 min.)
11:05~11:20  Mr. Hoang Manh Hoa, Viet Nam  Submission of Viet Nam’s Initial National Communication (10 min. + 5 min.)
11:20~11:40  Dr. Subodh Kumar Sharma, India  Submission of India’s Initial National Communication (15 min. + 5 min.)

11:40~12:00  Dr. Qingxian Gao, China  Submission of China’s Initial National Communication (15 min. + 5 min.)

12:00~12:20  Ms. Mimi Nameki, Japan  Current status of the GHG inventory in Japan (15 min. + 5 min.)

12:20~12:40  Prof. Seungdo Kim, Republic of Korea  Development of application procedures of the Tier 2 methodology for CH₄ emission from Korean landfills (15 min. + 5 min.)

12:40~12:55  All  Questions and discussion (15 min.)

12:55~14:25  Lunch Time (90 min.)

14:25~15:30  Session II : Sharing useful information and experiences in GHG inventory preparation (65 min.)
  Co-chairs: Mr. Dominique Revet, UNFCCC & Dr. Sirintornthep Towprayoon, Thailand

14:25~14:50  Mr. Leandro Buendia, IPCC-NGGIP/TSU  IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (18 min. + 7 min.)

14:50~15:00  Dr. Linda Anne Stevenson, APN  Overview of the APN CAPaBLE Programme (8 min. + 2 min.)

15:00~15:10  Dr. Hideaki Nakane, Japan  Introduction of the APN CAPaBLE Project “Capacity Building for GHG Inventory Development in Asia-Pacific Developing Countries (APN CAPaBLE GHG Inventory Project)” (8 min. + 2 min.)

15:10~15:30  Mr. Thy Sum, Cambodia  Cambodia’s LULUCF inventory improvement under the APN CAPaBLE GHG Inventory Project (15 min. + 5 min.)

15:30~15:45  Tea Break (15 min.)

15:45~17:00  Session II : Sharing useful information and experiences in GHG inventory preparation (75 min.)
15:45~16:10  Dr. Amnat Chidthaisong, Thailand  Rapid and accurate measurements of methane emissions from rice paddies under the APN CAPaBLE GHG Inventory Project (18 min. + 7 min.)
16:10~16:30  Ms. Chisa Umemiya, Japan  Identification of regionally-significant source/sink categories in Asia (15 min. + 5 min.)
16:30~17:00  All  Questions, discussion, and wrap-up of Day 1 (30 min.)

Day 2, Tuesday 8th February

9:00~10:30  Session III: Discussion for the future activities of the WGIA community (90 min.)
             Co-chairs: Dr. Shuzo Nishioka, Japan & Dr. Damasa Macandog, Philippines
9:00~9:20  Rapporteur: Dr. Qingxian Gao, China  Report on Day 1 (20 min.)
9:20~10:15  All  - Enhancement of use of WGIA as an effective network
             - Common features of GHG inventory preparation
             - How to determine short term strategies
             - Roles of each country and work plans
             (55 min.)
10:15~10:30  All  Wrap-up of the discussion (15 min.)
10:30~11:30  Tea Break (60 min.)
11:30~12:00  Closing Session (30 min.)
11:30~11:50  Dr. Shuzo Nishioka, Japan  Wrap-up (20 min.)
11:50~11:55  Dr. Qingxian Gao, China  Closing remarks (5 min.)
11:55~12:00  Ms. Mimi Nameki, Japan  Closing remarks (5 min.)
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THE 2\textsuperscript{nd} WORKSHOP ON GHG INVENTORIES IN ASIA REGION
7-8 February 2005, Shanghai, China

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DOCUMENTS

i) Presentations
ii) Other documents
iii) Appendix
i) Presentations
Overview of workshop and explanation of schedule

Hideaki Nakane
Manager,
Greenhouse Gas Inventory Office of Japan (GIO),
Center for Global Environmental Research (CGER),
National Institute for Environmental Studies (NIES)
Presented at the 2nd Workshop of GHG Inventories in Asia region
February 7-8, 2005

Joint Hosting Organizations

- Ministry of the Environment of Japan
  Ms. Mimi Nameki
- National Institute for Environmental Studies, Japan
  Dr. Shuzo Nishioka
- Chinese Research Academy of Environmental Science (Local Host)
  Dr. Gao Qingxian
Participants

- 29 participants (governmental officials and researchers) from 11 countries
- 4 representatives from 3 international organizations
  - UNFCCC Secretariat, Dr. Revet
  - IPCC-NGGIP/TSU, Dr. Leandro
  - Asia-Pacific Network for Global Change Research (APN), Dr. Stevenson
- Mr. Taka Hiraishi (IGES); Japan; IPCC’s work

Workshop objectives

1. Update the most up-to-date situation of GHG inventories in Asia
2. Share useful information and experiences in GHG inventory preparation and related research activities
3. Discuss on the future activities of the Asian network
Day 1 - Session 1

Co-chaired by: Dr. R. Boer & Mr. S. Sengchandala

Objective 1: To update the most up-to-date situation of GHG inventories in Asia

- Recent trend in IPCC/NGGIP and non-Annex-I NCs
- Submission of new NCs by participating countries
- Examples of some efforts of participating countries

Day 1 - Session 2

Co-chaired by: Mr. D. Revet (UNFCCC) & Dr. S. Towprayoon

Objective 2: To share useful information and experiences in GHG inventory preparation

- Use of IPCC GPG-LULUCF
- The APN CAPaBLE Programme; A Project “Capacity Building for GHG Inventory Development in Asia-Pacific Developing Countries”
- Lessons learned from other projects, eg. the UNDP-GEF Regional Capacity Building Project
- Ms. Chisa Umemiya (GIO); an example of analysis of the GHG inventories in Asia countries
Day 2 - Session 3

Co-chaired by Dr. S. Nishioka & Dr. D. Macandog and Dr. G. Qingxian as Rapporteur

Objective 3: To discuss the future activities of the Asian network

- Enhancement of effective use of the Asian network (eg. concrete outcomes; more visible)
- How to determine short term strategies for the region (??)
- Roles of each country and work plans (??)

Various ways, leaderships, roles, funding possibilities...:
Let's discuss together!!!

Expected outputs

- Clear ideas of the latest circumstances in Asia and global of the GHG inventories and related activities
- Enhanced capacity to prepare GHG inventories and related research
- Motivation and plans for the future activities of the Asian network
Roles of Co-chairs

- To introduce yourself
- To remind the subject of the sessions at the beginning of the session
- To make sure the session proceeds on time (*Mr. Aizawa as the time-keeper*)
- Very brief closing address may be helpful
IPCC’s Work for GHG Inventory Guidelines and National Communications from non-Annex I Parties

7 February 2005
Taka Hiraishi <hiraishi@iges.or.jp>
Senior Consultant
Institute for Global Environmental Strategies (IGES)

Contents

• IPCC National Greenhouse Gas Inventory Programme (NGGIP) and UNFCCC Reporting
• Non-Annex I National Communications
IPCC – Organisation

IPCC NGGIP

- IPCC/OECD/IEA GHG Inventories programme started 1991 (within IPCC Working Group-I)
- Since 1999 IPCC NGGIP (Technical Support Unit at IGES/Japan)
- Objectives and activities
  - to develop and refine an internationally-agreed methodology and software for the calculation and reporting of national GHG emissions and removals; and
  - to encourage the widespread use of this methodology by countries participating in the IPCC and by Parties of the United Nations Framework Convention on Climate Change (UNFCCC).
IPCC - NGGIP Products

“1995” and “Revised 1996” IPCC Guidelines for National Greenhouse Gas Inventories

<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>
(cf. COP Decisions 4/CP.1, 9/CP.2, 2/CP.3 & 17/CP.8)

Volume 1
Reporting Instructions

Volume 2
Workbook + IPCC Software

Volume 3
Reference Manual

IPCC NGGIP Products

IPPC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

<http://www.ipcc-nggip.iges.or.jp/public/gp/english/> (All UN language versions)

Complements the Revised 1996 IPCC Guidelines

Published in 2000
- Endorsed by SBSTA12 -

Background Papers: IPCC Expert Meeting on Good Practice Guidance and Uncertainty Management in National GHG Inventories
Published in late 2002
<http://www.ipcc-nggip.iges.or.jp/public/gpg-bgp.htm>
IPCC NGGIP Products

IPCC Good Practice Guidance for Land use, Land-Use Change and Forestry, 2003


- Actions by SBSTA at 19th, 20th & 21st (COP10) sessions -

Complements the Revised 1996 IPCC Guidelines.

GPG-LULUCF provides supplementary methods and good practice guidance for estimating, measuring, monitoring and reporting on carbon stock changes and greenhouse gas emissions from LULUCF activities under Article 3, paragraphs 3 and 4, and Articles 6 and 12 of the Kyoto Protocol.

Ongoing projects of the NGGIP

2006 IPCC Inventory Guidelines

- Revision of the Revised 1996 GLs;
  - First authors meeting in May 2004, five meetings held.
  - Expert Review of First Order Draft to begin on 28 Feb. 2004;
  - Final Report to be ready in early 2006

- Invitation by SBSTA 17.

Database for emission factors and other parameters (EFDB project)

- Objective: to provide information on emission factors and other parameters needed in inventory calculations (robust; applicable; and documented)
EFDB Web application

Welcome to EFDB!

All users are kindly invited to pay attention to this note. Guidance for users (as of 20 October 2002) can be downloaded (click here). The EFDB User Manual will be made available in due course.

- **Nature of EFDB**: EFDB is meant to be a recognised library, where users can find emission factors and other parameters with background documentation or technical references that can be used for estimating greenhouse gas emissions and removals. The responsibility of using this information appropriately will always remain with the users themselves.

- **Request for data input**: Users are encouraged to provide the EFDB with any relevant proposals on emission factors or other related parameters. If you wish to submit your data for the first time, please contact the Technical Support Unit to obtain your login name and password. Acceptance of such proposals will be subject to decisions by the EFDB Editorial Board using well-defined criteria.

- **Terminology**: EFDB is a database on various parameters to be used in the calculation of anthropogenic emissions by sources and by sinks of greenhouse gases. It covers not only the so-called “emission factors” but also the other relevant parameters. For convenience sake, however, the term “Emission Factor” or its abbreviation “EF” is sometimes used to represent parameters in this database generally.

- **Software requirements**: It is highly recommended to use Microsoft Internet Explorer version 5.0 or higher for best performance. Alternatively, Netscape Navigator version 6.0 or higher can be used. It is

Http://www.ipcc-nggip.iges.or.jp/EFDB/main.php
National Communications: Guidelines for Non-Annex-I Parties

Legal Basis:
UNFCCC Article 4.1 COMMITMENTS

All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

(a) Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;

(j) Communicate to the Conference of the Parties information related to implementation, in accordance with Article 12.
Legal Basis: UNFCCC Article 12.1
Communication of Information Related to Implementation

In accordance with Article 4, paragraph 1, each Party shall communicate to the Conference of the Parties, through the secretariat, the following elements of information:

(a) A national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be promoted and agreed upon by the Conference of the Parties;

(b) A general description of steps taken or envisaged by the Party to implement the Convention; and

(c) Any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends.

Legal Basis: UNFCCC Article 12 (cont.)

5. <Annex I countries> shall make its initial communication within six months of the entry into force of the Convention for that Party. ... Each Party not so listed shall make its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources in accordance with Article 4, paragraph 3. Parties that are least developed countries may make their initial communication at their discretion.
Non-Annex I Communication Guidelines

[Decision 10/CP.2]

• National and regional development priorities, objectives and circumstances should, in accordance with Article 4.1, and the provisions of Article 3 and Article 4.3, 4.4, 4.5, 4.7, 4.8, 4.9 and 4.10, be taken into account by COPs in considering matters related to their initial communications; and

• Non-Annex I Parties which wish to submit voluntarily additional information may use elements from the guidelines approved for Annex-I Parties when preparing their initial communications.

COP 8 Decisions related to NAI NCs

• Improved NAI NC Guidelines (Dec.17/CP.8)

• Continuation of CGE with the revised Terms of Reference (Dec.3/CP.8)

• Overall decision on NAI NCs (Dec.2/CP.8)
Non-Annex I Communication Guidelines
[Dec.17/CP.8]

• Scope of NC:
  – A national inventory of anthropogenic emissions by sources and removal by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be promoted and agreed upon by the Conference of the Parties;
  – A general description of steps taken or envisaged by the non-Annex I Party to implement the Convention;
  – Any other information that the non-Annex I Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends.

Non-Annex I Communication Guidelines
[Dec.17/CP.8]

Principal Objectives of the Guidelines

• To assist non-Annex I Parties in meeting their reporting requirements under the Convention;
• To encourage the presentation of information in a consistent, transparent and comparable, as well as flexible manner, taking into account specific national circumstances;
• To facilitate the presentation of information on support required for the preparation and improvement of national communications from non-Annex I Parties;
• To serve as policy guidance to the operating entity of the financial mechanism for the timely provision of financial support needed by developing country Parties in order to meet the agreed full costs of complying with their obligations…
Non-Annex I Communication Guidelines  
[Dec.17/CP.8 ]

National circumstances

– Non-Annex I Parties should provide a description of their national and regional development priorities, objectives and circumstances, on the basis of which they will address climate change and its adverse impacts. ….

– Non-Annex I Parties are encouraged to provide a summary of relevant information regarding their national circumstances, as appropriate, in tabular form.

– Non-Annex I Parties may provide a description of existing institutional arrangements relevant to the preparation of their national communications on a continuous basis.

Inventory

– Each Non-Annex I Party shall, in accordance with Article 4, paragraph 1(a) and Article 12, paragraph 1(a), communicate to the Conference of the Parties a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, to the extent its capacities permits, following the provisions in these guidelines.

– Non-Annex I Parties shall estimate national GHG inventories for the year 1994 for the initial national communication or alternatively may provide data for the year 1990. For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion.


– Non-Annex I Parties are encouraged to apply the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories …, taking into account the need to improve transparency, consistency, comparability, completeness and accuracy in inventories.
Non-Annex I Communication Guidelines

Other information

• General Description of steps taken or envisaged to implement the Convention.
• Other information considered relevant to the achievement of the objective of the Convention.
• Constraints and gaps, and related financial, technical and capacity needs.

Submission:

– The information provided in accordance with these guidelines shall be communicated by each non-Annex I Party to the COP in a single document, with an executive summary outlining the information contained in the full document, in both hard copy and electronic format.
– Each non-Annex I Party shall submit its national communication in one of the official languages of the United Nations. The executive summary, which is to be of no more than 10 pages, shall be translated into English and made publicly available. Parties are also encouraged to submit, to the extent possible and where relevant, English translations of their communications.
– Additional or supporting information may be supplied through other documents such as a technical annex.
Consultative Group of Experts on national communications from Parties not included in Annex I to the Convention (CGE) Terms of Reference (Decision8/CP5)

- Exchange experience and information on the preparation of national communications;
- Consider, as appropriate, the needs for and availability of financial resources and technical support, and the identification of barriers to and gaps in this support;
- Consider, as appropriate, information in national communications from non-Annex I Parties in accordance with the guidelines for the preparation of initial national communications;
- Review existing activities and programmes to facilitate and support the preparation of national communications by non-Annex I Parties;
- Identify the difficulties encountered by non-Annex I Parties in the use of the guidelines;
- Identify the analytical and methodological issues, including technical problems in the preparation and reporting of greenhouse gas inventories;
- Examine national communications, in particular greenhouse gas inventories, submitted by non-Annex I Parties, with a view to arriving at recommendations on ways of overcoming difficulties in the use of the IPCC methodologies and the UNFCCC guidelines;
- Encourage interaction among experts from all Parties.

CGE Mandate Revised (Decision3/CP8)

COP8 adopted the revised mandate of the Consultative Group of Experts, comprising 24 experts:

- Five members from each of the regions of non-Annex I Parties, namely, Africa, Asia and the Pacific, and Latin America and the Caribbean;
- Six members from Parties included in Annex I to the Convention (Annex I Parties), including one from countries with economies in transition;
- One member from each of three international organizations with relevant experience in providing technical assistance to non-Annex I Parties in the preparation of national communications.

- Identify and assess technical problems and constraints
- Identify and assess the difficulties encountered;
- Examine national communications submitted to the secretariat;
- Provide technical advice and support, by organizing and conducting workshops, including hands-on training workshops at the regional or sub-regional level;
- Provide technical advice to the SBI...

CGE: Current Members

A. African Region
- Ms. Emily Ojoo-Massawa (Kenya), Mr. Mohamed Etayari (Libya), Ms. Marília Manjate (Mozambique), Mr. Samuel Adejuwon (Nigeria), Ms. Madeleine Diouf (Senegal) (also LEG member)

B. Asian Region
- Mr. M. Asaduzzaman (Bangladesh), Mr. Subodh Kumar Sharma (India), Mr. Jaekyu Lim (Republic of Korea), Mr. Jose Villarin (Philippines), Mr. Muhammad Mundicar (Kuwait)

C. Latin America and the Caribbean Region
- Mr. Carlos Fuller (Belize), Mr. Arthur Rolle (Bahamas), Mr. Luis Paz Castro (Cuba), Ms. Lilian Portillo (Paraguay), Mr. Luis Santos (Uruguay)

D. Annex I
- Mr. Satender Singh (Canada), Ms. Riitta Pipatti (Finland), Ms. Renate Vandeputte (Belgium) (also LEG member), Mr. Othmar Schwank (Switzerland), Mr. Alexander Pisarenko (Ukraine), Mr. Jack Fitzgerald (United States of America)

E. Organizations
- Ms. Bo Lim (NCSU/UNDP), Mr. Taka Hiraishi (IPCC/GHG Inventory Task Force), Mr. Mahendra Kumar (Climate Change Enabling Activities/UNEP)
Work of CGE

- Regional workshop for the Latin America and the Caribbean region in Mexico City, Mexico, from 8 to 12 May 2000
- Regional workshop for the Africa region in Nairobi, Kenya, from 15 to 18 August 2000
- Regional workshop for the Asia and the Pacific region in Bangkok, Thailand from 16 to 20 October 2000
- Three interregional workshops of the CGE were held in 2001 and 2002
- CGE Workshops have been held; in Mauritius in April 2003, in Mexico in Sept. 2003, and in Malaysia in April 2004
- CGE hands-on training workshop on national greenhouse gas inventories for the Latin America and the Caribbean region was held in Panama on 25 - 29 October 2004
- Similar training workshop will be held in Shanghai on 8-10 February 2005.

CGE Findings - Inventories

- Insufficient resources to collect the necessary activity data for the estimation of the GHG emissions (land use change and forestry, energy, etc.).
- Need for appropriate emission factors (forests, transport, agriculture, waste disposal).
- No technical coordinators or secretariat or technical focal points for performing the technical work.
- A lack of adequate capacities in the existing institutions to carry out research and training on climate change issues.
- Need for exchange of information related to national inventories among the countries of the regions.
- Need to improve UNFCCC Guidelines.
- Provision of further financial and technical support.
The user manual is available electronically in PDF-format in three UN languages: English, Français, Español. 
(http://unfccc.int/files/essential_background/application/pdf/userman_nc.pdf)

Discussions: Issues re. NAI NCs

- NC is a commitment by all Parties, under the “common but differentiated responsibility” principle. 121 NAIs have done NCs
- NC preparation requires human, technological, institutional and financial capability.
- Continuation of NC activities and maintenance of NC institutional setup is difficult in many developing countries.
- Provision of agreed full cost funding is not a straightforward question.
- Unsuccessful negotiations at COP9, SBI 20 and COP10 (Dec. 2004).
NAI National Communications (As of January 2005)
(Red: 2nd communications)

ALBANIA, ALGERIA, ANTIGUA AND BARBUDA, ARGENTINA, ARMENIA,
AZERBAIJAN, BAHAMAS, BANGLADESH, BARBADOS, BELIZE, BENIN, BHUTAN,
BOLIVIA, BOTSWANA, BRAZIL, BURKINA FASO, BURUNDI, CAMBODIA, CAPE
VERDE, CENTRAL AFRICAN REPUBLIC, CHAD, CHILE, CHINA, COLOMBIA,
COMOROS, CONGO, COOK ISLANDS, COSTA RICA, COTE DIVOIRE, CUBA,
DEMOCRATIC PEOPLE’S REPUBLIC OF KOREA, DEMOCRATIC REPUBLIC OF THE
CONGO, DJIBOUTI, DOMINICA, DOMINICAN REPUBLIC, ECUADOR, EGYPT, EL
SALVADOR, Eritrea, ETHIOPIA, GABON, GAMBIA, GEORGIA, GHANA,
GRENADA, GUATEMALA, GUINEA, GUYANA, HAITI, HONDURAS, INDIA,
INDONESIA, IRAN, (Islamic Republic of), ISRAEL, JAMAICA, JORDAN, KAZAKHSTAN, KENYA, KIRIBATI, KYRGYZSTAN, LAOPEOPLE’S DEMOCRATIC
REPUBLIC, LEBANON, LESOTHO, MACEDONIA (The former Yugoslav Republic of),
MADAGASCAR, MALAWI, MALAYSIAS, MALDIVES, MALI, MALTA, MARSHALL
ISLANDS, MAURITANIA, MAURITIUS, MEXICO, MICRONESIA, MONGOLIA,
MOROCCO, NAMIBIA, NAURU, NEPAL, NICARAGUA, NIGER, NIGERIA, NIUE,
PAKISTAN, PALAU, PANAMA, PAPUA NEW GUINEA, PARAGUAY, PERU,
PHILIPPINES, REPUBLIC OF KOREA, REPUBLIC OF MOLDOVA, SAINT KITTS AND
NEVIS, SAINT LUCIA, SAINT VINCENT AND GRENADINES, SAMOA, SENEGAL,
SEYCHELLES, SINGAPORE, SOLOMON ISLANDS, SOUTH AFRICA, SRI LANKA,
SUDAN, SWAZILAND, TAJIKISTAN, THAILAND, TOGO, TRINIDAD AND TOBAGO,
TUNISIA, TURKMENISTAN, TUVALU, UGANDA, UNITED REPUBLIC OF
TANZANIA, URUGUAY, UZBEKISTAN, VANUATU, VIET NAM, YEMEN, ZAMBIA,
ZIMBABWE
The Second Workshop on GHG Inventories in Asia Region  
Shanghai, China, 7-8 February 2005

Submission of the Viet Nam Initial National Communication

Hoang Manh Hoa  
Senior Expert on Climate Change  
International Cooperation Department  
Ministry of Natural Resources and Environment of Viet Nam

Background

- Viet Nam signed the UNFCCC in 1992 and ratified it on 16 November 1994.
- In order to fulfill the commitment described in the articles 12.1, 12.5 of UNFCCC and following the guidelines “Preparation of the Initial National Communication” for Non-Annex I Parties, the Government of Viet Nam assigned the Ministry of Natural Resources and Environment as a National Authority to implement the project “Viet Nam: Preparation of the Initial National Communication to the UNFCCC – GF/2200-97-54” with financial and technical support from the GEF and UNEP.
- There were many workshops and seminars held to prepare and complete the Initial National Communication.
- The Initial National Communication of Viet Nam was submitted to the UNFCCC Secretariat in November 2003.
Institutional arrangements for Preparing National Communication

The climate change enabling activity to prepare the Initial National Communication to the UNFCCC led to the establishment of a National Study Team composed of the following institutions:

- Ministry of Natural Resources and Environment (MONRE)
- Ministry of Industry (MOI)
- Ministry of Planning and Investment (MPI)
- Ministry of Science and Technology (MOST)
- Ministry of Agriculture and Rural Development (MARD)
- Ministry of Finance (MOF)
- Ministry of Foreign Affairs (MOFA)
- Ministry of Transportation (MOT)
- Viet Nam Union of Science and Technology Associations (VUSTA).
Implemented activities

- 1994 National GHG Inventory was carried out for the main sectors:
  - Energy
  - Industry Processes
  - Forestry and Land Use Change
  - Agriculture
  - Waste

The methodology:
- The guidance of IPCC version 1996
- The guideline for preparation of National Communication for Non-Annex I Parties
- The data sources were collected and processed from the General Statistical Office and other related Agencies of Viet Nam

GHGs Inventory Results in 1994

<table>
<thead>
<tr>
<th>Emission sector</th>
<th>CO₂ equivalent (million tons)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>25.6</td>
<td>24.7</td>
</tr>
<tr>
<td>Industrial Processes</td>
<td>3.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Agriculture</td>
<td>52.5</td>
<td>50.5</td>
</tr>
<tr>
<td>Forestry and Land Use Change</td>
<td>19.4</td>
<td>18.7</td>
</tr>
<tr>
<td>Waste</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Total emission</strong></td>
<td><strong>103.8</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
**GHG Inventory Results in 1994**

<table>
<thead>
<tr>
<th>Sector</th>
<th>1994</th>
<th>2010</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use change and Forestry</td>
<td>19.38</td>
<td>-21.70</td>
<td>-28.40</td>
</tr>
<tr>
<td>Agriculture</td>
<td>52.45</td>
<td>57.20</td>
<td>64.70</td>
</tr>
<tr>
<td>Total</td>
<td>97.47</td>
<td>140.67</td>
<td>233.28</td>
</tr>
</tbody>
</table>

**GHG National & Sectoral Projection**

Unit: Tg CO₂ equivalent
**GHG Mitigation Options**

Based on the results of GHG Inventory, GHG mitigation options in Viet Nam were developed for 3 major sectors:

- Energy (9 options)
- Forestry and Land Use Change (6 options)
- Agriculture (3 options)

### GHG mitigation options in Viet Nam

#### Energy sector (Period 2000-2020)

<table>
<thead>
<tr>
<th>Options</th>
<th>Period 2000-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GHG mitigation</td>
</tr>
<tr>
<td></td>
<td>potential (Tg CO₂)</td>
</tr>
<tr>
<td>E1: Replacement of low-efficiency coal fired boilers by higher efficiency one</td>
<td>10.2</td>
</tr>
<tr>
<td>E2: Replacement of low-efficiency oil fired boilers by higher efficiency one</td>
<td>3.5</td>
</tr>
<tr>
<td>E3: Fuel efficiency improvements with lean burn engine in transportation</td>
<td>21.9</td>
</tr>
<tr>
<td>E4: Development of geo-thermal power</td>
<td>29.2</td>
</tr>
<tr>
<td>E5: Development of solar power</td>
<td>26.1</td>
</tr>
</tbody>
</table>
### Energy sector (Period 2000-2020)

<table>
<thead>
<tr>
<th>Options</th>
<th>Period 2000-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GHG mitigation</td>
</tr>
<tr>
<td></td>
<td>potential (Tg CO₂)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>E6: Development of wind power stations</td>
<td>34</td>
</tr>
<tr>
<td>E7: Efficiency improvement in coal-cooking stoves</td>
<td>73</td>
</tr>
<tr>
<td>E8: Replace incandescent light bulbs by</td>
<td>16</td>
</tr>
<tr>
<td>compact fluorescent lamps</td>
<td></td>
</tr>
<tr>
<td>E9: More efficient industrial motors</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>283.8</td>
</tr>
</tbody>
</table>

### Forestry and Land Use Change sector (Period 2000-2020)

<table>
<thead>
<tr>
<th>Options</th>
<th>Carbon Sink (Tg CO₂)</th>
<th>Reduced Cost ($/tCO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1: Protection of forest</td>
<td>1,320.6</td>
<td>0.21</td>
</tr>
<tr>
<td>F2: Combination of forest nursing and delineation for regeneration</td>
<td>372.6</td>
<td>0.11</td>
</tr>
<tr>
<td>F3: Planting of protective, specialized forest</td>
<td>325.8</td>
<td>0.26</td>
</tr>
<tr>
<td>F4: Short rotation reforestation</td>
<td>445.8</td>
<td>-0.15</td>
</tr>
<tr>
<td>F5: Long rotation reforestation</td>
<td>496.1</td>
<td>0.20</td>
</tr>
<tr>
<td>F6: Scattered trees planting</td>
<td>278.7</td>
<td>2.56</td>
</tr>
<tr>
<td>Total</td>
<td>3,221.6</td>
<td></td>
</tr>
</tbody>
</table>
GHG mitigation options in Viet Nam (Cont.)

Agriculture sector (Period 2000-2020)

<table>
<thead>
<tr>
<th>Options</th>
<th>Reduced methane (Tg CO₂ eq.)</th>
<th>Mitigation Cost ($/tCO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1: Water management in rice field</td>
<td>105.0</td>
<td>13.12</td>
</tr>
<tr>
<td>A2: Food processing for animal</td>
<td>8.0</td>
<td>5.19</td>
</tr>
<tr>
<td>A3: Utilization of biogas</td>
<td>27.3</td>
<td>3.41</td>
</tr>
<tr>
<td>Total</td>
<td>140.3</td>
<td></td>
</tr>
</tbody>
</table>

Implemented activities

- **Adaptation measures for water resources:**
  1. Building reservoirs for containing flood water to mitigate losses caused by flood, meanwhile regulate water during low-flow season.
  2. Upgrading and raising the scale of drainage system
  3. Upgrading existing sea and river-mouth dykes
  4. Actively limiting the population growth rate and organizing new resettlement areas to avoid the effects of sea level rise
  5. Reclaiming areas for agricultural production
  6. Using water scientifically and effectively with special attention paid to increasing run-off during low-flow season
  7. Exploiting while protecting water sources
  8. Conducting studies for planning rational and safe use of surface water sources.
Expanded activities

**Adaptation measures for agriculture sector:**
1. Development of crop patterns suitable to climate change
2. Effective use with of irrigation water
3. Upgrading of irrigation system for agriculture
4. Development of new varieties that could stand against severe environmental conditions
5. Reserve and storage of local crop varieties, establishing crop seed banks
6. Development of farming techniques appropriate to climate change

**Adaptation measures for forestry and land use change sector:**
1. Enhancing reforestation, regreening bare lands and hills, protecting and developing of mangrove forest
2. Protecting natural forest and going forward to closing natural forest exploitation. Preventing forest fire
3. Establishing bank of seeds of natural forest trees in order to protect some valuable varieties.
4. Enhancing timber processing and limiting use wood as material.
5. Selecting and developing plant varieties suitable to natural conditions taking into account climate change
Implemented activities

Adaptation measures for aquaculture:
1. Researching on prediction of movement of fishes and providing fishermen with fish monitoring equipment.
2. Importing and developing valuable aquaculture varieties that could adapt to high temperature.
3. Changing farming structure in some wet areas from rice monoculture to fish-rice rotation system.
4. Taking into account sea level rise and increase of temperature while building infrastructures, quays, ports, store house, etc.
5. Developing plan on brackish water aquaculture for Central Viet Nam with 2000 km of coast and sandy land
6. Building back-up dyke behind sea dyke to create transitional belts between agricultural land and sea.
7. Building storm shelter port systems along the coast as well as in islands.
8. Establishing natural ecological reserves.

Adaptation measures for coastal zone:
Three strategic options:
1. Full protection:
   Make all dykes higher and strengthen coastal management
2. Adaptation: reform infrastructures and habits of the people living in the coastal zone to adapt sea level rise.
3. Withdrawal (or avoidance): resettlement, moving house and infrastructures from threatened areas.
Implemented activities

Adaptation measures for energy, transportation sector:
1. Taking into account climate change factors in planning of energy and transport development
2. Upgrading and reconstructing transport infrastructure in areas often threatened by sea level rise and flood
3. Ensuring demand side management of energy based on high efficiency of energy use, economical and rational use of energy, ensuring energy security and safety
4. Developing strategies to response and adapt to the vagary of weather.

Adaptation measures for human health
1. Accelerating the implementation of the programme “Eliminating hunger and reducing poverty”, improving living standards of the people, especially of those in remote areas.
2. Developing national plan and programme for medical control and monitoring in areas that have high danger of infections in order to take timely response measures and prevent the spreading of diseases.
3. Establishing green, clean and beautiful areas in the dense populated areas.
4. Promoting public awareness on climate change so that every person could take adaptation measures for himself
5. Implementing strict quarantine at the borders, airports to prevent infection and disease transmission from outside.
## Portfolio of some projects on climate change

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Project</th>
<th>Location</th>
<th>Total Budget (million USD)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Development of renewable energy</td>
<td>All country</td>
<td>50</td>
<td>2005-2009</td>
</tr>
<tr>
<td>2</td>
<td>Energy saving in industry</td>
<td>All country</td>
<td>3.3</td>
<td>2005-2007</td>
</tr>
<tr>
<td>3</td>
<td>Encouraging utilization of renewable energy in rural areas</td>
<td>North of Vietnam</td>
<td>0.46</td>
<td>2005-2007</td>
</tr>
<tr>
<td>4</td>
<td>Forest plantation on sandy soil in the coast of the Southern Central Vietnam</td>
<td>Southern Central Vietnam</td>
<td>11.5</td>
<td>2005-2010</td>
</tr>
</tbody>
</table>

## Portfolio of some projects on climate change (cont.)

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Project</th>
<th>Location</th>
<th>Total Budge (million USD)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Improving cooking stoves of the rural-mountainous community</td>
<td>North of Viet Nam</td>
<td>0.35</td>
<td>2005-2009</td>
</tr>
<tr>
<td>6</td>
<td>Using biogas as fuel to mitigate GHG in rural areas</td>
<td>All country</td>
<td>1.5</td>
<td>2004-2008</td>
</tr>
<tr>
<td>7</td>
<td>Research on-generation technology from biomass fuel in Vietnam</td>
<td>All country</td>
<td>0.135</td>
<td>2004-2006</td>
</tr>
<tr>
<td>8</td>
<td>Energy conservation and saving in small and medium-sized enterprises</td>
<td>All country</td>
<td>1.5</td>
<td>2003-2006</td>
</tr>
</tbody>
</table>
Portfolio of some projects on climate change (cont.)

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Project</th>
<th>Location</th>
<th>Total Budge (million USD)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Wind power stations for the people in remote island</td>
<td>Quang Ninh Province</td>
<td>0.2</td>
<td>2004-2011</td>
</tr>
<tr>
<td>10</td>
<td>Planting protective forest in the watershed of Ngan Sau, Ngan Pho Rivers</td>
<td>Ha Tinh Province</td>
<td>7.01</td>
<td>2004-2012</td>
</tr>
<tr>
<td>11</td>
<td>Irrigation management of wetland rice field to reduce methane emission</td>
<td>Red River Delta and Mekong River Delta</td>
<td>5.025</td>
<td>2004-2007</td>
</tr>
<tr>
<td>12</td>
<td>Exploitation of geothermal energy in Vietnam</td>
<td>Central Viet Nam</td>
<td>0.3</td>
<td>2004-2005</td>
</tr>
</tbody>
</table>

Next steps

1. Carrying out the Project “Expedited financing for (interim) measures for capacity building in priority areas” (Phase II). This project is a following-up to the Initial National Communication.

- The main objective of the project is to enhance capacity building at national level and maintain efforts to access and disseminate information related to climate change technologies.

- The specific objectives are:
  - To help meet the added requirement of enhancing capacity in order to identify and analyse technologies needs
  - To access information on technology transfer and sensitise the public awareness on climate change
  - To build the capacity to prepare climate change programmes promoting technology transfer.
  - To build the capacity to improve the quality of climate change enabling activities.
Next steps

2. Developing climate change scenarios in Vietnam for period 2010-2070
3. Collecting database provided for second National Communication
4. Continuing to study adaptation measures
5. Developing climate change project portfolio including potential CDM projects

Thank you for your attention
GHG inventory preparation - India’s Experience

Subodh Sharma
National Project Director
National Communications

Ministry of Environment & Forests

The Framework of presentation

National Circumstances and Diversity of activities

Inventory Development
  Chronology of inventory development
  Inventory of 1994
  Uncertainty reduction
  Development of indigenous emission factors
  Utilisation of national emission factors

Constraints and gaps in inventory development

Need for improvement
  Sectors requiring improvement
  Steps of refinement of GHG inventory

Further Capacity building requirements
The Setting

India is a vast country (3.28 million sq km)
Diverse physiographical features
Himalayas, Coastal areas, northern plains, peninsular plateau and islands
Occupy 2.4% of the world’s land area but support 16.2% of the world’s human population
Dominating feature of climate is the Monsoon
Endowed with varied soils, climate, biodiversity and ecological regions

Under such diverse natural conditions, a billion people speaking different languages, following different religions, inhabiting in rural and urban areas live in harmony under a democratic system.

Diversity in emissions

Regional and sectoral variability exists in emissions across a large country like India
Wide technology diversity complicates India specific estimates as new and vintage technologies co-exist
For example:
Energy and transformation industries
  Different fuel combustion technologies operational
Industrial Process
  Diverse production technologies
Agriculture
  Dispersed sources therefore difficult to assess activity data
Land use Land use Change and Forestry
  Assessment of all forest types still not covered
Waste
  Rising urban population
### Chronology of Inventory Development

<table>
<thead>
<tr>
<th>Gases</th>
<th>CO₂, CH₄</th>
<th>CO₂, CH₄</th>
<th>CH₄</th>
<th>CO₂, CH₄, N₂O, NOₓ, CO, NMVOC</th>
<th>CH₄</th>
<th>CO₂, CH₄, N₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF</td>
<td>Used Published EF</td>
<td>Used Published &amp; also developed for rice</td>
<td>developed EF for various water regimes</td>
<td>IPCC default own published</td>
<td>EF developed for organically amended soil</td>
<td>EF developed for key sectors</td>
</tr>
</tbody>
</table>

### Inventory Estimation - Scope

**Sectors Covered:**
- Energy and Transformation
- Industrial Processes
- Agriculture
- Land Use, Land Use Change & Forestry
- Waste

**Gases Covered:**
- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous Oxide (N₂O)

**Base year:** 1994

**Guidelines:** IPCC 1996
### Inventory Estimation - Institutional Arrangement

- **FSI**
- **FRI**
- **IRPE**
- **RRL**
- **IARI**
- **CLRI**
- **Land Use & Land Use Change & Forestry IIISC**
- **Energy & Transformation IIMA**
- **INVENTORY ESTIMATES (MoEF)**
- **Agriculture NPL**
- **Waste NEERI**
- **Industrial Process TERI**
- **CMRI**
- **CFRI**
- **GRI**
- **DA**
- **CMA**
- **NCL**
- **CGCRI**
- **CMA**
- **19 Research Teams**

### GHG Emissions from Sources and Removals by Sinks - India 1994

<table>
<thead>
<tr>
<th>GHG source and sink categories</th>
<th>CO₂ emissions</th>
<th>CO₂ removals</th>
<th>CH₄</th>
<th>N₂O</th>
<th>CO₂ eq. emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (Net) National Emission</td>
<td>817023</td>
<td>23533</td>
<td>1808</td>
<td>178</td>
<td>1228540</td>
</tr>
<tr>
<td>1. All Energy</td>
<td>679470</td>
<td>2896</td>
<td>11.4</td>
<td></td>
<td>743820</td>
</tr>
<tr>
<td>2. Industrial Processes</td>
<td>99878</td>
<td>2</td>
<td>9</td>
<td></td>
<td>102710</td>
</tr>
<tr>
<td>3. Agriculture</td>
<td>14175</td>
<td>151</td>
<td>0.04</td>
<td></td>
<td>344485</td>
</tr>
<tr>
<td>4. Land use, Land-use change and Forestry</td>
<td>37675</td>
<td>23533</td>
<td>6.5</td>
<td>0.04</td>
<td>14292</td>
</tr>
<tr>
<td>5. Other sources as appropriate and to the extent possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5a. Waste</td>
<td></td>
<td>1003</td>
<td>7</td>
<td></td>
<td>23233</td>
</tr>
<tr>
<td>5b. Emissions from Bunker fuels</td>
<td>3373</td>
<td></td>
<td></td>
<td></td>
<td>3373</td>
</tr>
</tbody>
</table>

*Converted by using GWP indexed multipliers of 21 and 310 for converting CH₄ and N₂O respectively.
### Sectoral emissions - Energy and Industrial Processes

<table>
<thead>
<tr>
<th>GHG source and sink categories (Gg per year)</th>
<th>CO₂ emissions</th>
<th>CO₂ removals</th>
<th>CH₄</th>
<th>N₂O</th>
<th>CO₂ eq. emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total (Net) National Emission</strong></td>
<td>817023</td>
<td>23533</td>
<td>18083</td>
<td>178</td>
<td>1228540</td>
</tr>
<tr>
<td><strong>1. All Energy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Fuel combustion</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy and transformation industries</td>
<td>353518</td>
<td></td>
<td>4.9</td>
<td>355037</td>
<td></td>
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<tr>
<td>Industry</td>
<td>149806</td>
<td></td>
<td>2.8</td>
<td>150674</td>
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<tr>
<td>Transport</td>
<td>79880</td>
<td>9</td>
<td>0.7</td>
<td>80286</td>
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</tr>
<tr>
<td>Commercial/institutional</td>
<td>20509</td>
<td></td>
<td>0.2</td>
<td>20571</td>
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<tr>
<td>Residential</td>
<td>43794</td>
<td></td>
<td>0.4</td>
<td>43918</td>
<td></td>
</tr>
<tr>
<td>All other sectors</td>
<td>31963</td>
<td></td>
<td>0.4</td>
<td>32087</td>
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<tr>
<td>Biomass burnt for energy</td>
<td>1636</td>
<td></td>
<td>2.0</td>
<td>34976</td>
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</tr>
<tr>
<td><em>Fugitive Fuel Emission</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil and natural gas system</td>
<td>601</td>
<td></td>
<td></td>
<td>12621</td>
<td></td>
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<tr>
<td>Coal mining</td>
<td>650</td>
<td></td>
<td></td>
<td>13650</td>
<td></td>
</tr>
<tr>
<td><strong>2. Industrial Processes</strong></td>
<td>99878</td>
<td>2</td>
<td>9</td>
<td>102710</td>
<td></td>
</tr>
</tbody>
</table>

### Sectoral emissions - Agriculture

<table>
<thead>
<tr>
<th>GHG source and sink categories (Gg per year)</th>
<th>CO₂ emissions</th>
<th>CO₂ removals</th>
<th>CH₄</th>
<th>N₂O</th>
<th>CO₂ eq. emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total (Net) National Emission</strong></td>
<td>817023</td>
<td>23533</td>
<td>18083</td>
<td>178</td>
<td>1228540</td>
</tr>
<tr>
<td><strong>3. Agriculture</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Enteric Fermentation</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manure Management</td>
<td>8972</td>
<td></td>
<td></td>
<td></td>
<td>188412</td>
</tr>
<tr>
<td>Rice Cultivation</td>
<td>946</td>
<td></td>
<td>1</td>
<td></td>
<td>20176</td>
</tr>
<tr>
<td><em>Agricultural crop residue</em></td>
<td>4090</td>
<td></td>
<td></td>
<td></td>
<td>85990</td>
</tr>
<tr>
<td>Emission from Soils</td>
<td>167</td>
<td></td>
<td>4</td>
<td></td>
<td>4747</td>
</tr>
<tr>
<td></td>
<td>146</td>
<td></td>
<td></td>
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<td>45260</td>
</tr>
</tbody>
</table>
### Sectoral Emissions – Land Use, Land Use Changes and Forestry

<table>
<thead>
<tr>
<th>GHG source and sink categories (Gg per year)</th>
<th>CO₂ emissions</th>
<th>CO₂ removals</th>
<th>CH₄</th>
<th>N₂O</th>
<th>CO₂ eq. emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (Net) National Emission</td>
<td>817023</td>
<td>23533</td>
<td>18083</td>
<td>178</td>
<td>1228540</td>
</tr>
<tr>
<td>4. Land use, Land-use change and Forestry’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in forest and other woody biomass stock</td>
<td>37675</td>
<td>23533</td>
<td>6.5</td>
<td>0.04</td>
<td>14292</td>
</tr>
<tr>
<td>Forest and grassland conversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trace gases from biomass burning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uptake from abandonment of managed lands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions and removals from soils</td>
<td>19688</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sectoral Emissions – Waste Management

<table>
<thead>
<tr>
<th>GHG source and sink categories (Gg per year)</th>
<th>CO₂ emissions</th>
<th>CO₂ removals</th>
<th>CH₄</th>
<th>N₂O</th>
<th>CO₂ eq. emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (Net) National Emission</td>
<td>817023</td>
<td>23533</td>
<td>18083</td>
<td>178</td>
<td>1228540</td>
</tr>
<tr>
<td>5. Other sources as appropriate and to the extent possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5a. Waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal solid waste disposal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic waste water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial waste water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human sewage</td>
<td></td>
<td></td>
<td>7</td>
<td></td>
<td>2170</td>
</tr>
<tr>
<td>5b. Emissions from Bunker fuels’</td>
<td>3373</td>
<td></td>
<td></td>
<td></td>
<td>3373</td>
</tr>
<tr>
<td>Aviation</td>
<td>2880</td>
<td></td>
<td></td>
<td></td>
<td>2880</td>
</tr>
<tr>
<td>Navigation</td>
<td>493</td>
<td></td>
<td></td>
<td></td>
<td>493</td>
</tr>
</tbody>
</table>

* Not counted in the national totals.
Sectoral Distribution of GHG emissions – India 1994

- Energy: 61%
- Agriculture: 28%
- Industrial process: 8%
- Waste: 2%
- LULUCF: 1%

Emissions in terms of CO₂ equivalent

Relative GHG Emissions - India 1994

- CO₂: 793 Mt
- CH₄: 380 Mt
- N₂O: 55 Mt

CO₂ equivalent emission distribution (Mt)
**CO₂ Emission Distribution in 1994**

- Energy: 85%
- Industrial Process: 13%
- LULUCF: 2%

Key sources: Energy and transformation industries, Steel & Cement Production

**CH₄ Emission Distribution in 1994**

- Agriculture: 78%
- Waste: 6%
- All energy: 16%

Key sources: Enteric fermentation, Rice cultivation
**N₂O Emission Distribution in 1994**

- **Agriculture**: 84%
- **Energy**: 7%
- **Waste**: 4%
- **Ind. Proc.**: 5%

**Key sources:**
- N₂O emissions from Soils

---

**Levels of inventory estimations**

<table>
<thead>
<tr>
<th>Tier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Takes into account the gross consumption and average emissions factors. e.g. National level fuel consumption and common emission factors (tC/unit fuel used).</td>
</tr>
<tr>
<td>Tier 2</td>
<td>Refers to estimations based on sub-sectorial consumption and emissions coefficients developed representing specific conditions. e.g. Fuel combustion attributed to technology types (like Sub-critical pulverized coal for power generation).</td>
</tr>
<tr>
<td>Tier 3</td>
<td>Refers to emission estimates made using detailed activity and specific emission coefficients. e.g. emission factors expressed directly in terms of unit of activity like tC/kWh of power generated.</td>
</tr>
</tbody>
</table>

**Share of different Tiers used for NATCOM GHG estimates**

<table>
<thead>
<tr>
<th>Tier</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I approach</td>
<td>23%</td>
</tr>
<tr>
<td>Tier II approach</td>
<td>70%</td>
</tr>
<tr>
<td>Tier III approach</td>
<td>7%</td>
</tr>
</tbody>
</table>
Uncertainties in Inventory Estimation

- Top down and bottom up estimates of national activity data have variations due to aggregation errors
- Existing activity data reporting formats are not meant for inventory reporting purposes
- Most of the IPCC default emission coefficients not representative of India specific coefficients
- Methodological issues

Uncertainty Reduction

To capture the diversity of Indian emission characteristics
To enhance the quality of the inventory
Fresh emissions measurements / estimations were undertaken in some sectors

**Energy and Transformation Sector**
- Calorific values of Indian coals
- CH$_4$ from Coal mining
- GHGs from Road Transport
- CO$_2$ from some power, steel & cement plants

**Industrial Process**
- N$_2$O from Nitric Acid Production
- CO$_2$ from Cement, Lime and Dolomite

**Agriculture Sector**
- CH$_4$ from Enteric Fermentation
- CH$_4$ from Rice Cultivation
- N$_2$O from Soils
- GHG from biomass combustion

**Forestry**
- Estimation of annual growth rates

**Waste**
- CH$_4$ Municipal Solid Waste
Uncertainty Reduction – Institutional Arrangement

17 Research Teams

Indigenous Emission Factors Developed for India

<table>
<thead>
<tr>
<th></th>
<th>Emission Factor (EF)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Coal</td>
<td>NCV TJ/Kt</td>
<td>t CO₂/TJ</td>
</tr>
<tr>
<td>Coking coal</td>
<td>24.18±0.3</td>
<td>25.53</td>
</tr>
<tr>
<td>Non-coking coal</td>
<td>19.63±0.4</td>
<td>26.13</td>
</tr>
<tr>
<td>Lignite</td>
<td>9.69±0.4</td>
<td>28.95</td>
</tr>
<tr>
<td>Road Transport sector</td>
<td>TCO/Tj</td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>2W/3W</td>
<td>43.9 ± 7.3</td>
</tr>
<tr>
<td></td>
<td>Car/Taxi</td>
<td>61.5 ± 4.0</td>
</tr>
<tr>
<td>Diesel Oil</td>
<td>MCV/HCV</td>
<td>71.4 ± 0.55</td>
</tr>
<tr>
<td></td>
<td>LCV</td>
<td>71.4 ± 0.5</td>
</tr>
</tbody>
</table>
### India specific emission factors …………contd.

<table>
<thead>
<tr>
<th>Coal Mining</th>
<th>Emission Factor (EF)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground mining</td>
<td>m$^3$CH$_4$/ton</td>
<td>Singh, 2004</td>
</tr>
<tr>
<td>During Mining</td>
<td>Degree I</td>
<td>2.91</td>
</tr>
<tr>
<td></td>
<td>Degree II</td>
<td>13.08</td>
</tr>
<tr>
<td></td>
<td>Degree III</td>
<td>23.64</td>
</tr>
<tr>
<td>Post mining</td>
<td>Degree I</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>Degree II</td>
<td>2.15</td>
</tr>
<tr>
<td></td>
<td>Degree III</td>
<td>3.12</td>
</tr>
<tr>
<td>Surface mining</td>
<td></td>
<td>1.83</td>
</tr>
<tr>
<td>During Mining</td>
<td></td>
<td>0.23</td>
</tr>
<tr>
<td>Post mining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### India specific emission factors ………….contd.

<table>
<thead>
<tr>
<th>Emission Factor (EF)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement manufacturing</td>
<td>tons/ton of clinker</td>
</tr>
<tr>
<td></td>
<td>0.534 - 0.539</td>
</tr>
<tr>
<td>Nitric acid production</td>
<td>kg per ton of N2O</td>
</tr>
<tr>
<td>Medium pressure plant</td>
<td>6.48 – 13.79</td>
</tr>
<tr>
<td>High pressure plants</td>
<td>1.54 – 4.13</td>
</tr>
<tr>
<td>Dual pressure plant</td>
<td>0.24 – 0.57</td>
</tr>
</tbody>
</table>
### India specific emission factors ............ contd.

<table>
<thead>
<tr>
<th>Rice Ecosystem</th>
<th>Emission Factor (EF)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upland</td>
<td>g CH₄/m²</td>
<td></td>
</tr>
<tr>
<td>Rain fed Flood Prone</td>
<td>19.0±6.0</td>
<td>Gupta et al., 2004</td>
</tr>
<tr>
<td>Rain fed, Drought Prone</td>
<td>7.0±2</td>
<td></td>
</tr>
<tr>
<td>Irrigated, Continuously Flooded</td>
<td>17.5±4.0</td>
<td></td>
</tr>
<tr>
<td>Irrigated Single Aeration</td>
<td>6.6±1.9</td>
<td></td>
</tr>
<tr>
<td>Irrigated Multiple Aeration</td>
<td>2.0±1.5</td>
<td></td>
</tr>
<tr>
<td>Deep Water</td>
<td>19.0±6.0</td>
<td></td>
</tr>
</tbody>
</table>

### India specific emission factors ............ contd.

<table>
<thead>
<tr>
<th>Enteric fermentation</th>
<th>Emission Factor</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td>28±5</td>
<td>Singhal et al., 2004</td>
</tr>
<tr>
<td>Cross bred</td>
<td>43±5</td>
<td>Swamy et al., 2004</td>
</tr>
<tr>
<td>Non dairy cattle (Indigenous)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1 yrs</td>
<td>9±3</td>
<td></td>
</tr>
<tr>
<td>1-3 years</td>
<td>23±8</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>32±6</td>
<td></td>
</tr>
<tr>
<td>Non-dairy cattle (Cross Bred)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1 year</td>
<td>11±3</td>
<td></td>
</tr>
<tr>
<td>1-2 ½ year</td>
<td>26±5</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>33±4</td>
<td></td>
</tr>
<tr>
<td>Dairy buffalo</td>
<td>50±17</td>
<td></td>
</tr>
<tr>
<td>Non-Dairy buffalo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1 year</td>
<td>8±3</td>
<td></td>
</tr>
<tr>
<td>1-3 year</td>
<td>22±6</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>44±11</td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td>4±1</td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td>4±1</td>
<td></td>
</tr>
</tbody>
</table>
### Possible Reasons for Variation in Some Coefficients

<table>
<thead>
<tr>
<th>Coefficient type</th>
<th>Possible reasons for variation of Indian coefficients from IPCC default values</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ from coal combustion</td>
<td>Coal composition, boiler/combustion efficiency, regional variations across the country, coal definition issues</td>
</tr>
<tr>
<td>Industrial process emissions</td>
<td>Technological variability in level and extent of control processes</td>
</tr>
<tr>
<td>CH₄ from enteric fermentation</td>
<td>Thinner cattle, not so rich feed type</td>
</tr>
<tr>
<td>CH₄ from rice paddy cultivation</td>
<td>Irrigation practices, fertilizer and soil types in India are not conducive to high CH₄ production</td>
</tr>
<tr>
<td>CH₄ from Municipal Solid Waste</td>
<td>Waste composition, waste collection levels and mechanisms, dump management, reduction technologies</td>
</tr>
</tbody>
</table>

### Status of Preparation GHG inventory – Energy Sector

<table>
<thead>
<tr>
<th>Energy sector</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Type of emission factor used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy and transformation industries</td>
<td>28.9</td>
<td>Tier II</td>
<td>I</td>
</tr>
<tr>
<td>Industry</td>
<td>12.3</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>Transport</td>
<td>6.5</td>
<td>Tier II</td>
<td>I</td>
</tr>
<tr>
<td>Residential</td>
<td>3.6</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>Biomass burnt for energy</td>
<td>2.8</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>All other energy sectors</td>
<td>2.6</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>Commercial-institutional</td>
<td>1.7</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>Coal mining</td>
<td>1.1</td>
<td>Tier II</td>
<td>I</td>
</tr>
<tr>
<td>Oil and natural gas system</td>
<td>1.0</td>
<td>Tier I</td>
<td>D</td>
</tr>
</tbody>
</table>

I: Indigenously developed, D: IPCC Default Emission factors
### Status of Preparation GHG inventory – Industrial Processes

<table>
<thead>
<tr>
<th>Type of emission</th>
<th>Factor used</th>
<th>Tier used in the Initial NATCOM</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron and Steel production</td>
<td>D</td>
<td>Tier I</td>
<td>3.6</td>
</tr>
<tr>
<td>Cement production</td>
<td>D</td>
<td>Tier II</td>
<td>2.5</td>
</tr>
<tr>
<td>Nitric acid production</td>
<td>I</td>
<td>Tier II</td>
<td>0.2</td>
</tr>
<tr>
<td>Ammonia production</td>
<td>I</td>
<td>Tier I</td>
<td>1.2</td>
</tr>
<tr>
<td>All Others</td>
<td>D</td>
<td>Tier I</td>
<td>0.9</td>
</tr>
</tbody>
</table>

I: Indigenously developed, D: IPCC Default Emission factors

### Status of Preparation GHG inventory – Agriculture

<table>
<thead>
<tr>
<th>Agriculture sector</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Type of emission factor used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enteric Fermentation</td>
<td>15.3</td>
<td>Tier III</td>
<td>I</td>
</tr>
<tr>
<td>Rice Cultivation</td>
<td>7.0</td>
<td>Tier III</td>
<td>I</td>
</tr>
<tr>
<td>Emission from Soils</td>
<td>3.7</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>Manure Management</td>
<td>1.6</td>
<td>Tier I</td>
<td>D</td>
</tr>
<tr>
<td>Agricultural crop residue</td>
<td>0.4</td>
<td>Tier I</td>
<td>D</td>
</tr>
</tbody>
</table>

I: Indigenously developed, D: IPCC Default Emission factors
### Status of Preparation GHG inventory – LULUCF and Waste

<table>
<thead>
<tr>
<th>Type of emission factor used</th>
<th>Tier used in the Initial NATCOM</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LULUCF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions and removals from soils</td>
<td>I</td>
<td>1.6</td>
</tr>
<tr>
<td>Forest and Grassland Conversion</td>
<td>I</td>
<td>1.5</td>
</tr>
<tr>
<td>Trace gases from biomass burning</td>
<td>I</td>
<td>0.0</td>
</tr>
<tr>
<td>Uptake from abandonment of Managed lands</td>
<td>I</td>
<td>-0.8</td>
</tr>
<tr>
<td>Changes in Forest and other woody biomass stock</td>
<td>I</td>
<td>-1.2</td>
</tr>
<tr>
<td><strong>Waste sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal Solid Waste Disposal</td>
<td>I</td>
<td>1.0</td>
</tr>
<tr>
<td>Domestic/Industrial Waste water</td>
<td>I</td>
<td>0.7</td>
</tr>
<tr>
<td>Human Sewage</td>
<td>I</td>
<td>0.2</td>
</tr>
</tbody>
</table>

I: Indigenously developed, D: IPCC Default Emission factors

### Constraints and Gaps in Inventory Estimation

<table>
<thead>
<tr>
<th>Gaps and constraints</th>
<th>Description</th>
<th>Potential measures (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data organization</td>
<td>Published data not available in IPCC-friendly formats for inventory reporting</td>
<td>Design consistent reporting formats</td>
</tr>
<tr>
<td></td>
<td>Inconsistency in top-down and bottom-up data sets for same activities</td>
<td>Data collection consistency required</td>
</tr>
<tr>
<td></td>
<td>Mismatch in sectoral details across different published documents</td>
<td>Design consistent reporting formats</td>
</tr>
<tr>
<td></td>
<td>Time series data for some specific inventory sub-categories, e.g., municipal solid waste sites</td>
<td>Generate relevant data sets</td>
</tr>
<tr>
<td></td>
<td>Data for informal sectors of economy</td>
<td>Conduct data surveys</td>
</tr>
<tr>
<td></td>
<td>Data for refining inventory to higher tier levels</td>
<td>Data depths to be improved</td>
</tr>
<tr>
<td>Non-availability of relevant data</td>
<td>Proprietary data for inventory reporting at Tier III level</td>
<td>Involve industry and monitoring institutions</td>
</tr>
<tr>
<td></td>
<td>Data not in electronic formats</td>
<td>Identify critical datasets and digitize</td>
</tr>
<tr>
<td></td>
<td>Lack of institutional arrangements for data sharing</td>
<td>Establish protocols</td>
</tr>
<tr>
<td></td>
<td>Time delays in data access</td>
<td>Awareness generation</td>
</tr>
</tbody>
</table>
## Constraints and Gaps in Inventory Estimation

<table>
<thead>
<tr>
<th>Gaps and constraints</th>
<th>Description</th>
<th>Potential measures (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical and institutional capacity needs</td>
<td>Training the activity data generating institutions in GHG inventory methodologies and data formats</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Institutionalize linkages of inventory estimation with broader perspectives of climate change research</td>
<td>Arrange extensive training programmes Wider dissemination activities</td>
</tr>
<tr>
<td>Non-representative emission coefficients</td>
<td>Inadequate sample size for representative emission coefficient measurements in many sub-sectors</td>
<td>Conduct more measurements</td>
</tr>
<tr>
<td>Limited resources to sustain national communication efforts</td>
<td>Sustain and enhance research networks established under Initial National Communication</td>
<td>Global Environment Facility (GEF)/ international funding Conduct adequate sample measurements for key source categories</td>
</tr>
<tr>
<td>India-specific emission coefficients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vulnerability assessment and adaptation</td>
<td></td>
<td>Sectoral and sub-regional impact scenario generation, layered data generation and organization, modelling efforts, case studies for most vulnerable regions</td>
</tr>
<tr>
<td>Data centre and website</td>
<td></td>
<td>National centre to be established</td>
</tr>
</tbody>
</table>

## Sectors requiring improvement - Energy

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Desirability of switching over to a higher tier in the future</th>
<th>Whether improvement in activity data Required</th>
<th>Desirability of use of IPCC Good Practice guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENERGY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy and transformation industries</td>
<td>28.9</td>
<td>Tier II</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Industry</td>
<td>12.3</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Transport</td>
<td>6.5</td>
<td>Tier II</td>
<td>Tier III</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>3.6</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Biomass burnt for energy</td>
<td>2.8</td>
<td>Tier I</td>
<td>Tier II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other energy sectors</td>
<td>2.6</td>
<td>Tier I</td>
<td>Tier II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial-institutional</td>
<td>1.7</td>
<td>Tier I</td>
<td>Tier II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal mining</td>
<td>1.1</td>
<td>Tier II</td>
<td>Tier III</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Oil and natural gas system</td>
<td>1.0</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>
### Sectors requiring improvement - Industrial Processes

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Desirability of switching over to a higher tier in the future</th>
<th>Whether improvement in activity data Required</th>
<th>Desirability of use of IPCC Good Practice guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INDUSTRIAL PROCESSES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron and Steel production</td>
<td>3.6</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Cement production</td>
<td>2.5</td>
<td>Tier II</td>
<td>Tier II</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Ammonia production</td>
<td>1.2</td>
<td>Tier I</td>
<td>Tier I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Others</td>
<td>1.1</td>
<td>Tier I</td>
<td>Tier I</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sectors requiring improvement - Agriculture

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Desirability of switching over to a higher tier in the future</th>
<th>Whether improvement in activity data Required</th>
<th>Desirability of use of IPCC Good Practice guidance</th>
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<tbody>
<tr>
<td><strong>AGRICULTURE</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Enteric Fermentation</td>
<td>15.3</td>
<td>Tier III</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Rice Cultivation</td>
<td>7.0</td>
<td>Tier III</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Emission from Soils</td>
<td>3.7</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td></td>
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<tr>
<td>Manure Management</td>
<td>1.6</td>
<td>Tier I</td>
<td>Tier I</td>
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<tr>
<td>Agricultural crop residue</td>
<td>0.4</td>
<td>Tier I</td>
<td>Tier I</td>
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### Sectors requiring improvement - LULUCF

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Desirability of switching over to a higher tier in the future</th>
<th>Whether improvement in activity data Required</th>
<th>Desirability of use of IPCC Good Practice guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions and removals from soils</td>
<td>1.6</td>
<td>Tier I</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Forest and Grassland Conversion</td>
<td>1.5</td>
<td>Tier I</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Trace gases from biomass burning</td>
<td>0.0</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Uptake from abandonment of Managed lands</td>
<td>-0.8</td>
<td>Tier I</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Changes in Forest and other woody biomass stock</td>
<td>-1.2</td>
<td>Tier I</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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</table>

### Sectors requiring improvement – Waste Management

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Percentage of the total National CO₂ eq. emissions</th>
<th>Tier used in the Initial NATCOM</th>
<th>Desirability of switching over to a higher tier in the future</th>
<th>Whether improvement in activity data Required</th>
<th>Desirability of use of IPCC Good Practice guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Solid Waste Disposal</td>
<td>1.0</td>
<td>Tier I</td>
<td>Tier III</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Domestic/Industrial Waste water</td>
<td>0.7</td>
<td>Tier I</td>
<td>Tier II</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Human Sewage</td>
<td>0.2</td>
<td>Tier I</td>
<td>Tier I</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Steps of refinement of GHG estimations

- Through higher sectoral disaggregation and hence riding the Tier ladder
- Following Good Practices of Uncertainty Management and Quality Assurance and Quality Control
- Comparing emission estimates with model runs
- Comparisons with national, regional and global inventories

Steps for refinement of GHG estimations

1. Key source analysis
2. Determine emission coefficient of gases emitted from key sources
3. QA/QC Peer Review
4. Short-term Recalculation
5. Preparation
6. Measurement or estimate
7. Key source analysis
8. Validation through comparison of emissions
9. Validation through emission models
10. Archiving
11. Evaluation
12. Raising Awareness, Public Dissemination
13. Start new cycle
Capacity Building efforts required for further refinement

- Continuous and improved networking
- Bridging data gaps
- Strengthening existing emission coefficients
- Training on inventory development for estimating inventories of new gases, revised guidelines for preparation of inventories
- Developing emission factors representing Indian conditions for new gases to be reported
- Establishing an Emission Factor Data Base and a Nodal Centre for validation of inventories

Framework for a centre for validation of emission inventories and an emission factor database

- Region specific inputs
- Country specific inputs
- Emission Factor Database
- Center for validation of inventories
- Key source analysis
- QA/QC
- Uncertainty analysis
- Intercomparison
- Modeling
- Energy
- Industrial Processes
- Agriculture
- LULUCF
- Waste
Thank You
中华人民共和国
气候变化初始国家信息通报

The People’s Republic of China
Initial National Communication on Climate Change

2nd Workshop on GHG Inventory in Asia Region
Shanghai February 7, 2005

Contents

- Preparation for the INC
- Institutional Arrangement
- Process of Developing the INC
- Contents of the INC
- Experiences
Preparation for the INC

- China ratified the Convention in early 1993
- COP2 adopted the guidelines for preparing national communications from non-Annex I parties
- China started preparation its work in 1996, including consultation with UNDP China Office
- A PDF project was initiated in 1999

Preparation for the INC

PDF Process

- **Budget:** 324,000 US dollar
- **Duration:** 12 month
- **Objective:** To assess previous works and identify the capacity needs in China for preparation of initial national communication, in particular national GHGs inventory.
Preparation for the INC

Focusing Areas

- National GHG inventories:
  - Energy;
  - Industrial processes;
  - Agriculture;
  - Land use change and forestry;
  - Waste management

- Vulnerability and adaptation assessment:
  - Climate change scenarios, Agriculture, Water resources, Ecosystem, Coastal zone and sea level, Health

Previous Works Reviewed

- **Response Strategy on Global Climate Change in China** supported by ADB and completed in 1993;
- **China: Issues and Options in GHG Emissions Control** supported by the GEF and UNDP (executed by World Bank) and completed in 1994;
- **China Climate Change Country Study** supported by the US Country Studies Program and completed in 1998;
- **Asian Least-Cost GHG Abatement Strategy (ALGAS)** funded by GEF/UNDP, executed by ADB and completed in 1998;
- Other domestically supported projects
Preparation for the INC

Some Results from PDF

Needs identified:
- Understanding the methodology
- Expanding the coverage of the inventories
- Developing national emission factors
- Collecting of data and Improving data quality
- Analyzing climate change related policies
- Enhancing public awareness of climate change

A project proposal for “Enabling China to prepare its initial national Communication” was developed based on the outcomes of the PDF project.

Preparation for the INC

Design of the “Enabling China to Prepare Its INC” Project

- Seven immediate objectives
- Project activities including training, workshops, collection and analysis of data, development of emission factors, study tours, involvement of international consultants, experts review of the reports, government review of the reports, etc.
- Project output: INC
- Project budget
- GEF: $3,500,000
- Chinese government: $240,000
- Project duration: 28 months
Institutional Arrangement

Executing Agency

National Development and Reform Commission (NDRC), under the guidance of National Coordination Committee on Climate Change

Establishment of the Steering Committee

Providing guidance to the project implementation
Chaired by NDRC, consisting of members from MoFA, MOST, MoF, SEPA, CMA, ERI, and UNDP China Office

Designation of the NPD, NPM and NPC

NDRC appointed Mr. Gao Guangsheng, Director general of the Office to NCCCC, as the National Project Director (NPD)
Mr. Ma Aimin, Deputy Division Director of the NCCCC, was appointed as the Project Manager
Mr. Xu Huaqing, Director of Research Center for Energy, Environment and Climate Change, ERI, was recruited as the Project Coordinator

Project office

Established within ERI, NDRC
Institutional Arrangement

- Selection of the contractors through bidding process
- Criteria for contractors
- Evaluation Committee established to make final selection
- Five organizations contracted for the project

Institutional Arrangement

**Contractors**

- **Energy Research Institute**, for energy sector and industrial processes inventories
- **Institute of Atmospheric Physics**, Chinese Academy of Science, for agricultural sector inventory
- **Chinese Academy of Forestry**, for land use and forest sector inventory
- **Chinese Research Academy of Environmental Sciences**, for municipal waste inventory
- **Administrative Center for China’s Agenda 21**, for public awareness
**Process of Developing the INC**

PDF project in mid-1999  
INC Project approved by GEF Council on May 9th, 2000  
Project document signed in July, 2001  
Project inception in October, 2001  
First disbursement in November, 2001  
Submission in November, 2004

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**Phase 1: inception**

- Oct.2001-April, 2002  
- Project inception workshop and Inception workshops of contractors  
- Better understanding of UNFCCC guideline and IPCC methodologies, experts identification and networks, assessment of data availability, technical approaches, examination of previous works, etc.
Process of Developing the INC

Phase 2: implementation
- May, 2002-Dec.2003
- Development of GHG inventories by sectors
- Activity data, emission factors
- Draft of INC report outline and the first draft

Phase 3: finalization
- Jan.2004-Nov.2004
- Compilation of national GHG inventory
- Experts and government review and improvement of INC reports (draft 2-draft 5)
- Approval procedure
- Submission of China’s INC through UNFCCC secretariat
**Process of Developing the INC**

**Promulgation of China’s INC**

- The Initial National Communication was approved by the State Council
- A promulgation ceremony was conducted on Nov. 9th, 2004

**Contents of the INC**

- National Circumstances
- National GHG Inventory
- Impacts of Climate Change and Adaptation
- Policies and Measures Related to Climate Change Mitigation
- Research and Systematic Observation
- Education, Training and Public Awareness
- Needs for Funds, Technologies and Capacity Building
Located in the east of the Asian continent, on the western shore of the Pacific Ocean
China has a landmass of 9,600,000 km²
Extremely diverse: tropical in the south and frigid in the north

China has a shortage as well as an uneven distribution of water resources

- Per capita water resources are about one fourth of the world average
- Coal dominant energy reserves
- Per capita energy resources are less than half of the world average
Contents of the INC

National Circumstances

- Huge population (1267 million), although the growth rate is less than 1% in the year 2000
- Two thirds of population living in the rural areas
- Low income developing country with per capita GDP USD 1,000
- Need for development in many areas

Contents of the INC

National GHG Inventory

- **Sectors:** Energy, industrial processes, agriculture, land use change and forestry, wastes
- **GHGs:** CO$_2$, CH$_4$, and N$_2$O
- **Methodologies:**
  - ✔ Revised 1996 IPCC guidelines adopted;
  - ✔ IPCC good practice guidance and uncertainty management in national greenhouse gas inventory used as reference;
  - ✔ Necessary improvement in accordance with China’s circumstances
Contents of the INC

National GHG Inventory

- **CO₂**: 2.666 billion tons (728 million ton-C) from fossil fuel combustion and industrial processes
- **CH₄**: 34.29 million tons from rice growing, animal husbandry, energy production and waste management
- **N₂O**: 0.85 million tons, from agriculture, industrial processes and energy sectors

Difficulty in forecasting the future emission

Analysis of factors which will influence the future trends of GHG emission

These factors include:
- Population growth and increasing urbanization, improvement of living standard
- Economic development
- Changes of economic structure and technological progress
- Changes in forestry and ecological preservation and construction
**Contents of the INC**

*Impacts of Climate Change and Adaptation*

- **The trend of climate change:**
  - ☑ the warming would continue in the future

- **Water:**
  - ☑ The runoff of major rivers has decreased in the past 40 years
  - ☑ It is likely that the runoff of major rivers will decrease in northern China and increase in southern China.

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- **Contents of the INC**

*Impacts of Climate Change and Adaptation*

- **The mountain glaciers have been shrinking and the water supply in western China might be threatened in the future**

- **Agriculture:**
  - ☑ Plant growth will be speeded up and crop growing period will be shortened;
  - ☑ The cost for agricultural production will increase;
  - ☑ The distribution of crops will change, with the northern boundary extending northwards;
  - ☑ The grain production potential will be reduced due to climate change and extreme weather
Contents of the INC

Impacts of Climate Change and Adaptation

Sea level:
☑ It is projected that the sea level rise over five typical coastal zones would range from 31cm to 65 cm by 2100;
☑ The map shows the areas which are likely submerged in Guangzhou, south China when the sea level rises 30 cm

Contents of the INC

Policies and Measures Related to Climate Change Mitigation

Cross-sector policies and measures
☑ Sustainable development strategy:
☑ China’s Agenda 21 developed in 1994, Sustainable development strategy integrated into national economic and social development plans

• Relevant laws and regulations:
☑ Law for promotion of clean production;
☑ Energy conservation law;
☑ Renewable energy law (under preparation)
Contents of the INC

Policies and Measures Related to Climate Change Mitigation

- Industrial policies:
  - Providing guidance for investment;
  - Inventories of products and technologies to be encouraged;
  - Equipments and technologies to be phased out

- Economic incentives:
  - Tax reduction;
  - Low interest loan

---

Contents of the INC

Policies and Measures Related to Climate Change Mitigation

- Policies and measures in different sectors:
  - Management system;
  - Public awareness;
  - Technology improvement;
  - Standard, labeling, certification;
  - Demonstration projects;
  - ……
Contents of the INC

Policies and Measures Related to Climate Change Mitigation

- Energy supply
- Energy conservation
- Industry
- Building
- Transportation
- Agriculture
- Forestry
- Waste management
- International cooperation

Contents of the INC

Research and Systematic Observation

- A large three-dimensional network for observation of the atmosphere has been established, including 143 reference climate stations, 530 basic weather stations and 1736 ordinary weather stations.
- Marine observation and monitoring system, including stations for ocean observation, voluntary observation vessels, buoy observations, marine investigation vessels, seashore ice-monitoring radars.
Terrestrial observation system mainly consists of a network measuring data for hydrological systems, ice-snow, ecological systems, agro-meteorology and environmental protection. Meteorological satellite also plays important role for remote-sensing observation.

Climate change related research in the past years, including those sponsored by the Government and by international communities. Needs for future scientific research also identified, including research on the atmosphere science, impact of and adaptation to climate change, and national strategy and policies for addressing climate change issues.
**Contents of the INC**

*Education, Training and Public Awareness*

- Survey was made on the public awareness of climate change
- Education through media (newspapers, radios and TVs)
- Establishment of websites on climate change ([www.ccchina.gov.cn](http://www.ccchina.gov.cn))
- Training and workshops
- Publications: Books, newsletters
- Works by artists

*Contents of the INC*

*Needs for Funds, Technologies and Capacity Building*

- Development of national GHG inventory
  - Training
  - Statistics system
  - Improvement of emission factors
- Mitigation and adaptation
  - Technologies for mitigation
  - Technologies for adaptation
  - Research and systematic observation
- Capacity building
  - Needs identified primarily, self-assessment is going on
Experiences

Lack of activity data:
- Statistics system cannot provide all necessary data, some rely on experts’ judgment.
- Reliability and quality of data
  - Different data from different sources
- Emission factor:
  - IPCC default data could not be applied directly in China;
  - Data from specific sample observation may not fully reflect the situation due to time and financial constrains

Experiences

Lack of work for impact assessment and adaptation options
- The models used for assessing the impacts of climate change have mainly been introduced from abroad, whilst few models have been developed in China
- The assessment on the impacts of climate change is preliminary and there are still a lot of uncertainties
Experiences

A time-consuming process, adequate time allocation is necessary for ensuring the quality of the INC report:

☑ Complicated procedure for applying financial resources
☑ Difficulties with implementing agency
☑ Understanding of UNFCCC guidelines and IPCC methodologies
☑ Collection and analysis of information
☑ Review and approval process

Experiences

A resource-demanding process, full financial support critical for the success:

☑ In addition to the input from GEF, the Chinese government also provided resources;
☑ Based on works completed in the past years

Capacity building, an important part of the exercise:
Professional expert team;
☑ Training, continuous learning by doing process;
☑ International exchange of information and expertise
Experiences

- Political and Public Awareness, support from the different stakeholders needed
- Early preparations for the future
- ……

Thanks for your attention!
Current Status of the GHG Inventory in Japan

Mimi Nameki
Deputy Director
Climate Change Policy Division
Global Environment Bureau
Ministry of the Environment

Workshop on GHG Inventories in Asia Region
February 7-8, 2005

Outline

- National Level: Japan’s National Inventory
  - Background
  - Trends in overall emissions and removals

- Local Level: Guideline for local governments
  - to promote local activities against Climate change by establishing area specific action plan, Global Warming Countermeasures Area Promotion Plan
  - Plan, Do, Check, Action

*How we actually use Inv as a basis of policy making*
**Current Institutional Arrangement**

- **Ministry of the Environment**
  - Inventory compilation
  - Assessment of methodology
  - Uncertainty assessment
  - Specification of key sources
  - Development of QA/QC system etc.
  - Liaison with the expert review panel
  - Dissemination of information to the public

**Greenhouse Gas Inventory Office of Japan (GIO)**

**Consultants**

**Relevant ministries, governmental agencies, and organizations**

- Activity Data
- Data for Emission Factors
- Measured data
- Fuel mix ratios
- Product mix ratios etc.

**Enquiries relating to Uncertainty Assessment**

- *Improvement of source statistics for AD & EF*
- *Prompt submission of data*

**Sample numbers**

**Identification of errors**

**Truncation etc.**

**Current Institutional Arrangement**

- “the Committee for the GHGs Emissions Estimation Methods”, since 1999,
- Members: external experts, approximately 60
- The committee is in charge of methodological development of the inventory

**Committee for the GHG Emissions Estimation Methods**

**Inventory Working Group**

(crosscutting issue)

**6 subgroups** (for each sector)

- Energy and Industrial Processes
- Transportation
- Agriculture
- Waste
- F-gas
- LULUCF
Trends in overall emissions and removals

- Overall emission of GHGs:
  - 1,331 [Mt CO₂ eq.] in 2002 (CO₂, CH₄, N₂O, HFCs, PFCs, SF₆)
  - Increased by 7.6% since KP’s Base Year

<table>
<thead>
<tr>
<th>Year</th>
<th>CO₂</th>
<th>CH₄</th>
<th>N₂O</th>
<th>CH₄</th>
<th>SF₆</th>
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<tbody>
<tr>
<td>1990</td>
<td>1,103</td>
<td>-</td>
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<td>1995</td>
<td>1,112</td>
<td>-</td>
<td>-</td>
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<td>2000</td>
<td>1,128</td>
<td>-</td>
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</tr>
<tr>
<td>2002</td>
<td>1,169</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- Share of CO₂ amounts to be 93.7%

Trends in overall emissions

- CO₂ +11.2%, CH₄ -21.1%, N₂O -11.9% (since 1990)
- HFCs -34.1%, PFCs -23.4%, SF₆ -68.7% (since 1995)
**CO₂ Emissions by Sectors in 2002**

- **Residential**: 13.3% (5.5%)
- **Commercial & Institutional**: 15.8% (7.7%)
- **Transportation**: 21.0% (20.4%)
- **Manufacturing Industry & Construction**: 37.5% (30.1%)
- **Industrial Processes**: 3.9%
- **Waste**: 1.9%
- **Energy Industries (e.g. Public Electricity)**: 6.6%

**Total CO₂ Emissions 2002 (FY)** 1,248Mt

※Because of the round off, the total may not be 100%.

**Trends of CO₂ Emissions of each Sectors**

(Base=‘90)

- **Manufacturing Industry & Construction**: 476Mt → 468Mt (-1.7%)
- **Transportation**: 217Mt → 261Mt (+20.4%)
- **Commercial and Other Sector**: 144Mt → 197Mt (+36.7%)
- **Residential**: 129Mt → 166Mt (+28.8%)
- **Energy Industries**: 117Mt → 118Mt (≈1%)
- **Industrial Processes**: 58Mt → 53Mt (-9.1%)

Outside: CO₂ emissions from heat and power generation are allocated to demand side sectors
Inside: direct CO₂ emissions

Outside: CO₂ emissions from heat and power generation are allocated to demand side sectors
Inside: direct CO₂ emissions

**COCO₂2Emissions by Sectors in 2002**

- **Residential**: 13.3%
- **Commercial & Institutional**: 15.8%
- **Transportation**: 21.0%
- **Manufacturing Industry & Construction**: 37.5%
- **Industrial Processes**: 3.9%
- **Waste**: 1.9%
- **Energy Industries (e.g. Public Electricity)**: 6.6%
**Methane (CH₄)**
- **Agriculture** (Enteric fermentation, Rice Cultivation, etc.) - 69.4%
- **Fuel Combustion** - 27.2%
- **Industrial Processes** (Production of Adipic Acid and Nitric Acid) - 3.3%
- **Waste** (Solid Waste Disposal, Wastewater Handling, etc.) - 24.2%
- **Fugitive Emissions from Fuel** (natural Gas and Coal Mining) - 3.1%

**Nitrous Oxide (N₂O)**
- **Agriculture** (Manure Management, Agricultural Soils, etc.) - 56.7%
- **Fuel Combustion** - 27.2%
- **Industrial Processes** - 0.6%
- **Waste** (Wastewater Handling, Waste Incineration) - 11.9%
- **Anesthesia** - 0.9%

**HFCs, PFCs and SF₆**
- **Metal Production** - 4.0%
- **Semiconductor Manufacture, etc** - 20.1%
- **Solvents** - 17.0%
- **Refrigeration and Air Conditioning Equipment** - 12.7%
- **Other** - 0.0%
- **Electrical Equipment** - 5.5%
- **By-product Emissions of HFC-23 from Production of HCFC-22** - 21.6%
- **Production of F-gas** - 8.1%
- **Aerosols, MDI** - 9.5%
- **Foam Blowing** - 1.6%
Guideline to Establish Global Warming Countermeasures Area Promotion Plan

Guideline for Local Governments

Background

- **1990**: Action Program for Arrest Global Warming
- **1993**: Guideline to Establish “Global Warming Countermeasure Area Promotion Plan”
- **2002**: Revision of “Law to Promote Global Warming Countermeasures”
  - Each Entities’ (National Government, Local Government, Enterprising body, Citizen) responsibilities are clearly indicated
  - Under this Law, Local Governments are encouraged to promote their area specific plan of GW countermeasures
- **2003**: Revision of Guideline to Establish “Global Warming Countermeasure Area Promotion Plan”
**Objective of the Guideline**

- **To facilitate Local Government establishing GW Countermeasure Area Promotion Plan**

- **The Guideline is:**
  
  to grasp the actual GHG emissions to find the key emission sources to be addressed 
  (geographical, socio-economical characteristics need to be considered)
  
  to evaluate the effects of conducted countermeasures against climate change

---

**Global Warming Countermeasure Area Promotion Plan**

**Work Flow of the Area Promotion Plan**

1. Rough estimation of GHG emissions by related statistics
2. Analysis of GHG emissions
3. Selection of key categories
4. Study countermeasures (e.g. tax, regulation, PRs) and their feasibility
5. Collect information of the area (e.g. questionnaire, interview)
6. Detailed Estimation of GHG emissions & Analysis
7. Setting GHG reduction Targets
8. Consideration of management strategies
9. Establish the Area Promotion Plan
10. Implementation of the plan
11. Check the progress
**Current Status**

- 44 Prefectures and Large Cities have established GW Countermeasure Area Promotion Plans as of April 2004

**Summary of the Guideline**

**Target User**

- Prefectures (47) and Large Cities (13) (government ordinance designated cities)
- Municipalities are also expected and encouraged to use the Guideline

**Target Coverage**

- GHG Emissions from any activities in the area
- Evaluation of countermeasures, which are strongly expected to promote in the area
**Target Activities of Area Promotion Plan**

- GHG emissions caused by anthropogenic activities in the area are expected to be covered.
- Activities are classified into 5 categories: Energy Industries, Manufacturing and Construction Industries (Blue Workers), Resident & Commercial (White Workers and daily lives), Transport, Waste

### Relationship with category of GHG Inventory

<table>
<thead>
<tr>
<th>Category</th>
<th>GHG Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Industries</td>
<td>1A fuel combustion, 1B fugitive emissions</td>
</tr>
<tr>
<td>Industries</td>
<td>CO₂ allocated by electricity consumption*</td>
</tr>
<tr>
<td></td>
<td>1A fuel combustion</td>
</tr>
<tr>
<td></td>
<td>2 Industrial Processes (incl. F-gas), 4 Agriculture</td>
</tr>
<tr>
<td>Resident &amp; Commercial</td>
<td>CO₂ allocated by electricity consumption*</td>
</tr>
<tr>
<td></td>
<td>1A fuel combustion</td>
</tr>
<tr>
<td>Transport</td>
<td>1A fuel combustion</td>
</tr>
<tr>
<td>Waste</td>
<td>6 Waste</td>
</tr>
</tbody>
</table>

*These emissions are indirect emissions

**Policy and Measures of Local Government on Global Warming**

- Countermeasures according to each local government's geographical & social-economical conditions
- Countermeasures need not to cover all activities
- Feasibility counts

**To Grasp the actual GHG emissions**

- Estimate GHG emissions in the area, by category, and/or by gas
- Estimation methods are indicated in the guideline (Chapter 1 - 5)
- Each local government should choose methods taking into consideration its area-specific conditions
Global Warming Countermeasure Area Promotion Plan

Target of the Area Promotion Plan
• can be quantitative or qualitative
• each local governments’ targets can be different according to its geographical and/or socio-economical characteristics

Examples of Target,
E1: To reduce the certain % of total GHG emissions in the area compared to the base year by target year
E2: To reduce the certain % of GHG emissions related to domestic life compared to the base year by target year
E3: To reduce the certain % of GHG emissions per capita in the area compared to the base year by target year
E4: “Some” industrial segment will reduce the certain % of total GHG emissions compared to the base year by target year

Responsible Entity
• Countermeasures for all or main stakeholders in the area (citizens, companies and local government itself)
• Establishment of a forum for stakeholder dialogues is encouraged. (e.g. Local Conference for Global Warming Countermeasures)

Target Period
• Revision in conjunction with the national Policy Programme is preferable.
• National Policy Programme on Climate Change takes step by step approach.
  • 1st Step: 2002 – 2004
  • 2nd Step: 2005 – 2007
  • 3rd Step: 2008 - 2012
Thank you !!
Development of Application Procedure of the Tier 2 Methodology for CH₄ Emission from Korean Landfills

Seungdo Kim
Pyrolysis Research Laboratory
Dept. of Environmental System Eng.
Hallym University

Introduction
Hierarchy of Solid Waste Management in Korea

- Reduction
- Reuse
- Recycling
- Energy Recovery
- Incineration
- Landfill

Treatment Trend of Municipal Solid Waste in Korea

<table>
<thead>
<tr>
<th>Year</th>
<th>Landfill (%)</th>
<th>Incineration (%)</th>
<th>Recycling (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>72.3</td>
<td>4.0</td>
<td>23.7</td>
</tr>
<tr>
<td>2000</td>
<td>47.0</td>
<td>11.7</td>
<td>41.3</td>
</tr>
<tr>
<td>2005</td>
<td>31.0</td>
<td>23.0</td>
<td>46.0</td>
</tr>
</tbody>
</table>
### MSW Compositional Generation Rate (2001 Year)

<table>
<thead>
<tr>
<th>Item</th>
<th>Generation</th>
<th>Landfill</th>
<th>Incineration</th>
<th>Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (ton/day)</td>
<td>48,498.6</td>
<td>21,000.2</td>
<td>6,576.3</td>
<td>20,921.1</td>
</tr>
<tr>
<td>Non-Combustibles</td>
<td>29,663.0</td>
<td>13,550.0</td>
<td>6,475.7</td>
<td>6,637.3</td>
</tr>
<tr>
<td>Food wastes (%)</td>
<td>32.81</td>
<td>34.31</td>
<td>8.98</td>
<td>66.76</td>
</tr>
<tr>
<td>Papers (%)</td>
<td>16.78</td>
<td>62.53</td>
<td>35.84</td>
<td>1.83</td>
</tr>
<tr>
<td>Woods (%)</td>
<td>2.01</td>
<td>52.58</td>
<td>45.14</td>
<td>2.32</td>
</tr>
<tr>
<td>Rubber &amp; Leather (%)</td>
<td>3.48</td>
<td>66.45</td>
<td>32.98</td>
<td>1.95</td>
</tr>
<tr>
<td>Plastics (%)</td>
<td>7.25</td>
<td>69.91</td>
<td>31.42</td>
<td>1.93</td>
</tr>
<tr>
<td>Others (%)</td>
<td>16.37</td>
<td>78.78</td>
<td>20.84</td>
<td>0.90</td>
</tr>
<tr>
<td>Combustibles</td>
<td>19,835.6</td>
<td>7,450.2</td>
<td>104.7</td>
<td>190.7</td>
</tr>
<tr>
<td>Briquette ash (%)</td>
<td>1.76</td>
<td>91.52</td>
<td>--</td>
<td>8.72</td>
</tr>
<tr>
<td>Metals &amp; Glasses (%)</td>
<td>2.78</td>
<td>94.86</td>
<td>1.46</td>
<td>3.58</td>
</tr>
<tr>
<td>Earth &amp; Sand (%)</td>
<td>0.08</td>
<td>97.84</td>
<td>0.92</td>
<td>2.14</td>
</tr>
<tr>
<td>Others (%)</td>
<td>0.67</td>
<td>95.04</td>
<td>2.32</td>
<td>2.01</td>
</tr>
<tr>
<td>Sum (ton/day)</td>
<td>14,292.5</td>
<td>138.0</td>
<td>20.4</td>
<td>14,094.1</td>
</tr>
<tr>
<td>Papers (%)</td>
<td>45.10</td>
<td>0.25</td>
<td>0.08</td>
<td>99.68</td>
</tr>
<tr>
<td>Glasses (%)</td>
<td>15.47</td>
<td>1.34</td>
<td>--</td>
<td>98.66</td>
</tr>
<tr>
<td>Metals (%)</td>
<td>19.82</td>
<td>0.40</td>
<td>--</td>
<td>99.00</td>
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<tr>
<td>Cans (%)</td>
<td>4.44</td>
<td>2.38</td>
<td>--</td>
<td>97.62</td>
</tr>
<tr>
<td>Plastics (%)</td>
<td>8.00</td>
<td>1.85</td>
<td>0.72</td>
<td>97.43</td>
</tr>
<tr>
<td>Others (%)</td>
<td>0.56</td>
<td>4.51</td>
<td>0.72</td>
<td>94.77</td>
</tr>
</tbody>
</table>

### Management Schemes of MSW in Korea

- **Source Separation**
- **Recycling**
  - Yes
  - **Food wastes**
    - Aerobic digestion
    - Anaerobic digestion
    - Animal feeding
  - **Others**
    - Papers
    - Plastics
    - Metals
- No
  - **Inorganic wastes**
  - **Organic wastes**
    - **Landfill**
    - Ash
    - **Incineration**
Estimation Methodology of CH$_4$ from Landfill: Tier 2

Questions to be Answered

- Why should we apply the Tier 2?
- How much the accuracy may be improved as a result of applying the Tier 2?
- What would be the most efficient approaches to adopt the Tier 2?
Methane Emission from Landfill: (1) Extraction Well, (2) Surface Diffusion

Extraction Well

Surface Diffusion

Crack or Weak Point

Recovery of Methane

Emission Pattern of CH₄ from Landfill over time

Generation Rate of CH₄ (ton/yr)

Year

Composite Generation Pattern of CH₄

CH₄ emission from solid waste landfilled during the 1st year

2nd year

3rd year
Methodologies suggested by IPCC

Tier 1

\[ CH_4 \text{ (ton/yr)} = \left( MSW_T \times MSW_F \times MCF \times DOC \times DOC_F \times F \times \frac{16}{12} - R \right) \times (1-OX) \]

Assumptions

(1) CH4 generated by the waste is released in the same year the waste is deposited

(2) Landfilled amount is relatively constant over time

If waste disposal increases at about 2% per year over a 20~30 year period, the Tier 1 method would overestimate emissions by about 20~25%.

Tier 2

\[ Q_{CH_4} = L_0 \times M_t \times \{ \exp(-kC) - \exp(-kt) \} \]

L0 : Methane Generation Potential
Mt : Annual amount of solid waste landfilled
k : Methane generation constant (yr⁻¹)

Basics

(1) CH4 is emitted over a long period of time rather than instantaneously
(2) First-order decay model has been broadly used to model generation rate of CH4 from landfills
What are the difficulties in applying the Tier 2?

- Lack of information on MSW landfilled previously
  - resulting in difficulty in estimating $L_0$ value

- Lack of information on how to measure the surface diffusion of CH$_4$
  - resulting in difficulty in estimating $k$ value
Methane Generation Kinetics

Methane Generation Kinetic Equation
\[ \frac{dM_{CH_4}}{dt} = -k_0 L_0 M_{sw} \]

Tier 2

\[ Q_{CH_4} = L_0 \times M_0 \times \{ \exp(-k_c) - \exp(-kt) \} \]

Revised Tier 2

\[ Q_{CH_4}(t) = \sum_{i=1}^{N} M_0(i) \times L_0(i) \times \exp(-k(t-i)) - \exp(-k(t-i+1)) \]

Key Parameters for Tier 2 Methodology

- \( L_0 \) (Methane Generation Potential)
  - \( L_0 = MCF \times DOC \times DOC_F \times F \times 16/12 \)
    - MCF: 0.4~1.0
    - DOC: Country Specific Equation
    - DOC(%) = 0.114 \times FW + 0.320 \times PA + 0.366 \times WO + 0.571 \times RU + 0.061 \times SL + 0.114 \times AN + 0.285 \times OT
    - DOC_F: 0.5~0.6
    - F: 0.4~0.6
Key Parameters for Tier 2 Methodology

- **k (Methane Generation Constant)**

(1) First Methodology

\[
k = \frac{-\beta + \sqrt{\beta^2 - 4\alpha\gamma}}{2\alpha}
\]

\[
a = \frac{c^2 - t^2}{2}, \quad \beta = t - c, \quad \gamma = \frac{Q_{cm}}{L_0 M}
\]

(2) Second Methodology

Best fit to generation rate of CH₄ at a certain year

---

Surface Diffusion Measurements
Fortran Code for Estimating $k$ value

Fortran Output
$L_0$ and $K$ values for Korean Landfills

- $L_0 : 0.15\sim0.30$ ton-CH$_4$/ton-waste
- $k : 0.04\sim0.09$ yr$^{-1}$
  - IPCC default value : 0.05 yr$^{-1}$

Comparison of CH$_4$ emission from a Korean Landfill between Tier 1 and Tier 2
Estimation procedures for CH₄ emission by the Tier 2

Classification of landfills by characteristics

Estimation of k values for characteristic landfills

Estimation of CH₄ emissions from individual landfills

Summation of CH₄ emission from individual landfills

Considerations on changing emission methodology from Tier 1 to Tier 2

- Pre-requisites
  - Collecting information on landfill histories of all landfills: landfill amount, compositions of solid wastes, and landfill period etc.
  - Monitoring the seasonal emission rates of CH₄ from the surfaces of representative landfills

- Predicted Problems
  - Uncertainty arising from the assumption of the landfill histories of non-sanitary landfills
  - Difficulty in data managements: QA/QC and UA
Thank you very much!
IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry

Leandro Buendia
Programme Officer, IPCC-NGGIP-TSU

2nd Workshop on GHG Inventories in Asia Region (WG IA)
7-8 February 2005, Shanghai, China

Contents

- Background Information
- What is good practice guidance?
- Contents of GPG-LULUCF
- Summary of steps in LULUCF Inventory
- Conclusions
Background Information

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (3 Volumes & software)
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG2000)
  - Energy
  - Industrial Processes
  - Agriculture
  - Waste

- to avoid the risk of inconsistency with the SR-LULUCF
- KP sink negotiations were not concluded in 2000

---

Background Information

Good Practice Guidance for Land Use, Land-use Change and Forestry (GPG-LULUCF)

- Published in 2003
What is good practice guidance?

GPG2000 defines inventories consistent with good practice as those which contain neither over- nor underestimates so far as can be judged, and in which uncertainties are reduced as far as is practicable given national circumstances.

Good practice guidance further supports the development of inventories that are:

- transparent
- documented
- consistent over time
- complete
- comparable
- assessed for uncertainties
- subject quality control and assurance
- efficient in the use of resources available to inventory agencies
- uncertainties are reduced as better information becomes available
1. Overview

- sets out the mandate or the overall intent of the GPG
- summarizes the practical advice provided to inventory agencies
- provides relationship to 1996 GL
- short summaries of the other chapters
- discusses policy relevant issues
2. Basis for Consistent Representation of Land Areas

- Provides guidance on the selection of methods for identifying and representing land areas and land-use change
- Identifies 6 land-use categories
  - Forest Land
  - Cropland
  - Grassland
  - Wetland
  - Settlements
  - Other Land

2. Basis for Consistent Representation of Land Areas

- Describes 3 approaches to identifying land areas:
  - Use of basic (and usually existing) land-use data
  - Survey of land use and land-use change
  - Geographically explicit land-use mapping
- Advice on the development of land-use databases and some examples on their usage to approaches
2. Basis for Consistent Representation of Land Areas (Annexes)

- Examples of Approaches in Individual Countries
- Examples of International Land Cover Datasets

3. LUCF Sector Good Practice Guidance

- Provides methodological options for the estimation of emissions and removals of CO2 and non-CO2 GHG for the LULUCF sector
  - Methodological Issues
    - Choice of Method (3 tiers; decision trees)
    - Choice of EF
    - Choice of Activity Data
    - Completeness
    - Developing a Consistent Time Series
  - Uncertainty Assessment
  - Inventory QA/QC
  - Reporting and Documentation

...Mapping back table to GL96 (Chapter 5)
3. LUCF Sector Good Practice Guidance

- Addresses five carbon pools
  - Aboveground biomass
  - Belowground biomass
  - Dead wood
  - Litter
  - Soil C

- Annexes and Appendices
  - Biomass Default Tables for Forest Land
  - Reporting Tables and Worksheets
  - Basis for Future Methodological Development (e.g. HWP, etc.)

4. Supplementary methods and good practice guidance arising from the Kyoto Protocol

- General concepts of land-use change monitoring and reporting for KP.
- Summary tables of all reporting requirements, before, during, and after each Commitment Period.
- Decision trees that outline criteria to determine areas subject to afforestation (A), reforestation (R), deforestation (D), and management activities.
- Supplementary methods for estimating carbon stock changes and non-CO2 emissions for land-use change (AR, D) and land use (forest management, cropland management, grazing land management and revegetation).
4. Supplementary methods and good practice guidance arising from the Kyoto Protocol

4.3 LULUCF Projects

- Guidance for LULUCF projects on designing and implementing multi-tier measuring and monitoring plans
- Guidance is stand-alone, with cross-linkages to Chapters 3 and 5
- Does not cover:
  - baseline definition
  - Additionality
  - Leakage
  - non-permanence
  - monitoring of socio-economic/environmental impacts

Annexes...

- Tool for estimation of changes in soil carbon stocks associated with management changes in cropland and grazing lands based on IPCC default data (software in CD-ROM); see slides
- Examples of allometric equations for estimating aboveground biomass and belowground biomass of trees
5 Cross-Cutting Issues

- Uncertainty Assessment
- Collecting and analysing data by sampling
- Reconstruction of missing data
- Identification of Key Categories (to cover sink)
- Quality Assurance and Quality Control
- Time Series Consistency and Recalculations
- Verification approaches (e.g. comparison of inventories, modelling approaches, and direct measurements)
Steps in LULUCF inventory preparation

1. Use the 3 approaches (Chapter 2) to estimate land areas for each land-use category relevant to your country

2. Follow the good practice guidance (Chapter 3) to estimate the emissions and removals of GHGs for each land use, land-use change and pool relevant to your country. If necessary collect additional data to improve data quality. Perform key category analysis (Chapter 5).

3. Estimate uncertainties, report emissions/removals, and implement Quality assurance/quality control procedures (Chapter 5).

4. If required: prepare supplementary information for Kyoto Protocol reporting (follow Chapter 4))

Conclusions

➢ GPG produces more reliable estimates of the magnitude of uncertainties in GHG inventories

➢ GPG provides improved understanding of how uncertainties may be managed to produce emissions estimates that are acceptable to UNFCCC (i.e. transparency, consistency, comparability, completeness and accuracy in inventories)
Conclusions

Draft COP/MOP decision contained in Decision -/CP.10 (FCCC/CP/2004/L.26/Add.1)

- The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, ...
Decides that for the first commitment period Parties included in Annex I to the Convention that have ratified the Kyoto Protocol shall apply the good practice guidance for land use, land-use change and forestry, as developed by the Intergovernmental Panel on Climate Change, in a manner consistent with the Kyoto Protocol and draft decision -/CMP.1 (Land use, land-use change and forestry) and the annex to this draft decision,¹ for the purpose of providing information on anthropogenic greenhouse gas emissions by sources and removals by sinks from land use, land-use change and forestry activities under Article 3, paragraph 3, and, if any, elected activities under Article 3, paragraph 4, in accordance with Article 5, paragraph 2 of the Kyoto Protocol;

  * (footnote1) Noting that reporting methods contained in Chapter 4 of the Intergovernmental Panel on Climate Change Good Practice Guidance for Land Use, Land-use Change and Forestry, should ensure that areas of land subject to land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, are identifiable.

Conclusions

- Default EF/parameters in GPG-LULUCF are soon to be accessible from the EFDB http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

- The IPCC is in the process of preparing the 2006 Guidelines that will be based on:
  - 1996 GL, GPG2000, GPG-LULUCF
  - Emission Factor Database (EFDB)
  - Advances in science and technology
  - The experience in the use of GLs/GPGs as well as experience from UNFCCC inventory reviews
Asia-Pacific Network for Global Change Research

Dr. Linda Anne Stevenson
lstevenson@apn.gr.jp

Outline of Presentation

- APN - a very brief overview
- APN and CAPaBLE Programme
What is the APN?

Inter-governmental network in the Asia Pacific Region with the priority goals of:

- Fostering global change through regional cooperation and partnerships
- Increasing developing country participation in global change research through networking and capacity building
- Strengthening interactions between the natural and social sciences in global change with the policy- and decision-making community

Learn more about the APN
To support regional cooperation in global change research on issues particularly relevant to the region

To strengthen the interactions among scientists and policy-makers, provide a scientific input to policy decision making and scientific knowledge to the public

To improve the scientific and technical capabilities of nations of the region

To facilitate the standardisation, collection, analysis and exchange of scientific data and information relating to global change research

To cooperate with other global change networks and organizations

To facilitate the development of research infrastructure and the transfer of know-how and technology

6 Goals of the APN

APN Research Framework

Changes in Coastal Zones & Inland Waters
Climate Change & Variability
Changes in Atmospheric Composition
Changes in Terrestrial Ecosystems & Biodiversity

Integration of the findings of natural science with social and economic factors
Input to policy making and implementation

Human Dimensions of Global Change
9th SPG/IGM Meeting
Canberra, Australia
March 2004

Sombo Yamamura - Secretariat
Martin Rice – Secretariat
Linda Stevenson - Secretariat
Yuki Imanari - Secretariat
Randal Helten – Consultant

APN and CAPaBLE Programme
Scientific Capacity Building and Enhancement for Sustainable Development in Developing Countries

The CAPaBLE Programme is a concrete initiative to realize parts 110 to 114 of the Johannesburg Plan of Implementation for the WSSD and was registered as a WSSD Type II Partnership Initiative by the Ministry of the Environment, Japan.

The CAPaBLE programme is developing and enhancing scientific capacity in developing countries to improve their decision-making in the target areas related to climate change and water and food security that are directly linked to their sustainable development.

The Official Launch 8th IGM, April 2003

Making a Difference
A WSSD Type II Partnership Initiative
The CAPaBLE Programme is sponsored by the governments of Australia, Japan, New Zealand and the U.S.A.

Main Activities under Phase I (2003-2006)

- **Capacity Enhancement**: research projects planned and implemented by leading developing country scientists targeting specific topics related to climate change.
- **Capacity Building**: activities for aspiring scientists.
- **Dissemination**: activities for policy-makers, decision-makers & for civil-society.
- **End-Product**: an APN publication as an end-product (synthesis book that will synthesise the activities and outcomes that resulted from first Phase of CAPaBLE).
**CAPaBLE Regional Participation**

76% APN member countries participating in the first year

- **Southeast Asia**: 23%
- **Oceania**: 8%
- **East Asia**: 23%
- **South Asia**: 23%
- **Pan Asia-Pacific**: 15%
- **Inter-Regional**: 8%

**Comprehensive Research Projects**

- **CRP-Theme I: Dr. Khan, GCISC**
  Enhancement of National Capabilities in the Application of Simulation Models for the Assessment of Climate Change and its Impacts on Water Resources and Food and Agriculture

- **CRP-Theme II: Professor Shukla, IIM**
  Integrated Assessment Model for Developing Countries and Analysis of Mitigation Options and Sustainable Development Options
Comprehensive Research Projects

Regional Climate Models / CLIVAR Workshop CB-08

Capacity Building Activities

<table>
<thead>
<tr>
<th>CB-01</th>
<th>Building Capacity of Mekong River Countries to Assess Impacts from Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB-02</td>
<td>Training Institute on Climate and Extreme Events in the Pacific</td>
</tr>
<tr>
<td>CB-03</td>
<td>Capacity Building for GHG Inventory Development in Asia-Pacific Developing Countries</td>
</tr>
<tr>
<td>CB-04</td>
<td>Creating Climate Knowledge Networks through Strategic, Global Linkages (with IAI)</td>
</tr>
<tr>
<td>CB-05</td>
<td>Climate Change Mitigation with Locally Owned Technology and Systems</td>
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<tr>
<td>CB-06</td>
<td>UNFCCC Training Workshop on National Communications</td>
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<tr>
<td>CB-07</td>
<td>National CB Workshop on GC Research (Pakistan)</td>
</tr>
<tr>
<td>CB-08</td>
<td>Regional Climate Models / CLIVAR Workshop</td>
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</tbody>
</table>

Dr. Arshad M. Khan, GCISC, Pakistan

Professor Shukla, IIM, India

Capacity enhancement of leading researchers in developing countries to produce comprehensive scientific results on climate change impacts, vulnerabilities, adaptation and mitigation strategies.
Partnerships Creating Capacity

- Capacity enhancement of leading researchers in developing countries to produce comprehensive scientific results on climate change impacts, vulnerabilities, adaptation and mitigation strategies.

- Capacity building of aspiring scientists through sharing of knowledge, experience, scientific information and data collection on climate change impacts, vulnerabilities, adaptation and mitigation.

- Improvement of informed decision-making in developing countries by dissemination of the outcomes of research activities to policy-makers, decision-makers and civil society.
“As a regional forum bringing together policy-makers and researchers on practical, policy-relevant research and capacity building, the APN is making an invaluable contribution to our ability to respond to global change.”

Statement: Howard Bamsey, CEO, Australian Greenhouse Office

Thank you

http://www.apn.gr.jp
Introduction of the APN CAPaBLE Project
“Capacity Building for GHG Inventory Development in Asia–Pacific Developing Countries
(APN CAPaBLE GHG Inventory Project)"

Hideaki Nakane, Tomoyuki Aizawa and Chisa Umemiya
Greenhouse Gas Inventory Office of Japan (GIO),
Center for Global Environmental Research (CGER),
National Institute for Environmental Studies (NIES)
Presented at the 2nd Workshop of GHG Inventories in Asia region
February 7-8, 2005

Collaborators

➢ Thailand
  ➢ Dr. Sirintornthep Towprayoon
  ➢ Dr. Amnat Chidthaisong
  ➢ King's Mongkut's University of Technology Thonburi

➢ Cambodia
  ➢ Mr. Thy SUM
  ➢ Mr. Heng Chan Thoeun
  ➢ Ministry of Environment
Relation between the pilot project and WGIA

This pilot studies will pursue training in Japan, establishment of sustainable inventory, development of the system and studies on country/regional emission factors including field measurements in Thailand and Cambodia.

In the workshops, the direction of pilot studies and the results of them will be discussed. The accomplishments of the pilot studies will be shared by the participating countries of the workshops to establish more reliable emission factors and more involvement of ASIA-PACIFIC countries with the international activities on GHG inventories.

Main objectives

1. To carry out pilot studies on improvement of GHG inventories for effective countermeasures.
2. To make sustainable systems to develop GHG inventories.
3. To provide more realistic emission factors reflecting country and regional conditions
4. To exchange information and experiences to establish accurate activity data.
5. To clarify directions to apply the methodologies developed in the pilot studies to all ASIA–PACIFIC countries.
6. To enhance involvement and leadership of ASIA–PACIFIC developing countries in the international efforts to improve GHG inventories
7. To provide policy makers with basic information to formulate and implement measures to reduce GHG emissions and enhance GHG removals.
8. To share useful information and experiences in GHG inventory preparation
9. To discuss the future activities of the Asian network
Outcomes of the first year

- The 1st Workshop on GHG Inventories in Asia Region
  (1) promoted better understanding of outline of a pilot study,
  (2) exchanged information of GHG inventories of Cambodia and Japan,
  (3) created a well-structured file system for the Cambodia’s GHG inventory,
  (4) carried out a key category analysis.

- The first collaborator’s meeting with the collaborator from Cambodia:
  (1) promoted better understanding of outline of a pilot study,
  (2) exchanged information of GHG inventories of Cambodia and Japan,
  (3) created a well-structured file system for the Cambodia’s GHG inventory,
  (4) carried out a key category analysis.

Details of the activities of the pilot project will be given by Mr. Thy Sum and Dr. Amnat Chidthaisong.

Thank you very much!!
Cambodia’s LULUCF inventory improvement under the APN CAPaBLE GHG Inventory Project

Presented by: Sum Thy
Chief of Climate Change Office, Ministry of Environment, Cambodia
cceap@online.com.kh

Outline of Presentation

- Why improve Cambodia's LULUCF inventory
- Scope of study
- Location of Study
- Methodology
- Progress to date
- Next activities
- Conclusion/recommendation
1. Why improve Cambodia's LULUCF inventory (1)

- Emission from LULUCF contributed about 97% of the Cambodia's 1994 National GHG Inventory.
- There was no research on emission factor (aboveground biomass, biomass growth rate), therefore the IPCC emission factors were used for the preparation of Cambodia's 1994 GHG inventory.
- In 2001, a field study on aboveground biomass and biomass increment was conducted under CCEAP-phase 2. However the data from the field survey may not reflect to the overall condition of Cambodian forests, due to:
  1. limitation of time, financial support, and expertise
  2. limitation of number of location and sample selected
2. Scope of study

- The field survey will focus on the main forest types that play an important role as the key source/sink in the estimation of emission and removal in LULUCF.
- Selected Forest type to be conducted field survey:
  (a) deciduous,
  (b) evergreen, and
  (c) secondary forests.
- Data to be measured: Annual Growth Rate and aboveground biomass of the mentioned forest type.
- Proposed schedule for field survey: Starting from February 2005.

3. Location of study

[Map showing Deciduous, Evergreen, and Secondary forest types]
4. Methodology (1)

- FAO's methodology will be adapted, but more precise as CAPaBLE Project measures biomass in necromass, understorey, and litters.

- Two permanent plots of 2,500 m² (50 m x 50 m) for each forest type will be established in two different provinces. All trees species with a diameter of 30 cm or greater are numbered and measured.

- Furthermore, establish three sub-plots from the same corner peg for the collection of tree information of different tree diameter classes as follows:

4. Methodology (2)

(a) Sub-plot 1: a 2x2=4m² plot in which count is made for all seedlings less than 5 cm in diameter.

(b) Sub-plot 2: a 5x5=25m² plot in which all saplings by species or species class, over 5 cm and under 7.5 cm in diameter, are numbered and measured.

(c) Sub-plot 3: 20x20 = 400m² plot in which all trees with a diameter of 7.5 cm or greater and less than 29.9 cm (>7.5-29.9cm) are numbered and measured for diameter with species recorded.
5. Progress to date

- Visited Greenhouse Gas Inventory Office of Japan National Institute for Environmental Studies (NIES) in March 2004 to identify the potential improvement of emission factors reflecting country and regional conditions including actual measurements.
- Assessed key source category for Cambodian GHG Inventory
- Several discussion have been made through email to find out appropriate methodology for improving the GHG inventory in LULUCF.
- Three days field training has been organized for project team.
- Selected methodology, forest types and locations for field measurement.
6. Next Activities

- Field measurement for selected forest types and locations
- Data compiling and report writing.

7. Conclusion/recommendation

- APN CAPaBLE GHG Inventory Project will help Cambodia to improve its national GHG inventory by focusing on the key factors.
- Aboveground biomass and biomass growth rate of deciduous, evergreen, and secondary forests will be developed.
- Project team will gain experiences and skills in field measurement.

- Some difficulties: limited budget, expertise, equipment.

- Our recommendation:
  1. More research on Biomass After Conversion of each forest type would be done.
  2. Expend collaboration with other programs/projects
  3. APN's fund for next year activities is needed for second measurement.
Rapid and Accurate Measurements of Methane Emissions from Rice Paddies under the APN CAPaBLE GHG Project

Amnat Chidthaisong

Joint Graduate School of Energy & Environment,
King Mongkut’s University of Technology
Thonburi, Bangkok, Thailand

Thailand Greenhouse Gas Inventory 1994

<table>
<thead>
<tr>
<th>GHGs</th>
<th>Emission (Gg)</th>
<th>CO₂-equivalent (Gg)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>202,458</td>
<td>202,458</td>
<td>71</td>
</tr>
<tr>
<td>CH₄</td>
<td>3,171</td>
<td>66,598</td>
<td>23</td>
</tr>
<tr>
<td>N₂O</td>
<td>56</td>
<td>17,317</td>
<td>6</td>
</tr>
</tbody>
</table>
Methane Emission from Thailand
(Gg, 1994)

Rice cultivation
2111

Mannure management
140

Enteric Fermentation
630

Others
20

Oil & Natural gas
178

Current Inventory

⇒ Emission Factors calculated from;

- Derived using the average of the measurements conducted in four typical rice growing areas in Thailand (1.56 kg-CH4 per ha per d) which were under continuous flooding (no fertilizer) in the wet season during 1992 to 1994.

- The average methane emission rate was converted according to different water regimes and organic matter amendment using IPCC correction factors.
### Table 3.1 Measured Methane Emissions in kg CH₄/ha/day from Various Rice Cultivation Areas, with and without Soil Amendments

<table>
<thead>
<tr>
<th>Province</th>
<th>Soil series</th>
<th>NF</th>
<th>CF</th>
<th>CF+OM</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathum Thani</td>
<td>Rangsit</td>
<td>0.45</td>
<td>0.73</td>
<td>1.11</td>
<td>0.753</td>
</tr>
<tr>
<td>Ratchaburi</td>
<td>Nakompathom</td>
<td>1.13</td>
<td>2.32</td>
<td>5.93</td>
<td>3.127</td>
</tr>
<tr>
<td>Surin</td>
<td>Rolet</td>
<td>3.77</td>
<td>5.41</td>
<td>6.33</td>
<td>5.170</td>
</tr>
<tr>
<td>Chiangmai</td>
<td>Hang Dong</td>
<td>0.89</td>
<td>1.76</td>
<td>1.31</td>
<td>1.320</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>1.56</td>
<td>2.56</td>
<td>3.67</td>
<td>2.595</td>
</tr>
</tbody>
</table>

**Notes:**
- **NF** = no fertilizer application
- **CF** = with chemical fertilizer amendment
- **CF + OM** = with both chemical and organic fertilizer amendment


### Table 3.2 Methane Emission Factors for Different Water Ecosystem and Organic Amendment

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-category</th>
<th>Scaling factors for rice ecosystem</th>
<th>Correction factors for organic amendment</th>
<th>Emission factors kg CH₄/ha/day</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major rice</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upland</td>
<td>Rainfed</td>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Irrigated</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Low land</td>
<td>Rainfed</td>
<td></td>
<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.8</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Deep water</td>
<td></td>
<td>0.6</td>
<td>1</td>
</tr>
<tr>
<td><strong>Second rice</strong></td>
<td>Irrigated</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### Methane Emission from Rice Paddy in Thailand

- **Link to main economic activity (rice production) and majority of population well-being.**
- **Room to improve emission inventory:**
  - area covering
  - temporal variations
  - cultivation practices: organic/inorganic fertilization, water management, seasons.
Method for Emission Measurements

- Static Chamber methods

\[ \text{Flux}_{\text{CH}_4} = \frac{V}{A} \frac{dC}{dt} \]
**Current Procedures**

Chamber enclosure  

Gas samples  

Gas Chromatography  

Flux estimate

- Time consuming  
- Limited replication  
- Expensive  
- Accuracy concerns  
- Not applicable in the remote area
Training: Determination of CH$_4$ Concentration using semiconductor sensor at NIES

- To learn how to use the CH$_4$ sensor unit for determining CH$_4$ concentration.
- 1-30 March 2004, 15-31 August 2004
Sensing Mechanism

Conductivity increases as electrons are released; proportional to the amount of reduced gas

\[ R + O_2 \rightarrow RO + 2e^- \]

Gas-phase

Porous Catalytic Layer

SnO2 thin film

Electrode Substrate

Conductivity: \[ R + O_2 \rightarrow RO + 2e^- \] electrons are released; proportional to the amount of reduced gas.
Air flow in

CH₄ sensor, NDIR

Control Unit

Data logger

Air flow out

NDIR

Outlet

Insulator

P₂O₅ moisture trap

40.0

Nafion tube

Filter

Filter-inlet

3-way exchange valve

Mg(ClO₄)₂

Insulator

Out

In

In

Outlet

Data logger

air flow toward CH₄ sensor

CH₄ sensor,

NDIR

Control Unit

Data logger

162
Sensor Mobile Unit

CH₄ Determination

CH₄ sensor signal (V) vs. Acquiring time

1.60
1.62
1.64
1.66
1.68

1700.16
1753.85
1798.05
1821.23
1851.45
1903.27

1.60
1.62
1.64
1.66
1.68

04/03/23 6:41:11
04/03/23 6:49:31
04/03/23 6:57:51
04/03/23 7:06:11
04/03/23 7:14:31
04/03/23 7:22:51
04/03/23 7:31:11
04/03/23 7:39:31
04/03/23 7:47:51
04/03/23 7:56:11
04/03/23 8:04:31
04/03/23 8:12:51
04/03/23 8:21:11
04/03/23 8:29:31
04/03/23 8:37:51
04/03/23 8:46:11
04/03/23 8:54:31
04/03/23 9:02:51
04/03/23 9:11:11
04/03/23 9:19:31
Parameter | Value | Error
--- | --- | ---
A | 2.3986 | 0.01539
B | -4.00736E-4 | 8.49709E-6

<table>
<thead>
<tr>
<th>R</th>
<th>SD</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.9991</td>
<td>0.7324</td>
<td>6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

CH₄ signal output (V) vs. CH₄ concentration (ppb)

Measurement Range

Methane concentration (ppm) vs. Signal output (mV)
CH₄

Concentration by sensor (ppb)

$\rho^2 = 0.99923$

Concentration by NIES (ppb)

CO₂ Determination
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.02383</td>
<td>0.00203</td>
</tr>
<tr>
<td>B</td>
<td>0.00248</td>
<td>5.35869E-6</td>
</tr>
</tbody>
</table>

\[ r^2 = 0.99996 \]

\[ r^2 = 0.99998 \]
Field Deployment
Methane Flux

\[ CH_4 \text{ flux} = 1.43 \text{ mg CH}_4 \text{ m}^2 \text{ h}^{-1} \]

\[ y = 1.62577 + 0.01847x, \quad r^2 = 0.9970, \quad n=157, p<0.0001 \]

**CO\textsubscript{2}**

\[ \text{CO}_2 \text{ flux} : -3066 \text{ mg m}^{-2} \text{ hr}^{-1} \]

\[ y = 333.94 - 18.03x, \quad r^2 = 0.9963, \quad n=25, p<0.0001 \]
• The sensor unit:
  • ➔ mobile, no need for external power supply
  • ➔ quick measurement, reliable, accurate
  • ➔ many measurement replications
  • ➔ cheaper cost per measurement
  • ➔ relatively easy to operate

What’s next?

➔ Use for CH₄ emission measurement in Thai paddies
➔ Comparing with the conventional chamber-GC method
➔ Apply in various rice cultivation schemes
➔ Emission factor database for CH₄ emission in Thailand
➔ Application in other countries
Thanks

- NIES GHG Inventory Team---Japan
- Joint Graduate School of Energy & Environment (JGSEE), King Mongkut’s Univ. of Technology Thonburi---Thailand
- APN—Financial supports
Identification of regionally-significant source/sink categories in Asia

Chisa UMEMYA and Tomoyuki AIZAWA
Greenhouse Gas Inventory Office of Japan

The 2nd Workshop of GHG Inventories in Asia region
February 7-8, 2005

Outline

1. Purpose of presentation

2. Good experiences in other regions:
   UNDP-GEF Regional Capacity Development
   Project in Europe/CIS region

3. Regionally-significant source/sink categories in Asia

4. Summary
Purpose of presentation

- **Network** of Asia Region on GHG Inventories successfully established to:
  - Share experiences and information
  - Enhance technical and institutional capacity

*How can we utilize Network of Asia Region more effectively in the future?*

*Let's see what other regions are doing!!*

Good experiences in other regions

- **UNDP-GEF Regional Capacity Building Project**
  - **Goal:** to strengthen capacity to *improve* quality of GHG inventories
  - **Idea:** additional to efforts within a country while taking into account national priorities
  - **Size:** participated by 12 countries in the regions

**Good experiences in other regions**

- **UNDP-GEF Regional Capacity Building Project**

**Overview:**

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of countries</th>
<th>Duration</th>
<th>Funds (million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe/CIS</td>
<td>12</td>
<td>3 yrs since Jun. 2003</td>
<td>GEF:2.263 Co-finance:&lt;sup&gt;1&lt;/sup&gt;: 0.994</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West &amp; Francophone Central Africa</td>
<td>14</td>
<td>3 yrs since Jan. 2004</td>
<td>GEF:2.992 Co-finance:&lt;sup&gt;2&lt;/sup&gt;: 0.605</td>
</tr>
</tbody>
</table>

*<sup>1</sup>: 0.944 from Government in kind + 0.05 from Swiss Government *<sup>2</sup>: Only from Government in kind

**What they do:**

<table>
<thead>
<tr>
<th>Project objectives</th>
<th>Examples of actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Strengthened national arrangements</td>
<td>“Country-solution” manual ; Review mechanism</td>
</tr>
<tr>
<td>2) Sustainable inventory team</td>
<td>Database of national experts; Awareness-raising campaign</td>
</tr>
<tr>
<td>3) Enhanced technical capacity</td>
<td>Training of trainers in GPG; National QA/QC plan</td>
</tr>
<tr>
<td>4) Improved methodology &amp; EFs</td>
<td>Compilation of local EFs; Improved at least 3 regionally-significant EFs</td>
</tr>
</tbody>
</table>
Regionally-significant source/sink categories in Asia

**Methodology:**
1. Nation-by-Nation
   - key category analysis **nation-by-nation** (level only)
   - identify **Top 5** KCs in each country
   - count frequency of countries identifying as KC
2. Asia-combined inventory
   - combine all countries’ inventories into one **Asia-combined inventory**
   - key category analysis (level only)

**Target:**
Cambodia, China, India, Indonesia, Japan, Korea, Lao PDR, Mongolia, Philippines, Thailand, Viet Nam (Total 11)

**Source:**
- NC1 with Base Year 1994, if not available, 1990 (8)
- NC2 with 2001 (Korea)
- ALGAS Report with 1990 (China)
- GHG Inventory for 1995 (Japan)
**Regionally-significant source/sink categories in Asia**

<table>
<thead>
<tr>
<th>IPCC Categories</th>
<th>GHG</th>
<th>Freq.</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 5.A Changes in Forest and Other Woody Biomass Stocks</td>
<td>CO2</td>
<td>9</td>
<td>Cambodia, China, Indonesia, Japan, Korea, Laos PDR, Mongolia, Philippines, Viet Nam</td>
</tr>
<tr>
<td>#2 1.A.1 Fuel Combustion: Energy</td>
<td>CO2</td>
<td>8</td>
<td>China, India, Indonesia, Japan, Korea, Mongolia, Philippines, Thailand</td>
</tr>
<tr>
<td>#3 4.G Rice cultivation</td>
<td>CH4</td>
<td>7</td>
<td>Cambodia, China, Indonesia, Laos PDR, Mongolia, Philippines, Thailand, Viet Nam</td>
</tr>
<tr>
<td>#4 5.B Forest and Grassland Conversion</td>
<td>CO2</td>
<td>7</td>
<td>Cambodia, Indonesia, Laos PDR, Mongolia, Philippines, Thailand, Viet Nam</td>
</tr>
<tr>
<td>#5 1.A.2 Fuel Combustion: Manufacturing Industries and Construction</td>
<td>CO2</td>
<td>6</td>
<td>China, India, Indonesia, Japan, Korea, Thailand</td>
</tr>
<tr>
<td>#6 1.A.3 Fuel Combustion: Transport</td>
<td>CO2</td>
<td>5</td>
<td>India, Japan, Korea, Philippines, Thailand</td>
</tr>
<tr>
<td>#7 4.A Enteric Fermentation</td>
<td>CH4</td>
<td>3</td>
<td>Cambodia, India, Mongolia</td>
</tr>
<tr>
<td>#8 5.C Abandonment of Managed Lands</td>
<td>CO2</td>
<td>3</td>
<td>Indonesia, Mongolia, Viet Nam</td>
</tr>
<tr>
<td>#9 1.A.4 Fuel Combustion: Other Sectors, e.g. Commercial, Residential</td>
<td>CO2</td>
<td>3</td>
<td>China, Japan, Korea</td>
</tr>
<tr>
<td>#10 4.D Agricultural Soils</td>
<td>N2O</td>
<td>1</td>
<td>Cambodia</td>
</tr>
<tr>
<td>#11 5.D CO2 Emissions and Removals from Soil</td>
<td>CO2</td>
<td>1</td>
<td>Viet Nam</td>
</tr>
</tbody>
</table>

**Perhaps, potential priority areas in Asia**

**Regionally-significant source/sink categories in Asia**

**Comparison to those in Europe/CIS region**

<table>
<thead>
<tr>
<th>Asia</th>
<th>IPCC Categories</th>
<th>GHG</th>
<th>Freq. (of 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 5.A Changes in Forest and Other Woody Biomass Stocks</td>
<td>CO2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>#2 1.A.1 Fuel Combustion: Energy</td>
<td>CO2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>#3 4.G Rice cultivation</td>
<td>CH4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>#4 5.B Forest and Grassland Conversion</td>
<td>CO2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>#5 1.A.2 Fuel Combustion: Manufacturing Industries and Construction</td>
<td>CO2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>#6 1.A.3 Fuel Combustion: Transport</td>
<td>CO2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>#7 4.A Enteric Fermentation</td>
<td>CH4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>#8 5.C Abandonment of Managed Lands</td>
<td>CO2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>#9 1.A.4 Fuel Combustion: Other Sectors, e.g. Commercial, Residential</td>
<td>CO2</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Europe/CIS**

<table>
<thead>
<tr>
<th>IPCC Categories without LULUCF</th>
<th>GHG</th>
<th>Freq. (of 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 9.A Solid Waste Disposal on Land</td>
<td>CO4</td>
<td>7</td>
</tr>
<tr>
<td>#2 1.B.2 Fugitive Emissions from Solid Fuels: Oil and Natural Gas</td>
<td>CO4</td>
<td>7</td>
</tr>
<tr>
<td>#3 4.A Enteric Fermentation</td>
<td>CH4</td>
<td>6</td>
</tr>
<tr>
<td>#4 1.A.3 Fuel Combustion: Transport - Road Transportation</td>
<td>CO2</td>
<td>6</td>
</tr>
<tr>
<td>#5 4.D Agricultural Soils</td>
<td>N2O</td>
<td>5</td>
</tr>
<tr>
<td>#6 1.A.1 Fuel Combustion: Family</td>
<td>CO2</td>
<td>3</td>
</tr>
<tr>
<td>#7 1.B.1 Fugitive Emissions from Solid Fuels: Fuel</td>
<td>CO4</td>
<td>3</td>
</tr>
<tr>
<td>#8 4.B Manure Management</td>
<td>N2O</td>
<td>2</td>
</tr>
<tr>
<td>#9 1.A.2 Fuel Combustion: Manufacturing Industries and Construction</td>
<td>CO2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Unique to Asia!**

**Not including LULUCF**
### Regionally-significant source/sink categories in Asia

<table>
<thead>
<tr>
<th>Regionally-significant source/sink categories</th>
<th>Impacts on countries reporting</th>
<th>Total 45.4%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Forest and Other Woody Biomass Stocks</td>
<td>CO2</td>
<td>12.2</td>
</tr>
<tr>
<td>Fuel Combustion: Energy</td>
<td>CO2</td>
<td>18.9</td>
</tr>
<tr>
<td>Non-Combustion</td>
<td>CH4</td>
<td>5.6</td>
</tr>
<tr>
<td>Forest and Grassland Conversion</td>
<td>CO2</td>
<td>8.7</td>
</tr>
<tr>
<td>Fuel Combustion: Manufacturing Industries and Construction</td>
<td>CO2</td>
<td>19.0</td>
</tr>
<tr>
<td>Fuel Combustion: Transport</td>
<td>CO2</td>
<td>7.5</td>
</tr>
<tr>
<td>Enteric Fermentation</td>
<td>CH4</td>
<td>4.1</td>
</tr>
<tr>
<td>Abandonment of Managed Lands</td>
<td>CO2</td>
<td>0.4</td>
</tr>
<tr>
<td>Fuel Combustion: Other Sectors, e.g. Commercial, Residential</td>
<td>CO2</td>
<td>8.7</td>
</tr>
<tr>
<td>Agricultural Soils</td>
<td>N2O</td>
<td>1.3</td>
</tr>
<tr>
<td>CO2 Emissions and Removals from Sod</td>
<td>CO2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Potential regionally-significant areas*

*More reports can be generated?*

---

### Summary

**Overall:**

Our existing network has excellent potential to evolve into more concrete project status that can effectively contribute to an improved inventory.

**More precisely, my suggestion is:**

- To improve accuracy of EFs and AD of regionally-significant categories since regional characteristics in key categories are identified.
- To encourage information transfer in certain categories with insufficient reports by countries.

Any other suggestions??
Thank you very much!

Regionally-significant source/sink categories in Asia

Comparison to those in the world...

<table>
<thead>
<tr>
<th>IPCC Category</th>
<th>GHG</th>
<th>Brazil</th>
<th>EU</th>
<th>Former USSR</th>
<th>USA</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Combustion</td>
<td>CO2</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Fugitive</td>
<td>CH4</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
</tr>
<tr>
<td>Industrial Processes</td>
<td>CO2</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>N2O</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
</tr>
<tr>
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<td>△</td>
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<td>Other</td>
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<tr>
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<td>○</td>
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</tbody>
</table>


Not including LULUCF
### Regionally-significant source/sink categories in Asia

**KC analysis results of Asia-combined inventory**

<table>
<thead>
<tr>
<th>IPCC Categories</th>
<th>GHG</th>
<th>No. of reports</th>
<th>LULUCF (Gg CO₂eq.)</th>
<th>Absolute Value (Gg CO₂eq.)</th>
<th>Without LULUCF</th>
<th>Cumulative Total Without LULUCF</th>
<th>With LULUCF</th>
<th>Cumulative Total With LULUCF</th>
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<tr>
<td>SUM</td>
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### Regionally-significant source/sink categories in Asia

**Nation-by-Nation & Asia-combined inventory**

<table>
<thead>
<tr>
<th>IPCC Categories</th>
<th>GHG</th>
<th>Freq</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>1.A.1</td>
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<td>China, India, Indonesia, Korea, Mongolia, Philippines, Thailand</td>
</tr>
<tr>
<td>1.A.3</td>
<td>CO₂</td>
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<td>India, Japan, Korea, Philippines, Thailand</td>
</tr>
<tr>
<td>1.A.4</td>
<td>CO₂</td>
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<td>1.B.1</td>
<td>CH₄</td>
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<td>Cambodia, Indonesia Laos PDR, Mongolia, Philippines, Thailand, Viet Nam</td>
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<tr>
<td>2.A</td>
<td>CO₂</td>
<td>5</td>
<td>Cambodia, India, Mongolia</td>
</tr>
<tr>
<td>3.A</td>
<td>CH₄</td>
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<td>Cambodia, China, Indonesia, Japan, Korea, Mongolia, Philippines, Thailand</td>
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<td>4.A</td>
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<td>CH₄</td>
<td>5</td>
<td>Cambodia, Indonesia, Japan, Korea, Thailand</td>
</tr>
</tbody>
</table>

---

*Notes: All values are in Gg CO₂eq.*
ii) Other documents
Why is the EFDB needed?

- Desirably, emission factors that reflect national circumstances should be used in inventory compilation.
- However, development of such emission factors is difficult - it is costly, time consuming, requires much expertise.
Why is the EFDB needed?

- By sharing data/information, emission factors that take into account local conditions (national circumstances) can be obtained cost-effectively.

Why is the EFDB needed?

- An easily accessible database on emission factors and other relevant parameters will facilitate sharing data/information by inventory compilers, experts, scientists worldwide.
**EFDB is expected to serve as...**

- **Library** of well documented emission factors and other parameters which
  - Evolves dynamically through contributions of new data from researchers, scientists, industry...
  - Provides a wide variety of emission factors and other parameters with background documentation or technical references so that users can select and use appropriate data on their own responsibility.

- **Communication platform** for distribution and commenting on new research and measurement data

**Data contained in EFDB**

- At present, EFDB contains only the IPCC default data and the data from CORINAIR94.
- New data are expected to be provided by the global scientific and inventory society.
- New data will be evaluated for acceptance by EFDB Editorial Board according to the following criteria.
  - EFDB should assist countries in producing inventories that are neither over- nor underestimates so far as can be judged and in which uncertainties are reduced as far as practicable.
  - To this end, the data to be included should be...
Criteria for Inclusion of New Data

- Robust
  - Within the accepted uncertainty, the value is unlikely to change if there was repetition of the original measurement programme or modelling activity.

- Applicable
  - An emission factor can only be applicable if the source and its mix of technology, operating and environmental conditions and abatement and control technologies under which the emission factor was measured or modeled are clear and allow the user to see how it can be applied.

- Documented
  - Access information to the original technical reference must be provided to evaluate the robustness and applicability as described above.

How to Access the EFDB

- Two different applications are available.
  
  - **Web application**
    - For all users to carry out on-line search
    - For data providers to submit new emission factors or other parameters
  
  - **CDROM application**
    - For all users, in particular for those who have difficulty with Internet connection, to carry out off-line search

- The web application is the core of this system. New data will be made available in the Web application first.
EFDB Web application

Welcome to EFDB!

All users are kindly invited to pay attention to this note. Guidance for users (as of 25 October 2002) can be downloaded (click here). The EFDB User Manual will be made available in due course.

- **Nature of EFDB**: EFDB is meant to be a recognised library, where users can find emission factors and other parameters with background documentation or technical references that can be used for estimating greenhouse gas emissions and removals. The responsibility of using this information appropriately will always remain with the users themselves.

- **Request for data input**: Users are encouraged to provide the EFDB with any relevant proposals on emission factors or other related parameters. If you wish to submit your data for the first time, please contact the Technical Support Unit to obtain your login name and password. Acceptance of such proposals will be subject to decisions by the EFDB Editorial Board using well-defined criteria.

- **Terminology**: EFDB is a database on various parameters to be used in calculation of anthropogenic emissions by sources and removals by sinks of greenhouse gases. It covers not only the so-called “emission factors” but also other relevant parameters. For convenience sake, however, the term “emission factor” or its abbreviation “EF” is sometimes used to represent parameters in this database generally.

- **Software requirements**: It is highly recommended to use Microsoft Internet Explorer version 5.0 or higher for best performance. Adobe Acrobat Reader or equivalent PDF reader can be used, too.

---

EFDB Local CDROM application

- Can be operated locally (on a stand-alone PC).
- For detailed guidance, see the User Guide for Local CDROM application.
- For supplementary information, see also:
  - Appendices A-D of the User Manual for Web application
  - Annex to the User Manual for Web application

---

Http://www.ipcc-nggip.iges.or.jp/EFDB/main.php
**EFDB Local CDROM application**

- EFDB Local CDROM application works with MS Access MDB file, which contains the copy of the on-line web database.

- The latest MDB file will be made available
  - Through the Internet: At the "Downloads" section of the web application; and/or
  - In the form of CD-ROM: Will be distributed annually or biannually, possibly on the occasion of sessions of SBSTA or COP.

**Success – depending on input from the global scientific and inventory society**

- EFDB is open to any relevant data proposals.
- If you have your own data on emission factors, please contact the Technical Support Unit (TSU) by e-mail &lt;ipcc-efdb@iges.or.jp&gt;.

**Continuous improvement on the content and functionality – Users’ feedback will be quite important**

**Your involvement is highly appreciated!!**
Identify sources of available data from prior and ongoing international and regional projects

- Mongolia prepared its first greenhouse gases (GHG) inventory in 1996 for the base year 1990 under the US Country Studies Programme
- Updated within the Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS),
- As part of the enabling activities of preparation of the Initial National Communication (GEF/UNEP), the GHG inventories were updated to 1998 with base year 1994.
Problems and Gaps

Information
• No standard data for inventory
• No system in collection and checking
• No Institutional framework

Methodologies and tools
• No country specific emission factor

What should do…

Mongolia participate in the project Capacity Building for Improving the Quality of GHG Inventories Europe /CIS Region
What should do...

- Improve reliability of activity data
- Increase number of NE and Train NE
- Archive and document
- Improve GHG inventory procedure
- Improve the EFs
- Establish NDB for GHG inventory

STS: Experts involved

- National Agency for Meteorology, Hydrology and Environment Monitoring
- Institute of Meteorology and Hydrology
- Mongolian State University
- Energy Conservation Co.Ltd
- Ulaanbaatar City Governor's Office
- Expert for EF
Improve reliability of activity data

- AD assessment
- EF assessment
- Methodology assessment

Data and EF assessment

<table>
<thead>
<tr>
<th>No</th>
<th>Sector</th>
<th>Activity data necessary for GHG inventory</th>
<th>Data source</th>
<th>Barriers to find activity data</th>
<th>How to overcome the barrier</th>
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<tbody>
<tr>
<td>5</td>
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<td></td>
<td>Landfill</td>
<td>Urban population</td>
<td>Statistical year book</td>
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<tr>
<td></td>
<td>Domestic wastewater</td>
<td>Urban population</td>
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<td></td>
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<tr>
<td></td>
<td>Commercial and</td>
<td>Annual wastewater</td>
<td>Annual Water usage Report of Water management institute</td>
<td></td>
<td>There are necessary official documentation is included in annual report on environmental issues of Ministry of nature and Environment.</td>
</tr>
<tr>
<td></td>
<td>industrial wastewater</td>
<td>annual wastewater</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sectors

• Mobile sources
• Waste. Urban solid waste, WW

Identify prior and ongoing national sources of existing data

• Annual statistical book
• only general activity data, such as
  – fuel consumption,
  – cement production,
  – livestock population,
  – area of cultivated land
Methodologies

- IPCC GPG
- IPCC default EF
- Country Specific EF

**SRS:** Archiving existing data and information

Prepared
* all available information
* World version
* Excel version
* Design of documentation
LTS: Improve GHG inventory procedure

* Develop NM for GHG Inventory
  - Drafting
  - Approval

Outline of NM for GHG inventory

- Introduction
- Legal framework
- Institutional framework
- Data collection
- Methodology
- EF
- Completeness
- Documentation
- Reporting
- Annex
**Long-term strategy**

- Establish legal framework
  - Data collection
  - Archiving and documentation
  - Preparation of GHG inventory
  - Information access (related to GHG issue)
  - Agreement/memorandum
- Establish institutional framework
  - Institutions: national/sectoral
  - Compiling/Reporting
  - Person/staff
  - QA and QC
  - Review

---

**LTS**

- Establish electronic data base
  - Access or SQL
- Implementation
  - Annual inventory
Thank you for your attention
INDONESIA:
Climate Change Activities

M. Natsir
Ministry of Environment

The Second Workshop on Inventories in Asia Region
Shanghai, China
7-8 February 2005

Outline

- Climate Change Activities in Indonesia
- Ratification of Kyoto Protocol
- Indonesian DNA
  - Update on process
  - Structure and working mechanism
  - Sustainable Development (SD) criteria
- CDM projects in Indonesia
- CDM Indonesia Information Desk
- Preparation of National Communication
Climate Change Activities in Indonesia

ACTIVITIES ON CLIMATE CHANGE (1)

- NSS on Energy Sector, 2001
- NSS on Forestry Sector, 2003
- Bilateral cooperation with:
  - GTZ to establish Indonesian DNA
  - The Netherlands to form National Committee on Climate Change & awareness building to all stakeholder
- Developing Regional and National Capacity regarding climate change mitigation
ACTIVITIES ON CLIMATE CHANGE (2)

- Establishment of National Committee on Climate Change by MOE Decree No. 53 of 2003
- Ratification of Kyoto Protocol through the Act no. 17/2004
- Development of Regional and National Capacity in climate change mitigation by:
  - Project of Global Warming Prevention – JICA Need Survey 2003
  - CTI Industry Join Seminar on Technology Division in ASEAN and the Pacific Region (Jan 2003, NEDO Japan)
  - Feasibility Study on Lodoyo Hydro Electric Power Plant Expansion – East Java (Japan 2003)

GERIAP PROJECTS IN INDONESIA

- The project runs from July 2002 until December 2005 and includes the following steps:
  - Capacity building through training NFPs on Cleaner Production/ Energy efficiency
  - Practical demonstration of energy efficiency resulting in four sector specific manuals
  - Review of national policies and other factors that affect industry’s ability to manage energy and climate change
  - Reporting and dissemination of project outputs
GERIAP PROJECTS IN INDONESIA

Companies Commitment
6 companies committed to GERIAP as followed:
1. Cement industry:
   PT. SEMEN CIBINONG, PT SEMEN PADANG,
   PT INDOCEMENT
2. Steel Industry:
   PT KRAKATAU STEEL
3. Fertilizer:
   PT PUPUK KUJANG
4. Pulp and Paper Industry:
   PT PINDO DELI PULP AND PAPER

Indonesian DNA Development (1)

- The process has been initiated in April 2003.
- The Ministry of Environment with support from GTZ and assisted by Pelangi, conducts this process
- Consultations have been conducted:
  - Multi-stakeholders consultation: 1 Steering Committee meeting
  - Interdepartmental consultation: 2 technical committee meetings
  - Consultation with departments
Indonesian DNA Development (2)

- DNA is expected to be finalized and operated on October 2004
- Main principles: efficient, rigorous, easy access, low cost, accountable and transparent
- Multi stakeholder consultation process continuous

Basic functions of DNA

- Stating that the country’s participation in a CDM project activity is voluntary
- Stating that the project activity assists the country in achieving sustainable development
- Stating that the project have fulfilling related national environmental regulation such as environmental impact assessment
- Stating that stakeholders’ comment have been taken into account
CDM projects in Indonesia (1)

ENERGY SECTOR
The National Strategy Study (NSS) has developed a strategy for energy sector as followed:

- The technical potential for and cost of GHG emission reduction projects
- Using both top-down and bottom-up approach
- International market scenarios, including the size of CDM market and the factors that will affect Indonesia’s share
- The international and national institutional setting for the CDM.
- Lessons learned from pilot emission reduction projects in Indonesia.
- A range of potential CDM projects that could be implemented relatively quickly
CDM projects in Indonesia (2)

- Since 1996, Indonesia has actively supported the Activities Implement Jointly (AIJ) mechanism.
- The energy component financed by GTZ and coordinated by the State Ministry for the Environment, which was completed in late 2001.
- Based on NSS potential energy sector volume is 125 – 300 MT CO2 for the year 2008-2012
- Project WayangWindu Unit 2 has been accepted by CERUPT and around 20 projects are looking for potential buyers and preparing the PDDs

CDM projects in Indonesia…(3)

Potential Project in Energy Sector based on NSS:

**Renewable Energy/ Electricity Supply**
- Sarulla Geothermal Field in North Sumatera
- Satar Messe, Manggarai, Flores, East Nusa Tenggara
- PLN Yapen Selatan, Jayapura, Irian Jaya
- PLN East Nusa Tenggara and West Nusa Tenggara
- PLN Sulawesi

**Energy Efficiency**
- Suralaya Power Generation Plant

**Waste Management / Fuel Switch**
- PT. Fajar SuryaWisesa, Bekasi, West Java
- Ponorogo, East Java
- Torgamba Palm Oil Plantation, North Sumatera
- Pangkalanbrandan, North Sumatera

**Energy Conservation**
- TBA, Central Java
CDM projects in Indonesia…(4)

**FORESTRY SECTOR**
- Potential volume in forestry sectors: 3,020 MT CO2e
- The NSS attempts to explore issues and challenges in sink or land-use, land-use change and forestry (LULUCF) sectors.
- The current LULUCF component is funded by AusAID, which will be dealt with the implementation of the CDM.
- Total CDM volume is 36 Mt Co2 per year which provide 6% of market share.
- 32.5 Mha land as potential in the forest carbon projects.
- The allocation of the area for the forest carbon projects were Regreening (3.2 Mha), Agroforestry (12.7 Mha), Community forestry (9.8 Mha), Forest Plantation known as HTI (1.9 Mha), Reforestation known as Reboisasi (4.9 Mha).

**CDM Indonesia Information Desk**
- Will be designed as an information desk.
- Requirements for CDM projects in Indonesia, i.e. national SD, priorities and other documents will be posted on the website.
- Application for DNA approval on potential projects can be done online.
- Potential projects will be listed on the website.
- Potential buyers will be listed on the website.
- Operational Entities will be listed on the website.
Preparation of Indonesia’s 2\textsuperscript{nd} National Communication (1)

- Development of the 2\textsuperscript{nd} Natcom proposal facilitated by the GEF through Climate Change Enabling Activity (Self-assessment exercise)
- Objectives: identify and fill in the gaps between the activities carried out under the First National Communication (FNC) and the current status of climate change related activities in Indonesia

Preparation of Indonesia’s 2\textsuperscript{nd} National Communication (2)

- Activities undertaken on self-assessment exercise:
  - Stakeholder consultation
  - Data gathering (through stocktaking exercise)
  - 2\textsuperscript{nd} Natcom project proposal preparation
  - Workshop on draft of proposal
  - Finalization and submission of 2\textsuperscript{nd} Natcom proposal
THANK YOU ...

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Republic of Indonesia
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climate@menlh.go.id
iii) Appendix
### National Communications to the UNFCCC of Countries that Participated in the 1st and/or 2nd Workshop on GHG Inventories in Asia Region (WG1A) (Data as of 18 Feb 2005)

<table>
<thead>
<tr>
<th></th>
<th>Initial National Communications</th>
<th>Second National Communications</th>
<th>Third National Communications</th>
<th>Download Most Recent Version</th>
</tr>
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<td>08/10/02</td>
<td></td>
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<td>China</td>
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<td>3.</td>
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<td>22/06/04</td>
<td></td>
<td><img src="India" alt="India" /> (5,892 kB)</td>
</tr>
<tr>
<td>4.</td>
<td>Indonesia</td>
<td>27/10/99</td>
<td></td>
<td><img src="Indonesia" alt="Indonesia" /> (1,167 kB)</td>
</tr>
<tr>
<td>5.</td>
<td>Japan</td>
<td>20/09/94 02/12/97 31/05/02</td>
<td></td>
<td><img src="Japan" alt="Japan" /> (14,178 kB)</td>
</tr>
<tr>
<td>6.</td>
<td>Lao P.D.R.</td>
<td>02/11/00</td>
<td></td>
<td>![Lao P.D.R](Lao P.D.R) (10,466 kB)</td>
</tr>
<tr>
<td>7.</td>
<td>Mongolia</td>
<td>01/11/01</td>
<td></td>
<td><img src="Mongolia" alt="Mongolia" /> (2,367 kB)</td>
</tr>
<tr>
<td>8.</td>
<td>Philippines</td>
<td>19/05/00</td>
<td></td>
<td><img src="Philippines" alt="Philippines" /> (2,147 kB)</td>
</tr>
<tr>
<td>9.</td>
<td>Korea (ROK)</td>
<td>12/02/98 01/12/03</td>
<td></td>
<td><img src="Korea" alt="Korea" /> (4,265 kB)</td>
</tr>
<tr>
<td>10.</td>
<td>Thailand</td>
<td>13/11/00</td>
<td></td>
<td><img src="Thailand" alt="Thailand" /> (5,525 kB)</td>
</tr>
<tr>
<td>11.</td>
<td>Viet Nam</td>
<td>02/12/03</td>
<td></td>
<td>![Viet Nam](Viet Nam) (1,007 kB)</td>
</tr>
</tbody>
</table>

**Notes:**
1. Dates are in the form DD/MM/YY.
Greenhouse Gas Inventory Office of Japan
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