Joint IPCC/IEA Expert Meeting on Data: Energy data collection, energy statistics and data for IPCC Emission Factor Database (EFDB) – 15th Expert Meeting on Data for EFDB

Meeting Report

13-14 December 2017, Paris, France

Task Force on National Greenhouse Gas Inventories (TFI) /

Energy Data Centre, International Energy Agency (IEA)

iea International Energy Agency

ipcc INTERGOVERNMENTAL PANEL ON climate change

Task Force on National Greenhouse Gas Inventories (TFI)

WMO UNEP

Joint IPCC/IEA Expert Meeting on Data:

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Supporting material prepared for consideration by the Intergovernmental Panel on Climate Change (IPCC). This supporting material has not been subject to formal IPCC review processes.

This Joint IPCC/IEA Expert Meeting on Data: Energy data collection, energy statistics and data for IPCC Emission Factor Database (EFDB) – 15th Expert Meeting on Data for EFDB was jointly organized by International Energy Agency (IEA) and the IPCC Task Force on National Greenhouse Gas Inventories (TFI). It was hosted by IEA at the French Ministry of International Affairs.

IPCC co-sponsorship does not imply IPCC endorsement or approval of these proceedings or any recommendations or conclusions contained herein. Neither the papers presented at the Expert Meeting nor the report of its proceedings have been subjected to IPCC review.

This meeting report was prepared jointly by the organizers from IEA (Mr. Duncan Millard and Ms. Roberta Quadrelli) and the Technical Support Unit for the IPCC TFI (Mr. Andrej Kranjc, Ms. Maya Fukuda, Mr. Pavel Shermanau, Ms. Baasansuren Jamsranjav, Ms. Sekai Ngarize and Mr. Yurii Pyrozhenko) as well as TFI Co-Chairs (Mr. Eduardo Calvo Buendia and Mr. Kiyoto Tanabe), and subjected to review by the meeting participants.

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Foreword

The IPCC Task Force on National Greenhouse Gas Inventories (TFI)

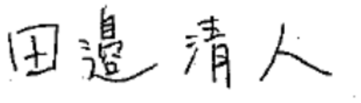
The IPCC Task Force on National Greenhouse Gas Inventories (TFI) has, as part of its mandate, the objective of encouraging the widespread use of the IPCC Guidelines for estimation of national greenhouse gas (GHG) emissions and removals. This report is one in a series, developed through expert meetings, which aims to assist users of the guidelines by addressing specific problem areas.

One of the pillars of TFI work is a management of EFDB, which 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 GHG emissions and removals. This information is important especially for developing countries, which often do not have good data available on emission factors, or resources to develop that information.

TFI holds annually a meeting of the Editorial Board of EFDB and Data meeting(s). Data meetings are designed to bring together experts of a particular subject who can provide data for EFDB. During Data meetings the Editorial Board Members and data providers have an opportunity to interact directly with each other. The decision on publication of data in EFDB is taken by the EFDB Editorial Board.

This time TFI organized jointly with International Energy Agency (IEA) a joint meeting to have a broader look on energy data including energy data collection process. The meeting brought together two groups of experts: energy statisticians and GHG inventory experts, who considered a wide range of issues regarding energy data collection. The meeting also aimed to identify, select and approve data for Energy and Industrial Processes & Product Use sectors to be included in the EFDB, particularly focusing on calorific values of fuels and GHG emission factors for Iron & Steel and Petrochemical Industries.

The Co-chairs of the Task Force Bureau would like to thank all those involved in this meeting, in particular IEA, for enabling the expert meeting to take place and all the expert participants without whom this meeting and report would not be possible.



Kiyoto Tanabe
Co-Chair Task Force Bureau

Eduardo Calvo Buendia
Co-Chair Task Force Bureau

International Energy Agency (IEA) Energy Data Centre

One of the core mandates of the International Energy Agency is to collect energy data to provide a comprehensive global picture of energy and as a key tool to inform and track energy policies. The IEA Energy Data Centre has been collecting and disseminating energy data since the foundation of the Agency, and has expanded the data scope over time to reflect changing policy priorities, from the initial focus on oil supply to broader energy statistics - enhancing the detail on demand-side, to support countries to develop full energy balances, emission estimates, energy efficiency data and associated indicators.

National energy balances provide a coherent understanding of the energy situation of a country and as such are a fundamental analytical tool for governments. They are also a core component of national inventories of greenhouse gases and thus have a direct impact on environment and climate change policies beyond those of energy. That's why sound national energy data, developed following internationally comparable methodologies, are a vital pre-requirement for inventory compilers, globally.

In recent years, alongside its strong capacity building activity, the IEA has been leading a global harmonisation effort on energy statistics definitions, together with a group key international organisations producing and using energy statistics, also including IPCC and UNFCCC. This work fed the International Recommendations on Energy Statistics (IRES), a manual adopted by the United Nations Statistical Commission which provides a solid basis for all countries in the world approaching work on energy data.

Data cooperation between IEA and IPCC has always been strong starting with the work on national inventories, through coordination of methodologies for energy statistics and related inventory guidelines, as well as data exchange. With this meeting, the two institutions worked together to reinforce experts across the energy and inventory domains that national cooperation is essential to optimise resources and produce consolidated datasets for different national policy purposes and their associated international reporting obligation.

The IEA was delighted to welcome to this workshop the IPCC Task Force on National Greenhouse Gas Inventories, as well as experts from across the world from the energy and inventory data communities. This fruitful dialogue will need to continue to ensure that reliable and policy-relevant energy statistics and inventories are consolidated and enhanced across the world.

Duncan Millard

IEA Chief Statistician and Head of the Energy Data Centre

List of Acronyms and Abbreviations

AFREC	African Energy Commission
BOG	Break-out group
BOF	Basic Oxygen Furnace
BTU	British Thermal Units
EAF	Electric Arc Furnace
EF	Emission Factor
EFDB	Emission Factor Database
EU ETS	European Union Emission Trading System
CDM	Clean Development Mechanism
DRI	Direct Reduced Iron
GCV	Gross Calorific Value
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IRES	International Recommendations for Energy Statistics
MoU	Memorandum of Understanding
NCV	Net Calorific Value
NDA	Non-Disclosure Agreement
NDC	Nationally Determined Contribution
TFI	Task Force on National Greenhouse Gas Inventories
OLADE	Latin American Energy Organization
UNFCCC	United Nations Framework Convention on Climate Change
WSA	World Steel Association

1. Introduction

The idea of the joint meeting was to discuss issues related to energy data collection, particularly national problems to gather energy statistics, to produce energy balances, to define fuels properties (caloric values, carbon content and CO_2 emission factors), to properly account/allocate fuel consumption between different categories in Energy and Industry sectors, particularly Iron and Steel Industry and Petrochemical industry. In addition, the meeting aimed at considering suitable energy data for EFDB and discussing what international organizations (IEA, IPCC, UNFCCC, others) can do to improve data collection at national and international levels.

Energy data collection is a fundamental issue for many purposes: understanding countries' state-of-business, policy development, implications for environment and many others. While IEA and IPCC have different mandates and a focus of work, the accurate data collection and estimation of CO_2 emissions is of a common interest.

The joint meeting has brought two different communities together: i) energy statisticians/energy experts and ii) GHG inventory experts in Energy and Industry Sectors. Representatives of 24 countries and 4 international organizations took part in the meeting (please, see the List of Participants in Annex 3).

The goal of the meeting was twofold:

- *to discuss the data collection practices and methods of measurements in Energy and Industry Sectors and ways to enhance the international cooperation on data quality;*
- *to populate the EFDB with data on calorific values, carbon content and GHG emission factors.*

The meeting was structured in two days (please, see the Agenda in Annex 2). The first day focused on presentations of countries' experiences and country-specific data suitable for EFDB. Day 2 was dedicated to the work in three break-out groups (BOGs): 1) cross-cutting issues/data collection, 2) energy data for EFDB, and 3) industry data for EFDB. In BOGs 2&3 the members of the Editorial Board of EFDB took part.

2. Meeting Discussions

Welcome Remarks

The joint expert meeting started with opening remarks by ***Paul Simons, Deputy Executive Director of IEA***. He warmly welcomed participants of the meeting and pointed out several important things: IEA work on collecting energy data and tracking indicators for energy efficiency, energy transition, energy investments, etc.; importance of harmonization of energy data and methods; data-for-policy perspectives, e.g. decoupling GDP and emissions, energy efficiency, renewables and development of climate NDCs; a need for a strong support to countries/data producers.

The ***IPCC TFI Co-Chair Kiyoto Tanabe*** complemented to welcome remarks with a message that the data collection is a key element for GHG inventory which is used to develop climate policies and measures; a strong cooperation is essential between international organizations and countries, the IEA is a very important partner in this process. He expressed a sincere gratitude to IEA for co-organizing and hosting this joint expert meeting.

General presentations from IPCC and IEA *(see all Abstracts in the Annex 1)*

Andrej Kranjc, Head of IPCC TFI TSU. He presented the history of IPCC dated back to 1988 and explained one of its main goals is to assess and to develop methodologies, such as IPCC Guidelines for National GHG Inventories. The joint IPCC/OECD/IEA inventory programme was launched in 1991 with a production of the first Methodology Report in 1994 - *1994 IPCC Guidelines for National GHG Inventories*. Then in 1998 this initiative was formalized in the IPCC Task Force on National Greenhouse Gas Inventories (TFI) and the Technical Support Unit moved to Japan in 1999. The main products of the IPCC TFI now: 2006 IPCC Guidelines for National GHG Inventories (*2006 IPCC Guidelines*); IPCC Emission factor Database (EFDB); IPCC Inventory Software, and others. All of them can be found at the IPCC TFI web-site: http://www.ipcc-nggip.iges.or.jp/.

With regards to Energy Sector and data collection, there is a good harmonization between IEA and IPCC documents. For example, the *2006 IPCC Guidelines* reference the IEA Energy Manual, and vis-à-vis the IEA Report on CO_2 emissions from fuel combustion utilizes the methodology of the *2006 IPCC Guidelines*. The IPCC launched a new project of *2019 Refinement to 2006 IPCC Guidelines for National GHG Inventories (2019 Refinement)* where the main fundamental energy-related things will not be revisited, like stationary and mobile combustion, but some attention will be dedicated to fugitive emissions and fuel transformation.

One of the tasks for the meeting is to populate the EFDB with country-specific EFs. The EFDB is an open library for emission/removal factors and parameters available to GHG inventory compilers and other experts involved in GHG estimations (http://www.ipcc-nggip.iges.or.jp/EFDB/main.php). Currently it contains around 17 000 emission factors (Energy – around 7000) with a majority of default emission factors from the IPCC guidelines. The population of EFDB with a national emission factors is a priority for IPCC TFI.

Duncan Millard, Chief Statistician and Head of Energy Data Centre, IEA. The IEA was formed in 1973 and works with members and partner countries. Data and statistics are at the heart of IEA work. It collects data from

150 countries. The most prominent relevant publications are “Energy Balance” and “CO_2 Emissions from Fuel Combustion”. IEA is leading harmonization efforts with partners, which resulted in the International Recommendations for Energy Statistics (IRES) adopted in 2011 (https://unstats.un.org/UNSD/energy/ires/default.htm). Examples of IEA cooperation activities related to energy and carbon data: review of UNFCCC inventories, contribution to IPCC Guidelines and broader cooperation with IPCC, collaboration with JRC/PBL (EDGAR database). Another important pillar of IEA work is a support to countries, work on training and capacity building in order to achieve continuous improvement in data quality.

Countries Presentations

Sander Brummelkamp, Netherlands statistics CBS (Netherlands). Presented data collection process in Petrochemical Industry. This was done with a help of questionnaires and registries; a full mass balance of oil energy products with differentiation by 5 types of companies: production, refineries, stockholding, traders, petrochemical industry; a monthly oil questionnaire utilizes balance of 37 feedstocks and products. One of the main challenges - it is not possible to see transformation from feedstocks to products. This challenge was supported by other experts (*Japan and Germany*), e.g. where to find the off-gas(?), how to work with IEA questionnaire. *Duncan Millard (IEA)* noted that the special Working group has been established at IEA; *Kiyoto Tanabe (IPCC)* added that this category (Petrochemical Industry) is a difficult one to accurately estimate GHG emissions, Araceli Fernandez Pales (IEA) pointed out the issue of “efficiency” related to energy input or product within the existing statistics.

Wolfgang Bittermann, Statistics Austria (Austria). Presented the country case facing challenges in alignment of the four main data sources for energy use in industry: 1) MIS (Material input statistics); 2) STS (Short term statistics); 3) ETS (EU Emission Trading System); 4) CHP (Statistics on electricity and combined heat and power). This alignment resulted in Synchronized material input statistics (SMIS) which includes all establishments of the ETS and CHP statistics with the total input of each energy source per establishment in the SMIS $\geq$ ETS and/or CHP. In addition, it helped to achieve more complete picture on district heat (heat sold) production, to eliminate double counting of district heat production, and to add missing transformation inputs (for heat only production).

The discussion among experts (*Japan, India, IEA*) was around several issues: different accounting frameworks, data/emissions inside or outside the boundaries (e.g., EU ETS), a hesitant attitude from industry to disclose information, a need for synchronization of information and bridging gaps in data collection. *Kiyoto Tanabe (IPCC)* noted that similar discussion happened during the 2010 IPCC expert meeting in Sydney, Australia; meeting report “Use of Models and Facility-Level Data in Greenhouse Gas Inventories” can be found at: http://www.ipcc-nggip.iges.or.jp/public/mtdocs/pdfiles/1008_Model_and_Facility_Level_Data_Report.pdf.

Niklas Notstrand, Swedish Energy Agency (Sweden). The presentation was focused on complexity of statistics and cooperation of different national stakeholders. There are 28 responsible agencies for official statistics in Sweden; a diversity of forms (monthly, quarterly, annually) and reports both national and international (IEA, JODI, Eurostat); collaboration in data collection and a review process in environmental field. The other important issues discussed: sampling/population, number of no-responses to questionnaire, a scientific proof or method for data collection, etc.

Kari Juhani Grönfors, Statistics Finland, (Finland). Presented the work of Statistics Finland on energy data (https://www.stat.fi/til/ehk/2016/ehk_2016_2017-12-08_tie_001_en.html) and GHG emissions data (https://www.stat.fi/til/khki/2016/khki_2016_2017-12-08_tie_001_en.html). Talked about national circumstances of accounting bio-fuels (many types), data improvements brought with EU ETS data and challenges in accounting Petrochemical Industry.

Sam Bradley and Anna Mikis, Department for Business, Energy and Industrial Strategy (UK). The UK has long-established systems of data supply, statutory reporting requirements and data checking. The largest data sources of Energy and IPPU data in UK GHG inventory: DUKES and EU ETS. The Digest of UK Energy Statistics (DUKES) – the UK energy balance derived from comprehensive reporting of fuel production, import/export and supply, based on data from energy companies and UK import-export statistics. As for EU ETS installation-level data, analysis performed from >1000 installations in EU ETS with detailed data on carbon emission factors and NCVs, and is used to finesse/verify energy allocations within DUKES. Another source of information for GHG inventory is the Pollution Inventory with installation-level data provided via the UK regulatory agencies for IED/IPCC. Analysis of data from >5000 installations that report under IED/IPCC, and is used to estimate fugitive releases and emission factors for industrial processes.

The important elements of the Department work among others are interaction with individual facilities, companies' engagement, data quality assurance and audit process.

Kendal Blanco Salas, National Meteorological Institute (Costa Rica). Presented results of National GHG Inventory in Costa Rica with a focus on Energy Sector, examples of use of bio-ethanol and bio-diesel in a transport sector, a project to improve data quality - NCV of fuels (the results of it can be publicly available soon).

Roberta Quadrelli (IEA). Presented the IEA data work on calorific values. Calorific values are a key input to develop energy balances and GHG Inventories of a good quality. The data collection is done via the IEA questionnaire, the data on calorific values varies from country to country, over time and in some cases by flow. The national data collection must be a priority for countries, and international data should serve only as a reference point.

The experts *(Japan, India, Mongolia, Argentina, Sweden, Germany)* discussed several things: data availability and data quality, CDM and IEA data, NCV and GCV, differences in national and international circumstances (balances, and questionnaires, fuel types and physical inconsistencies), importance of accurate data collection and international harmonization for energy data (International Recommendations on Energy Statistics - IRES).

Araceli Fernandez Pales (IEA). Brought several important issues regarding data collection, efficiency indicators and emission factors. The ambition is to develop meaningful indicators and to make cross-country comparisons, but there are several challenges: i) definitions and boundaries of products, processes, and sectors; ii) quality of input resources that can vary significantly in terms of energy content; iii) allocation of co-generation and on-site generation data. In addition, there is a hierarchy with indicators/factors when at the top level there are international aggregated data that do not really reflect the specifics, but shows the average. On the opposite, a bottom-level data (industrial facility data) is confidential and very diverse, because of varieties of technologies, inputs and outputs, and changes to it. That makes nearly impossible to produce a meaningful factors/indicators, which would enable comparison across countries (cases of Petrochemical and Iron&Steel Industries).

Gregg Marland, Appalachian State University (USA). Presented the US framework for energy and GHG inventory data collection. The US energy consumption statistics mandated by the Federal Energy Administration Act of 1974 which created the Energy Information Administration (EIA). The US mineral resource research is conducted by the United States Geological Survey (USGS). He pointed out the variability in fuel properties (oil and oil products, coal, gas). The sulphur content influence significantly carbon content and calorific values. The fuel properties values vary temporally and spatially (from the East coast to the West coast). In the inventory process, it is important to utilize satellite observation data to estimate emissions from large point sources, which account for 30-40% of GHG emissions.

Kazunari Kainou, Research Institute for Economy, Trade and Industry (RIETI), Government of Japan (Japan). Presented an interesting case of numerical modelling in identifying calorific values based on chemical properties of fuels. As a result, the approximation formulas for fuels (coal, oil, oil products) were developed which helped to identify GCV. Lessons learned: 1) clear authority (governmental) commitment needed; 2) clear prior specification of conditions for measurement was successful; 3) interpolation & approximation formula of GCV&CEF works well; 4) numerical modelling of industrial process in energy statistics is helpful.

Kristina Juhrich, German Environment Agency (UBA), (Germany). Presented the 2016 UBA "CO_2 Emission Factors for Fossil Fuels". The initial idea was as follows. There are thousands of measurement data available from ETS, also measurement data available from different unpublished studies and results of measurement campaigns from several institutes. Therefore, there is a large number of high quality data, but no quotable source! Therefore, the 2016 UBA publication contains information on: hard coal, raw lignite, lignite products, derived gases from iron and steel, petroleum products, natural gas, brown coal briquettes. For Germany, there are some challenges with IPCC Guidelines: the default value for lignite is lower, no values for lignite coke, difficulties with fuel definitions (black lignite and hard coal). The data on various fuels were presented for consideration for publication in EFDB.

Dzmitry Melekh, RUE "Bel SRC "Ecology" (Belarus). Presented regulatory framework and technical standards for energy data collection, shared the findings of national studies on country-specific calorific values and carbon content for patent fuel, natural gas, residual fuel oil and diesel oil (these data were proposed for publication in EFDB).

Tegshjargal Bumtsend, Climate Change Project Implementing Unit (CCPIU) of the Environment and Climate Fund (ECF) under the Ministry of Environment and Tourism (MET) of Mongolia (Mongolia). Presented results from the scientific and technological project “Studies on country-specific GHG emission and removal factors for Mongolia”. Coal is a strategic fossil fuel and the main source of energy & heat production for Mongolia (98% of the total electricity generation and 100% of the heat produced). Research was done on coal production for each mine for the period 2001-2012 (data from mines differ from data from national statistics); and for bituminous and coking coal export from 2003 (almost a half of production will be exported). The study analysed a type of coal stoves &

boilers and their combustion efficiency, coal types and conversion factors (NCV), and CO_2 emission factors from coal combustion. Main conclusions: i) the value of CO_2 emissions from fuel combustion is dependent on the fuel type, net calorific value, combustion efficiency and it should be updated for a certain period of time; ii) more than 90% of Mongolia's energy is produced by the burning of lignite, so CO_2 emissions are dependent on its characteristics.

Ajay Kumar Singh, private consultant (India). Presented GHG emission factors, carbon content and heating value of Indian coals. He talked about coal origins, types and general characteristics of different coals, classification systems, methodologies for identification of NCVs and carbon content/emission factors, fugitive emission from coal mines. Several country-specific data were presented. As for conclusions: i) institutions in India have developed their own national emission factors; ii) a number of constraints usually experienced need to be addressed strategically by the participating institutions, Industries and the Ministry of Environment, Forest and Climate Change, Gov. of India; iii) The following additional measures for success in our endeavour – a pro-active support of and co-ordination among policy-makers, regulators, institutions and other government agencies, etc.

Samuel Ojelel, Makerere University (Uganda). Presented the results of the study on fuel value indices of selected woodfuel species in Uganda. Biomass in Uganda accounts for 94% of energy: woodfuel (80%), charcoal (10%) and crop residues (4%). The study objectives were: i) to identify the woodfuel species commonly used in Masindi and Nebbi districts of Uganda; ii) to determine the Fuel Value Indices (FVIs) of ten (10) selected tree species from basic properties namely: moisture content, density and gross calorific value. The results of the study were presented pointing out that moisture content and density are vital properties in woodfuel selection since they vary significantly, fuel value index was suggested (caloric value x density / moisture), because it offers a better woodfuel species prioritization than a single parameter.

Henk (Jan Hendrik) Reimink, World Steel Association (worldsteel). Presented a process of data collection, analysis and reporting of CO_2 emissions set up by *worldsteel.* The basic documents are: CO_2 Emissions Data Collection User Guide and ISO Standards 14404-1, 14404-2 14404-3, and 19694-1/2. The aggregated data on iron and steel production and CO_2 emission factors are presented at the *worldsteel* web-site, facility-level data are confidential. The CO_2 emission factors were presented for different technologies (BOF, EAF, sinter, iron, DRI).

Tan Ee San, Universiti Tenaga Nasional (UNITEN)/Ministry of Natural Resources and Environment, (Malaysia). Presented improvements of data collection in Malaysia GHG Inventory for Petrochemical and Iron & Steel Industries. The presentation provided with an interesting case of engagement with stakeholders from the industries to participate via a Non-Disclosure Agreement (NDA). The outcome of the NDA has enhanced the data quality and enabled the use of higher tier methodologies. In addition, this exercise has reduced much of the overestimations of GHG emissions in the time series, e.g. in Ammonia and Ethylene Production. Particularly good relationship has been established with Malaysian Iron and Steel Federation (MISIF) which helps to disaggregate the production data based on the type of iron and steel-making processes. Prior to this exercise, GHG estimations were based on DRI production data, which is associated with higher EF. Since 99% of steelmaking plants in the country uses EAF method, the emission factors were reduced significantly which causes reduction of GHG emissions for this sector. As for conclusion: the engagement with industry stakeholders is crucial as many of them have the access to the data; their involvement in the GHG calculation process from the start to the finish will provide a more accurate representation of their system/process.

Ekaterina Imshennik, Institute of Global Climate and Ecology (Russian Federation). Presented an insight from IPPU sector in Russia regarding Petrochemical Industry and Tier 2 IPCC Methodology for this sector. The Tier 2 approach is applicable in cases where activity data are available for both feedstock consumption and primary and secondary product production and disposition. Moreover, it is a real challenge - an accurate estimation and accounting in the Petrochemical Industry, because of a diversity of processes and a mixture of products. Therefore, the investments in data collection process are needed (time and resources). Despite of that the estimates may not bring more reliable results. As for data, feedstock specific CO_2 emission factors were presented which are based on estimates of Russian ethylene producing industry.

2.1 BOG 1: Cross-cutting issues. Challenges to Data Collection

Co-facilitator: Roberta Quadrelli (IEA).

BOG1 participants discussed various challenges and good examples in energy data collection. The situation varies from country to country. There are several aspects to consider:

- *Regulatory Framework (e.g., National Statistical Acts)*
- *Institutional cooperation (e.g., MoU, sometimes simply does not work)*
- *International or Regional cooperation (e.g., OLADE is a good example)*
- *Financial issues (data cost and can be bought or sold)*
- *Technical experts (responsible knowledgeable persons in the field who is familiar with and have the data)*
- *Data quality*
- *Definitions, harmonisation and comparison*
- *Countries' commitments and sustainability to the process of data collection*
- *Support, training and accumulation of knowledge ("Bad Practice Guidance" – common mistakes and poor practices dealing with data, production of energy balance, etc.).*

BOG1 Conclusions:

- *Underlying need for cooperation between international organisations: joint programmes, raising awareness, capacity building (also for decision-makers), harmonised definitions;*
- *Leverage on regional organisations (Ministerial level). Examples: OLADE, AFREC, others;*
- *Synergy between energy and inventory statistics: need for a national system for energy balance, even simplified. Data need to be national;*
- *Share good examples/practices and define elements of a "roadmap for national data collection" ("IKEA Manual").*

The initial elements of such *a roadmap* could be:

- *Nationally: political commitment: why data matter for national policies? Benefits. Link to priority policies and coordination across Ministries (environment/energy/others);*
- *Data collection needs a top-down mandate and possibly legal framework. Coordination requires MoUs/ agreements among institutions (if decentralised);*
- *Establish good collaboration among data producers/users; engage private sector: why data sharing is beneficial (win-win). Formal agreements to address confidentiality;*
- *Technical training (methodologies, definitions, data matching, etc.).*

2.2 BOG 2: Energy. Specific energy emission factors suitable for IPCC EFDB

Co-facilitator: Maya Fukuda (IPCC TFI TSU).

BOG2 considered the data submissions by the following 7 data providers which mainly focused on net calorific values and carbon content of fuels. This topic was carefully decided by the IPCC TFI taking various matters into consideration, such as objective of this joint meeting, data coverage in the EFDB, results of previous EFDB Editorial Board meetings etc.

- *Gregg Marland (USA)*
- *Kazunari Kainou (Japan)*
- *Kristina Juhrich (Germany)*
- *Dzmitry Melekh (Belarus)*
- *Tegshjargal Bumtsend (Mongolia)*
- *Ajay Kumar Singh (India)*
- *Samuel Ojelel (Uganda)*

BOG2 conclusions:

- *The presentations are very good and contain many useful country-specific data to populate the EFDB;*
- *In total, 98 data were accepted for publication in the EFDB.*

2.3 BOG 3: Industry. Specific industry emission factors suitable for IPCC EFDB

Co-facilitators: Pavel Shermanau (IPCC TFI TSU).

BOG3 considered the following presentations and materials.

1. Presentations and materials by experts/data providers (Iron&Steel and Petrochemicals):

- *Henk (Jan Hendrik) Reimink (WSA)*
- *Tan Ee San (Malaysia)*
- *Ekaterina Imshennik (Russian Federation)*

2. Literature:

2.1 Iron and Steel:

1. *Best Available Techniques (BAT) Reference Document for Iron and Steel Production, Authors: Rainer Remus, Miguel A. Aguado Monsonet, Serge Roudier, Luis Delgado Sancho. European Commission, Joint Research Centre, Institute for prospective technological studies, 2013*
2. *CO_2 Emissions Data Collection User Guide, Version 7, World Steel Association*
3. *Industrial energy efficiency. Benchmarking Report for the Iron and Steel Sector. Prepared by Austrian Energy Agency and Eng.Ayman Elzahaby. United Nations Industrial Development Organization (UNIDO), 2014*
4. *CO_2 emissions from China's iron and steel industry. Wenqing Xu, Bin Wan, Tingyu Zhu, Mingpan Shao. Journal of Cleaner Production 139 (2016) 1504-1511. Available online 24 August 2016*
5. *Material Flow Analysis of CO_2 Emissions from Blast Furnace and Basic Oxygen Furnace Steelmaking Systems in China. Wenqing Xu, Wanjie Cao, Tingyu Zhu, Yinjiao Li, and Bin Wan. Steel Research int. 86 (2015) No. 9. https://www.researchgate.net/publication/271589864*

2.2 Petrochemicals

6. *Energy technology transitions for Industry: Strategies for the next industrial revolution. International Energy Agency, OECD/IEA, 2009*
7. *Energy and GHG Reductions in the Chemical Industry via Catalytic Processes. DECHEMA/IEA/ICCA, 2013*
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10. *DRAFT. Best Available Techniques (BAT) Reference Document in the Large Volume Organic Chemical Industry. European Commission, Joint Research Centre, Directorate B – Growth and Innovation, Circular Economy and Industrial Leadership, European IPPC Bureau. Final Draft (February 2017).*

2.3 Other literature (on lime production submitted by Kendal Blanco Salaz (Costa Rica))

11. *Evaluación de las emisiones de dióxido de carbono del proceso de producción de cal hidratada en la planta de Industrias de Calcio S.A., Kendal Blanco Salas, Topicos Meeteorologicos y ocenaograficos, Volumen 14, December 2015*

BOG3 conclusions:

- *Literature on GHG emissions from industrial sector is commonly not peer-reviewed; it is mainly reports with a different focus and assumptions;*
- *Some good publications contain energy (efficiency) data, aggregated data, LCA, BAT data, which is quite useful, but not suitable for the IPCC EFDB/Guidelines;*
- *Data for EFDB: accepted data – 23.*

3. Summary

Due to several limitations (financial, time constraints, others) it was difficult to bring as many experts as needed, to have sufficient time to go into all interesting details during discussion, nevertheless the meeting was recognised as very interesting.

Besides a substantial work on input data for EFDB on Energy and Industry (more than 100 emission factors were accepted), the participants discussed problems with energy data collection, particularly in developing countries.

The challenges concerning data collection, production of energy balances and GHG Inventories are well-known; the participants pointed out the following ones:

- Legal and institutional circumstances;
- Capacities of the countries
- Cooperation between different agencies;
- Availability of data and experts with relevant expertise;
- Diversity of data, data sources (e.g. EU ETS and national statistics) and reports;
- Data quality and sustainability of data collection process.

The meeting participants aspired at least to formulate possible solutions to some of these issues based on countries' experiences. The key solution concepts are:

1. *To produce "the first energy balance".*
2. *To make data collection process on a systematic basis with a continuous improvement.*
3. *To support countries* inter alia *with "IKEA Manual" – a step-by-step guidance or a roadmap how to build a system for energy data collection.*

The experts agreed that more consideration is needed for these ideas. Another expert meeting would be helpful to discuss the elements and to develop more concrete proposals for implementation projects that can be supported by international agencies and national governments.

And needless to answer why a good quality data matter – it can bring *win-win* solutions in improvement of energy balances and GHG Inventories, GHG emission projections, formulation of policies and measures for energy saving/efficiency and climate protection, information sharing and transparency.

As a message forward, which was coined by one of the participants – *The stories of success are based on successful statistics stories.*

Annex 1. Abstracts

List of Presenters/Abstracts

1. Andrej Kranjc (IPCC)
2. Sander Brummelkamp (Netherlands)
3. Wolfgang Bittermann (Austria)
4. Niklas Notstrand (Sweden)
5. Kari Grönfors (Finland)
6. Sam Bradley and Anna Mikis (UK)
7. Kendal Blanco Salas (Costa Rica)
8. Roberta Quadrelli (IEA)
9. Araceli Fernandez Pales (IEA)
10. Gregg Marland (USA)
11. Kazunari Kainou (Japan)
12. Kristina Juhrich (Germany)
13. Dzmitry Melekh (Belarus)
14. Tegshjargal Bumtsend (Mongolia)
15. Ajay Kumar Singh (India)
16. Samuel Ojelel (Uganda)
17. Henk (Jan Hendrik) Reimink (WSA)
18. Tan Ee San (Malaysia)
19. Ekaterina Imshennik (Russian Federation)

IPCC Task Force on National GHG Inventories: Main activities and products.

Data Collection and Energy guidance in the *2006 IPCC Guidelines*

Andrej Kranjc and Pavel Shermanau

IPCC TFU TSU

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The joint IPCC/OECD/IEA inventory programme was launched in 1991 to assess, and to develop as necessary, internationally agreed methodologies for national GHG inventories. It published the first methodology report in 1995 (out of print, replaced by *Revised 1996 Guidelines*) - *1994 IPCC Guidelines for National GHG Inventories*. Then, in 1998, this initiative was formalized in the Task Force on National Greenhouse Gas Inventories (TFI) and the Technical Support Unit (TSU) moved to Japan (in 1999).

The main publications of TFI as of now (http://www.ipcc-nggip.iges.or.jp/):

- *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Revised 1996 IPCC Guidelines)*
- *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000 Good Practice Guidance)*
- *Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003 LULUCF Good Practice Guidance)*
- *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)*
- *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (2013 Wetlands Supplement)*
- *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (2013 KP Supplement)*

The other TFI products are:

- *IPCC Emission Factor Database (EFDB)*
- *IPCC Inventory Software*
- *FAQ web-site*
- *Primer for 2006 IPCC Guidelines and Presentation materials to explain the contents of the 2006 IPCC Guidelines*
- *Reports of expert meetings*

With regards to Energy Sector and data collection, there is a good harmonization between IEA and IPCC documents. For example, *the 2006 IPCC Guidelines* reference the *IEA Energy Manual*, and vis-à-vis the IEA Report on *CO_2 Emissions from Fuel Combustion* utilizes the methodology of the *2006 IPCC Guidelines*. IEA and IPCC took part in preparation of the International Recommendations for Energy Statistics (IRES).

Chapter on Data collection (Chapter 2 Volume 1 of the *2006 IPCC Guidelines*) contains a helpful guidance how to collect the data needed to produce GHG estimates. Different aspects are discussed: data sources, data collection (surveys, censuses, measurements and expert judgements), generation of data and adaptation for inventory purposes, collection of activity data and emission factors.

Volume 2 Energy of the *2006 IPCC Guidelines* provide with a methodology to estimate GHG emissions from energy sources, transport, including aviation and maritime, fugitive emissions. The fundamental methods are based on amount of a fuel burnt and its characteristics (net calorific values and carbon content). The method is rooted in the 1994 methodology produced jointly by IPCC/OECD/IEA.

Currently the IPCC has launched a new project to refine the *2006 IPCC Guidelines* - to produce *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement),* where the main energy-related concepts will not be revisited, like stationary and mobile combustion, but some attention will be dedicated to fugitive emissions and fuel transformation (*http://www.ipcc-nggip.iges.or.jp/home/2019refinement.html*).

Another pillar of TFI work is maintenance and improvement of the EFDB (*http://www.ipcc-nggip.iges.or.jp/EFDB/main.php)* which is an open library of emission factors and other parameters that can be used for estimation of national GHG emissions and removals. The EFDB is open to any data proposals. The data proposals submitted to the EFDB considered by Editorial Board for inclusion into the EFDB against three criteria: robustness, applicability and documentation.

Currently EFDB contains around 17 000 factors (for Energy – around 7000) with a majority of default emission factors from the IPCC guidelines. The population of EFDB with country-specific emission factors is a priority for IPCC TFI.

Methodology for calculating CO_2 emission factor waste gasses in the petrochemical sector

Sander Brummelkamp
Netherlands statistics CBS, Netherlands

Background

The petrochemical industry in the Netherlands is relatively large. The chemical sector which includes the petrochemical sector is responsible for 10% of the total CO_2 emissions in the Netherlands (http://opendata.cbs.nl/statline/#/CBS/nl/dataset/70946ned/table?dl=FF64).

The typical petrochemical process of cracking oil molecules into smaller olefine molecules by heating them up to 2000^{0}C requires a lot of heat. This heat is almost completely produced by burning the waste gasses that are the by-product of the cracking process. The waste gasses have no standard emission factor that can be used because the different petrochemical plants all produce their own waste gasses with a specific composition and specific calorific value and thereby emission factor. This document will explain how to calculate this specific emission factor for the burned waste gasses.

Methodology for obtaining the emission factor for waste gasses

To calculate the emission factor for waste gasses we require the total CO_2 emissions per petrochemical plant and the tonnes of burned waste gasses. Combined with the standard emission factors of the IPCC the unknown emission factor of the waste gas be obtained.

Data input

1. *Final use of energy products (Px). The statistics Netherlands monthly receives from every major petrochemical plant a questionnaire with a full mass balance of 36 energy products. From this data the amounts of every burned energy product, including the tonnes of waste gasses, per petrochemical plant can be obtained. The official standard calorific value is used to calculate the final use in TJ.*
2. *Total CO_2. Every large company in the Netherlands is obliged for the EU ETS system to report the total yearly CO_2 emissions to the NEA (the Dutch Emissions Authority).*
3. *The IPCC provides a standard table with the emission factors (EF) for every energy product except waste gas (EFwg) which are burned for final use in the petrochemical industry.*

Calculating the emission factor for waste gas

From the data above the calculation of the unknown waste gas emission factor is possible with one equation with one unknown factor.

Total CO_2 emission for single petrochemical company per energy product (EU ETS data) must be equal to:

$$\text{Total } CO_2\text{: SUM}=((TJP_1)*(EFP_1))+((TJP_2)*(EFP_2))....+((TJwg)*(EFwg))$$

Calculation of Emission Factor waste gas:

TJwg = known from data collection petrochemical industry, data per company

EFwg = can now be calculated

Typical EFwg = between 55 and 70 depending on the type of petrochemical factory

Alignment of the four main data sources for energy use in industry

Wolfgang Bittermann
Statistics Austria, Austria

Why and how….

Goal of the action is to improve data quality and to obtain the data breakdown needed to compile energy balances. The four data sources are:

- Material Input statistics (MIS): Energy and material consumption of the largest enterprises in the manufacturing industry, concentration sample survey, sample size some 3000 enterprises;
- Combined heat and power and electricity statistics (CHP): Electricity and heat production and corresponding fuel consumption;
- Short term statistics (STS): production of derived fuels, sample survey, sample size some 16 000;
- European emission trading system (EU ETS): Energy consumption of all plants participating in EU ETS, census.

From these data sources, only CHP is designed and conducted for energy statistics primarily. This results in the fact that the other three data sources have to be adapted to get the data breakdown needed. This is possible because the data sets overlap partly in both - respondents and consumption as well as production data.

The procedure:

- ✓ EU ETS provided by the Austrian Environment Agency (UBA)&MIS by Statistics Austria
  - → The information in the EU ETS about the **renewable share** of each energy source is used to calculate amounts of **industrial waste** (non-renewable), **wood waste** and **other solid biomass** (both renewable) and to apply this information to the MIS and CHP where applicable
  - → The EU ETS contains practical **calorific values** (CV) for biofuels and wastes, which are used to calculate **specific CVs by economic sector and regions** and to distinguish between **lignite** and **subbituminous coal**
  - → Fuel consumption of plants reporting in EU ETS but not in MIS are added to MIS
- ✓ EU ETS&CHP provided by E-Control
  - → The information in the EU ETS about the **renewable share** of each energy source is used to calculate amounts of **industrial waste** (non-renewable), **wood waste** and **other solid biomass** (both renewable) and to apply this information to the CHP where applicable
  - → **Calorific values** (CV) and fuel consumption in CHP and thermal electricity plants from EU ETS and CHP are compared and if necessary adjusted
- ✓ CHP&MIS
  - → the information of CHP is used to separate **sectoral final energy consumption** from **transformation inputs** for electricity and CHP production
  - → More detailed fuel specification in CHP is used to adjust MIS and *vice versa*
  - → Final energy consumption from CHP (consumption of energy for production of heat unsold by auto producers are added to MIS if missing)

- ✓ STS provided by ST AT&CHP&MIS
  - → If district heat output in **CHP > STS** → CHP is used for the energy balance
  - → If district heat output in **CHP < STS** → district heat output of CHP is subtracted from district heat output of STS, the rest is treated as non-CHP district heat
  - → Transformation input for the non-CHP district heat is calculated for energy sources from the MIS with calorific values from CHP
  - → To avoid double counting, the transformation input of each fuel for the non-CHP district heat is subtracted from the material input statistics

The alignment procedure results in a clear separation of transformation processes from final energy consumption without double counting. Additionally it guarantees the most detailed fuel breakdown and more realistic calorific values.

Energy statistics, design, data collection, methods from Sweden official statistical system used for editing in IPCC

Niklas Notstrand
Swedish Energy Agency, Sweden

Greenhouse gases have always been present in the atmosphere, but now concentrations of several of them are rising as a result of human activity, which intensifies the greenhouse effect. The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 and two years later, they concluded that anthropogenic climate change is a global threat, which needs to be addressed through an international agreement. The United Nations started negotiations on a framework convention on climate change (UNFCCC), which came into force in 1994.

Background of Energy statistics used in IPCC

The statistical system in Sweden is decentralized with 27 different authorities responsible for different areas in statistics. The 27 authorities are coordinated by Council of official statistics at Statistics Sweden. The history until today have been that all the authorities have by them self-selected how important quality and methodology are in their responsibility, this have to change, because peer review from Eurostat and our Government have said that the coordination and quality in the system have to be better. Statistics Sweden have a new responsibility by law and ordinance quality in the statistical system. In the Energy subject area Swedish Energy Agency (SEA) is responsible, and, for example, in climate Swedish Environmental Protection Agency is responsible. This means that in National Inventory Report (NIR) second editing from authorities (the statistics used to report climate, pollution to UN or MMR to Eurostat) is produced by a group association named SMED, which contains of members from actors and authorities, where somehow Swedish Energy Agency in past have been forgotten, but it is energy statistics, which have the biggest share of data from energy use in industry. This have been one factor that have played an important role in problems in the editing NIRs in past, for example, in area of quality, data transparency, methods used, calorific values, emissions, because the system of Sweden's case SMED with many players means that classifications and definitions have not been fully harmonized between different sectors and authorities. This is nowadays much better, we SEA have more interventions with Swedish National Protection Agency than we have had in past, but still one piece is missing and that is we have to have a more important role in SMED, but we are not still partners in the association, but we are progressing to be that.

Energy statistics. Design, Methods, Data collection

In SEA responsibility of energy statistics we conduct several surveys 27 and we have responsibility to do that in area Energy:

- Energy supply and use
- Energy balances
- Price trends in energy market

Most of our statistics are produced by Statistics Sweden (which can be the case of SEA been forgotten in the past). Statistics Sweden are in SMED taking care of the microdata and editing, modelling, combining all sources from other actors and authorities.

Nowadays SEA have an energy statistics database and there are more interventions that SEA take part of the data handling then before.

In the Industry field SEA request Statistics Sweden to produce a yearly Energy consumption in manufacturing industries, cutoff census from Business register at Statistics Sweden. The survey unit is work unit the cutoff is variable employee from 10 and above is included in the cutoff survey and between 1-9 is survey every 5 year in the Energy consumption in small manufacturing industries.

The industry field in SEA responsibility also produce a quarterly cutoff Quarterly fuel statistics which is a survey combined of cutoff in industry from the cutoff population of yearly manufacturing survey (cutoff boarder counted total energy consumption from work units in manufacturing survey above to 325 (approx. 1000 work units).

The MMR and the system for air pollution control conducted by Statistics Sweden nowadays use our quarterly fuel statistics as much as possible but for IPCC and other organizations I am sure that Energy balances, monthly fuel statistics, manufacturing survey and others are used.

Problems

Definitions, harmonizing standardization
None response
Different sources have different purposes
Not enough combined with the secure business register economic activities
Lack of data, non-coverage, not fully transparent reports, no talk about confidence in estimates.
Emissions differ
Net calorific values differ (different methodology)
IPCC standard is difficult to find harmonized indicators nationally (different definitions between purposes of process, work unit in IPCC report) than in the energy statistics where microdata is collected.

Fuel data collection for energy statistics and GHG inventory in Finland, energy and industrial sectors

Kari Grönfors

Greenhouse gas inventory unit, Statistics Finland, Finland

Statistics Finland, Environment and Economy department, has two units working on energy issues:

- Environment and energy unit/energy team is responsible for energy statistics, energy balance and international reporting;
- GHG inventory unit is responsible for calculation of emissions from energy and industrial processes (except F-gases) and compilation of all sectors, and also reporting of inventory submissions.

Both units work side-by-side, in daily co-operation. Energy statistics and GHG inventory are largely based on plant/installation-level data, which are collected by separate organizations.

The most important data sets are:

Finnish Energy Federation and StatFi	survey for electricity and heat production (all power plants, heat plants > 5MW), total number around 400
StatFi	energy consumption survey for manufacturing industry, around 3000 industrial plants/local units
Regional environment offices	emission register, 2000 plants/installations (mostly in energy production and industrial sectors)
Finnish Energy Authority	EU ETS data (>600 installations)

These data sets are largely overlapping. There are also separate supporting data sets, for example wood consumption survey, biogas register etc. Plant/installation level data covers around 65 % of total combustible fuels used in Finland. EU ETS data covers around 60 % of total fuels and almost 90 % of fuels used in energy and industrial sectors (in 2016).

Around half of the fuels used in energy and industrial sectors are biomass (mostly different types of wood fuels: black liquor, bark, sawdust, forest residues etc.)

EU ETS data and emission register data include fuels used in physical quantities as well as in energy units (TJ). Other data sets include usually only energy content (TJ or MWh).

StatFi combines plant level data from all sources mentioned above, choosing the best (most reliable) data for each plant in the cases where figures are different in separate data sets. Country-specific annual average NCVs are calculated for the most important fuels based on EU ETS and emission register data. Correspondingly, annual CO_2 emission factors are calculated based on EU ETS data.

StatFi maintains the list of fuels (Fuel classification), that is obligatory in EU ETS data collection and mostly used in other fuel data collection systems (see www.tilastokeskus.fi/polttoaineluokitus, also in Swedish and English).

Fuel classification gives national default values (NCV, CO_2 EF and oxidation factor) for each fuel type and default densities in some cases. These default values can be used in EU ETS reporting in the case of minor fuel uses. For major fuel uses the NCV and CO_2 EF need to be measured. Default values have been estimated by StatFi based on previous years' calculated average values. In the case of those fuels that are less covered by EU ETS (mainly transport fuels, gasoil and LPG), StatFi updates default values, more or less regularly, in co-operation with refinery staff and fuel importers.

Addendum. The case of fossil diesel oil

The default values of fossil diesel in were updated 2015, based on measurements made in 2013. At that time we saw the first signs of paraffinic diesel, and based on that we guessed a small correction to density.

Since the latest update we have used the same density 835 kg/m^3 for fossil diesel. However, the share of paraffinic diesel has grown up to some 40-50% of fossil content. The density of paraffinic diesel seems to be somewhere between 800 and 810, and we have to take that into account. This means, that we have to revise/recalculate data on diesel oil, probably for 2014-2016.

We are still waiting additional data on the annual shares/amounts and properties of paraffinic diesel (density, NCV, carbon content) from the refineries and from the importers.

We have the data on bio-components available, but the changes in the fossil components change total amount of diesel in tonnes, terajoules and also CO_2 emissions.

Data collection and validation in the Energy and Industrial sectors in the UK

Sam Bradley and Anna Mikis

Greenhouse Gas Inventory, Department for Business Energy and Industrial Strategy, UK

The United Kingdom's greenhouse gas inventory relies on the Digest of UK Energy Statistics (DUKES) and the EU Emissions Trading Scheme (EU ETS) for the majority of its Energy and IPPU figures. DUKES is the UK government's primary means for data collection on energy use. The DUKES team has a core statistics unit split into teams that cover different fuels, and a separate team with individuals seconded in different policy areas. This ensures that the DUKES team is kept up to date with any relevant changes in policy.

The DUKES team collects data from energy providers, such as refineries, upstream oil and gas companies, gas suppliers, and other agencies in a monthly census. Data is usually collected and collated between the 5th and 20th of every month, and then submitted to the IEA and EU and published on the DUKES website. Failure of an organisation to provide data can result in fines. Data is provided on a range of standard excel forms and submitted through a secure portal to ensure confidentiality and to protect commercially sensitive data.

Quality assurance is conducted internally through statistical analysis of the data, externally by the UK statistics authority, and through audit and engagement exercises run by the DUKES team. Audits take place every 12 to 18 months, while engagement exercises run more frequently. The most rigorous assurance is the audit the DUKES team carry out with substantial suppliers of oil (refineries and large importers). These site visits take randomly selected numbers from the return and compare these with the companies' paper and electronic records to assess accuracy. Several improvements have been made thanks to this method, including improvements to the sectoral analysis of sales and identification of the need for other surveys (e.g. a resellers survey the team are in the process of launching). Effective QA requires excellent relationships with all parties to ensure that data collection is smooth and unobstructed.

A large part of the data that contributes to the inventory is not captured by DUKES. Carbon factors and non-energy uses come primarily from the EU ETS and from engagement with stakeholders in the energy and industrial sectors. The EU ETS is also used to help validate and update DUKES figures. For example, petroleum coke used as a reductant in industrial processes is not captured by DUKES as it is a non-energy use process. However, the inventory agency was able to determine that by-products from its use are utilised as a secondary energy source and should be included in the inventory as such. Similarly, the petrochemical industry has a number of examples where its by-products are not picked up by DUKES.

Prior to the EU ETS, the UK Greenhouse Gas Inventory relied on relationships with individual energy suppliers and industry bodies, such as Tata steel and the UK Petroleum Industry Association for data. The EU ETS now collates this information; however, these relationships are still maintained to help validate and clarify the data where it is needed. The strong relationship between the UK Government and the industries is beneficial for both sides: the UK inventory is supplied with reliable data, and the industries are accurately reflected in the inventory.

Energy data in the National GHG Inventory of Costa Rica

Kendal Blanco Salas

National Meteorological Institute, Costa Rica

Costa Rica is a small country located in Central America. Its economy is based on services, mainly tourism; also, there is great income generation due to agricultural exports and specialized manufacturing such as medical devices. For the year 2016 the population reached 4890000.

Of the 11250 kt of net equivalent carbon dioxide emitted during 2012, 7213 kt corresponded to the energy sector, that is, 64% of the national total. The behaviour of the energy sector in Costa Rica is not common. Barely 8% of the total emissions of the sector are due to the use of fuels for electricity production, leaving the transport as the largest emitter with about 5000 kt of CO_2 equivalent for 2012 and an average annual growth close to 5% for the period 1990-2015.

Costa Rica, through the Costa Rican Institute of Electricity (ICE), has extensive experience in the production of energy using hydroelectric, wind and recently solar generation, reaching in 2015 and 2016 a production of electricity from these sources above 95% of the total.

The National Meteorological Institute estimates greenhouse gas emissions included in the National Inventory and is in charge of the activity data collection. In the case of the energy sector, the methodology used to the 2012 inventory presented in 2015 was a tier 1, using default emission factors and following the 2006 IPCC Guidelines. The main source of activity data is the national energy balance, but the data is also obtained from the institutions in charge of fuels and electricity in the country. The information obtained from both sources is cross-checked and quality control processes are performed.

Costa Rica has a national biofuel plan that includes important studies on production and use; however, production and consumption have not yet reached the large scale. As reference there is a pilot plan carried out by the Costa Rican Oil Refinery (RECOPE) in the 2006-2010 period, which consisted in the addition (1.3%-4.5%) of ethanol to gasoline in the central and northern pacific area of the country, avoiding the emission of 23100 tons of CO_2 at the end of the period. This pilot plan is planned to restart in 2018 increasing the addition up to 10%. Regarding biodiesel, two plants sell to external users but are limited by legislation.

The improvement plan includes, in the short term (first half of 2018), a sampling of fuels for the determination of carbon content and calorific value to obtain an emission factor for CO_2, this sampling will includes fossil fuels of greater consumption in the country. In the long term, it is expected to have more disaggregated activity data including vehicle types and average annual distance travelled by the vehicle to be able to use other tiers following the *2006 IPCC Guidelines*.

The IEA data work on calorific values

Roberta Quadrelli

Energy Balances, Prices, Emissions, Efficiency; IEA Energy Data Centre

While the energy data collection generally focuses on physical quantities, accurate data on calorific values are essential to develop sound energy balances and greenhouse gas inventories.

Calorific values measure the quantity of energy per unit of mass or volume of any given fuel; and vary by product, from flow to flow (for example imports versus production) and over time, as quality of products generally vary. Values vary greatly for primary products, such as coal, oil and natural gas.

The IEA collects data on calorific values from countries that submit annual questionnaires; in other cases, information on calorific values is scarcer and default values are used.

More information on ranges of calorific values by products is available at the IEA annual questionnaires (*http://www.iea.org/statistics/resources/questionnaires/annual/*) and within the United Nations International Recommendations on Energy Statistics (IRES) *(https://unstats.un.org/unsd/energy/ires/IRES-web.pdf).* As international guidance has been developed coherently with the IPCC community, default values are consistent across international sources, and can be used in the absence of national data.

However, given the importance of such data in determining the quality of balances and inventories, the IEA strongly encourages countries to develop their own data collection for calorific values, at least for the most important products nationally. Examples of methodologies across countries include use of administrative sources (like refineries, coal trade companies, industrial users, etc.) or specific measurements of samples.

A key enhancement of data quality for inventories will certainly be achieved – for calorific value as for broader sets of energy data – through stronger exchange at national level among inventory and energy statistics experts. The IEA is willing to support such effort, globally.

Measuring industrial energy and GHG emissions – iron & steel and petrochemicals

Araceli Fernandez

International Energy Agency

The IEA analysis of the industry sector is a key component of several IEA deliverables, such as modelling and scenario analysis; technology roadmaps; and tracking reports. In particular, the IEA has developed - together with the international community working on energy efficiency - a methodological framework to track energy efficiency progress(manuals available here:https://webstore.iea.org/energy-efficiency-indicators-fundamentals-on-statistics), with industry as one of the key sectors analysed.

A range of indicators can be used to track energy efficiency progress in industry, with particular value of those metrics that are specific to the physical production output (e.g. energy use/emissions per unit of tonnes steel produced) or even the type of process/technology (e.g. shares of BOF- and EAF-based production).

Collecting appropriate data is associated with a set of challenges, such as the highest degree of detail needed, boundary issues for definitions, standardisation, and confidentiality – as the most detailed data are typically collected by companies or industry associations and may not always be available to the public. Some private international initiatives exist for industrial data collaboration (such as World Steel; Cement Sustainability Initiative, World Aluminum), with generally aggregated metrics available and more detailed indicators only shared across members.

Besides encouraging cooperation across organisations to enhance information sharing for data that are meaningful for country analysis/reporting but aggregated enough not to bypass confidentiality concerns, the IEA also values the option of using best available technology energy performance information as a benchmark, when country-specific actual performance information is not available.

USA–Specific Emission Factor Development

Gregg Marland, Vincent Camobreco, and Leif Hockstad, US EPA, USA

Estimating CO_2 emissions from fossil fuel combustion requires data on the quantity of fossil fuel consumed, as measured in some units of activity that are related to the carbon content of the fuel, and a coefficient (an emission coefficient) that expresses the amount of contained carbon in terms of those same units of activity. If, for example, the activity data are expressed in terms of the tons of fuel consumed, the emissions coefficient must be expressed in terms of tons of carbon per ton of fuel. Coal is an extremely variable fuel but we show that there is a strong relationship between the energy content of coal and its carbon content. If the amount of coal consumed can thus be expressed in terms of energy units (e.g., joules) and the emissions coefficient in tons of carbon per energy unit (e.g., joule), we can accurately estimate the total amount of carbon released on combustion. There is similarly a useful relationship between the energy content of natural gases and their carbon content. For liquid fuels the relationship between energy content and carbon content can also be used, for consistency, although it may often be easier to go directly from tons of mass to tons of carbon if the specific fuel is well defined.

The U.S. Environmental Protection Agency has access to a large amount of data on the chemical and physical properties of fossil fuels and is thus able to accurately estimate emissions of CO_2 from fossil fuel combustion. This extensive database and the derived emissions coefficients may be useful to other countries that are consuming similar fuels but have less access to detailed chemical and physical data.

The largest challenge for other countries to use or compare with U.S. emissions coefficients is that the U.S. uses units of measure that are not consistent with those of most international analysts. For example, heat content may need to be converted from BTUs to joules and adjusted from the Higher Heating Value (Gross Heating Value) to the Lower Heating Value (Net Heating Value), and other conversions may be necessary as well.

In this presentation, we provide reference to the publication that details U.S. CO_2 emissions from combustion of fossil fuels and that derives the emissions coefficients used (https://www.epa.gov/sites/production/files/2016-03/documents/us-ghg-inventory-2015-annexes.pdf). We also show the basic framework of data collection behind the U.S. emissions estimates. The coal coefficients are based on 7,092 samples from the many coal deposits across the U.S. and the natural gas coefficients are based on 6,743 samples. The data are sufficiently extensive to illustrate the range of variability among samples and to show that the mean values change with time but over a relatively small range. We show some of the data in both common U.S. and preferred international units.

Finally, we illustrate that a large fraction of global CO_2 comes from a relatively small number of large point sources and argue that international monitoring, reporting, and verification could be facilitated if countries reported both national total emissions and emissions from their largest point sources.

Recommendation of Draft Revised Standard Calorific Value and Carbon Emission Factor for Fossil Fuel Energy Sources in Japan: 2013 FY revised standard calorific value and carbon emission factor

KAINOU Kazunari

Research Institute for Economy, Trade and Industry (RIETI), Japan

The author quantified Japanese standard Gross Calorific Value and Carbon Emission Factor for various fossil fuels used in Japan upon the request of the Ministry of Economy, Trade and Industry and the Ministry of the Environment under the cooperation of relevant industrial organizations by the request of these Ministries, using real measured physical and chemical data and calorific value in 2013.

The revised standard values have several unique natures compared to the current one as follows:

- *The standard values are comprehensive and clearly traceable from the real measurement data of physical, chemical characteristics and calorific value of fuels and the data process and treatment.*
- *The gross calorific value and carbon emission factors are simultaneously measured from the same samples in a consistent manner, different from the current standard values.*
- *The interpolation and approximation equations are estimated using these data and that enabled estimation for minor energy sources and adjustment of small changes of physical, chemical characteristics for major energy sources.*

As a result, highly accurate and up to date standard gross calorific value and carbon emission factor are measured for various fossil fuels used in Japan listed in the current standard. So the author recommends the revision of the standard values.

Moreover, based on the revision works, the author proposes several changes and amendments of energy origin CO_2 emission quantification and estimation process in Japanese greenhouse gas inventory system under the UNFCCC.

[https://www.rieti.go.jp/en/publications/summary/14100003.html]

Emission Factors for Fossil Fuels in Germany

Kristina Juhrich

German Environment Agency (Umweltbundesamt/UBA), Germany

Abstract of the presentation

Germany is the largest greenhouse gas emitter in Europa. Although the use of renewable energy for power generation increased remarkably during the last ten years, there is still a large number of coal-fired plants in operation. Additionally, the energy intensive industries like iron & steel, refineries and the production of chemicals are important emission sources in Germany. After the introduction of the EU ETS in 2005, a large amount of high quality measurement data including the carbon contents and net calorific values (NCV) became available.

Many calculated emission factors from ETS were aggregated and explained in the publication: "Emission Factors for Fossil Fuels in Germany" in order to provide a quotable source. Furthermore, the unpublished results of a measurement project on natural gas and lignite briquettes were included into the publication. Therefore, it was possible to suggest CO_2 emission factors for several different fuels: for raw lignite from different regions, lignite products, hard coal, and natural gas from different regions, derived gases from iron & steel production as well as petroleum products for the emission factor database (EFDB). Additional information on the NCV is also available. This is especially useful since the strong correlation between the NCV and the carbon content should be always considered.

N_2O and CH_4 emissions from stationary combustion plants are of minor importance. Nevertheless, country specific data is available in Germany, derived from a measurement project from the VGB PowerTech, published in the study: "Fortschreibung der Emissionsfaktoren für Feuerungs- und Gasturbinenanlagen nach13./17. BImSchV und TA Luft". The results show higher emissions than expected, therefore the German emission factors are even higher than the default values. Since the non-CO_2 emissions depend on the combustion technology used, it is important to publish this information in the EFDB as well.

Discussion with the IEA on hard coal species

Structure and fuel categories of the emission factor database follow the IPCC Guidelines, which in turn follow the IEA data structure. Hard coal is differentiated into anthracite, coking coal, other bituminous coal and sub-bituminous coal. The German energy statistic as well as the external trade statistic do not provide the information on coal at such a detailed level, and many other countries face similar problems. The emission trading scheme (ETS) data system does not contain any information on this either. Therefore, only expert estimates can be used, usually with a high degree of uncertainties. An exception is coking coal, which can be easily identified as coal used in coking plants. This particular information is also important for the calculation of CO_2 emissions of the iron & steel sector. But all the other coal species cannot be determined.

In contrast to other countries, the German ETS system has no restrictions regarding the fuel designation. Therefore, many detailed information is available. However, in many cases additional declaration refers to the fuel origin. The fuel categories "other bituminous coal" and "sub-bituminous coal" do not play a role in the system. ETS data were used to calculate weighted average emission factors of the hard coal mix, which is used in different sectors. An information on fuel specific subcategories is not available and not necessary for the CO_2 calculation. In the GHG Inventory, hard coal can directly be allocated to the subordinated fuel category: “solid”. Using an intermediate fuel levels like bituminous coal increases complexity but not necessarily the data quality.

Net Calorific Value and Carbon Content of fuels used for estimation of the GHG emissions in Belarus, Energy Sector

Dzmitry Melekh

Belarusian Research Center Ecology (RUE "Bel SRC "Ecology"), Belarus

The Republic of Belarus is an Annex I Party to the Convention. Currently, Belarus is country with the economy in transition. The Republic of Belarus is a European country with the medium area and the population size. Belarus locates in Central and Eastern Europe.

The main legal documents that regulate the inventory process and the preparation of GHG inventories in the Republic of Belarus are:

- *Resolution of the Council of Ministers of the Republic of Belarus of 10.04.2006, N485 "On Approval of the Regulations on the Procedure of the State Inventory of Anthropogenic Source Emissions and Greenhouse Gases Sinks Absorption"[1]. Preparation of the state inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases is delegated to the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus (hereinafter - the Ministry of Natural Resources).*
- *Resolution of the Council of Ministers of 4.05.2006, N585 "On Approval of the Regulations on National Greenhouse Gas Inventory System"[2].*
- *Order of the Ministry of Natural Resources N417 of 29.12.2005 on the Appointment of RUE Bel SRC "Ecology" as a GHG Inventory Centre.*

Thus, a legal mechanism to ensure preparation of GHG inventory on an annual basis, its revision according to UNFCCC requirements is established in the country. Ministry of Natural Resources is the coordinating body that ensures the functioning of the national GHG inventory system, timely collection of the activity data, as well as submission of the National Inventory Report (NIR) to the UNFCCC Secretariat.

Also, the Republic of Belarus has adopted the Law "On Technical Regulation and Standardization". The national state bodies within the limits of one's authority organize the development of the Technical codes of common practice (TCCP) based on the results of general practice according to the above mentioned Law.
So, the Ministry of Natural Resources adopted the following TCCP:

- *Technical code of common practice 17.08-01-2006 (02120) "The procedure for determining emissions from fuel combustion in boilers with a heat release of up to 25 MW"*
- *Technical code of common practice 17.09-01-2011 (02120) "Rules for the calculation of emissions for the account of implementation measures for energy saving, renewable energy sources"*

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[1] National Law Registry of the Republic of Belarus, 2006, #59, 5/22174.

[2] National Law Registry of the Republic of Belarus, 2006, #73, 5/22273.

Net calorific value (TJ/kt) and Carbon content (kg/TJ) of Patent Fuel, Residual Fuel Oil and Diesel Oil were provided for the IPCC Emission Factor Database according to abovementioned TCCP.

Type of fuel	Net calorific value (TJ/kt)	Carbon content (kg/TJ)
Patent Fuel	16.59 – 17.37*	27064.5 – 27115.7**
Residual Fuel Oil	39.64 – 40.48*	20787.1 – 21319.2**
Diesel Oil	42.44 – 42,71*	19503.6 – 19627.7**

** from Annex A of the TCCP 17.08-01-2006 (02120)*

*** calculated according to Equation 6 of the TCCP 17.09-01-2011 (02120)*

Data for the IPCC Emission Factor Database
CO_2 emission and conversion factors for Energy sector
(Results from the scientific and technological project "Studies on country-specific GHG emission and removal factors for Mongolia" Namkhainyam B. et al., 2014)

Tegshjargal Bumtsend

Climate Change Project Implementing Unit (CCPIU) of the Environment and Climate Fund (ECF) under the Ministry of Environment and Tourism (MET), Mongolia

In order to improve further the quality of the GHG Inventory and emissions results, there was a need to estimate GHG emission and removal factors based on country own coal research data. For this purpose, the Ministry of Environment and Green Development of Mongolia has decided to implement the project "Studies on country-specific GHG emission and removal factors for Mongolia" and raised fund from Mongolian Foundation for science and technology. The executing institution was the Mongolian University of Science and Technology and the project has been implemented for the period 2012-2013 with the participation of experts and researchers from each sector including all sources of GHG emissions and removals.

This kind of study conducted for the first time in Mongolia and includes energy, transport, industry, cropland, animal husbandry and waste economic activities. As a result of this project, the accuracy of activity data and GHG emission and removal estimates will be improved. The baseline data required for GHG emissions Inventory and mitigation estimates, but not included in the national statistical yearbooks, are studied and determined. These include:

For energy sector:

- *the characteristics of the commonly used fuel types (coal, liquid fuel, dung, wood etc.);*
- *the characteristics of the stoves used and their combustion efficiency;*
- *coal specifications for all types of coal in Mongolia;*
- *energy conversion factor (net calorific values) for commonly used coal types;*
- *carbon content for biofuels (dung and fuel wood);*
- CO_2 *emission factors for commonly used coal types.*

For industrial sector:

- *conduct a research on food industries, which emitting the GHG emissions;*
- *technological features of cement and lime industries.*

For agriculture sector:

- *number of cattle;*
- *average weight of cows, horses, camels, sheep and goat;*
- *daily manure from above animals.*

For waste sector:

- *the volume of waste per capita a day;*
- *percentage of total waste on waste disposal points;*
- *contents and classification of organic substances in solid household waste, etc.*

GHG emission factors, carbon content and heating value of Indian coals

Ajay Kumar Singh
Private Consultant, India

Presentation provided an overview of India's demographics profile and emphasized that for a large country like India with its over 1.20 billion population and high economic growth rate, no single energy resource can meet the rapid growth in energy demand. Special focus was laid on the current energy mix of the country including non-carbon emitting resources comprising hydro, nuclear and other renewables and it was underscored that coal is India's energy security and will continue to be the primary source of energy in the foreseeable future. A key point highlighted was the importance of coal in India's energy scenario as well as the other following topics:

1. Occurrence of Coal in India in two geological provinces viz. Gondwana in eastern and central part of peninsular India and Tertiary in north-eastern India. While Gondwana coals are of bituminous to sub-bituminous rank with moderate to high in ash and low in Sulphur, tertiary coal are of meta and ortholignitous rank of high sulphur content and strongly caking to non-caking characteristics.
2. Occurrence of lignite in the western and southern India was also discussed. Lignites are high in moisture and volatile matter.
3. General characters of coking and non-coking coals of Karharbari, Barakar and Raniganj formations were provided.
4. Depth-wise and category-wise resource of Indian coal was presented. With a total geological resource of about 315 billion tonnes as on 1st April 2017, coal forms the back bone of India's energy scenario.
5. An overview of prevalent quality classification system of coking, semi-coking, weakly coking and non-coking coals along with new GCV based classification system of non-coking coal was given.
6. NCV and CEF of coking and non-coking coals and that of lignite were presented. It was highlighted that most CO_2 emissions comes from the combustion of fossil fuel especially coal for electricity generation.
7. However, while data collection is a big challenge but efforts are underway to estimate GHG emissions from the individual power plants.
8. National methane emission factors for estimating fugitive methane emissions from coal mining and handling activities were also furnished. It was stated that 90% of Indian mines are surface mines and are fast depleting. Methane emission inventory has been conducted in about 100 mines out of the 400 mines in India and this has helped to improve the credibility of their GHG inventory report.

Fuel Value Indices of selected woodfuel species in Masindi and Nebbi districts of Uganda

Samuel Ojelel
Makerere University, Uganda

Biomass currently meets 94% of the total energy requirements in Uganda. However, contrary to this heavy reliance on biomass, there is paucity of information regarding the fuel value indices (FVIs) of woodfuel species used in different locations of the country such as Masindi and Nebbi districts. This study therefore sought to identify ten woodfuel species commonly used by the communities in these two districts and examine their FVIs from basic properties, namely: moisture content, density and gross calorific value. A semi-structured interview using a checklist of guiding questionnaire was conducted to generate a woodfuel species list. The familiarity index (FI) was calculated for each species and then used to rank ten commonly used species for further analysis. The moisture content, density and gross calorific value of the selected species were determined in triplicate. The FVI of each species was then determined from these basic properties. One-way ANOVA, Pearson product moment correlation, and Spearman rank correlation coefficient analyses were performed in SPSS ver.16.0 to examine the variation and relationship of variables. Ten woodfuel species belonging to seven families and eight genera were identified as commonly used species. Combretum collinum was mentioned by every respondent as a suitable woodfuel species. A significant variation in moisture content and density was recorded among the species ($F(df = 9) = 92.927$, $p = 0.0001$) unlike in gross calorific value ($F(df = 9) = 1.400$, $p = 0.253$). There was a positive correlation between density and gross calorific value ($r = 0.895$, $n = 30$, $p = 0.0001$) and a negative correlation between moisture content and gross calorific value ($r = −0.518$, $n = 30$, $p = 0.003$). The FVIs obtained ranged from 1.10 in Ficus natalensis to 13.09 in Albizia grandibracteata. There was also a positive relationship ($rho = 0.62$) between FVIs and FIs using Pearson rank correlation coefficient. Moisture content and density are more important properties in the selection of woodfuel species than gross calorific value. On the proposition of the FVIs, A. grandibracteata is a suitable woodfuel species than F. natalensis. These findings fit well into the ongoing efforts by Government and Civil Society Organizations to encourage woodlot management to ensure the sustainability of woodfuel in the country.

Worldsteel CO_2 Data collection process and methodology

Henk Reimink

World Steel Association

Worldsteel has developed a data collection system with its members since 2009 till the present.

This system has now been used for a decade and refined over that time, the basic principles have been maintained and strengthened were necessary. The calculation method and process has been enshrined in a ISO standard (ISO 14404 pt. 1,2,3 in 2013) for the three main process routes, iron ore route using the blast furnace and basic oxygen furnace (BF-BOF), the scrap route using the Electric Arc Furnace (EAF) and the iron ore route using direct reduction process combined with the EAF unit.

The system considers a site as a total operating unit with all inputs and outputs calculated using a mass balance model, it covers scope 1,2,3 with credits for by-products excluded as this is still not an agreed method with other industries.

A comprehensive user-guide is available publicly and data submission system is available to steel producers whether they are a member of *worldsteel* or not.

The data is submitted annually by *worldsteel* members using a secure web based system and in a anonymous way. The annual reports provided to the data submitting company identifies each site on a pareto chart on how they perform compared to other sites using similar routes (over 200 sites submit each year).

The data is analysed by *worldsteel* for anomalies and finally approved by the submitting company making the data theirs to own.

Over the past decade the system has been refined to make submission easier and include other product types as well such as stainless steel producers.

Conversion factors on the CO_2 intensity per unit of production have been measured and agreed and used consistently in the industry, or international acceptable factors are used from reports from the IEA or World Resource Institute for instance for a global electricity mix.

One key factor that is the most significant is the split in the process routes, which has moved significantly in favour of the iron ore route (BF-BOF) and dropped in proportion for the scrap route mainly due to the rapid expansion of the steel industry nearly doubling the steel making output over two decades. In 2016 the split was 75:25 for iron ore and scrap respectively for the 1627 million tonnes of crude steel produced in that year.

The scrap uprising in future years once the material is recycled following its end of life will increase in proportion as well, the time lag varies according to where the steel is used naturally and ranges from weeks to centuries and an average of approximately 42 years before it is reproduced into a new product of the same or better quality steel.

Improvement of Data Collection in Malaysia GHG Inventory for Petrochemical and Iron & Steel Industry

Ee Sann Tan, Grace Pua, Asnani Aida Nawawi, Elizabeth M. Philip, Kok Seng Yap, Jaya S. Rajoo,

Universiti Tenaga Nasional (UNITEN) / Ministry of Natural Resources and Environment, Malaysia

The presentation enables information sharing of Malaysia's national data and emission factors used for the calculation of GHG Inventory in the Iron & Steel industry and Petrochemical industry. These two industries are the key categories for the country's GHG inventory in the Industrial Processes and Product Use (IPPU) sector.

In addition, there will be sharing on how Malaysia overcomes the challenges in this subsector through the engagement of stakeholders from the industries to participate via a Non-Disclosure Agreement (NDA). The outcome of the NDA has enhanced the inventory data quality and enabled the use of higher tier methodologies for both subsectors. This exercise has also reduced much of the overestimations of GHG emissions in the time series, particularly in the iron and steel production of the country.

Although the use of country-specific emission factor is not yet apparent in Malaysia, one of the key manufacturers is currently using Tier 3 methodologies to estimate the GHG emissions within its own company's boundaries. This presentation would allow avenue for discussions on the acceptance of IPCC in using plant-specific emission factors.

Proposal for streamlining Tier 2 methodology for ethylene production and estimated emission factors based on Russian data

Ekaterina Imshennik
Institute of Global Climate and Ecology, Russia

Carbon mass balance approach is proposed as Tier 2 methodology for CO_2 emission estimation for all source categories in petrochemical industry (*2006 IPCC Guidelines*, Volume 3, Part 1, p. 3.67, equation 3.17).

The Tier 2 carbon balance methodology seems to be time and resource consuming. A lot of data from many facilities should be collected to implement this methodology properly. The Tier 2 methodology looks more like Tier 3 (facility level) methodology.

Implementation of this approach for CO_2 emission estimation from ethylene production may cause problems and will not result in solid and reliable emission estimates.

A source of CO_2 emission from steam cracking process is combustion of some secondary products of the process. All other potential sources of emissions are negligible because steam cracking process is carried on without oxygen. Most of the secondary products are marketable chemicals. Only few of them are likely to be combusted for energy recovery.

Alternatively, the amount of combusted secondary products can be calculated using feedstock-product matrix on the base of proportions between these products and ethylene output. It is not necessary to collect information on amounts of feedstock used and other secondary products output. Using this approach only the data on ethylene production disaggregated by feedstock used should be collected. National emission factor for every type of feedstock can be derived from relevant feedstock-product matrixes.

Equations for CO_2 emission estimation are presented below:

$$ECO_2 = \sum_j EF_j * MEP_j$$

$$EF_j = \frac{\sum_i (FP_{ij} * C_i) * 44/12}{EP_j}$$

ECO_2 = CO_2 emission from ethylene production, *tonnes*

EF_j = CO_2 emission factor for feedstock ***j***, *tonnes CO2/tonne ethylene produced*

FP_{ij} = output of secondary product ***i*** combusted for energy, for feedstock ***j***, *tonnes*

C_i = carbon content of combusted secondary product ***i***, *tonnes C/tonne product*

EP_j = ethylene output for feedstock ***j***, *tonnes*

MEP_j = total annual ethylene production from feedstock ***j***, *tonnes*

Feedstock specific CO_2 emission factors were estimated on the base of Russian ethylene producing industry information as presented in table 1.

Table 1

tonnes CO_2/tonne ethylene produced				
Naphtha	**NGL**	**Ethane**	**Propane**	**n-Butane**
2.37	1.88 – 2.07	0.33 – 0.41	1.70 – 1.90	1.72 – 2.00

Source:

1. Mukhina T.N., Baranov N.L., Babash C.E. et al. Steam cracking of hydrocarbon feedstock Moscow, Khimiya, 1987, 240 p. (in Russian)
2. Akhmediyanova R.A., Rakhmatullina A.P., Shaykhutdinova L.M. Technological processes of natural gas processing and use., St. Petersburg , Professiya, 2016, 368 p. (in Russian)

Agenda (Draft)

Joint IPCC/IEA Expert Meeting on Data: Energy data collection, energy statistics and data for EFDB – 15th Expert Meeting on Data for the IPCC Emission Factor Database (EFDB)

13-14 December 2017
Paris, France

Day 1 – Wednesday, 13 December	9:00 - 09:30	Registration
	09:30 - 10:15	Welcome and Introduction: • Welcome address – IEA – Paul Simons (Deputy Executive Director) • Welcome address – IPCC – Kiyoto Tanabe/Eduardo Calvo Buendia (IPCC TFI Co-Chairs) • IPCC presentation – Andrej Kranjc (Head of IPCC TFI TSU) • IEA presentation – Duncan Millard (Chief Statistician and Head of Energy Data Centre)
	10:15 - 13:00	1. Data collection practices and methods of measurements in Energy and Industrial Sectors. International cooperation on enhancing data quality Presentation by experts: • Sander Brummelkamp (Netherlands) • Wolfgang Bittermann (Austria) • Niklas Notstrand (Sweden) • Kari Grönfors (Finland) • Sam Bradley&Anna Mikis (UK) • Kendal Blanco Salas (Costa Rica) • Roberta Quadrelli (IEA) • Araceli Fernandez Pales (IEA) Discussion

Day 1: Coffee break: 11:00 and 16:00

Lunch: 13:00-14:15

Cocktail: 17.15-18.30

<table>
<tr><td rowspan="2">Day 1 –

Wednesday,
13 December</td><td rowspan="2">14:15 -17:15</td><td>2. Population of the EFDB with data on following topics:

2.1 Fuels: calorific values, carbon content and GHG emission factors

<u>Presentation by data providers:</u>
• Gregg Marland (USA)
• Kazunari Kainou (Japan)
• Kristina Juhrich (Germany)
• Dzmitry Melekh (Belarus)
• Tegshjargal Bumtsend (Mongolia)
• Ajay Kumar Singh (India)
• Samuel Ojelel (Uganda)</td></tr>
<tr><td>2.2 Iron&Steel and Petrochemicals: statistics and GHG emission factors

<u>Presentation by data providers:</u>
• Henk (Jan Hendrik) Reimink (WSA)
• Tan Ee San (Malaysia)
• Ekaterina Imshennik (Russian Federation)</td></tr>
<tr><td rowspan="2">Day 2 –

Thursday,
14 December</td><td>9:30-16:00</td><td>3. Consideration of data proposals
• Fuels: calorific values, carbon content and GHG emission factors
• Iron&Steel and Petrochemicals: statistics and GHG emission factors

<u>Break-out Groups (BOGs): Energy and IPPU:</u>
Consideration of data proposals for inclusion into the EFDB and interaction between data providers and EFDB Editorial Board Members of Energy and Industrial Processes & Product Use (IPPU) sectors</td></tr>
<tr><td>16:20-18:00</td><td>Wrap-up: Reports from BOGs. Close the meeting</td></tr>
</table>

Day 2: Coffee break: 11:00 and 16.00

Lunch: 13:00-14:30

Amr Mohamed Osama Abdel-Aziz
Integral Consult
Egypt

Wolfgang Bittermann
Statistics Austria
Austria

Kendal Blanco Salas
National Meteorological Institute
Costa Rica

Sam Bradley
Department for Business, Energy and Industrial Strategy
UK

Sander Brummelkamp
Netherlands statistics CBS
Netherlands

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Climate Change Project Implementing Unit (CCPIU) of the Environment and Climate Fund (ECF) under the Ministry of Environment and Tourism (MET) of Mongolia
Mongolia

Eduardo Calvo Buendia (TFI Co-chair)
Universidad Nacional Mayor de San Marcos (UNMSM)
Peru

Laura Elena Dawidowski
National Atomic Energy Commission
Argentina

Amit Garg
Indian Institute of Management Ahmedabad
India

Dario Gómez (EB Co-chair)
Comisión Nacional de Energía Atómica
Argentina

Kari Juhani Grönfors
Statistics Finland
Finland

Tatsuya Hanaoka
National Institute for Environmental Studies
Japan

Rana Humbatova
SOCAR
Azerbaijan

Ekaterina Imshennik
Institute of Global Climate and Ecology
Russia

Kristina Juhrich
Umweltbundesamt
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Kazunari Kainou
RIETI: Research Institute for Economy, Trade and Industry, IAI, Government of Japan
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Inga Konstantinaviciute
Lithuanian Energy Institute
Lithuania

Youngsook Lyu
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Dzmitry Melekh
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Ole-Kenneth Nielsen
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Niklas Notstrand
Swedish Energy Agency
Sweden

Samuel Ojelel
Department of Plant Sciences, Microbiology & Biotechnology, College of Natural Sciences, Makerere University
Uganda

Natalya Parasyuk
PMR Ukraine Project
Ukraine

Henk (Jan Hendrik) Reimink
World Steel Association

Dominique Revet
UNFCCC Secretariat

Kristina Saarinen (EB Co-chair)
Finnish Environment Institute SYKE
Finland

Ajay Kumar Singh
Private Consultant
India

Ee Sann Tan
UNITEN / Ministry of Natural Resources and Environment
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Kiyoto Tanabe (TFI Co-chair)
Institute for Global Environmental Strategies (IGES)
Japan

Julien Vincent
CITEPA
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International Energy Agency (IEA)
Paul Simons

Duncan Millard

Roberta Quadrelli

Loic Coent

Araceli Fernandez Pales

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Andrej Kranjc

Baasansuren Jamsranjav

Maya Fukuda

Sekai Ngarize

Pavel Shermanau

Yurii Pyrozhenko

Toru Matsumoto

Eriko Nakamura

Koh Mikuni