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Introducing Calculation Methodologies for CH_4 and N_2O from Stationary Combustion in Japan

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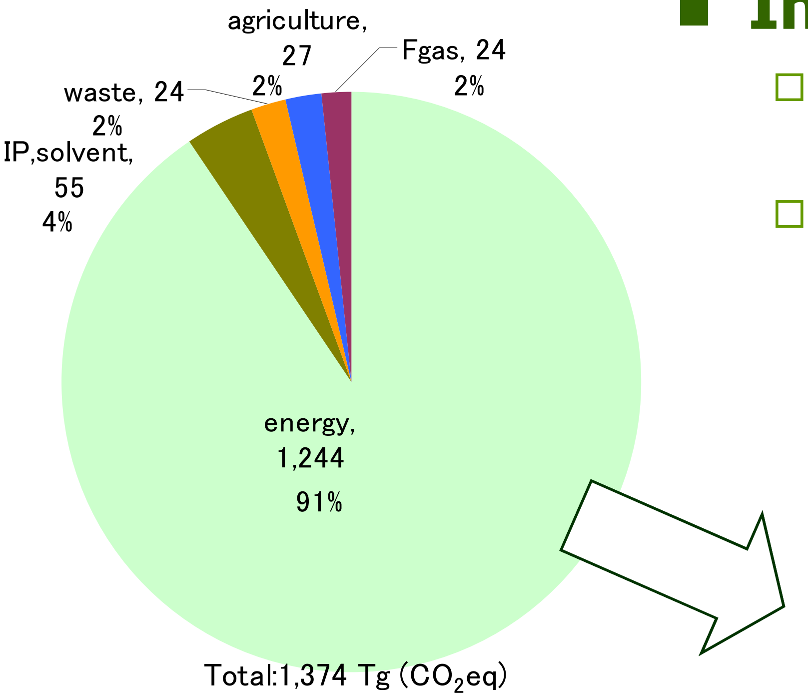
Overview

- GHG emissions in Japan
- CH_4 and N_2O emissions from stationary combustion
  - Methodology of Estimating CH_4 and N_2O emissions from Stationary Combustion
  - Emission factors and activity data
- The aim of statistical survey of Air Pollutant Emissions from Stationary Sources
- Co-benefits approach to Climate Change
  - Viewing Inventories from Co-benefits perspective
  - Co-benefits approach of Climate Change concerning developing counties
  - CDM chances

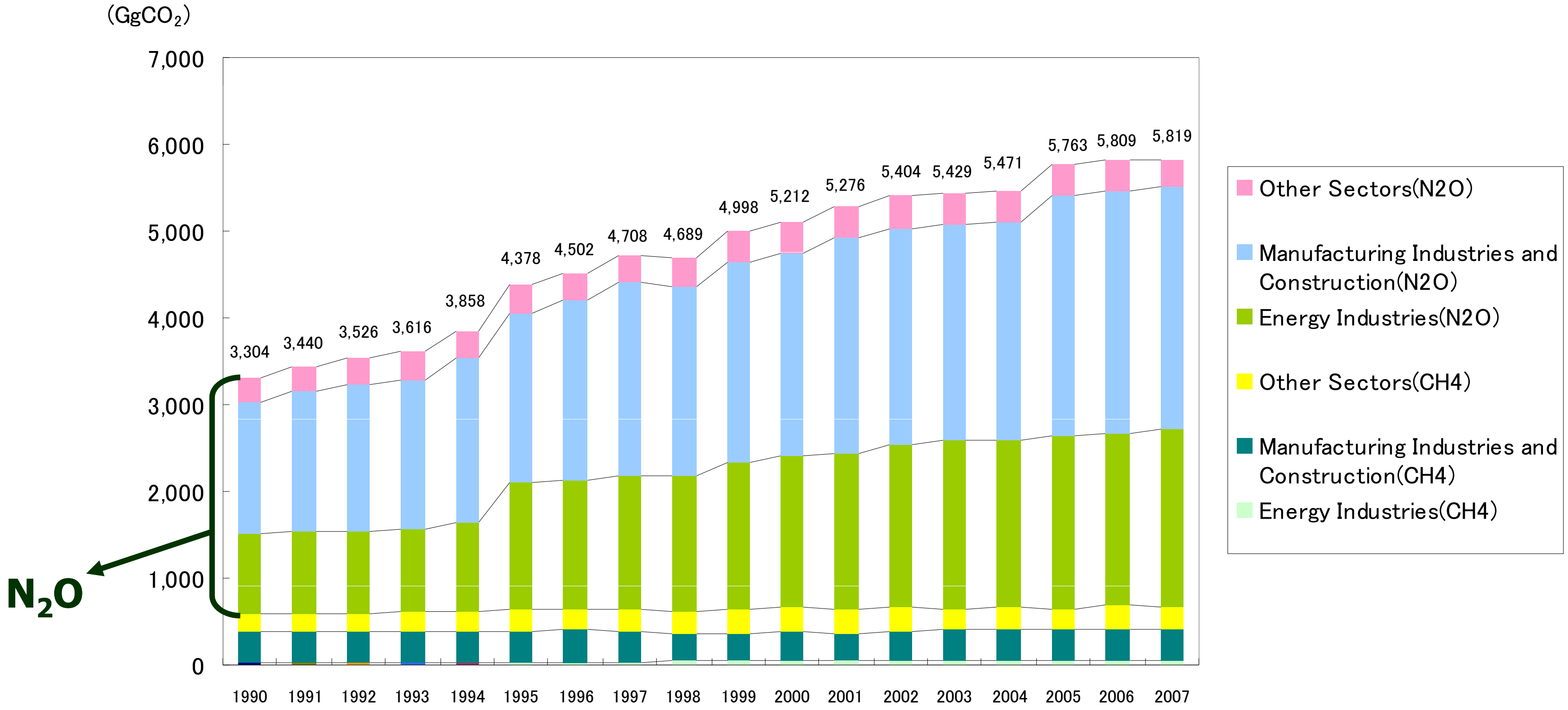
GHG emissions in Japan



- **In 2007 emissions,**
  - **In 2007, total GHG emissions were 1,374 Tg (CO_2eq).**
  - **GHG emissions from energy sector (1.A and 1.B) were 1,244 Tg (CO_2eq). (91 per cent of the total emissions)**

CH_4 and N_2O emissions were 9 Tg (CO2eq).

CH_4 and N_2O emissions from stationary combustion



- **Notes:**
  - CH_4 and N_2O emissions from this category represented a very small portion of the total national emissions. (0.4%,2007)
  - CH_4 and N_2O emissions from this category have risen 76% from 1990 to 2007.
  - N_2O emissions were the largest portion in this category.

The primary factor in the increase of emissions in this category

- N_2O emissions from Fluidized Bed Boiler are relatively large in this category. And the emissions have increased because the introduction of Fluidized Bed Boiler has been advanced since 1990 in Japan.

- The reasons for increasing number of Fluidized Bed Boiler are …
  - Wide range of fuel type
  - Low NOx, SOx emissions
  - High combustion efficiency
  - Space-saving and easy maintenance

Methodology of Estimating CH_4 and N_2O emissions from Stationary Combustion

- CH_4 and N_2O emissions from stationary combustion were estimated using IPCC Tier 2 method in accordance with the 1996 Revised IPCC Guidelines and Good Practice Guidance (2000). Emissions were obtained by multiplying country-specific emission factors (by fuel type and furnace type) by energy consumption (by fuel type, furnace type and sector type).

$$\mathbf{E} = \sum \left(\mathbf{EF_{ij}} \cdot \mathbf{A_{ijk}} \right)$$

E : Emissions from stationary combustion (kgCH_4, kgN_2O)
EF_{ij} : Emission factor for fuel type i, furnace type j (kgCH_4/TJ, kgN_2O/TJ)
A_{ijk} : Fuel consumption for fuel type i, furnace type j, sector k (TJ)

Emission Factors

- **Based on the study results of actual measurements of CH_4 and N_2O concentrations emitted from stationary sources, emission factors were estimated by the fuel type and furnace type.**

Samples of Furnace Type	
Boiler	Other drying kilns
Sintering furnace (excluding copper, lead, and zinc) for refining	Electric arc furnace
Pelletizing furnace (steel and non-ferrous metals)	Other industrial furnaces
Metal rolling furnace, metal treating furnace, metal forging furnace	Gas turbine
Petroleum and gas furnace	Diesel engine
Catalytic regenerator	Gas engine, gasoline engine
Brick kiln, ceramic kiln and other types of kiln	Household equipments
Aggregate drying furnace, cement raw material drying furnace, brick raw material drying furnace	

Calculation procedure for establishing EFs

- ## Equation for calculating emission factors

1. **Calculate emission factors from actual measurement data of CH_4, N_2O and O_2 concentrations in flue gas.**

$$\mathbf{EF} = \mathbf{C} \cdot \left(\mathbf{G}_0^{'} + (\mathbf{m} - 1) \cdot \mathbf{A}_0\right) \cdot \mathbf{MW} / \mathbf{V_m} / \mathbf{GCV}$$

EF:	Emission factor ($kgCH_4/TJ$, kgN_2O/TJ)
C:	CH_4 or N_2O concentration in emission gas (ppm)
G_0':	Theoretical amount of emission gas (dry) from combusted fuel ($m^3N/kg,l,m^3N$)
A_0:	Theoretical amount of air necessary to completely combust fuel ($m^3N/kg,l,m^3N$)
m:	Air ratio ≡ Actual air amount / Theoretical air amount (= *$21/(21-CO_2)$*)
MW:	Molecular weight of CH_4 or N_2O (constant)
V_m:	Volume of 1 mole of ideal gas under normal conditions (constant) ($10^{-3}m^3/mol$)
GCV:	Gross calorific value of combusted fuel ($MJ/g,l,m^3N$)

2. **Calculate average emission factors by fuel type and furnace type for each facility.**

3. **A t-test with a 1% significance level was also conducted when calculating the average emission factors. The rejected data by the t-test, also called outliers, were eliminated from the average calculation. Even in the cases where the t-test results do not point out any outliers, if experts judged the data as an outlier, the specified data was eliminated from the average.**

Activity Data

Determine energy consumption

- Energy consumption from stationary combustion activities has been grouped by fuel type in each sector (Energy Industry, Manufacturing Industry and Construction, Commercial & Others and Residential; Obtained from the General Energy Statistics).

- Break Energy consumption data into furnace type.

  In *the General Energy Statistics*, fuel consumption amounts are not indicated clearly by furnace type for stationary combustion. In the case of Japan, <u>the Research of Air Pollutant Emissions from Stationary Sources</u> provides statistics that will help to determine fuel consumption amount by furnace type and fuel type.

  Therefore, the proportion of fuel consumption by each furnace type is estimated using data from the Research.

Calculations of activity data

- **The equation for calculating the activity data**

$$A_{ijk} = A_{EBik} \cdot w_{ijk}$$

A_{ijk}: **Activity data for fuel type i, furnace type j, sector k (TJ)**

A_{EBik}: **Fuel consumption for fuel type i, sector k from *the General Energy Statistics* (TJ)**

w_{ijk}: **Ratio of furnace type j associated with consumption of fuel type i in sector k**

$$w_{ijk} = A_{RESijk} / \sum_{m} A_{RESimk}$$

A_{RESijk}: **Fuel consumption for fuel type i, furnace type j, sector k according to *the research* (TJ)**

Calculation of activity data

1. **Calculating A_{RESijk} from the research**
   - Sum up the fuel consumption data in the research by fuel type, furnace type, and sector, and calculate A_{RESijk} (fuel type i, furnace type j, sector type k, according to the research).

2. **Calculating w_{ijk}**
   - Calculate w_{ijk} (ratio of furnace type j by fuel type i in sector type k) by dividing A_{RESijk} by $\Sigma_m A_{RESimk}$.
   - If the research data is not available for the target year, interpolate data of years before and after the target year to calculate w_{ijk}.

3. **Calculating activity data by fuel type, furnace type, and sector**
   - Calculate activity data A_{ijk} for fuel type i, furnace type j, and sector type k, by multiplying w_{ijk} by fuel consumption data A_{EBik} of fuel type i, sector type k from *the General Energy Statistics*.

4. **Calculating activity data for fuel types, furnace types, and sectors that cannot be determined from *the General Energy Statistics*.**
   - Use fuel consumption data A_{RESijk} from the research as activity data, for fuel consumption data for fuels (such as charcoal) that are not specified in *the General Energy Statistics* and furnace types for which fuel consumption data from *the General Energy Statistics* cannot be used.

5. **Calculating activity data for the residence sector.**
   - For the residence sector, fuel consumption by fuel type stated in the General Energy Statistics are used.

The aim of statistical survey of Air Pollutant Emissions from Stationary Sources

- This survey is conducted using questionnaires.
- Statistical survey is conducted to
  1. Promote reasonable and effective atmospheric environmental policy,
  2. Obtain information on current activities within the context of the Air Pollutant Control Law (e.g., the current status of regulation of stationary sources that emit soot and smoke in facilities that are registered to a local government and in facilities that emit ordinary soot or particular soot, and the current status of air pollutant control),
  3. Develop the submitted data on facilities emitting soot and smoke,
  4. Estimate the amounts of air pollutant emissions from facilities that emit soot and smoke.

Viewing Inventories from Co-benefits perspective

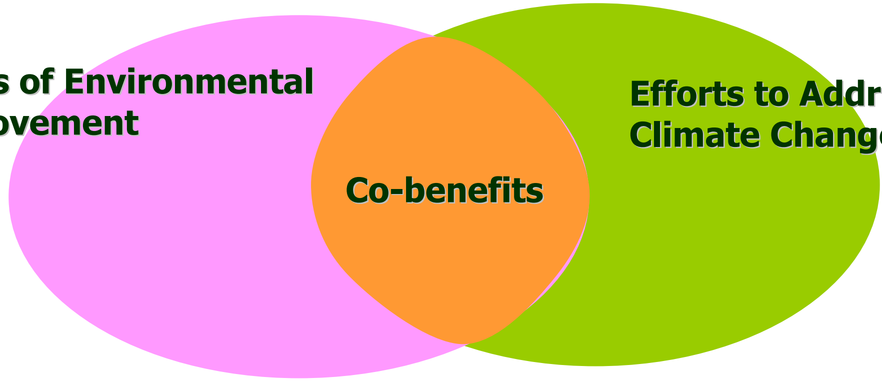
- The data of Air Pollutant Emissions from Stationary Sources are used for estimating GHG emissions in Japan.
- The data of fuel consumption and air pollutant emissions from facilities emitting soot and smoke are useful for addressing environment control as well as reducing Climate Change.
- The air pollution measurement data also contributes to Climate Change.

Example

- Lower CH_4 and N_2O EFs from stationary sources

Co-benefits approach of Climate Change concerning developing counties

- Co-benefits approach means contributing to environmental pollution control and to addressing climate change.



Example of benefits

- Climate benefits
  - Reduction of GHG emissions

- Environmental benefits
  - Reduction of pollutants (ex. SOx,NOx,dust,etc)
  - Reduction of BOD,COD
  - Reduction of waste amount ,etc

CDM chances

- **Viewing from co-benefits perspective is very important. Prompting the implementation of co-benefits approach will improve opportunities of CDM.**

Examples of co-benefits approach projects (Registered CDM project activities)

CDM-EB Ref	CDM Project	Host Parties	Climate Change Benefits Emission Reduction (tCO2/y)		Environmental Benefits
1397	Comprehensive utilization of waste coal gas for electricity generation project in Shaanxi Xinglong Cogeneration Co.	China	CO_2	270,045	soot and dust 21 tons Sox 0.232 tons
0032	Methane capture and combustion from swine manure treatment for Peralillo	Chili	CH_4	78,867	Prevent water pollution

URL:http://cdm.unfccc.int/Projects/registered.html

- **I hope this case study in Japan is helpful in addressing Climate Change in your countries.**

Thank you very much!

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