Estimating NMVOC emissions in Japan, China, and India

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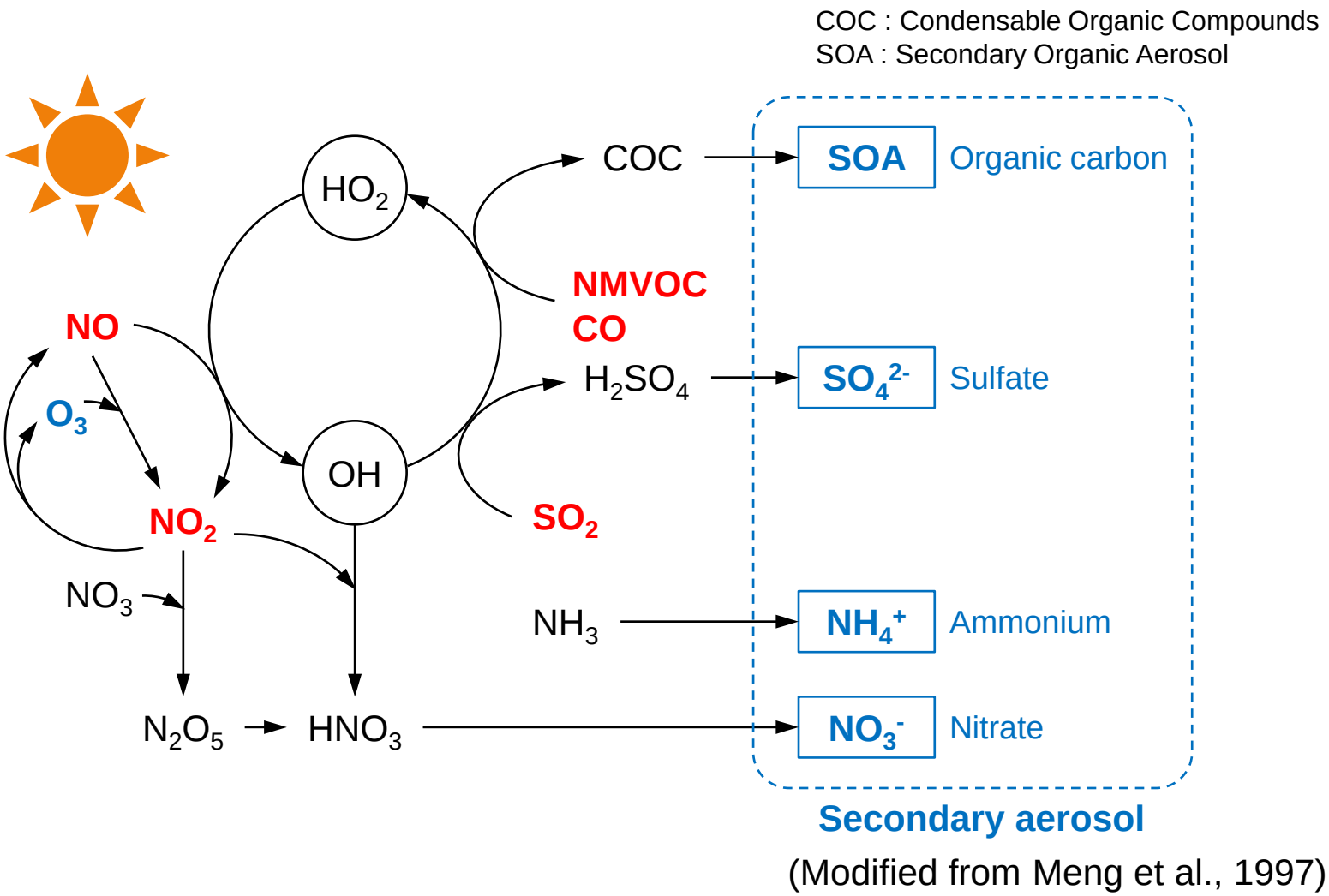
Background

- Emissions of precursors as well as GHGs should be provided to UNFCCC.
  - Carbon monoxide (CO)
  - Nitrogen oxides (NO_X)
  - **Non-methane volatile organic compounds (NMVOCs)**
  - Sulphur oxides (SO_X)
- These precursors play important roles in the formation of tropospheric ozone and secondary aerosols in the atmosphere.
- Various non-combustion (fugitive) sources should be considered to estimate NMVOC emissions.
  - Separate estimations from combustion sources are necessary.
- This talk introduces:
  - Framework to estimate NMVOC emissions in Japan.
  - Studies to estimate NMVOC emissions in China and India.

Photochemical reaction cycle

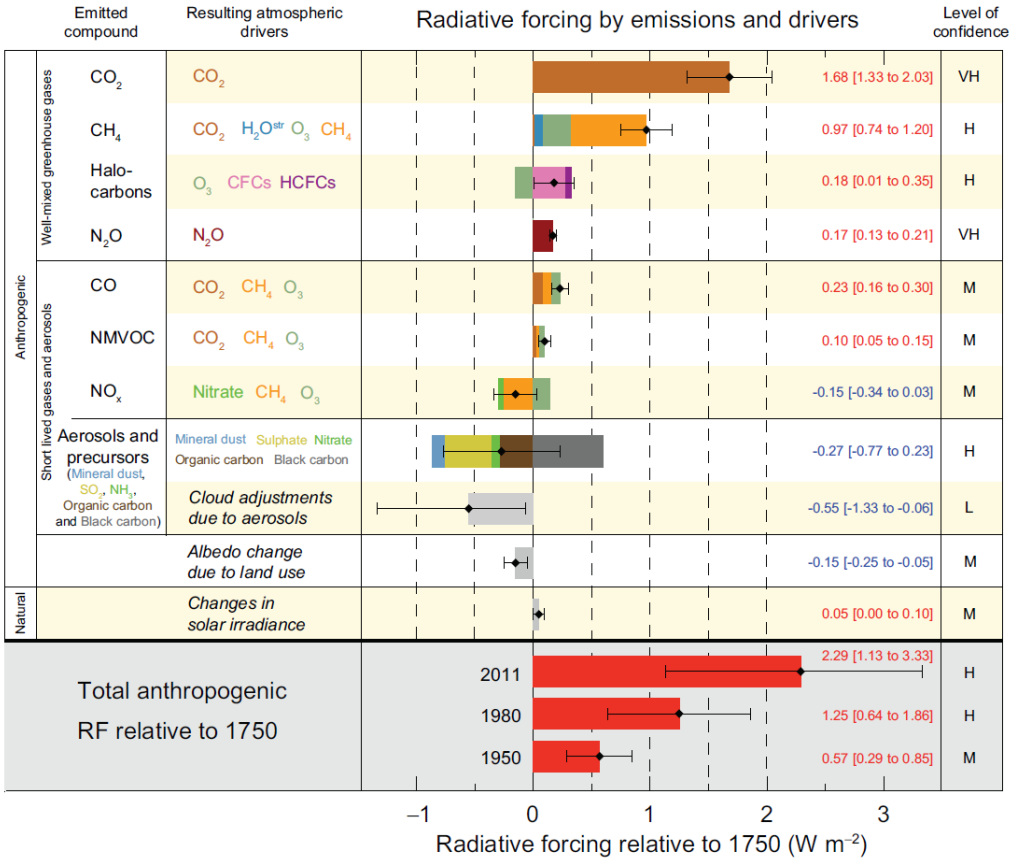


(Modified from Meng et al., 1997)

- Precursors are mutually related to form tropospheric ozone and secondary aerosols.

Impact on climate change

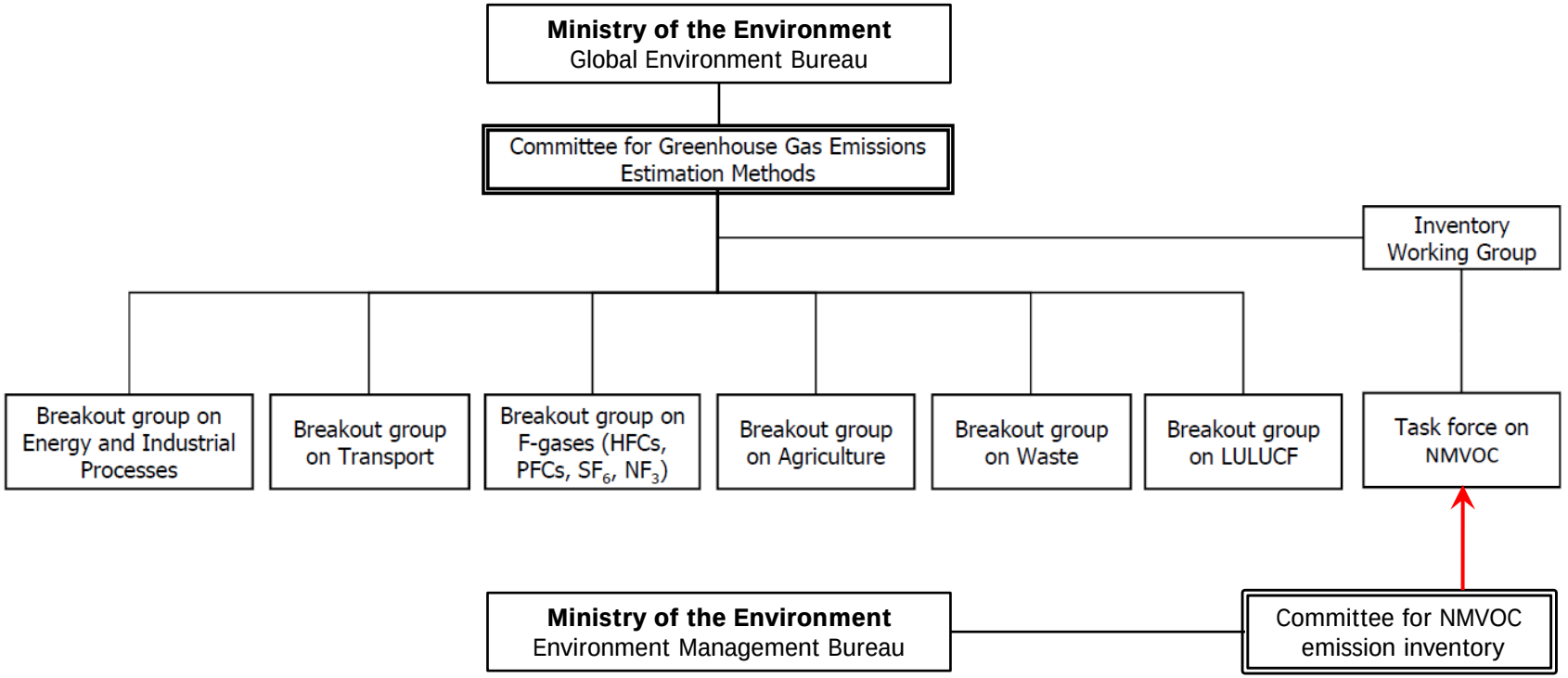
- Precursors impact the climate change through tropospheric ozone and secondary aerosols.
- Tropospheric ozone has received attention as “Short-Lived Climate Pollutant (SLCP)”.



(IPCC, 2013)

Japanese framework for NMVOC emissions

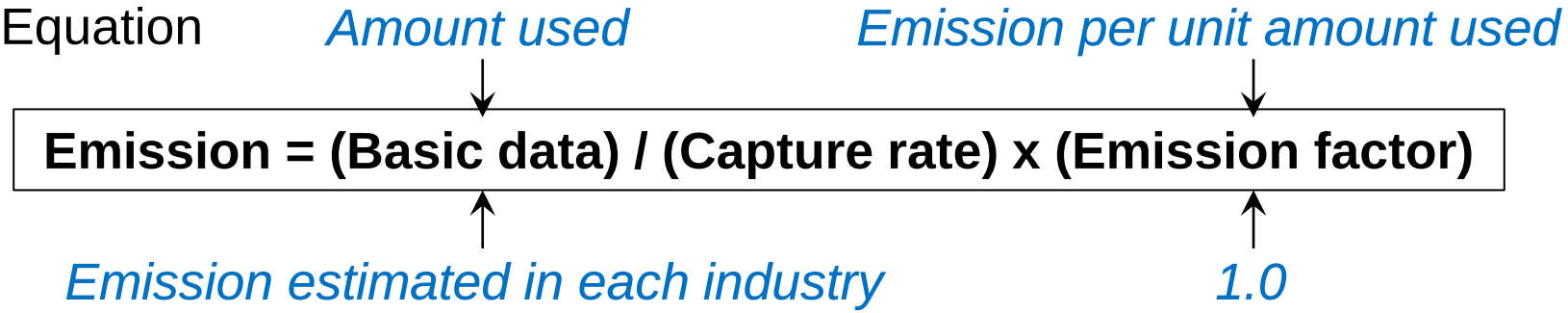
- The committee for NMVOC emission inventory has been established since 2006 to manage the NMVOC emission inventory for air pollution controls.
- Its outcomes have been utilized in the task force on NMVOC for the GHG emission inventory.



(Modified from GIO, 2015)

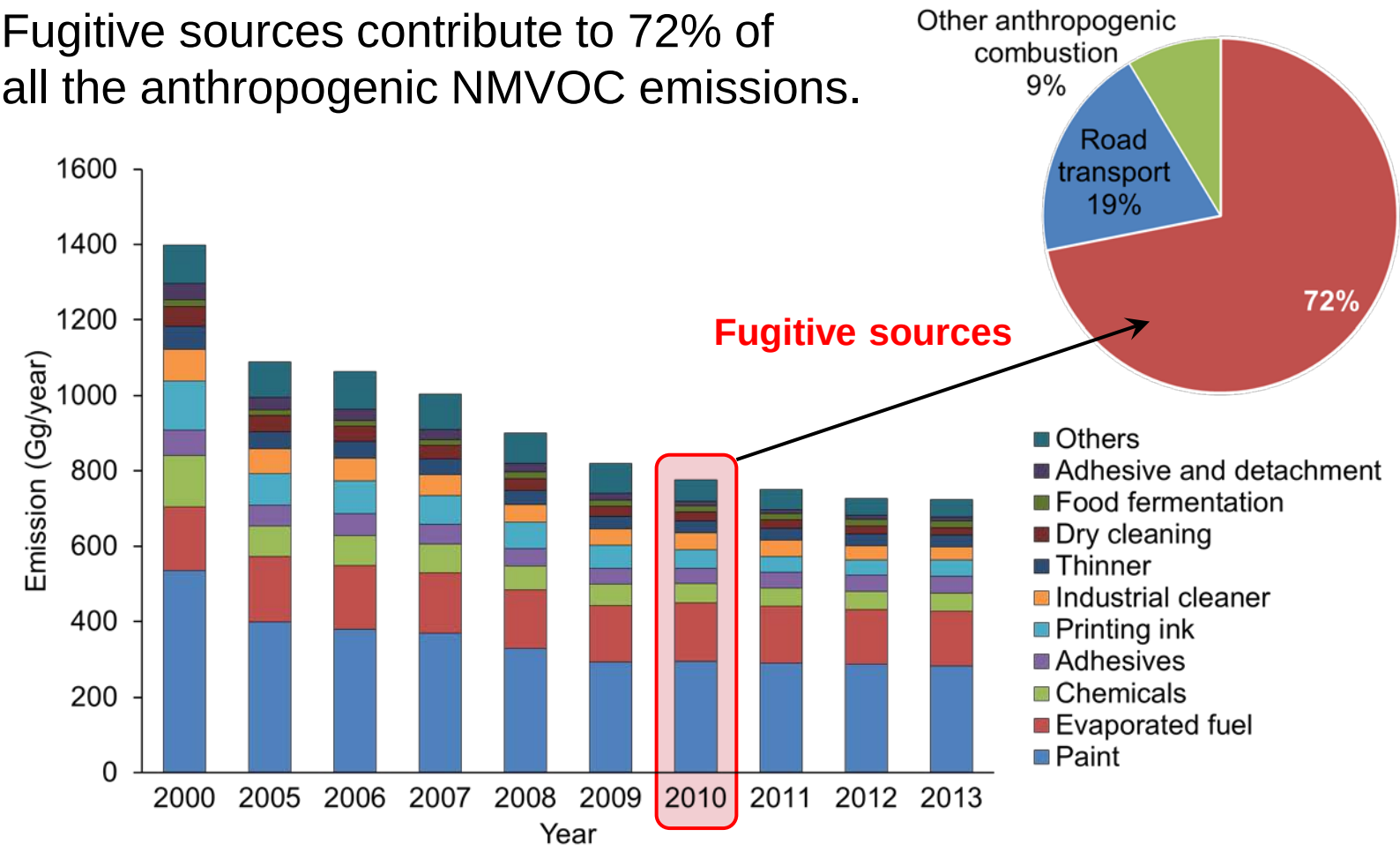
NMVOC emission inventory in Japan

- Target sources
  - Fugitive sources
    - Manufacturing (chemicals, etc.)
    - Storage and shipping (evaporated fuel)
    - Solvent (Paint, printing ink, adhesives, dry cleaning, etc.)
    - Other agent
  - ✓ Combustion sources are NOT included.
- Committee members
  - Governments
  - Academics
  - Industries (Adhesive, printing, cleaning, paint, chemicals, etc.)
- Equation



Estimated NMVOC emissions in Japan

- Paint and evaporated fuel are important sources in Japan.
- Fugitive sources contribute to 72% of all the anthropogenic NMVOC emissions.



Estimated amount of annual fugitive NMVOC emissions in Japan (MOEJ, 2015)

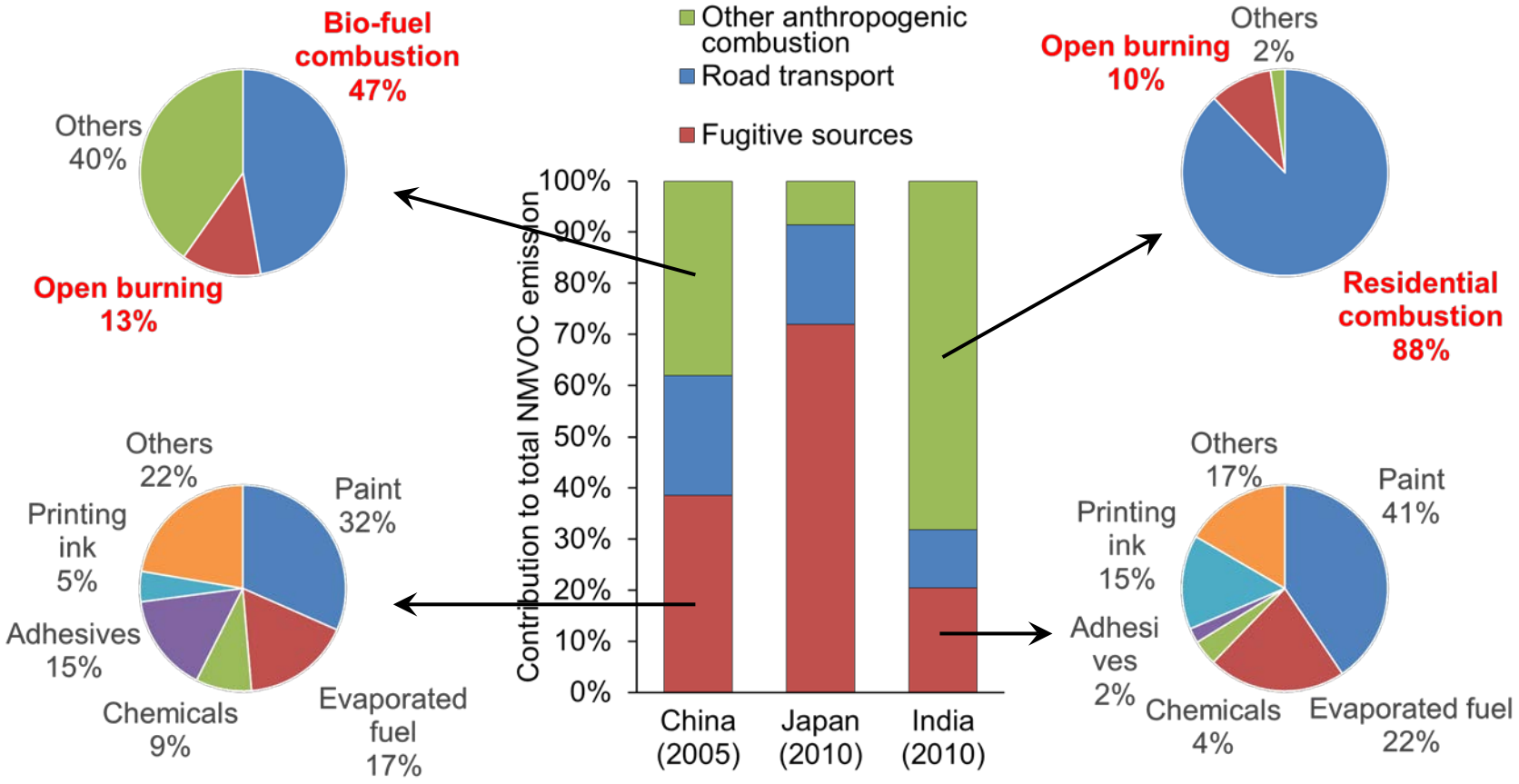
Estimating NMVOC in China and India

- Collaboration study
  - China : Tsinghua University
    - Wei et al., *Atmos. Environ.*, 2008
    - Wei et al., *Front. Environ. Sci. Eng.*, 2014
  - India : The Energy and Resources Institute (TERI)
    - Sharma et al., *Atmos. Environ.*, 2015
  - The International Institute for Applied Systems Analysis (IIASA) as an advisor for both countries
- Target sector
  - Combustion sources

    Road transport, domestic, industry, etc.
  - Fugitive sources

    Paint, evaporated fuel, printing, dry cleaning, etc.
- Target year
  - 2005 (China), 2010 (India)

Source contributions in countries

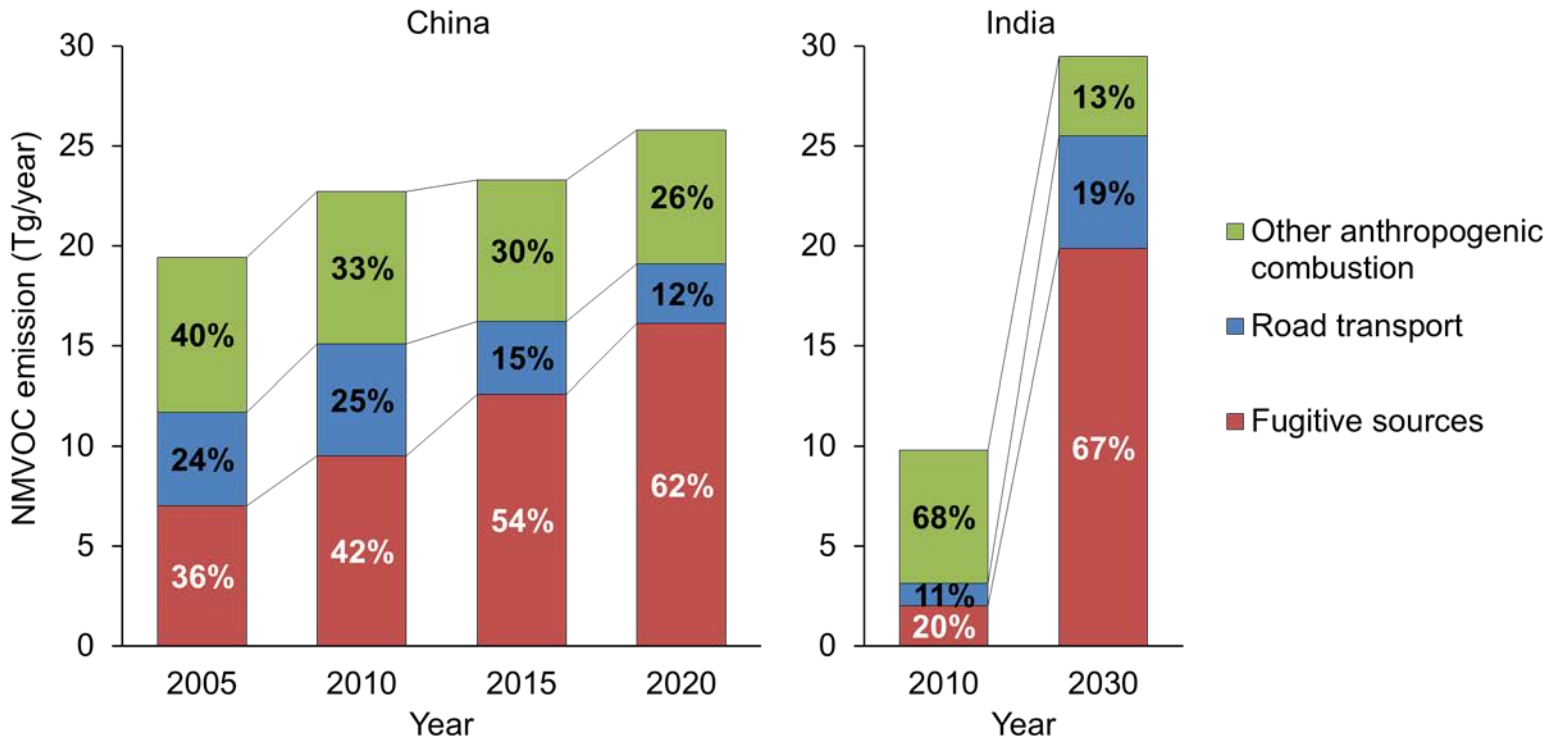


- Relative contributions of other anthropogenic combustion are higher in China and India.
- Biomass combustion (fuel and open) is a major source.

Prediction of future NMVOC emissions

- Future NMVOC emissions in China and India were predicted.
- Business-as-usual (BAU) scenario
  - Future energy consumption was predicted by IPAC-AIM model (China) and MARKAL model (India).
  - Future activities for non-combustion sources were predicted by the regression models against the economic growth.
  - Current and future energy and environmental legislations which have been already determined were taken into account.
  - No additional strategies for reducing NMVOC emissions were considered.
- Target years
  - 2010, 2015, and 2020 (China)
  - 2030 (India)

Predicted future NMVOC emissions



- Future NMVOC emissions in China and India increase due to rapid economic growth.
- Emissions from fugitive sources significantly increase.
- Relative contribution of biomass combustion decreases due to economic growth, infrastructure, energy structure, etc.

Summary

- Various fugitive sources should be considered to estimate NMVOC emissions. Separate estimation from combustion sources is necessary.
- A framework to estimate NMVOC emissions from fugitive sources has been established in Japan. Its outcomes have been utilized in the GHG emission inventory reported to UNFCCC.
- Fugitive sources contribute to 72% of all the anthropogenic NMVOC emissions in Japan.
- Contributions of biomass combustion (biofuel combustion and agricultural open burning) are relatively higher in China and India.
- NMVOC emissions from fugitive sources will increase whereas those from biomass combustion will decrease.

- Relative importance of sources on total NMVOC emissions is different among countries reflecting economic growth, infrastructure, energy structure, etc.