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SLCFs emission inventory in China

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Outlines

- Inventory system of China
- Differences with IPCC methods
- Gaps and advices

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- ☐ **Inventory system of China**
- ☐ **Differences with IPCC methods**
- ☐ **Gaps and advices**

Guide of SLCFs emission inventory in China

MEP (Ministry of Ecology and Environment of the People's Republic of China) has issued a series (3+5+1) of technical guidelines for compilation of emission inventory of air pollutants.

Technical guide for compilation of Chinese emission inventory

Guide Name	Year	Institute	Web Link
Technical guide for compilation of primary source emission inventory of atmospheric fine particulate matter(Trial)	2014	MEP	http://www.mee.gov.cn/gkml/hbb/bgg/201408/W020140828351293619540.pdf
Technical guide for compilation of emission inventory of volatile organic compounds (Trial)	2014	MEP	http://www.mee.gov.cn/gkml/hbb/bgg/201408/W020140828351293705457.pdf
Technical guide for compilation of atmospheric ammonia emission inventory (Trial)	2014	MEP	http://www.mee.gov.cn/gkml/hbb/bgg/201408/W020140828351293771578.pdf
Technical guide for compilation of particulate matter emission inventory from dust sources (Trial)	2014	MEP	https://www.mee.gov.cn/gkml/hbb/bgg/201501/W020150107594588131490.pdf
Technical guide for compilation of primary source emission inventory of inhalable particulate matter(Trial)	2014	MEP	http://www.mee.gov.cn/gkml/hbb/bgg/201501/W020150107594587771088.pdf
Technical guide for compiling air pollutant emission inventory of road motor vehicles(Trial)	2014	MEP	http://www.mee.gov.cn/gkml/hbb/bgg/201501/W020150107594587831090.pdf
Technical guide for compilation of emission inventory of air pollutants from non road mobile sources(Trial)	2014	MEP	https://www.mee.gov.cn/gkml/hbb/bgth/201407/W020140708387895377980.pdf
Technical guide for compilation of emission inventory of air pollutants from biomass combustion sources(Trial)	2014	MEP	https://www.mee.gov.cn/gkml/hbb/bgg/201501/W020150107594588071383.pdf
Technical guide for compiling air pollutant emission inventory of civil coal (Trial)	2016	MEP	https://www.mee.gov.cn/gkml/hbb/bgg/201610/W020161031388726962758.pdf

Sources category of the guidelines in China

Name	Definition
Stationary combustion	A combustion equipment that produces heat when burning fossil fuels to provide heat and power for power generation, industrial production and life
IPPU	The industrial activities with the purpose of physical and chemical conversion of industrial raw materials in the process of industrial production and processing
Mobile sources	Various passenger, freight transportation facilities and mechanical equipment pulled by and movable by the engine
Solvent use sources	The industrial production and living department that produces and uses volatile organic solvents
Agricultural sources	Various agricultural activities that have harmful effects on the atmospheric environment in agricultural production
Dust sources	Various emission sources of particulate matter that do not pass through the exhaust cylinder, unorganized, irregular discharge of loose surface particles under the action of natural force or manpower
Biomass burning sources	The combustion process of boilers, stoves and other biomass materials without modified processing, as well as forest fire, grassland fire, straw open burning, etc
Oil and gas storage and transportation	The process by which volatile oil and gas products are collected, stored, transported and sold
Waste disposal sources	The waste water, solid waste produced by industrial and living departments and waste gas after flue gas denitration into the centralized treatment and disposal facilities after treatment and pollutant discharge source
Other emission sources	The collection of air pollutant emission sources not covered

Energy

Name	NOx	NH_3	SO_2	CO	NMVOC	BC	OC
Power production	√	√	√	√	√	√	√
Power supply	√	√	√	√	√	√	√
Industrial heat production and supply	√	√	√	√	√	√	√
Civil heat production and supply	√	√	√	√	√	√	√
Gas production and supply	√	√	√	√	√	√	√
Industrial boilers of mining and manufacturing	√	√	√	√	√	√	√
Urban household sources	√	√	√	√	√	√	√
Rural household sources	√	√	√	√	√	√	√
Passenger vehicles	√	√	√	√	√	√	√
Truck	√	√	√	√	√	√	√
Motorcycle	√	√	√	√	√	√	√
Construction machinery	√	√	√	√	√	√	√
Agricultural machinery	√	√	√	√	√	√	√

Energy

Name	NOx	NH_3	SO_2	CO	NMVOC	BC	OC
Small general machinery	√	√	√	√	√	√	√
Diesel generator sets	√	√	√	√	√	√	√
Ship	√	√	√	√	√	√	√
Railway diesel locomotive	√	√	√	√	√	√	√
Aviation	√	√	√	√	√	√	√
Biomass fuels	√	√	√	√	√	√	√
Biomass open combustion	√	√	√	√	√	√	√

- Energy emission sources are mainly composed of combustion sources of fossil fuels, mobile source and biomass burning sources.
- Industrial boilers of mining and manufacturing include multiple industrial emission sources, such as iron and steel, non-ferrous metals, chemicals et al.

IPPU

Name	NOx	NH_3	SO_2	CO	NMVOC	BC	OC
Coal mining and washing			√		√		
Black metal smelting and rolling processing	√		√	√	√	√	√
Non-ferrous metal smelting and rolling processing industry			√				
Non-metallic mineral products industry	√		√	√	√	√	√
Oil, coal and other fuel processing industries	√		√	√	√	√	√
Chemical raw materials and chemical products manufacturing industry		√	√	√	√		
Chemical fiber manufacturing					√		
Rubber and plastic products industry					√		
Paper and paper products industry			√		√		
Wine, beverage and refined tea manufacturing industry					√		
Food manufacturing industry, agricultural and sideline food processing industry					√		
Cottonocracy					√		

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Differences with IPCC methods: Energy sector

For the vast majority of SLCFs emissions from the energy sector, it is most based on activity level of emission sources (e.g. fuel consumption) and production coefficient of pollutants (e.g. emission factor of fuels).

$$E = A \times EF \times (1 - \eta)$$

A is the emission source activity level; EF is the production coefficient of pollutants; η is the the actual removal efficiency of pollutants by pollution control technology.

Continuous Emission Monitoring System (CEMS) that meet the normative requirements are used to calculate pollutants (SO2, NOx and PM) emissions for combustion sources of fossil fuels, e.g. boilers of power, heat production and supply industry.

$$E = \sum_k C \times Q \times T \times 10^{-6}$$

k is the k section of flue monitoring; C is the hourly average pollutant discharge concentration (mg/m^3); Q is the hourly average pollutant flue gas discharge (m^3/h); T is the total production hours (h)

Differences with IPCC methods: Transpotation

Micro-level emission simulation method are used to calculated SLCFs emissions from the mobile sources, it is mostly based on fuel consumption and production coefficient of pollutants, or vehicle ownership (P), the average annual mileage (VKT) and the pollutant emission per unit distance (EF).

$$E_1 = \sum_i A_i \times EF_{1i} \qquad E_2 = \sum_i P_i \times VKT_i \times EF_{2i} \times 10^{-6}$$

A is the fuel consumption, EF_{1i} is the production coefficient of pollutants; P is the vehicle ownership; VKT is the average annual mileage (km); EF_{2i} is the pollutant emission per unit distance (kg/km).

Difference: For the micro-level emission simulation, the road network emission can be calculated by combining the traffic flow data, and the real-time discharge of each road.

$$E_{y,d,h,l} = \sum_i TV_{i,y,d,h,l} \times L_l \times EF_i(v) \times 10^{-6}$$

$E_{y,d,h,l}$ is the pollutant discharge (ton) of section l at h hour on day d y year; $TV_{i,y,d,h,l}$ is the traffic flow of type i vehicle on day d y year l road; L is the length of section l (km); E_{fi} is the emission coefficient of type i vehicle at speed v (g / km)

Differences with IPCC methods: Aviation

The flight process of the aircraft are divided into LTO cycle (take-off, climb out, approaching and landing) and cruise phase, and total aviation SLCFs emissions include emissions during the LTO cycle and cruise phase.

$$(1)\ E_1 = F \times EF \qquad (2)\ E_2 = E_{LTO} + E_c = C_{LTO} \times EF_{LTO} + L \times EF_c$$

F is the total energy consumption, include energy consumption during the LTO cycle and cruise phase; EF is the emission factor of fuel.
C_{LTO} is the number of landing cycles (times); EF_{LTO} is the emission factor (kg/LTO); L is the cruise mileage; EF_c is the emission factor of aircraft engine(kg/km);

Difference: Only **calculate SLCFs emissions of LTO cycle, which is based on the number of LTO cycles and the emission factor of one LTO cycle, but lacks methods for calculating SLCFs emissions in the cruise phase.**

$$E = (C_{LTO} \times EF) \times 10^{-3}$$

C_{LTO} is the number of landing cycles (times); EF is the emission factor (kg/LTO)

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Gaps list

IPCC code	Category	Gaps	Guide of SLCFs emission inventory in China
1.A.3.a.ii	**Domestic aviation**	Embedding emissions from landing and take-off in the Tier 1 EFs of a fuel-based approach	**Just calculate emissions of LTO cycle (take-off, climb out approaching and landing)**
1.A.3.b.i	**Cars**	Time dependency of technologies	**Technology advances is reflected through the emission factors of different emission standards.**
1.A.3.b.ii	**Light duty trucks**		
1.A.3.b.iii	**Heavy duty trucks and buses**		
1.A.3.b.iv	**Motorcycles**		
1.A.3.e.ii	**Off-road**	Most alternative methodologies do not cover BC and OC emissions	**Some BC and OC emission factors for off-road mobile machinery are provided. e.g. the BC and OC emissions factor of non-road machinery with national III emission standard.**
	IPPU	Abatement techniques and efficiencies	**Technical differences are considered when providing IPPU emission factors for different industrial processes. e.g. the CO, BC and OC emission factor of lime production by rotary kiln with solid fuel; CO, BC and OC emission factor of lime production by vertical kiln with gas fuel.**

Advices

- **Establish and improve SLCFs emission calculation methodology in the aviation, including:**
  1. **Referring to IPCC methodology, established a full-stage aviation SLCFs emission accounting method, including take-off, climb out, cruise, approach and taxiing.**
  2. **Improve SLCFs emission factor database for different aircraft types and engine types.**
  3. **Improve the space allocation method for aviation emissions.**
- **Establish and improve SLCFs emission calculation methodology in the field of mobile sources, especially the BC and OC emissions from tire wear.**
- **More and more energy departments (especially factories and enterprises) have developed real-time calculation methods for on-line monitoring (CEMS), which is worthy of further exploration.**

Thanks!