# Aspects of European emission inventory efforts

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Aether

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# 1. The CLRTAP: An overview

## Convention on Long-Range Transboundary Air Pollution (CLRTAP)

- The "main" AQ Convention of the UN/ECE
- In place since 1979
- Made up of different "Protocols" which are periodically updated
- Just starting Gothenburg Protocol update
  - Includes commitments relating to $SO_2$, $NO_X$, NMVOC, $NH_3$, $PM_{2.5}$

# 1. The CLRTAP: An overview

- Geographical scope
- US & Canada:
  - Are CLRTAP “Parties”
  - But not included in emissions reporting requirements

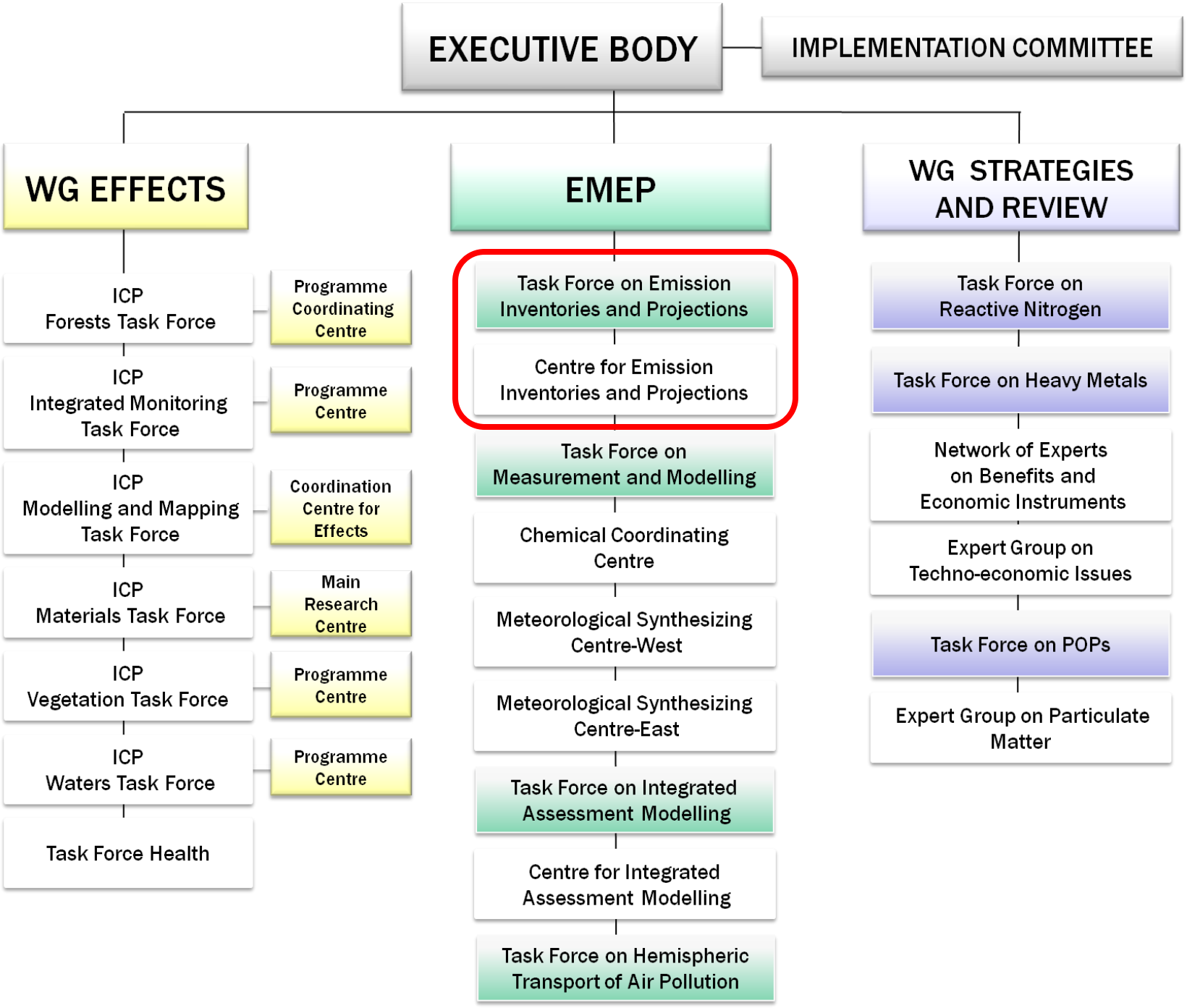
# 1. The CLRTAP: An overview

Emissions reporting requirements:

- Annual emissions inventory reporting
  - >20 AQ pollutants ("main" pollutants, heavy metals, POPs… technically some are voluntary)
  - Reporting format aligned with UNFCCC GHG reporting
- 4 yearly reporting of:
  - Emission projections
  - Emission maps (0.1° x 0.1° grid)
  - Large point source emissions (facility level only)

# 1. The CLRTAP: Centres and Task Forces

- Aspects of the CLRTAP are administered by the European Monitoring and Evaluation Programme (EMEP) which oversees various technical “Centres” and “Task Forces”
- In addition:
  - Working Group on Effects
    - Develops the necessary international cooperation in research and monitoring of pollutant effects
  - Working Group on Strategies and Review
    - Principal negotiating body for the Convention, assists the Executive Body in policy-oriented matters


EXECUTIVE BODY
IMPLEMENTATION COMMITTEE
WG EFFECTS
ICP Forests Task Force
Programme Coordinating Centre
ICP Integrated Monitoring Task Force
Programme Centre
ICP Modelling and Mapping Task Force
Coordination Centre for Effects
ICP Materials Task Force
Main Research Centre
ICP Vegetation Task Force
Programme Centre
ICP Waters Task Force
Programme Centre
Task Force Health
EMEP
Task Force on Emission Inventories and Projections
Centre for Emission Inventories and Projections
Task Force on Measurement and Modelling
Chemical Coordinating Centre
Meteorological Synthesizing Centre-West
Meteorological Synthesizing Centre-East
Task Force on Integrated Assessment Modelling
Centre for Integrated Assessment Modelling
Task Force on Hemispheric Transport of Air Pollution
WG STRATEGIES AND REVIEW
Task Force on Reactive Nitrogen
Task Force on Heavy Metals
Network of Experts on Benefits and Economic Instruments
Expert Group on Techno-economic Issues
Task Force on POPs
Expert Group on Particulate Matter

# 1. The CLRTAP: Centres and Task Forces

**Centre** for Emissions Inventories & Projections (CEIP)

- Funded by the CLRTAP
- Collects national submissions and Informative Inventory Reports, prepares datasets for modellers, oversees reviews, etc.
- Hosted at the Austrian Environment Agency (Umweltbundesamt)

**Task Force** on Emissions Inventories & Projections

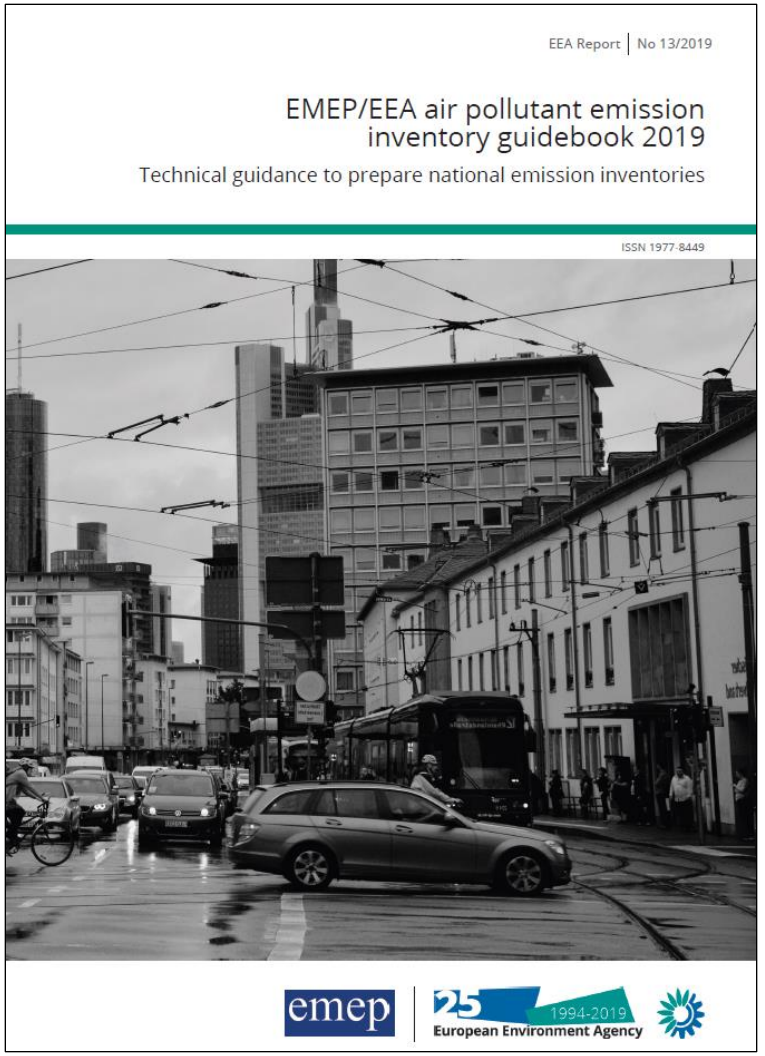
- Supports Parties with their reporting
- Relies on voluntary contributions
- Promotes scientific discussions
- Maintains/updates guidance material
- Led by the United Kingdom, Finland and the European Environment Agency

# 2. The EMEP/EEA Emissions Inventory Guidebook

TFEIP

Comprehensive guidance on compiling and reporting AQ emissions inventories

"… effectively an AQ version of the UNFCCC GHG emissions reporting guidelines"



# 2. The EMEP/EEA Emissions Inventory Guidebook

TFEIP

- Sectors and sources are described with Nomenclature for Reporting (NFR) codes which are analogous to higher-level US Source Classification Codes
- The quality of emission estimates is based on three tier levels of increasing methodological complexity, which is aligned to the structure used for GHG emissions inventory methodologies.
  - Tier 1 methods assume a simple linear relation between emissions and activity data, i.e., do not take technologies or other variables into account.
  - Tier 2 methods use the same or similar activity data to Tier 1 methods, but calculations are done at a more detailed level to account for country-specific information, e.g., on process conditions, fuel qualities, abatement technologies, etc.
  - Tier 3 methods may include using facility-level data and/or sophisticated models.

# 2. The EMEP/EEA Emissions Inventory Guidebook

- Extensive reference made to US EPA publications
- Particularly for combustion sources

TFEIP

**Table 3-19** **Tier 2 emission factors for source category 1.A.1.a, reciprocating engines using gas oil**

| Tier 2 emission factors | | | | | |
|---|---|---|---|---|---|
| | Code | Name | | | |
| NFR Source Category | 1.A.1.a | Public electricity and heat production | | | |
| Fuel | Gas Oil | | | | |
| SNAP (if applicable) | 010105 | Public power - Stationary engines | | | |
| Technologies/Practices | Large stationary CI reciprocating engines | | | | |
| Region or regional conditions | NA | | | | |
| Abatement technologies | NA | | | | |
| Not applicable | | | | | |
| Not estimated | $NH_3$ | | | | |
| Pollutant | Value | Unit | 95% confidence interval | | Reference |
| | | | Lower | Upper | |
| NOx | 942 | g/GJ | 500 | 1380 | Nielsen et al., 2010 |
| CO | 130 | g/GJ | 30 | 230 | Nielsen et al., 2010 |
| NMVOC | 37.1 | g/GJ | 18.5 | 55.6 | US EPA (1996), chapter 3.4 |
| SOx | 46.5 | g/GJ | 4.65 | 465 | See Note |
| TSP | 28.1 | g/GJ | 14.1 | 56.2 | US EPA (1996), chapter 3.4 |
| $PM_{10}$ | 22.4 | g/GJ | 11.2 | 44.8 | US EPA (1996), chapter 3.4 |
| $PM_{2.5}$ | 21.7 | g/GJ | 10.8 | 43.4 | US EPA (1996), chapter 3.4 |
| BC | 78 | % of $PM_{2.5}$ | 63 | 93 | Hernandez et al., 2004 |
| Pb | 4.07 | mg/GJ | 0.41 | 40.7 | US EPA (2010), chapter 1.3 |
| Cd | 1.36 | mg/GJ | 0.14 | 13.6 | US EPA (2010), chapter 1.3 |
| Hg | 1.36 | mg/GJ | 0.14 | 13.6 | US EPA (2010), chapter 1.3 |
| As | 1.81 | mg/GJ | 0.18 | 18.1 | US EPA (2010), chapter 1.3 |
| Cr | 1.36 | mg/GJ | 0.14 | 13.6 | US EPA (2010), chapter 1.3 |
| Cu | 2.72 | mg/GJ | 0.27 | 27.1 | US EPA (2010), chapter 1.3 |
| Ni | 1.36 | mg/GJ | 0.14 | 13.6 | US EPA (2010), chapter 1.3 |
| Se | 6.79 | mg/GJ | 0.68 | 67.9 | US EPA (2010), chapter 1.3 |
| Zn | 1.81 | mg/GJ | 0.18 | 18.1 | US EPA (2010), chapter 1.3 |
| PCDD/F | 0.99 | ng I-TEQ/GJ | 0.1 | 10 | Nielsen et al., 2010 |
| HCB | 0.22 | µg/GJ | 0.022 | 2.2 | Nielsen et al., 2010 |
| PCBs | 0.13 | ng I-TEQ/GJ | 0.013 | 1.3 | Nielsen et al., 2010 |
| Benzo(a)pyrene | 0.116 | mg/GJ | 0.0582 | 0.11 | US EPA (1996), chapter 3.4 ("Less than" value based on method detection limits) |
| Benzo(b)fluoranthene | 0.502 | mg/GJ | 0.251 | 0.75 | US EPA (1996), chapter 3.4 |
| Benzo(k)fluoranthene | 0.0987 | mg/GJ | 0.0493 | 0.098 | US EPA (1996), chapter 3.4 ("Less than" value based on method detection limits) |
| Indeno(1,2,3-cd)pyrene | 0.187 | mg/GJ | 0.0937 | 0.18 | US EPA (1996), chapter 3.4 ("Less than" value based on method detection limits) |

Notes:
For conversion of the US EPA data the values have been converted to NCV using a factor of 0.95. Furthermore, units have been converted using 1055.0559 J/BTU and 453.59237 g/lb.

# 2. The EMEP/EEA Emissions Inventory Guidebook

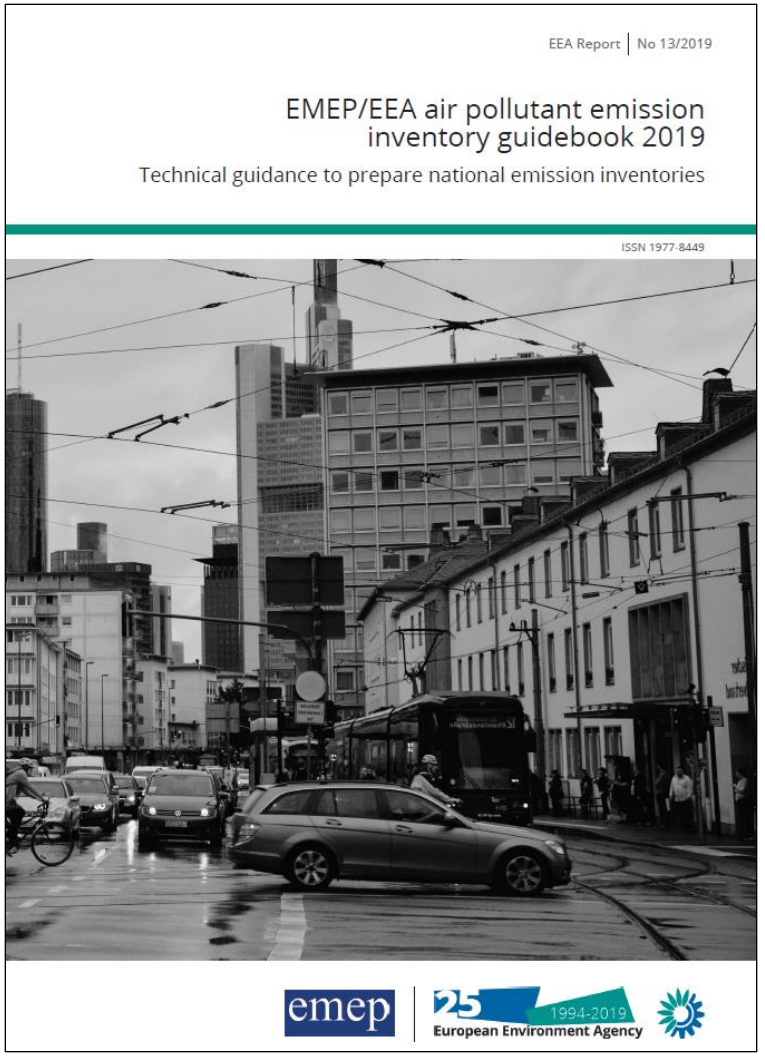
TFEIP

- Maintained and updated by the TFEIP
- Updated every 3 - 4 years (… 2016, 2019, 2023)
  - To capture information from measurement studies, literature reviews, and improved scientific understanding of emission sources
- Enables a high degree of agility to respond to emerging issues

# 2. The EMEP/EEA Emissions Inventory Guidebook

TFEIP

- Reliant on voluntary contributions…
  - Updates may depend on Parties particular interests and priorities
  - Comprehensiveness of updates is therefore “variable”!



# 2. The EMEP/EEA Emissions Inventory Guidebook

TFEIP

- Initial drafts developed by expert panels:
  - Combustion & Industry
  - Transport
  - Agriculture & Nature
  - Waste
  - Projections
  - User Engagement
- Reviewed and discussed at TFEIP annual meeting
- Finally approved by the EMEP Steering Body

- Recent updates for the 2023 Guidebook

| Relevant Expert Panel | Chapters |
|---|---|
| Combustion and Industry | 1.A.1 Electricity & heat generation<br>1.A.2 Industrial combustion<br>1.A.3.e Pipeline transport<br>1.A.4 Residential/Commercial<br>1.A.4 new Annex for future reporting<br>Fugitives - 1.B.1.a, 1.B.1.b, 1.B.2.a.i, 1.B.2.b, 1.B.2.a.iv, 1.B.2.a.v<br>Industrial Processes: 2.A.1, 2.B, 2.C.1, 2.C.3, 2.D.3.g, 2.H.1 |
| Transport | 1A3a Aviation<br>1A3b Road transport<br>1A3b Road transport – tyre & brake wear<br>1A3c Railways<br>1A3d Navigation (shipping)<br>1A3ei Pipeline transport |
| Agriculture & Nature | 3B Manure management<br>3D Agricultural soils<br>6A Other (included in national total) |
| Waste | 5A Solid waste disposal<br>5C1a Municipal solid waste incineration<br>5C1bi Industrial waste incineration<br>5C1biii Medical waste incineration<br>5D Wastewater handling<br>5E Other waste |
| User Engagement | A7 Spatial mapping of emissions |

# 3. Delivering to scientists and policymakers

One challenge for inventory compilers is that they are delivering to two different stakeholder groups… who want different things

- Scientists need:
  - The most up to date information
  - An understanding of uncertainties
- Policymakers need:
  - The “goal posts” to not keep changing
  - An understanding of how likely revisions are

# 3. Delivering to scientists and policymakers

The CLRTAP includes several **“flexibility mechanisms”**

- Continued requirement for all Parties to report “best science” emission estimates
- Options that additionally apply for reporting “national totals for compliance purposes”

# 3. Delivering to scientists and policymakers

Some flexibility mechanisms are straightforward concepts:

- Option to report (for compliance purposes) a three-year averaged national total… if there had been extreme weather conditions.

Some flexibility mechanisms are not so straightforward:

- Emission inventory “adjustments”…

# 3. Delivering to scientists and policymakers

## Adjustments

Under certain circumstances…

- Typically when "scientific understanding" changes

… Parties can apply to use "old methods" to calculate a national total for compliance

- In addition to reporting a "best science" total

A relatively simple concept… but challenging to define and implement the details.

# 3. Delivering to scientists and policymakers

## Quality and completeness of reporting

There is a wide range of quality & completeness of reporting:

- Western European countries are consistently good quality (see comments on EU later)
- Some Parties do not regularly report
- Reporting from some Parties is not good enough to be used in datasets for modelers, and “expert judgement” data is used instead to gap fill

# 3. Delivering to scientists and policymakers

## Emissions Inventory Review

- National submissions are subject to a technical review led by the CEIP to improve the quality of reported data
  - Stage 1: An initial check of submissions for timeliness, completeness and formats.
  - Stage 2: A synthesis and assessment of all national submissions with respect to consistency, comparability, Key Category Analysis, trends and Implied EFs of data with recommendations for data quality improvement.
  - Stage 3: In-depth reviews of selected inventories, by pollutant, country or sector, as in the workplan approved by the EMEP Steering Body. Up to ten countries are checked annually by two review teams.

# 3. Delivering to scientists and policymakers

## Emissions Inventory Review

Harmonised with review of data reported under the EU National Emissions Ceilings Directive

- But it relies on voluntary contributions

  … and is hence resource limited

- Parties are peer reviewed every several years, with limited scrutiny

The review process has recently changed to focus on sector-specific reviews

# 3. Delivering to scientists and policymakers

## Emissions Inventory Review

Contrast this to the European Union's reviews:

- Funded – delivered by a consultancy team
- Parties reviewed annually… in detail!
- Review team empowered to implement changes to the national totals

Countries are very engaged in this review…
… perhaps because the EU is able to impose unlimited fines for non-compliance with emissions reduction commitments!

# 4. Looking forward

- The European emission inventory community represents an ecosystem of cooperative effort and diverse expertise similar to the emission inventory community in the US.
- While underlying legislative and regulatory structures vary, both communities strive to produce coherent inventories suitable for developing and evaluating the progress of air quality management policies, including the development of inputs for photochemical and transport models.
- The range of emission source types and inventory technical experience and capabilities amongst countries in Europe is analogous to the differences amongst the US states.

# 4. Looking forward

- High quality inventories are hard won!
- We are hoping to promote and facilitate enhanced engagement and cooperation between the European and North American emission inventory communities
- We will have shared challenges and experiences
- We will certainly have limited resources!
- Improving awareness of our current initiatives and priorities could be very beneficial

# 4. Looking forward

- Likely TFEIP priority list for the next year:
  - Some work on NMVOC speciation
  - Checks and improvements are still needed for road transport emission estimates
    - Recent measurement studies suggest that COPERT is under-estimating emissions from modern LGVs
  - Heavy metals and POPs have been somewhat neglected
    - We will try to resource a review of EFs (particularly for mercury)
  - Small-scale burning of domestic and garden waste has been a long-standing gap in the EMEP/EEA Guidebook
  - Review whether to centralise emission estimates from shipping
  - We are told that current emissions inventories don't explain urban $NH_3$ concentrations.

# Thank you

# Questions?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