# Uncertainties in Emissions Inventories

## Current Challenges

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LRTAP
Long-range Transboundary Air Pollution

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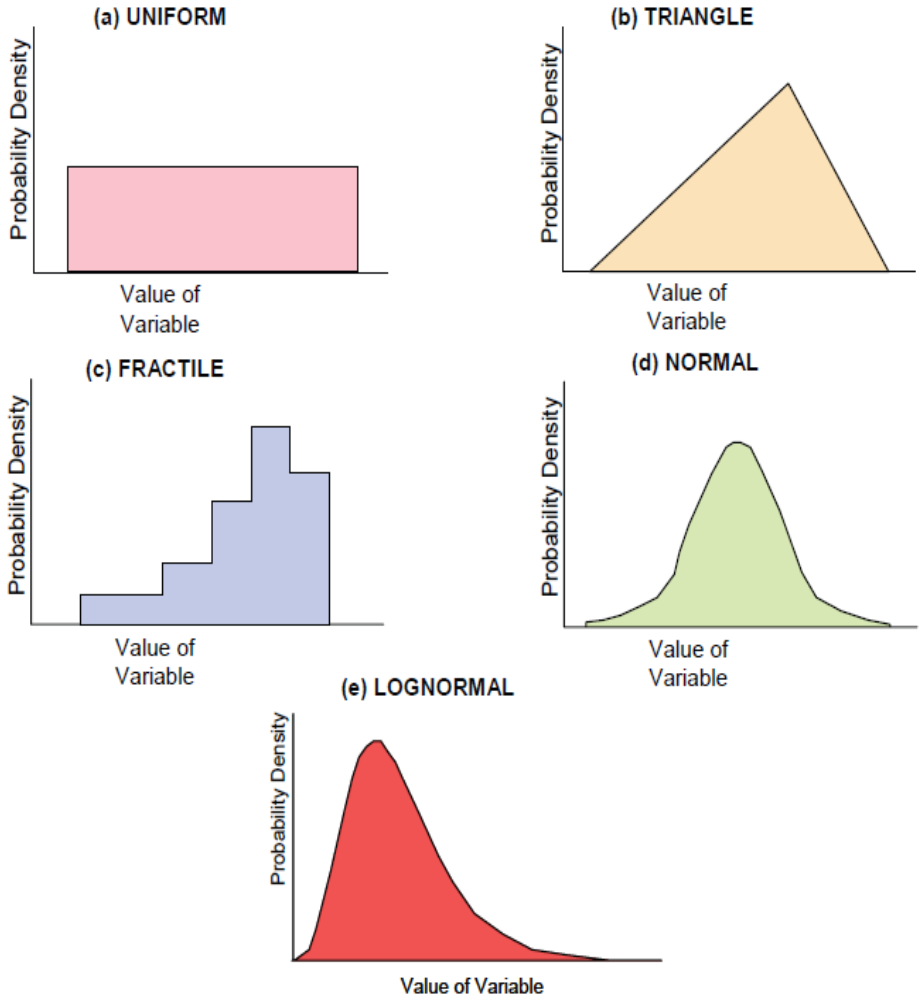
# 1. Current Methodologies

## Best Practice – a reminder

- **Propagation of Errors**
  - Assess uncertainties of individual components
  - Combine to get an overall uncertainty
  - Absolute and Trend uncertainties

- **Monte-Carlo Analysis**
  - More sophisticated way of “combining” uncertainties
  - Requires probability distributions & “correlation” assessment

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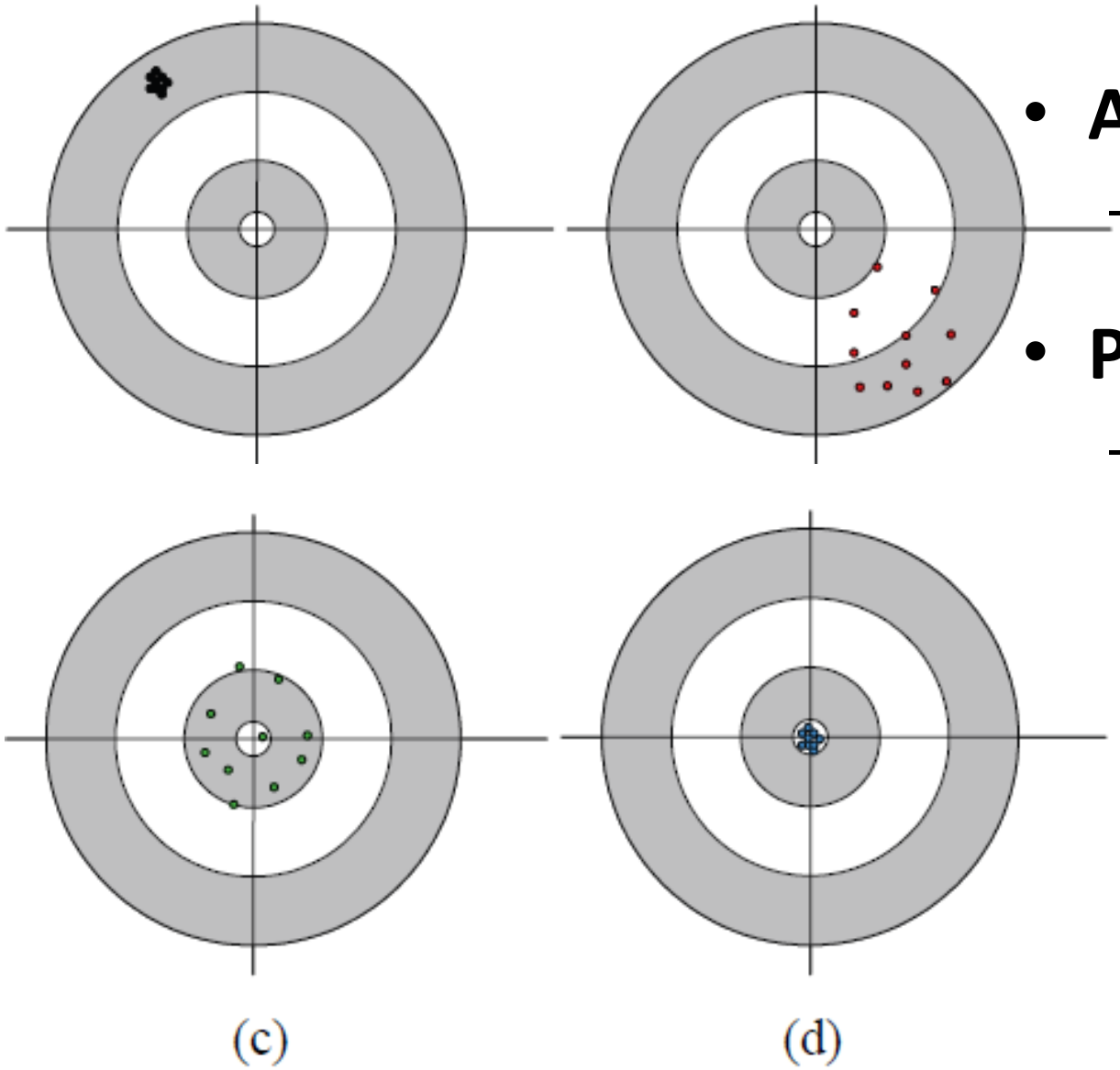
# 1. Current Methodologies




- **Accuracy**
  - Closeness to the “real” value
- **Precision**
  - Consistency of measurement

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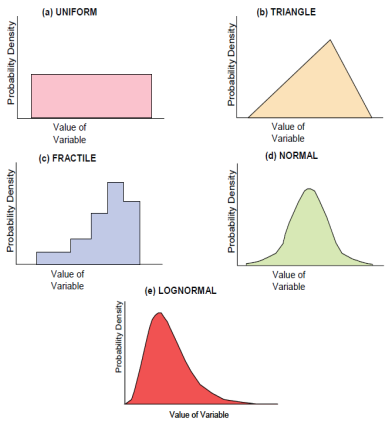
# 1. Current Methodologies

## Best Practice – a reminder



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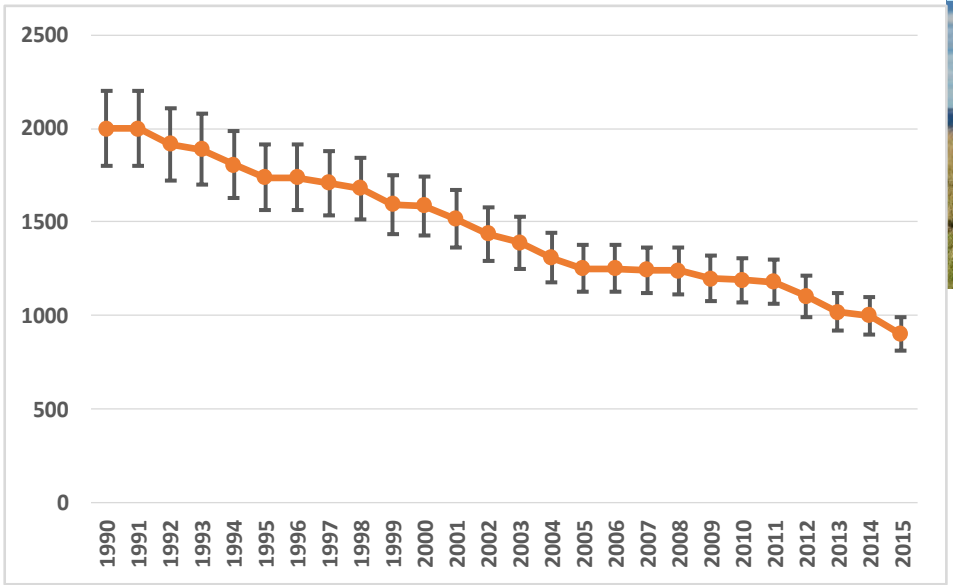
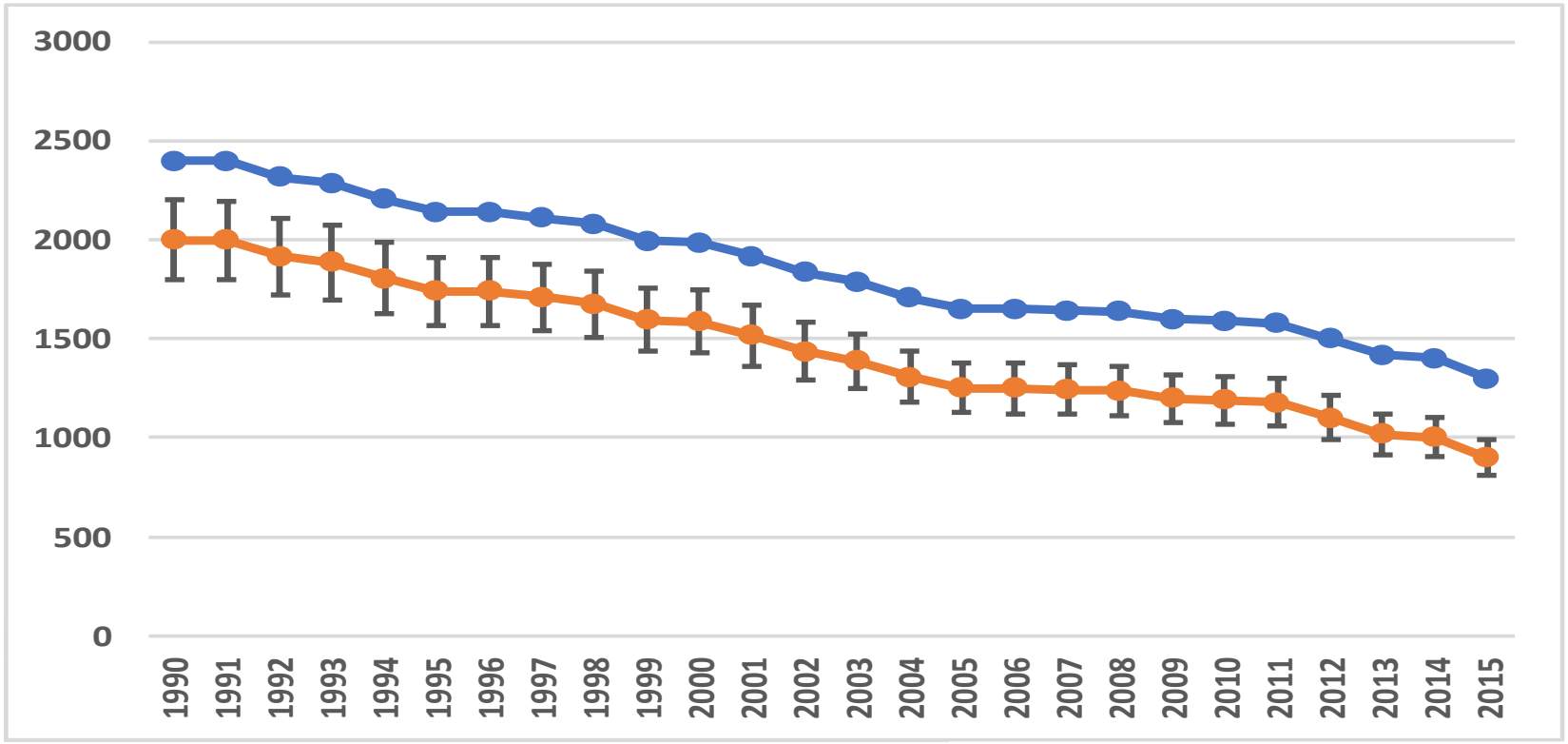



- **… 100 ktonnes ± 10% in 2015**

# 1. Current Methodologies

## Best Practice – doesn't deliver everything

- **Updated estimates… 120 ktonnes ± 10% in 2015**
- ***"… but last year you said 100 ktonnes ±10% for 2015!"***

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# 1. Current Methodologies

## Best Practice – doesn't deliver everything

- **Updated estimates… 120 ktonnes ± 10% in 2015**
- ***"… but last year you said 100 ktonnes ±10% for 2015!"***

- **What does best practice deliver?**
  - Absolute and trend uncertainties
  - A Method that is transparent, consistent etc.
  - It handles "known unknowns"
  - Gives an indication of relative uncertainty across sources, pollutants and countries… to steer improvement efforts.

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# 1. Current Methodologies

## Best Practice – doesn't deliver everything

- **Updated estimates… 120 ktonnes ± 10% in 2015**
- ***"… but last year you said 100 ktonnes ±10% for 2015!"***

- **Shortcomings**
  - It cannot account for "unknown unknowns"
  - Therefore prone to "surprises"
  - Big issues with "representativeness" (see Condensable PM)
  - **… this is bad news for the science community**
  - **Bad news for policymakers** (although "adjustments" address some issues)
  - It works better for the GHG emission estimates.

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# EMISSIONS INVENTORY UNCERTAINTY ASSESSMENT:

## DEVELOPING A COMPLEMENTARY APPROACH

Dr Chris Dore

10/05/2017, WORKSHOP ON UNCERTAINTIES & QA/QC
Krakow

Aether

# Developing a Complementary Approach

*How can we account for "unknown unknowns" to avoid surprises?*

**Review historic revisions** to the time series.

Identify **reasons for changes** to emissions

- Improved activity data
- Methodology change (country specific or Guidebook update)
- Improved EFs (country specific or Guidebook update)
- Flagged by CLRTAP/NECD reviews??
- Etc.

# Developing a Complementary Approach

*How can we account for "unknown unknowns" to avoid surprises?*

**Common Impacts**

- Tier 1 to Tier 2 – emissions reduction
- New version of Guidebook – increases (more sources)
- CLRTAP/NECD reviews – increases (addresses gaps)
- Periodic review of national statistics – increase & decreases

- Inventories that are more frequently updated allow better characterisation.

# Developing a Complementary Approach

*How can we account for "unknown unknowns" to avoid surprises?*

**Quantification**

For each pollutant, and each reason, characterise:

- Frequency of changes (trends in sectors)
- Magnitude of changes (+ve or –ve?)

Establish **probability distribution for changes**

- Expressed as "version" dependent.
- Earlier years change less!

# Conclusions

## *Best Practice (Precision)*

- Transparent and consistent
- “Relative” uncertainties are useful
- … but totals are prone to “surprises”

## *Complementary Assessment (Accuracy)*

- Understanding can be gained from what has gone before
- … to account for unknown unknowns

Approach in the development stage

# Quality Assurance & Quality Control

## The need for sharing ideas & approaches

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# Quality Assurance & Quality Control

## Importance

**Recognised as a fundamental part of an inventory system**

- To steer inventory improvement/development
- To ensure verified estimates & error-free working

**However…**

- It is never reviewed (not on the AQ side)
- We all do it differently
- It is difficult to know when you've got it right
- … and easy to have too much or too little!

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# Quality Assurance & Quality Control

## Sharing information on approaches

**In a world of limited resources**

- Should we do more QA/QC… or less!?

- The answer is probably to invest in innovation and automation
- … and learn from each other.

- Hopefully the presentations that follow will help.

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# Filterable/Condensable PM EFs

## What are the main issues?

**PM emissions can be measured in different ways:**

- Filterable, or filterable including condensable/semi-volatile PM
- The difference can be up to a factor of 5.

- The Guidebook contains EFs taken from a wide range of measurement studies
- The modelling community need to know what national emission estimates represent.
- This complicates the use of emission inventories for compliance purposes
- Effectiveness of abatement measures (CBA) can be significantly affected.

# Filterable/Condensable PM EFs

## What work has been undertaken to date?

### Set up of TFMM-TFEIP Working Group

#### TFEIP/TFMM Joint workshop

- Workshop held in 2016 to discuss the issue.
- Short-term actions, and long-term aspirations, agreed:
  - Draft a questionnaire to Parties to gather information on the PM EFs used in national inventories
  - Revised Tier 1 methodology for domestic combustion
  - Draft guidance document on condensables

#### Review of Guidebook content

- Information added to the Guidebook on the definition of each PM EF (if known).

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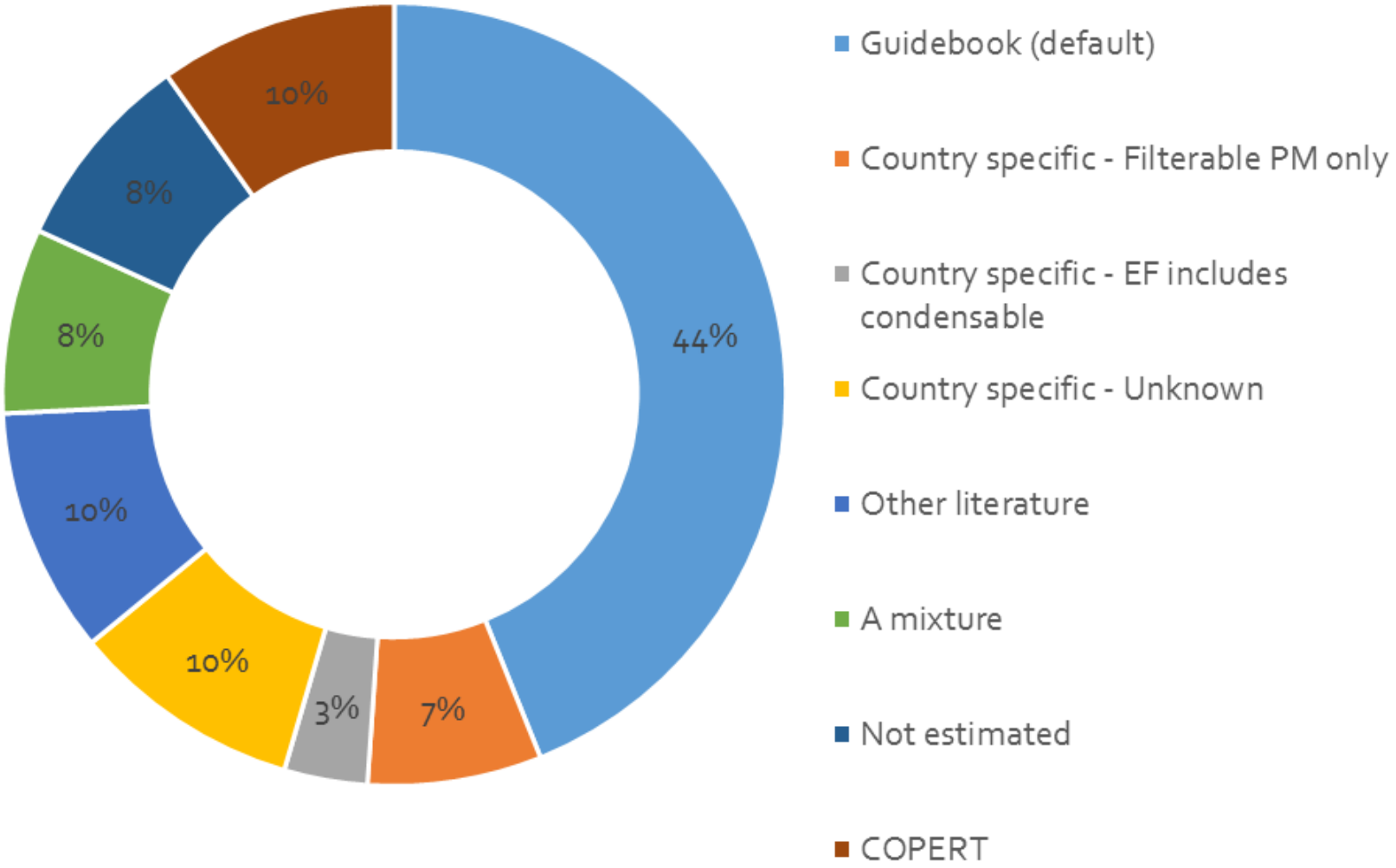


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# Filterable/Condensable PM EFs

## What work is planned for the future?

**Reworking of the guidance document**

- Initiative being led by TFMM. Revised document with action list.
- Technical information needs to be presented in a way that supports the Executive Body in making some political decisions.

- Modellers requesting detailed NMVOC speciation into volatility bins

**Long-term aims**

- Standardise reporting of PM, to include the condensable component as appropriate:
  - Likely to be done on a sector-level basis (requires Guidebook updates).
- Further research needed to understand the organic component of PM (OM).

# Filterable/Condensable PM EFs

## What decisions do we need to make?

**Recommend the detail of future reporting:**

1. PM emissions to exclude condensable component
2. PM emissions to include condensable component
3. Selected sectors to include/exclude condensable component on a consistent basis (across all Parties).
4. Exclude condensable component, but include every 4 years.

**There are implications that would arise:**

- Development of the Guidebook
- Revisions to national emissions inventories
- Impacts on reduction commitments (adjustments)

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