



Course on review of higher tiers General issues and non-LULUCF sectors

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Background and general issues

- › What are Tiers?
- › What is a Tier 3 method?
- › Why would a Party use a Tier 3 method?
- › What are the objectives to review a higher Tier method?

The screenshot shows a Moodle course page for 'Reviewing Higher Tier Emission Estimates'. The page title is 'A draft e-learning course'. The breadcrumb trail is 'Home -> Tier Review Training -> 2: Background'. The main content area is titled 'Background' and contains the text: 'This part of the course will be the same for all sectors.' Below this, there is a note: 'The word "chapter" could be adapted to indicate different sections within the course if needed.' The page also features a table of contents with the following items:

- 2.1 What are tiers?
- 2.2 What is a Tier 3 method?
- 2.3 Why would a Party use a Tier 3?
- 2.4 Objectives of reviewing a Tier 3

At the bottom of the screenshot, there is a footer with the text: 'page revision: 0, last edited: 15 Feb 2011, 16:12 GMT+0100 (26 days ago). Stop watching site: be2.wikidot.com [1]'. There are also links for 'Edit', 'Tags', 'Discuss', 'History', 'Files', 'Print', 'Site tools', and 'Options'.



What are Tiers?

- › “Tiers” are central in IPCC **Good Practice**
- › Related concepts:
 - › Key categories
 - › Decision trees
 - › Default data

Tiers: A *tier* represents a level of methodological complexity. Usually three tiers are provided. Tier 1 is the basic method, Tier 2 intermediate and Tier 3 most demanding in terms of complexity and data requirements. Tiers 2 and 3 are sometimes referred to as *higher tier* methods and are generally considered to be more accurate.



What are Tiers?

- › **Tier 1**
 - › Fall back option;
 - › Simple method with default parameters or centrally modelled data sets
 - › Cannot be used for “important” sectors
- › **Tier 2**
 - › Same method with country specific parameters and/or higher stratification
- › **Tier 3**
 - › Anything more complex than this

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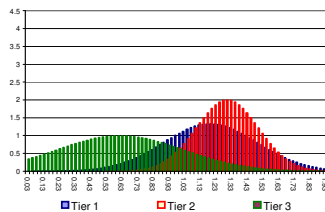
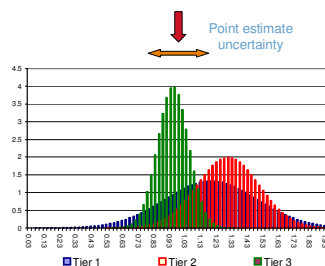
What are Tiers?

- › Uncertainty
 - › The main reason for using a higher Tier is to decrease uncertainty.
There is no point in investing in a higher Tier if this does not decrease uncertainty.
 - › Successive tiers would all lie within each other's uncertainty range,
 - › Uncertainty ranges would decrease from Tier 1 to Tier 2 to Tier 3.
- › This basically suggests two important handles for the reviewer:
 - › The Tier 3 estimate would be expected to lie within the uncertainty range surrounding the Tier 1 approach.
 - › The Party's uncertainty estimate for the estimated value would be expected to be smaller than the Tier 1 uncertainty.
- › With these two handles, the ERT should in principle have a first and probably sufficient idea on the quality of the higher tier approach
If the estimate is outside the Tier 1 estimate's uncertainty range or if the uncertainty as reported by the Party is not smaller than the uncertainty in a Tier 1 estimate, the ERT should ask questions to clarify this.



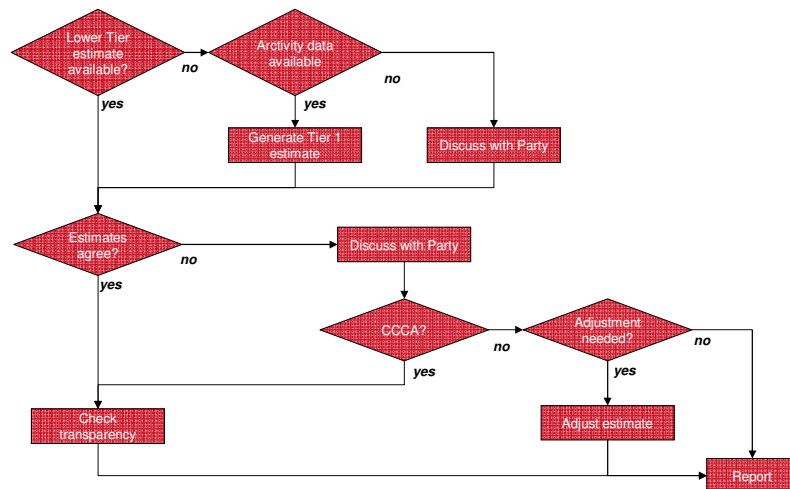
Higher Tier estimates: more confidence

- › Looks good:
 - Tier 3 (green) is clearly within the uncertainty ranges of Tier 2 (red) and Tier 1 (blue) and the uncertainty decreases with higher Tier.
- › Doesn't look good:
 - Tier 3 estimate is lower than expected on the basis of Tier 1 and/or Tier 2
- › Looks even worse





Generalized higher Tier review procedure



What is a Tier 3?

- › Tier 3 methods actually come in two varieties:
 - › Emission models
 - › Use of detailed (facility level) information / measurements
- › Emission modelling
 - › a quantitative abstraction of a real-world situation. An emissions model is based on assumptions, data and relations and translates these into a complete set of algorithms to estimate the emissions of a specific source category or group of source categories.
 - › Strictly speaking also Tier 1 and Tier 2 methods represent a model.
- › Facility level data
 - › A Party might want to use facility level emission measurements or data from emissions trading activities

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Emission model: Copert

- › A number of Parties use a sophisticated model for road transport, such as Copert (several EU Member States).
- › Fuel use in this model needs to be consistent with national energy statistics
- › For CO₂ no improvement above Tier 1 or Tier 2
- › Might work for N₂O (and methane)

From IPCC 2006 GL

Particularly for road transport, using a Tier 2 or Tier 3 technology-specific method for estimating N₂O and CH₄ emissions will usually bring large benefits. However, for CO₂ in general, a Tier 1 method based on fuel carbon and fuel amount used will often suffice. This means that the generalized decision tree might result in different approaches for different gases for the same source category. Since emission models and technology-specific methods for road transport might be based on vehicle kilometres travelled rather than on fuel used, it is *good practice* to show that the activity data applied in such models and higher tier methods are consistent with the fuel sales data. These fuel sales data are likely to be used to estimate CO₂ emissions from road transport. The decision tree allows the inventory compiler to use sophisticated models in combination with any other Tier methodology, including measurements, provided that the model is consistent with the fuel combustion statistics. In cases where a discrepancy between fuel sales and vehicle kilometres travelled is detected, the activity data, used in the technology-specific method should be adjusted to match fuel sales statistics, unless it can be shown that the fuel sales statistics are inaccurate.



Emission model: Copert Example from Italy 2010 NIR Road Transport

3.5.3.5 Source-specific recalculations

In 2009 submission, the transition from COPERT III to COPERT 4 was the occasion for a general review of input data, as activity data, model parameters and emission factors. The new version revised both the estimation methodology and the software. Methodological differences affected mainly emission estimates of heavy good vehicles, especially in terms of fleet classification, emission factors, and emission degradation parameters. In addition, hot emission factors of regulated pollutants for conventional passenger cars and powered two wheelers and nitrous oxide and ammonia from passenger cars and light duty vehicles have been updated; particulate matter emissions have been distinguished by exhaust and non-exhaust emissions. COPERT 4 also includes a new methodology for the estimation of evaporative emissions and a revision of heavy metal estimates due to the inclusion of emissions from tyre and brakes wear.

The most recent update of the software is COPERT 4, version 7.1 since February 2010 (EEA, 2010), which is a user-friendly version enhancing import/export capabilities and the management of time series of estimates. The new version of the model upgraded the methodology, the software and fixed some bugs, and it has been used to estimate emissions in the 2010 submission determining a recalculation of emission estimates, with respect to the previous submission.

Methodological updates of the software regarded mileage degradation parameters, new hot emission factors for motorcycles, new CH₄ cold emission factors for EURO5 gasoline passenger cars and light duty vehicles, and the update of CO, NO_x, NMVOC, CH₄, PM and NH₃ emission factors especially for LPG fuelled passenger cars especially from EURO3 to EURO6. Regarding the software, the new version enhances export capabilities and the management of time series of estimates. Moreover, important bugs of the software have been corrected. The more relevant concerns the calculation of N₂O, NH₃ and CH₄ hot and cold emissions. Because of this bug there was a misallocation between the hot and cold emissions of these pollutants. Furthermore, the N₂O cold emissions were stored in place of NH₃ cold emissions and vice versa. These updates resulted in a further reduction of CH₄ and N₂O emission levels and an increase of NMVOC emissions, with respect to previous submission.

From NIR2010 Italy

- Transparent description of what happened: new version of model
- Bugs repaired ...
- "updated EFs for N₂O and CH₄"
- Result
 - Lower N₂O and CH₄ emissions
- Is this transparent?
- Not only Italy, but also other Parties use Copert and have recalculated emissions due to these "model improvements".



Emission model Industrial Processes

Process modelling

- › In Industrial Processes Tier 3 methods are in many cases
 - › built on a clear chemical description of the processes used or
 - › derived from mass balances
- › The IPCC Guidelines provide equations for many of these
- › Review should not be more complicated than for other methods;
 - › Where are the input data coming from?
 - › Are parameter values well chosen?



Model uncertainties

Box 3.3

DEALING WITH MODEL UNCERTAINTY IN A PROBABILISTIC ANALYSIS

A Tier 3 modelling approach is designed for flexibility so that a national inventory can be conducted using a more highly refined model representing national circumstances than in Tier 1 or 2. In particular, it is good practice to address uncertainties attributed to model inputs and structure. Input uncertainty deals with activity data and possibly other ancillary information that is needed to describe the environmental setting, such as climate and soil characteristics in an inventory for the AFOLU Sector. Uncertainty in model structure is attributed to imperfect algorithms and parameterisation. Empirically-based approaches are commonly used for assessing structural uncertainties (Monte *et al.* 1996). This approach involves comparing modelled emissions estimates with measurements from experiments or a national monitoring network, which was designed for validation of model-based inventories, addressing both the bias and variance in modelled values (Falloon and Smith 2003).

From IPCC 2006 GL

From IPCC GP 2006

A statistically-derived relationship may be used to quantify uncertainties in model structural error in a Tier 3 inventory, addressing imprecision based on the estimated variance, or a similar measure such as the Root Mean Squared Error, while also dealing with biases based on statistically significant differences between modelled and measured values (Falloon and Smith 2003). In general, uncertainties related to model choice will be reflected in the uncertainty ranges derived for use in the context of the model selected.

structural uncertainty using error propagation equations or a Monte Carlo approach.

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Facility level data Example from ... (looking for a good example)

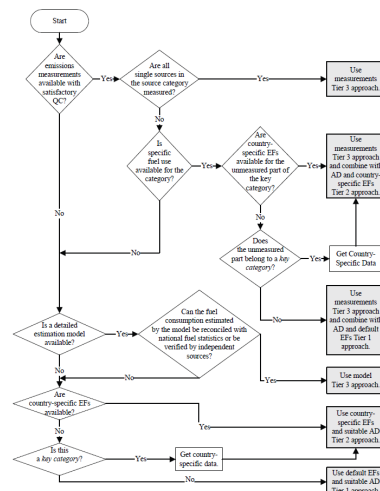
- › Emission Trading data: CO₂
 - › Technical:
 - › Continuous emissions monitoring (CEM) of flue gases is generally not justified for accurate measurement of CO₂ emissions only
 - › Carbon content and CO₂ concentrations generally used to measure the flue gas flux !
 - › Need to consolidate with national energy statistics
- › Facility level reporting:
 - › CO₂ Same as above
 - › Other GHGs:
 - › Could be used to derive source of country specific emission factors
 - › Could be completed with default EFs for all fuels in the same source category / fuel combination not included in these facility reports



Tier 3 in Combustion sources

- › No rationale to use it for CO₂
- › How should facility level data be used in a higher Tier:
- › Decision tree

Figure 1.2 Generalized decision tree for estimating emissions from fuel combustion



Note: See Volume 1 Chapter 4 "Methodological Choice and Key Categories" (starting section 4.1.2 on limited resources) for discussion of key categories and use of decision trees.



Why would a Party use a Tier 3?

- › There is no obligation to use a Tier 3; a Tier 2 is “good enough” for any key category!
- › Nevertheless a Party might use a Tier 3 for one or more source categories because:
 - › an elaborated model is available
 - › facility level reporting and/or measurements are available
 - › it better reflects policies and measures in the country



Conclusion: Reviewing a Tier 3

1. Check whether the estimate is what one would expect:
 - › Does the party's NIR show that
 - › The method results in a value within the lower Tier uncertainty range?
 - › The uncertainty is decreased compared to a lower Tier estimate?
 - › If not, make your own estimate by asking specific questions to the Party
 - › Can the deviation be explained?
2. Is the Tier 3 method transparent?
 - › Model used as provided by IPCC Guidelines (1996 and/or 2006)?
 - › Parameters documented?
 - › Uncertainty properly established?



Conclusion: Please help

- › All important issues are covered?
- › There is a need for “practical detail or examples”:
 - › All sectors
 - › Anonymized
- › We like to use “recent experience”
 - › Good practice examples ?
 - › Problems / issues during review ?
- › Could Lead Reviewers and experienced reviewers propose these for inclusion in the course?
- › Any suggestions?