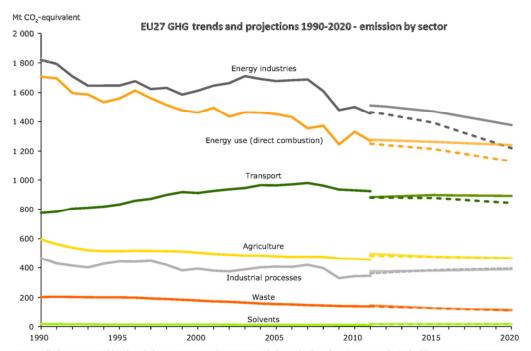
# DRAFT GHG Projection Guidelines

Part A: General Guidance



Note: Solid lines represent historic emissions up to 2011 and WEM GHG emission projections from 2011 onwards. Dashed lines represent WAM GHG emission projections.

Source: EEA, 2012. Greenhouse gas emission trends and projections in Europe 2012. Tracking progress towards Kyoto and 2020 targets. EEA Report No 6/2012

# Part A General Guidance

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# A.0 Executive summary

#### Compiling an Emission Projection: A harmonized Approach

Compiling a greenhouse gas emission projection is a step-by-step process. This section provides guidance on these steps for the *projection compiler*, i.e., the person, persons or institutions who put together or develop the projection from materials gathered from several sources. Compilation includes the collection of projected activity data (in most cases outputs from projection models), estimation of emissions and removals, checking and verification, uncertainty assessment, sensitivity analysis and reporting.

Before undertaking estimates of projected emissions and removals from specific categories in specific years, a projection compiler should become familiar with the material in this document *General Guidance*. The general guidelines provide *good practice guidance* on issues that are common to all the estimation methods covered by the sector-specific guidance provided in Part B.

# 0.1 Summary for Policy makers

Parts A and B of the Reporting Guidelines are complementary. After the compilers (tasked with preparing emission projections for specific emission and removal categories) have familiarised themselves with the general guidance in Part A they should use the specific sectoral guidance. Following the specific guidance in Part B they should be able to apply the methodologies in a manner appropriate to their national circumstances.

The following aspects of greenhouse gas projections are addressed in the guidelines:

- ✓ **Data collection:** Collection of data is a fundamental part of the projection preparation. To compile a GHG emission projection, it is extremely important that the latest historic inventory and associated activity data and assumptions contained therein are available. Chapter 4 Data Collection provides guidance on initiating and maintaining a data collection program, using the latest historic inventory as the base.
- ✓ Key category analysis: Good practice guidance on how to identify key categories of emissions and removals in both the base year and projected years is provided in Chapter 5.2.1 .The key category concept is used in Part B Sectoral Guidance to guide users in their methodological choice for each category.
- ✓ **Time series consistency:** Ensuring the time series consistency of the projection in relation to historic inventory estimates is essential to establishing confidence in the projected emission and removal trends. Chapter 6, Time Series Consistency, provides some guidance on this issue.
- ✓ Quality Assurance (QA) and Quality Control (QC): A QA/QC system is an important part of inventory development. Chapter 8, QA/QC and Verification, describes the general QA/QC aspects to consider when compiling GHG emission and removal projections. *Good practice guidance* on sector specific quality control checks are addressed in every sector in Part B Sectoral Guidance.
- ✓ Reporting: Chapter A.9 Reporting, specifically addresses issues related to reporting projected GHG emissions. The harmonised reporting tables for the projected GHG emissions are discussed along with the complementary reporting requirements on parameters and indicators.

# 0.2 Harmonized approach

With the current legislation, within the European Union, all Member States have the obligation to report every two years a greenhouse gas projection<sup>1</sup>. The basic principles and methods to estimate emissions for GHG projections are the same as for GHG inventory<sup>2,3</sup> unless indicated otherwise.

To ensure that these MS projections are transparent, comparable, consistent, complete and accurate (TCCCA)<sup>4</sup> the Guidelines propose a harmonized approach to project GHG emissions. Figure 1 illustrates the steps of a typical emission projection activity, following this harmonized approach.

- 1. The starting point of each projection activity is the **latest greenhouse gas emissions inventory** reported to the EU Monitoring Mechanism (MM) Decision and the UNFCCC. Using the latest reported inventory<sup>5</sup> contributes to the harmonization between Member States. They all follow the same guidance and, due to the UNFCCC review process<sup>6</sup>, one can be confident that these inventories indeed comply with the respective guidelines and provide most accurate data for the starting point of GHG projections.
- 2. Identify **key categories**, both in level (latest year) and trend (latest year to projected year). The latter obviously is only possible if an earlier projection is available.
- 3. Prepare in parallel a projection of **the activity data and of the emission factors**. These projections may be calculated with different levels of sophistication ("grades", to distinguish these from the "tiers" in emission estimation methods):
  - ✓ Grade 1: Use proxies for parameters to simulate future development of emissions; a proxy is a measurable unit which can be used to construct a not direct measurable unit. (for instance population size can be used as a proxy for the energy use of consumers). A proxy is something that does not in itself have a causal relation with the parameter or variable one is looking for, but from which this variable of interest can be obtained. In order for this to be the case, the proxy must have a close correlation, not necessarily linear or positive, with the inferred value (Error! Reference source not found. presents an example of Grade 1 projection)<sup>7</sup>

Article 3(2).b of Decision 280/2004/EC (Monitoring Mechanism Decision), http://eur-lex.europa.eu/LexUriSery/LexUriServ.do?uri=OJ:L:2004:049:0001:0008:EN:PDF

The latest adopted guidelines under UNFCCC. At the moment (IPCC, 1996) (<a href="http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html">http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html</a>) and (GPG,2001) (<a href="http://www.ipcc-nggip.iges.or.jp/public/gp/english/">http://www.ipcc-nggip.iges.or.jp/public/gp/english/</a>), starting in 2015 it will be (IPCC, 2006) (<a href="http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html">http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html</a>)

An "Emission Projection" is an inventory for a future year, assuming some well-defined changes in economic activity, technological developments and policies and measures. Because of that, the methods are very similar to those for emission inventories.

The TCCCA criteria (Transparency, Completeness, Consistency, Comparability and Accuracy) are the 5 key indicators to be monitored following *good practice* standards (IPCC, 2006; IPCC GPG, 2000).

The inventory compilation process is a cyclic process that aims at improving the inventory wherever needed as part of the annual inventory submission process. Therefore one has to assume that the latest historic inventory is the best inventory available for the Member State.

Later on there might also be annual reviews in the framework of the Monitoring Mechanism Regulation in order to assess Member States inventories and performances in the context of the ESD.

Proxies should be used only if detailed information on parameters/future development of emissions is not available.

- ✓ Grade 2: Use the most relevant existing parameters or projection results (from relevant studies or models executed at EU level).
- ✓ Grade 3: Use complex country-specific parameters or models, in most cases developed within the Member State.
- 4. Calculate the projected emissions from the projected activity data and emission factors.
- 5. Extract or generate the values for the **common parameters** from the projection calculation (e.g. model input, parameters and indicators) and document them.
- 6. Document and report the projection.

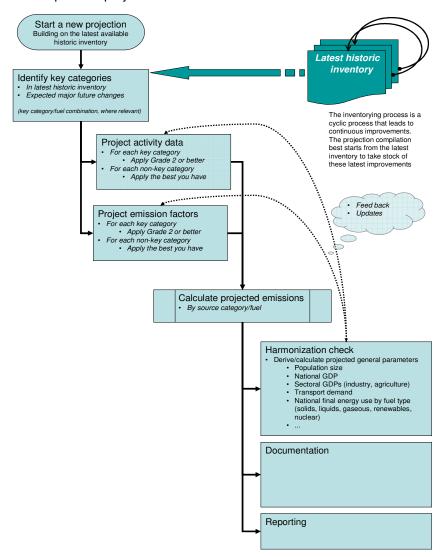


Figure 1 Projection development process

The projection compiler should base future projection revisions on the latest available submitted inventory. Thus the iterative process builds on and updates the projected emissions each time a new inventory is compiled as illustrated in Figure 1. When a revised inventory has become available, it is

good practice to review all earlier projected emissions for consistency and update any feasible improvements where necessary. These improvements will then be incorporated into the new emission projections.

This figure presents an example of the Grade 1 projections using a proxy. PFCs were introduced in 90' and since they are reported they have a good correlation with population. Therefore, as long as there are no recent relevant new policies and measures, projections of population can be used to estimate future HFCs from 2.F.1 – Refrigeration and air conditioning equipment.

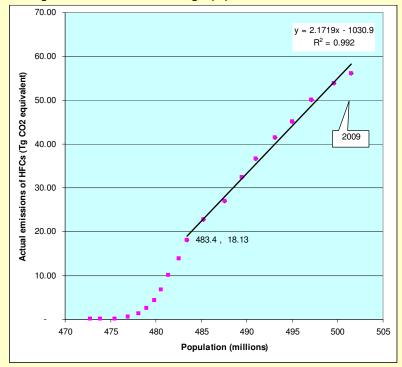


Figure 2 Example of Grade 1 approach using proxy: HFCs emissions (Gg CO2 eq) from 2.F.1-Refrigeration and air conditioning equipment for EU27.

# 0.3 Key assumption

A precondition of good quality emission projections is to achieve consistency with the GHG emission estimated in the latest historic inventory. To reach that, historic activity data and (implied) emission factors should be where possible based on or calibrated to the latest available GHG emission inventory and need to be developed at the same level of detail, at least for key activities. It is good practice for the future activity data and future emission factors to show an explainable development from the historic values.

The next step is to ensure GHG projections comparability between MS at European level. This can be achieved when MS are estimating identical (harmonised) entities based on identical (harmonised) bases. Therefore it is necessary to harmonise definitions and units between MS. It is good practice

to use the definitions of e.g. GDP, final energy consumption per sector, fuels, etc. developed by EUROSTAT<sup>8</sup> and energy expressed in (TJ) and emission factors in (kg/TJ).

The GHG projections reporting should also be comparable, consistent and complete. The methodology and data sources used in compiling an emission projection scenario should be appropriately documented. It should include sufficient information to allow readers to understand the underlying assumptions and to reconstruct the calculations for each of the estimates included. Documentation of estimation methods for GHG projections should follow the same general guidance as used in the national GHG inventory: numbers are recorded in the reporting template (Annex A.IV), whereas descriptions and explanations are part of the National Projections Report (NPR).

It is important to ensure that resulting emission projections have similar QA/QC as applied to the historic inventory. The first step is to apply a "general" QA/QC (described in Chapter A.8, Quality Assurance and Quality Control (QA/QC) for Projections) to ensure the quality (TCCCA) of the projections. It is good practice to check the following:

√ "Completeness" : missing sources/fuels;

✓ "Comparability" : misallocation of estimates to sub-sectors;

✓ "Consistency" : inconsistency in the time series (including historic to projected) or

between approaches for different pollutants/categories;

✓ "Accuracy" : errors in application of assumptions or biased assumptions.

In addition to the general QA/QC, the source specific QA/QC (described in Part B Sectoral Guidance in every sectoral chapter) should be applied.

# 0.4 **Key parameters**

To make MS GHG projection comparable it is essential to report some of the parameters, used as input data in the projections and projection models at an aggregated, national level. These key parameters which support comparable presentation of the GHG emission projections between Member States include: energy projections, economic projections, population projections. Table 1 presents a format to be used to report the specific parameters which are used for the GHG projection estimation. It is good practice to indicate (yes / no) whether each parameter was used in GHG projections for a particular sector<sup>9</sup>. Where a MS does not have its own projections of the key parameters they should be retrieved from the default sources indicated in Table 1. It is good practice to report the value, unit, and in the case where it is not a default source the source of data of each parameter. GDP needs also to include to which year the constant prices apply.

Please note that the values of the key parameters should be the same in all sectors where they are used in the projections.

http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/
http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST\_NOM\_DTL\_GLOSSARY&StrN\_om=CODED2&StrLanguageCode=EN

Not all parameters listed in the Table 1 need to be reported, only those which were used.

# **Table 1 Key Parameters**

	Used in	n:						_							
	1.A.1	1.A.2	1.A.3	1.A.4	1.A.5	1.B	2	ω	4	6	Default	_		De	Source
Parameter	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	ault source	Value *	Unit	Default Unit	rce of data
Population											1			Count	
Gross Domestic Product (GDP, at constant prices, including the year)											2			€ million	
Sector specific Gross Value Added (GVA)											2			€ million	
International fuel price: coal, oil, gas, etc.	yes	yes	~								2			€/TJ	
National fuel price: coal, oil, gas, etc.											2			€/TJ	
National electricity price	no										2			€/kWh	
EU ETS Carbon Price	yes	yes	yes			no	yes	no	no		2			€/tCO2eq	
International growth											3			%/annum	
Exchange rates											4			€/currency	

Default sources:

<sup>1-</sup>EUROSTAT

<sup>2-</sup>European energy trend projections

<sup>3-</sup> International Monetary Fund (IMF)

<sup>4-</sup> Euro foreign exchange reference rates (http://www.ecb.int/stats/exchange/eurofxref/html/index.en.html)

<sup>\*:</sup> In case more than one value is used for the different years or scenarios please refer to underlying reports were these values can be found.

## 0.5 **Possible data sources**

Dependent on the grade of the projection method different data sources can be identified:

Grade3: Member States might have developed their own sector projection models. In that case it is good practice to use MS model and appropriately report the underlying methodologies and assumptions so that reader could be able to retrieve the undertaken steps.

Grade 2: In case that a MS does not have national models there are different models or data sources which might be useful available at the European level.

Projections of energy consumption / supply projections:

- PRIMES http://www.e3mlab.ntua.gr/e3mlab/
- POLES <a href="http://www.enerdata.net/enerdatauk/solutions/energy-models/poles-model.php">http://www.enerdata.net/enerdatauk/solutions/energy-models/poles-model.php</a>
- TIMES <a href="http://www.iea-etsap.org/web/index.asp">http://www.iea-etsap.org/web/index.asp</a>
- ➤ PROMETHEUS Model http://www.e3mlab.ntua.gr/e3mlab/index.php?option=com\_content&view=ca tegory&id=37&Itemid=72&lang=en

## Agricultural projections:

- CAPRI model http://www.ilr1.uni-bonn.de/agpo/rsrch/capri/caprifp4 e.htm
- ➤ AGLINK-COSIMO model http://agrilife.jrc.ec.europa.eu/AGLINK.htm
- The Food and Agriculture Organisation <a href="http://www.fao.org/">http://www.fao.org/</a>
- The European Fertilizer Manufacturer Association http://www.efma.org/site/index.php?id=317
- The International Fertilizer Industry Association <a href="http://www.fertilizer.org/">http://www.fertilizer.org/</a>

## Transport projections:

10

- TREMOVE model http://www.tremove.org/
- PRIMES-TREMOVE model http://www.euclimit.eu/Models.aspx#PRIMESTREMOVE
- SCENES http://netze.iww.kit.edu/102\_200.php
- EX TREMIS http://www.ex-tremis.eu/
- TRANS-TOOLS Model http://energy.jrc.ec.europa.eu/transtools/index.html
- AsTra model http://www.astra-model.eu/structure-overview.htm
- > COPERT <a href="http://www.emisia.com/copert/General.html">http://www.emisia.com/copert/General.html</a>

There are also various models for the LULUCF sector<sup>10</sup>, however, there is a need for their verification/validation/adjustment before they can be used for GHG projections.

Grade 1: In case that specific projection models are not available emission projection can be calculated using proxies. A proxy is a measurable unit which can be used to construct a not

EFISCEN model <a href="http://www.efi.int/portal/">http://www.efi.int/portal/</a>
YASSO model <a href="http://www.ymparisto.fi/default.asp?contentid=250208&lan=en&clan=en">http://www.iasa.ac.at/Research/FOR/globiom.html?sb=12</a>, <a href="http://www.euclimit.eu/Models.aspx#GLOBIOM">http://www.euclimit.eu/Models.aspx#GLOBIOM</a>

direct measurable unit (for instance population size can be used as a proxy for the energy use of consumers). Proxies can be identified on the basis of historic data. It is good practice to estimate the projected data with the projected value for this proxy. Candidate proxy variables are:

- Population size
- > Energy demand in a specific industrial production sector
- ➤ GDP in an industrial sector, agriculture, ...
- Crops areas
- Livestock

# 0.6 Policies and measures interactions

There are different legislation dependencies between policies and measures (PAMs), i.e. relationships in terms of implementation, replacement etc.

Particular scrutiny should be given to consistently and (between Member States) comparably distinguish existing and additional measures, and to an appropriate representation of national and European policies and measures. If European legislation does not prescribe the substance of the measure, national implementation measures and their adoption status are key in this respect.

In the projections it should be ensured that changes in parameters induced by a PAM are dealt with in the same manner throughout the projections for the different sectors.

# A.1 Background and Objectives of GHG Projections

# 1.1 EU domestic use of GHG projections

Greenhouse gas (GHG) emission projections are essential for EU climate change policies. Taking into account current and future EU domestic and international needs, GHG emission projections are necessary for:

Domestic: tracking progress towards GHG targets as agreed in the climate and

energy package<sup>11</sup>,

o International: meeting obligations and commitments under the United National

Framework Convention on Climate Change (UNFCCC) and the Kyoto

Protocol.

EU Member States therefore need to develop their projections individually to track progress towards their individual GHG targets as well as inform the Commission about that. As regards to current EU domestic reporting obligations, Member States (MS) are required to report their greenhouse gas projections biennially under the Monitoring Mechanism Decision (MMD)<sup>12</sup> and will also be required to submit projections (annually according to the EC proposal) under the Monitoring Mechanism Regulation (MMR)a. Member States use diverse methodologies to develop their national projections, making it challenging to compare MS projections and to compile them into EU-wide projections. The EC commissioned study "Assessment and Improvement of methodologies used for greenhouse gas projections" which was performed in 2006-2008 was a first step towards a more harmonised projection methodology for Member States.

The guidelines for GHG emission projections, in the first place ensure that EU domestic obligations are fulfilled and reporting of projections by MS as required under the MMD and MMR is improved.

The Effort Sharing Decision (ESD<sup>13</sup>) sets annual emission reduction and limitation targets for MS in the Non-ETS<sup>14</sup> sector for the period 2013 – 2020. Its implementation requires an enhanced quality and transparency of MS actual emission reports for compliance assessment at the end of each year. Projections and their quality are extremely important in the compliance action plan which has to be developed in cases of non-compliance with the targets.

The overall organisation of the GHG reduction commitments by 2020 requires a split of total GHG projections between the emissions trading scheme (EU ETS) emissions and non-ETS .

These guidelines address the above mentioned EU domestic aspects.

http://ec.europa.eu/clima/policies/package/index\_en.htm

Decision No 280/2004/EC

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0136:0148:EN:PDF

ETS: European Emissions Trading Scheme; http://ec.europa.eu/clima/policies/ets/index\_en.htm

# 1.2 International use of GHG projections

Greenhouse gas emission projections are also needed under reporting obligations to the UNFCCC in the form of National Communications. Therefore, the guidelines address international needs. The European Union (being a Party to the UNFCCC and the Kyoto Protocol) as well as its Member States has to submit National Communications under the UNFCCC that include periodical GHG emission projections. The EU also has to track progress towards its GHG reduction target under the Kyoto Protocol.

One of the key issues that ensures better quality of MS data is an enhanced QA/QC cycle for Member States' reports on GHG emission projections, which would include a more advanced QA/QC system for Member States' projections at EU level, e.g. related to:

- o completeness in terms of gases and sources,
- o comparability in terms of assumptions,
- o consistency related to the impacts of policies and measures,
- o consistency with GHG inventories and verified emissions from EUETS,
- o accuracy and quality of methodologies, data and assumptions used for the projections
- transparency of data and information on methodologies and assumptions provided to the Commission.

An essential issue when compiling an EU-wide projection is that MS projections are comparable and that the underlying methodologies and assumptions are transparent. To support the assessment of comparability between MS and to provide additional information to support the interpretation of MS submissions a set of indicators are needed.

To develop the EU-wide GHG emission projections the EU relies on projection from MS. In order to ensure the quality of EU-wide projections (compiled on the basis of MS data) MS projections must be transparent, comparable, consistent, complete and accurate (TCCCA).

The transparency of MS projections, at the EU level, helps/aids:

- Tracking MS and EU progress in reaching the GHG targets agreed in the climate and energy package
- Tracking progress towards the Kyoto Protocol targets
- Reporting under the UNFCCC for example in the EU National Communication

The key issues in the development of these guidelines were that they:

- Build on the findings of previous projects with special attention given to the Transparency,
   Comparability, Consistency, Completeness and Accuracy quality criteria of projections (TCCCA criteria as defined in the UNFCCC GHG inventory Guidelines can be used as reference).
- Assist MS to compile their national GHG projections in an EU-wide harmonised way.
- Are seen in the light of internal EU obligations (MMD, EUETS, ESD and MMR) as well as the UNFCCC obligations. Therefore the guidelines specifically address, and give distinctive guidance for the separate projections of EUETS and non-EUETS sectors as well as total projections.
   Aid/feed into the revision of the UNFCCC reporting guidelines for national communications. As

projections are part of the National Communications (NC) these guidelines should also provide some ideas as regards improvements/changes in the UNFCCC reporting guidelines for NC.

# 1.3 Objectives of these Guidelines

As stated earlier Member State reporting on projections is crucial in the process of:

- Tracking the progress by MS and EU towards Kyoto targets (annual report by the Commission, biennial projections submissions by MS)
- Tracking progress towards targets under the Climate and Energy Package (especially the Effort Sharing Decision (406/2009/EC) targets).

Thus, the use of MS projections require additional methodological and reporting guidance for MS on their internal QA/QC checks and the preparation of a QA/QC system at EU level. These guidelines provide among others such guidance.

These guidelines build on the QA/QC procedures which were used by the EEA to evaluate from 2011 on. The QA/QC procedures developed under this project aim to enhance GHG projections over and above those developed prior to 2011.

The projections guidelines aim to facilitate the maximum level of transparency, comparability, consistency, completeness and accuracy taking into account MS capabilities and resources. The guidelines do not prescribe a specific projection method to each MS, but guide the MS in a graded methodological approach to reflect different approaches and data situations at MS level. Guidance is given to provide all information on projections' assumptions, parameters, algorithms and results that allow the Commission to derive EU-wide projections that can be seen as a consolidation of the individual MS national projections.

## A.2 Policies and Measures

The primary objective of emission projections is to give an indication of future trends in GHG emissions and removals, given current national circumstances and implemented and adopted policies and measures <sup>15</sup> and to give an indication of the path of emissions and removals without such policies and measures

Projected estimates therefore will need to be able to reflect the impacts of relevant policies and measures (PAMs) in the projection estimates to assess whether or not these PAMs deliver as expected and are sufficient to meet the emission reduction targets as set in both international (UNFCCC) and domestic (EU) climate policy.

Full guidance on interpreting PAMs and extracting meaningful assumptions and parameters are included in the sectoral chapters. This section presents the basic ideas behind these assumptions and parameters and provides definitions and understanding related to the European Climate Change policy.

# 2.1 Types of policies and measures

One of the most important objectives of any emission projection is the assessment of the influence of existing and additional policies and measures (PAMs). The main question here will be whether or not these policies and measures deliver the emission reductions they aim to and whether or not the combination of policies and measures will bring the targets into reality.

For GHG projections, following these guidelines, several aspects of the policies and measures are relevant:

- Are policies and measures implemented in the year for which the projected emissions are calculated? A distinction can be made between following scenarios:
  - ✓ without measures (WOM): it is assumed that none of the existing or additional policies and measures are implemented from a chosen base year<sup>16</sup>.
  - ✓ with existing measures (WEM): A WEM projection encompasses currently adopted policies
    and measures at the time of the projection compilation and that following these adopted
    policies and measures can be assumed to be implemented in the projected years.
  - with additional measures (*WAM*): A WAM scenario encompasses in addition to currently adopted policies and measures (as in the WEM scenario) also planned policies and measures that have not been adopted yet, but are expected to be adopted and implemented from a specific future year onwards.
- O What is the legal status of the policies and measures?

<sup>15</sup> In the years following the implementation of the PAM

WOM scenarios are not requested. Member States that want to use this scenario could choose any year as the base year. It could be for instance the base year of the UNFCCC/KP (1990).

• Are these policies and measures part of European policies with relevant impact on greenhouse gas emissions or are they national policies and measures, additional to European policy.

This section will provide general guidance on how to classify Policies and Measures when developing projections.

Text box: WEM and WAM, hypothetical example.

A specific measure is planned to be adopted as law in 2014 and will be implemented as of 2018.

In a projection submission in 2012, this measure will be "planned" and would be part of the WAM scenario.

In a projection submitted in 2016, this measure is adopted and will be implemented in 2018. This measure would be part of the WEM scenario and takes effect in projected years after 2018.

# 2.2 Policy areas with relevance for greenhouse gas emissions

The EU website<sup>17</sup> lists thirty six "Policy areas", where the EU is active. Policies and measures developed in the following areas might have a significant effect on the emissions of greenhouse gases:

- Agriculture
- Climate action
- Consumers
- Energy
- Environment
- Transport

In addition other policy areas might lead to legislation that influences greenhouse gas emissions, e.g. cohesion policy, competition policy or research and innovation policy.

# 2.3 **Legal status**

## 2.3.1 EU Legal instruments

Legal instruments available to the European Community institutions to carry out their tasks under the Treaty establishing the European Community<sup>18</sup> are:

http://europa.eu/pol/index\_en.htm

EC Treaty: EUROPEAN UNION, CONSOLIDATED VERSIONS OF THE TREATY ON EUROPEAN UNION AND OF THE TREATY ESTABLISHING THE EUROPEAN COMMUNITY

URL: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2006:321E:0001:0331:EN:PDF

#### A regulation

is a legislative act of the European Union that becomes immediately enforceable as law in all member states simultaneously.

Regulations can be distinguished from directives which, at least in principle, need to be transposed into national law. Regulations can be adopted by means of a variety of legislative procedures depending on their subject matter.

#### A directive

is a legislative act of the European Union, which requires member states to achieve a particular result without dictating the means of achieving that result.

A Directive can be distinguished from regulations which are self-executing and do not require any implementing measures. Directives normally leave member states with a certain amount of leeway as to the exact rules to be adopted. Directives can be adopted by means of a variety of legislative procedures depending on their subject matter.

#### A decision

is a legal instrument which is binding upon those individuals to which it is addressed. Decisions may be addressed to Member States or individuals.

The Council of the European Union can delegate power to make decisions to the European Commission.

Since these types of legislation are binding, their effects on greenhouse gas emissions would be included in the "with existing measures" scenario.

Whenever a legislative act includes a deadline (the date the legislation should be implemented), the default approach would be that the effects of this Directive or Decision on either the activity data or on the emission factors or both will start from this deadline onwards. It is good practice to explicitly report so, whenever a Member State will deviate from this deadline (either earlier or later).

An exception are decisions or directives which only set targets or procedures but leave the substance of the measures to national decision makers (e.g. Effort Sharing Decision, Renewables Directive targets, Energy Performance of Buildings directive part on existing buildings, Energy Efficiency Directive parts on saving targets). In such cases, the WEM scenario should only include implemented or adopted national measures, including those that are explicitly aimed at meeting the targets set by these decisions or directives. The effect of these national measures on activity data and/or emission factors will start from the deadline, as detailed in the national legislation, onwards.

Any national measures that are not adopted or implemented yet, but that also are aimed at meeting the targets set by EU legislation, should be included in the WAM scenario.

In addition to the instruments listed in Article 249 of the EC Treaty, practice has led to the development of a whole series of other types of documents: inter-institutional agreements, resolutions, conclusions, communications, green papers and white papers. These do not have a

legally binding nature for Member States, but may contain intentions and proposals for binding legislation to be developed in the future.

## 2.3.2 Policy documents and programmes

Other policy documents include recommendations and opinions that in many cases will be provided in strategies, communications, white papers, green papers, etc. of MS governments.

## 2.3.3 National policies and measures

National and where relevant also subnational policies and measures with relevant impacts on GHG emissions should be covered by the projections. It is good practice to make a similar distinction (as described in section2.3.1) between legally binding national policies and measures and those only or planned or announced in various types of national policy documents. The inclusion of non-legislative measures (e.g. voluntary agreements etc.) has to be judged according to the expected effectiveness of the monitoring and sanctioning mechanisms.

A national policy or measure can be considered as adopted if:

- it has passed the full legislative process in the Member State and has been published in the national official journal or similar, and/or;
- all provisions required by an adopted national policy or measure have effectively been put in place, such as budgetary measures to promote f.i. introduction of low carbon technologies.

If an adopted national policy or measure includes a gradual implementation, these implementation stages in time should be reflected in the projections.

# 2.4 Existing and additional measures

Table 2 lists policies and measures (PAMs) which are relevant for particular sectors. It also indicates the legislation dependencies, i.e. relationships in terms of implementation, replacement etc. The other list of all PAMs with full titles can be found in Annex A.I.

In the projections it should be ensured that changes in parameters induced by a PAM are dealt with in the same manner throughout the projections for the different sectors.

As an example: If a PAM results in an increase of the fuel price for coal, this higher price should be used for all relevant sectors. It is good practice to explicitly take these interactions into account for all relevant sectors. Table 2 provides an overview where this would occur.

Table 2 **EU** PAMs relevant for particular sectors

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
2001/14/EC	amended by	2007/58/EC	1	Development of the Community's railways			٧								
2003/87/EC	amended by	2004/101/EC	2	Kyoto Protocol project mechanisms	٧	٧					٧		٧		٧
		2008/101/EC	3	Amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance			٧								
		2009/29/EC	4	Amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community	٧						٧				٧
2005/32/EC	implemented	107/2009	5	Ecodesign requirements for simple set-top boxes	٧			٧							
	by	1222/2009	6	Labelling of tyres			٧								
		1275/2008	7	Ecodesign requirements for standby and offoff mode electric power consumption	٧			٧							
		244/2009	8	Ecodesign requirements for non-directional household lamp	٧			٧							
		245/2009	9	Ecodesign requirements for fluorescent lamps	٧			٧							
		278/2009	10	Ecodesifn requirements for external power supplies	٧			>							
		640/2009	11	Ecodesign requirements for electric motors	٧			٧							

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
		641/2009	12	Ecodesign requirements for circulators	٧			٧							
		642/2009	13	Ecodesign requirements for television	٧			٧							
		643/2009	14	Ecodesign requirements for freezers and refrigerators	٧			٧							
96/61/EC	recasted by	2008/1/EC	15	Integrated pollution prevention and control (IPPC) recast	٧	٧				٧	٧			٧	٧
Energy efficiency for	implemented by	106/2008	16	Energy-efficiency labelling for office equipment recast	٧			٧							
office		2422/2001	17	Community energy efficiency labelling programme for office equipment	٧			٧							
Energy labelling of	implemented by	2002/31/EC	18	Energy labelling of household appliances (air conditioners)	٧			٧							
appliances		2002/40/EC	19	Energy labelling of household appliances (electric ovens)	٧			٧							
		2003/66/EC	20	Energy labelling of household appliances (friges and freezers)	٧			٧							
		96/60/EC	21	Energy labelling of household appliances (washerdriers)	٧			٧							
		96/89/EC	22	Energy labelling of household appliances (washing machines)	٧			٧							

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
		98/11/EC	23	Energy labelling of household appliances (lamps)	٧			٧							
		99/9/EC	24	Energy labelling of household appliances (dish washers)	٧			٧							
Packing and	implemented	2004/12/EC	25	Packaging and packaging waste										٧	
packing	by	2005/20/EC	26	Packaging and packaging waste										>	
waste		94/62/EC	27	Packaging and packaging waste										٧	
Shifting the modes	implemented by	2001/12/EC	28	Shifting the balance between modes of transport, in particular towards rail			٧								
balance		2001/13/EC	29	Shifting the balance between modes of transport, in particular towards rail			٧								
		2004/49/EC	30	Shifting the balance between modes of transport, in particular towards rail	٧		٧								
		2004/50/EC	31	Shifting the balance between modes of transport, in particular towards rail			٧								
		2004/51/EC	32	Shifting the balance between modes of transport, in particular towards rail			٧								
		881/2004	33	Shifting the balance between modes of transport, in particular towards rail	٧		٧								
1268/1999			34	Pre-accession measures for agriculture and rural	_								٧		

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
				development											
1782/2003			35	Common rules for direct support schemes under CAP									٧		
1783/2003			36	Support for rural development, amending a number of other Regulations									٧		
1692/2006			37	Marco Polo II			٧								
1999/31/EC			38	Landfill Directive										٧	
1999/94/EC			39	Labelling of new passenger car			٧								
2000/25/EC			40	Emission by engines to power agricultural or forestry					٧						
2000/55/EC			41	Energy efficiency requirements for ballasts for fluorescent lighting	٧			٧							
2000/60/EC			42	Water Framework Directive									٧	٧	٧
2001/77/EC			43	Electricity from Renewables	٧			٧						٧	
2001/80/EC	-	_	44	Emissions from large combustion plants	٧										
2001/81/EC			45	National Emission Ceiling Directive	٧	٧	٧	٧		٧	٧		٧	٧	٧
2002/91/EC			46	Energy performance of buildings	٧			٧							
2002/95/EC			47	Waste electrical and electronic equipment Directive										٧	
2003/2003			48	EC Fertiliser									٧		
2003/30/EC			49	Biofuels Directive			٧						٧	٧	

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
2003/54/EC			50	Internal electricity market, incl. third package	٧										
2003/55/EC			51	Common rules for the internal market in natural gas	٧										
2003/96/EC			52	Taxation of energy products and electricity				٧							
2004/8/EC			53	Promotion of cogeneration	٧	٧		٧							
2006/1005/EC			54	Energy-efficiency labelling programmes for office equipment	٧			٧							
2006/12/EC			55	Waste Framework Directive										٧	
2006/144/EC			56	Common Agricultural Policy (CAP) Reform									٧		
2006/32/EC			57	End-use efficiency and energy services	٧			٧							
2006/38/EC			58	Eurovignette Directive			٧								
2006/40/EC			59	Mobile Air Conditioning Directive			٧				٧				
2007/715/EC			60	Regulation EURO 5 and 6			٧								
2008/28/EC			61	Framework for the setting of ecodesign requirements for energy-using products	٧			٧							
2008/98/EC			62	Waste Management Framework Directive										٧	
2009/125/EC			63	Recast of the Ecodesign requirements for energy- using products	٧			٧							
2009/28/EC			64	Biofuels directive (RES)	٧		٧	٧					٧	٧	
2009/30/EC			65	Fuel Quality Directive			٧								

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
2009/31/EC			66	Geological storage of CO2	٧						٧				
2009/33/EC			67	Promotion of clean and energy efficient road transport vehicles			٧								
2009/595/EC			68	Regulation Euro VI for heavy duty vehicles			٧								
2009/663/EC			69	European Energy programme for Recovery	٧					٧				٧	
2010/30/EU			70	Labelling and standard product information of the consumption of energy and other resources by energy related products (recast)	٧			٧							
2010/31/EU			71	Recast of the Energy performance of buildings				٧							
2010/75/EU			72	IED Directive	٧	٧				٧					
2078/92			73	Agricultural production methods compatible with environment									٧		
2080/92			74	Aid scheme for forestry measures in agriculture									٧		
2603/1999			75	Transition to rural development support									٧		
406/2009/EC			76	Effort Sharing Decision	٧	٧	٧	٧			٧		٧	٧	٧
443/2009			77	CAP "Health Check" 2008 and the "Set aside" regulation			٧								
73/2009			78	Community eco-management and audit scheme (EMAS)									٧		
761/2001			79	F-gas regulation	٧			٧		٧					

Parent PAM	Reversed/ replaced/ repealed/ implemented/ revised	Child PAM	URL	Short description	Energy industry	Industrial Combustion	Transport	Residential and Commercial	Combustion other sources	Fugitive emissions from energy	Industrial Processes	Product Use	Agriculture	Waste	Cross cutting
842/2006			80	Sewage Sludge Directive							٧				
86/278/EEC			81	Emissions from large combustion plants									٧	٧	
88/609/EEC			82	Urban waste water treatment	٧	٧				٧					
91/271/EEC			83	Nitrates Directive										٧	
91/676/EEC			84	efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels									٧		
92/42/EEC			85	labelling and standard product information of the consumption of energy and other resources by household appliances	٧			٧							
92/75/EC			86	Landfill Directive	٧			٧				٧			
ACEA			87	voluntary agreement between the European Automobile Manufacturers Association (ACEA) and the EC to limit the amount of CO <sub>2</sub> emitted by passenger cars sold in Europe			٧								
COM (2002) 18	3 final		88	Integrated European railway area (2nd + 3rd Railway package)			٧								

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This report is accompanied by a spread sheet (GHG Projection guidelines PAM overview.xls) containing the above table. This spread sheet allows the user to make user-specific cross sections of the table fit for specific purposes.

Emission projections are aimed at assessing what emissions will be if specific sets of policies and measures are or are not implemented in these years. One can never be fully certain that any policy, following present decisions or intentions, indeed will be in place in these future years. Emission projections are essentially "what-if" analyses and three major alternatives can be compared: i.e. what would be emissions levels be:

- when nothing would have been done at all: no policies or measures would be implemented in the years of the projection?
- when all is done, what is decided to be done: all measures that are decided to be taken indeed are implemented?
- when more is done than has been decided to do: additional measures, not yet decided upon but will be implemented; this latter alternative can be understood in two varieties:
  - ✓ implement all measures that are not formally decided upon, but that are in plans, programmes and other official policy documents
  - ✓ implement all measures one can think of to estimate the maximum feasible emission reductions.

The latter one is mainly of theoretical and scientific interest and will not be relevant for the GHG projections produced following these guidelines.

Based on the above, it is good practice to apply the following definitions:

#### Existing policy or measure

is any policy or measure that is adopted at the time of the projection compilation and that will be implemented in a specific year for which the projection is calculated, following all legislation that is officially decided on at the time the projection is calculated<sup>19</sup>.

In other words, any policy or measure that, following existing legislation, will be implemented or be effective as from any date between the time of preparation of the projection and the year for which the projection is calculated, is regarded as an existing policy. These should be included in the "With Existing Measures" scenario. However, if EU policies do not define the substantive measures, the above-mentioned exceptions apply and only adopted national policies should be included.

#### Additional policy or measure

is any policy or measure that will be implemented if specific plans or proposals, included in existing policy documents is likely to be implemented.

In other words, policies that are not yet included in formal legal instruments, but could be seen as proposals or intentions to implement such policies and measures in the (near) future, are regarded as "additional measures". These should be included in the "With Additional Measures" scenario.

# 2.5 EU vs. national policies and measures

It is good practice to make a distinction between policies and measures as adopted by the EU and those adopted nationally. This may be undertaken as follows:

Type of legislation	EU or national	Explanation
EU Regulations	EU	These are immediately enforceable as law in all Member States simultaneously.
EU Directives	EU	May be transposed exactly in conformity with the requirements and provisions of the EU Directive
	National	Implementation in national legislation goes beyond or complements the provisions and requirements of the EU Directive, either in terms of the deadlines or in strength of the quantitative targets, incentives and limit values, see also 2.3.
EU Decisions	EU	These are binding upon those individuals or Member States to which they are addressed
EU Opinions and Recommendations <sup>20</sup>	National	These are not binding, implementation in national policy is by definition a national policy.
All other National		These may or may not be binding and implementation in national policy is by definition a national policy.

Any legal text might include obligations and paragraphs and articles describing the aims of the legislation and/or other ambitions. Substantial requirements in most cases will be formulated in terms of "shall" reflecting on individual Member States, the Commission or other actors. Each "shall" (or similar legal language) reflects a PAM that must be implemented by the relevant actor. Any national action, aiming at implementing or transposing these "shall" obligations into national legislation or policy is understood as an EU measure. In some cases, the "shall" obligations are mainly procedural and the important parts of substantive measures are left to MS (e.g. Effort Sharing Decision, Renewables Directive, Energy Performance of Buildings Directive). In this cases both the EU part and the national part of the measure are important.

## Textbox EU vs National policy; an example

The Energy Performance of Buildings Directive (2002/91/EC) requires the Member States to derive quantitative standards for new and (renovation of) existing buildings, but allows MSs to set these standards at a level that fits best national and regional climate conditions and other local conditions. The directive itself defines its objective as " to promote the improvement of the energy performance of buildings".

Wherever a MS translates this qualitative requirements into a quantitative standard, this should be seen as a "national policy".

# 2.6 **Overview of EU legislation**

Annex A.I and Table 2 present an overview of all present EU legislation, organised by type of legislation and the policy field.

# A.3 Modelling Emission Projections

## 3.1 Introduction

Every emission projection shall start with two main elements:

- 1. A *historic starting point*. This is a well-defined inventory of emissions from a historic period of time (e.g. EUMM GHG emissions reported for 1990 2009) with a suitable level of sectoral disaggregation.
- 2. One or more (scenario) sets of projected parameters/variables and assumptions. In simple terms, these parameters and assumptions are applied to "modify" the historical activity data and emission factors and provide projected activity data and emission factors to estimate emissions for future years consistent with the historic inventory starting point.

#### **Level of Detail**

In many cases assumptions used to construct the scenarios might be at a lower level of detail (economic sectors or similar) as compared to the latest historic inventory. There are two possible approaches to overcome such a mismatch in available data:

- Assume that the assumptions are the same for all source categories and fuels in the inventory that fall under this higher level scenario and use interpolation to distribute the assumptions to the higher level of detail of the inventory
- Aggregate the source categories in the inventory to the level of the available assumptions in the scenario.

Mathematically both approaches are quite similar. To enable identification of key categories, the former one would however be preferable.

A greenhouse gas emission projection consists of a series of consecutive steps dealing with respectively developments in the economy, the technology and in policy:

- the (expected) development of the *economy*, reflecting the changes in extent to which each relevant activity in the country is occurring
- the (expected) development of technology or practices, reflected in changes to emission factors (emissions per unit of activity)
- the (expected) policy measures with effects on both the development of the activity data and the possible changes in emission factors by influencing the development and penetration of specific technologies into the national economy.

Emission projection models (described in the next section) combine the information from the historic inventory with available assumptions and understanding of future developments in the economy, the technology and policy to provide an estimate of the emissions that would result if all assumptions and understanding will become a reality.

All projections are modelled in some way. Models can be complex systems involving multiple variables or simple assumptions. All projections require input data, assumptions and provide emissions and activity output data.

*Models* used in emission projections are almost by definition mathematical models in which economic societal and technical developments are expressed in a set of mathematical equations.

A mathematical model and mathematical modelling can be described as follows:

A mathematical model is a description of a system using mathematical language. The process of developing a mathematical model is termed mathematical modelling (also spelled modeling). Mathematical models are used not only in the natural sciences (such as physics, biology, earth science, meteorology) and engineering disciplines (e.g. computer science, artificial intelligence), but also in the social sciences (such as economics, psychology, sociology and political science); physicists, engineers, statisticians, operations research analysts and economists use mathematical models most extensively.

A mathematical model usually describes a system or process by a set of *variables* and a set of equations that establish relationships between the variables. The equations include in most cases one or more *parameters* that define the exact quantitative relation between the input variables and the resulting output variables. In projection models parameters might include coefficients in equations but also the starting or boundary conditions of a specific model or model run.

# 3.2 **Generic approach to Projection Models**

# 3.2.1 General algorithm

An emission projection is an inventory for the future years. The emission projection calculation will follow the calculation procedures as used in a historic inventory, but will use projected values rather than historic values for all variables, both activity rates and emission factors. In emissions inventory compilation the simplest model in most source categories is multiplying an activity rate with a specific emission factor, thereby assuming a linear relationship between the intensity of an activity and the resulting emission:

$$E_{gas} = \sum_{\text{all activities}} AR_{\text{activity}} \cdot EF_{\text{activity,gas}}$$
 (1)

with:

 $E_{gas}$  is the emission of the gas (in mass unit), the output variable of the model  $AR_{activity}$  is the activity rate (in an appropriate unit; e.c. number of animals, energy units (combustion) etc.), i.e. the input variable

EF<sub>activity,gas</sub> is the emission factor (in mass units per activity unit) for this activity and this gas, i.e. the parameter in the model.

It is good practice to apply this equation in a projection at least at the disaggregation level of the latest reported historic inventory. This would mean that the projection will need projected activity data and projected emission factors for all source categories reported in the latest historic inventory.

For each of these source categories, one of the following levels of complexity ("Grades") could be used. These are represented in the table and graphic below.

Grade	Activity data projection	Emission Factor projection
1	Activity data for the years of the projection are directly derived from EU level projection studies; where these are not available, the projection could fall back on the assumption that the activity rate will not change	The emission factors are equal to those used in the latest historic inventory; in inventory terms this would mean that the projection could use Tier 1 default emission factors from the IPCC 2006 Guidelines
2	Activity data for the years of the projection are directly derived from EU level projection studies; where these are not available, generic growth factors or proxies should be used to project activity rates	Emission factors should reflect the technological developments within the Member State, both those that occur autonomously and those that are induced by policies and measures; in inventory terms this would mean that the projection would use Tier 2 or Tier 3 emission factors.
3	The Member State could use its own projected activity data, provided that these are produced with a sophisticated model in a transparent, comparable, consistent and complete manner.	Emission factors should reflect the technological developments within the Member State, both those that occur autonomously and those that are induced by policies and measures; in inventory terms this would mean that the projection would use Tier 2 or Tier 3 emission factors.

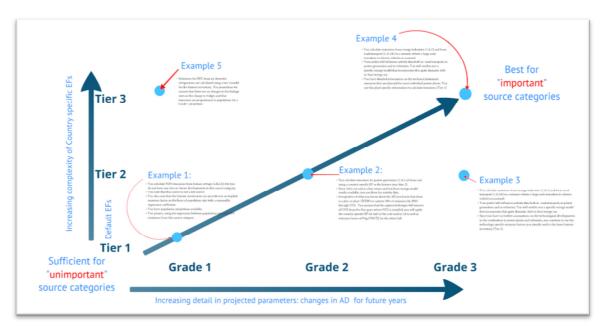


Figure 3 Schematic representation on the use of "Grades" and Tiers; the examples are listed in the table below

	Example		
1	<ul> <li>You calculate projections for N<sub>2</sub>O emissions from human sewage (6.B.2.2), but do not have any idea on future developments in this source category.</li> <li>You note that this source is not a key source</li> <li>You also note that the historic inventories can provide you an implied emission factor on the basis of population size with a reasonable regression coefficient.</li> <li>You have population projections available.</li> <li>You project, using the regression between population size and N<sub>2</sub>O emissions for this source category</li> </ul>	1	1
2	<ul> <li>You calculate projections for the emissions for power generation (1.A.1.a) from coal using a country specific EF from the historic year (tier 2).</li> <li>Since 1A1a on coal is a key source and you have energy model projection result available, you use these for activity data.</li> <li>Irrespective of what you know about the AD you know that there is a plan in pla (WEM) to capture 50% of emissions by 2020 through CCS. You assume that the capture technique will remove all CO<sub>2</sub> from the flue gases where CCS is installed you will apply the country specific EF for half of the coal used in 1A1a and an emission factor of 0 kg CO<sub>2</sub>/TJ for the other half.</li> </ul>	ace 2	2
3	<ul> <li>You calculate projections for the emissions from energy industries (1.A.1) and from road transport (1.A.3.b) in a scenario where a large scale transition to electric vehicles is assumed.</li> <li>Your policy will influence activity data both in road transport, in power general and in refineries. You will need to run a specific energy model that incorporates this quite dramatic shift in final energy use.</li> <li>Since you have no further assumptions on the technological developments in the combustion in power plants and refineries, you continue to use the technology specific emission factors you already used in the latest historic inventory (Tier 2).</li> </ul>	s 3	2
4	<ul> <li>You calculate projections for the emissions from energy industries (1.A.1) and from road transport (1.A.3.b) in a scenario where a large scale transition to electric vehicles is assumed.</li> <li>Your policy will influence activity data both in road transport, in power general and in refineries. You will need to run a specific energy model that incorporates this quite dramatic shift in final energy use.</li> <li>You have detailed information on the technical abatement measures that are planned for most individual power plants. You use this plant specific information to calculate emissions (Tier 3).</li> </ul>	s 3	3
5	Emissions for HFC from air domestic refrigeration are calculated using a Tier 3 model for the historic inventory. For projections we assume that there are no changes to the leakage rates or the charge to fridges and that emissions are proportional to population for a Grade 1 projection.	1	3

It is good practice to use a Grade 2 or Grade 3 approach for all source categories that are considered as key category in the projection.

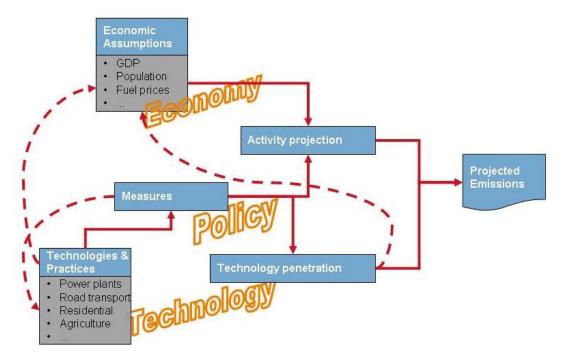


Figure 4 The three modules within a projections model

In an emission projection therefore, both the activity data  $AR_{activity}$  and the emission factors  $EF_{activity,gas}$  must be estimated for each source category in each year of the projection. To do this every projections model should consist of three distinct parts ("modules", see the Figure 4):

- a policy module, providing the information on what policies and measures are assumed to be
  in place in the years of the projection; in many cases more than one set of assumptions are
  used; frequently used policy scenarios include: without measures, with existing measures and
  with additional measures.
- an economy module, estimating projected activity data for all years in the projection; in many
  cases the economy module is indeed seen as a separate model, providing the necessary
  activity input for the emissions calculation; sometimes more than one projected economic
  future is needed, for instance when different economic growth assumptions (low, medium,
  high) must be compared (economic scenarios).
- 3. a technology module, performing the actual emission calculations, based on the projected activity rates for one or more economic scenario and the assumed policies in place for one or more policy scenarios; for each combination emission factors need to be selected that fit with the policies and measures and with the expected technological development.

## a) .Policy module:

A series of policy measures and packages is defined, that will influence both the activity in the economy and the development and implementation of specific technologies for specific activities.

## b) Economy module:

A model that generates the development of activity levels in all sectors of a country's economy and society, and including relevant policies impacting upon activities and technology choices is run to generate:

- ✓ final energy demand in economic sectors, transport and households etc.
- energy transformation sector (power plants, refineries, other energy conversion industries)
- ✓ production volumes in all economic sectors, including manufacturing industries, agri- and horticulture, fisheries etc.
- ✓ waste volumes (municipal wastes, industrial wastes etc.).

An *economy scenario* might model different assumptions on economic growth, fossil and other fuel price paths and similar economic assumptions. Generally greenhouse gas emission projections select only one of such possible economic scenarios, characterized by GDP growth, population growth and a specific assumed primary energy price path.

## c) <u>Technology module:</u>

Finally some kind of an emissions model is run that translates the activity scenarios to resulting emissions under the assumed policy packages and future technologies in each policy separate scenario. It is good practice to use a Grade 2 or Grade 3 approach for all source categories that are considered as key category in the projection. The policy module will be hardly relevant in Grade 1 projections, but might influence both the activity data projections and the emission factor projections in Grade 2 and Grade 3. These grades are mainly relevant for the Economy and Technology modules.

The models in the different modules are governed by "parameters", fed with "input variables" and generate "output variables" that are transformed into "indicators". More detail on parameters, variables and indicators is provided in the next section.

In the rest of this chapter the principles of each of the three modules are described in more detail. The flow of variables between the different parts within the full projection model is shown schematically in Figure 5.

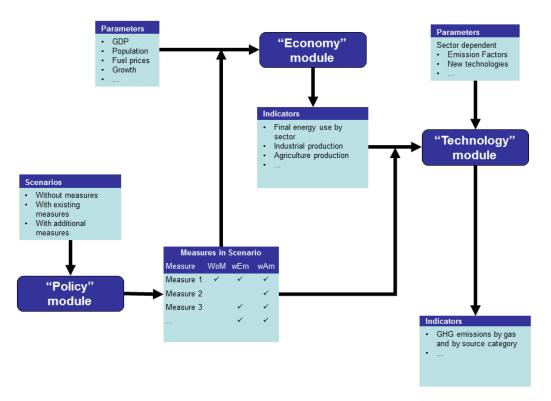


Figure 5 Variables flow between the three modules within a projection model

# 3.2.2 Parameters, Variables and Indicators in Projection Models

An important issue in this guidance is the language to be used when discussing models and the results thereof. A distinction is made between:

#### Model variables

Model variables are values that may change within the scope of the application of a model in a given projection. There are

- ✓ input variables: the entities on which the value of the output variable in the model depends
- output variables: the entity that is to reflect quantitatively the result of the model and communicate it to the model user;

#### Model parameters

Parameters define the behaviour of a relationship (mathematical function) between the input variables and the output variables. They are basically constants, although in some applications such a parameter might be given a different value for different times in such cases where the behaviour of such an entity is not internally calculated in the model.

#### Projection indicators

Indicators are output variables<sup>21</sup> that are used to communicate the results of the projections exercise to the outside world in a comparable and agreed upon manner. Typical indicators are per capita energy use, per capita emissions, emissions per unit of added value, etc.

The difference between parameters and variables is that the former are not varied in a specific projection, while the latter reflect changing activity intensities and similar entities and reflect the resulting emissions over time.

As indicated in Figure 4 output variables from one sub module will in many cases be used as input variables in another. The parameters are internal constants used in each of the modules.

# 3.3 **Economy module**

# 3.3.1 Available economy models

# 3.3.1.1 Energy

Many countries spend significant resources modelling energy supply and demand, based on assumptions on GDP growth ( and related energy demand changes), structural changes in the economy and many more. This provides important strategic and economic analysis needed to shape future policies and economic activities as well as assessing energy security issues.

Energy models which provide the supply and demand of energy by fuel type and user/producer type can be used as the basis for input into emission projection models. Key assumptions in the energy models will be economic growth, international energy price and resounce and process capacity assumptions that result in estimates of final supply and demand into the future.

#### These include:

- ✓ PRIMES<sup>22</sup> is an energy modelling system that simulates a market equilibrium solution for energy supply and demand in the European Union (EU) member states. PRIMES is used for forecasting, scenario construction and policy impact analysis up to the year 2030. It is used mainly in the field of energy and environmental policy to analyse, for example, impacts of carbon emission trading and of renewable and energy efficiency policies on energy markets within each of the 27 Member States.
- ✓ MARKAL<sup>23</sup> a generic model tailored by input data to represent the evolution over a period of usually 40 to 50 years of a specific energy system at the national, regional, state or province, or community level.
- ✓ TIMES<sup>24</sup> The Integrated MARKAL-EFOM System (TIMES) is an evolved version of MARKAL with new functions and flexibilities. Its main features are described in the paper "ETSAP-TIAM: the TIMES integrated assessment"<sup>25</sup>
- ✓ *EFOM* Energy Flow Optimization Model (EFOM) is a supply techno-economic dynamic energy model that simulates and/or optimises the primary energy requirements and the

Or predefined manipulations of the output variables

http://147.102.23.135/index.php?option=com\_content&view=category&id=35&Itemid=80&lang=en

http://www.iea-etsap.org/web/Markal.asp

http://www.iea-etsap.org/web/Times.asp

http://home.eng.iastate.edu/~jdm/ee590-Old/TIMES1.pdf

related investments in energy production and consumption necessary to satisfy a given exogenous demand of useful or final energy. It is a linear cost minimisation model which covers energy production, transformations and consumption. EFOM describes the energy system as a network of energy flows, by combining the extraction of primary fuels, through a number of conversion and transport technologies, to the demand for energy services or large energy consuming material.

- ✓ MESSAGE <sup>26</sup>Model for Energy Supply Strategy Alternatives and their General Environmental Impact. MESSAGE is a systems engineering optimization model used for medium- to long-term energy system planning, energy policy analysis, and scenario development.
- ✓ POLES<sup>27</sup> model provides a tool for addressing long-term energy, technology and climate change issues. Its world dimension makes explicit the linkages between energy demand and supply. The model simulates the energy demand and supply for 32 countries and 18 world regions. There are 15 energy demand sectors (main industrial branches, transport modes, residential and service sectors) and approximately 40 power and hydrogen production technologies.
- ✓ PROMETHEUS Model<sup>28</sup> A fully stochastic World energy model used for assessing uncertainties and risks associated with the main energy aggregates including uncertainties associated with economic growth and resource endowment as well as the impact of policy actions (R&D on specific technologies, taxes, standards, subsidies and other supports). The model projects endogenously to the future the world energy prices, supply, demand and emissions for 10 World regions. World fossil fuel price trajectories are used for the EU modelling as import price assumptions for PRIMES.
- ✓ **Economy-Energy-Environment (3E) models** which combine economic and energy modelling, e.g. E3ME, GEM E3, PACE, Worldscan, ASTRA etc
- ✓ Transport models: TREMOVE, PRIMES-TREMOVE, TRANSTOOLS, ASTRA and others

A helpful overview on European expectations for the development of energy supply and use can be found at <a href="http://ec.europa.eu/energy/observatory/index\_en.htm">http://ec.europa.eu/energy/observatory/index\_en.htm</a>, including "energy updates 2030". These scenarios take into account the latest economic developments, energy price environment of recent years, and new policies and measures implemented on EU level and in Member States.

#### 3.3.1.2 Population growth models:

Differential equations allow one to mathematically model quantities that change continuously in time, like population. They can be grouped according to the following:

- ✓ Linear growth population growth which is modelled by adding a fixed amount for each time period. The linear growth model thus assumes a constant increase per time unit.
- ✓ Exponential growth occurs when the growth rate of the population is proportional to the current population value.
- ✓ Couttsian Growth Model a mathematical model describing a scientific law of population growth (and shrinkage) which applies universally to all replicating populations.

26

http://www.iiasa.ac.at/Research/ECS/docs/models.html#MESSAGE

http://www.enerdata.net/enerdatauk/solutions/energy-models/poles-model.php

# 3.3.1.3 Industrial processes:

✓ Projected industrial production

# 3.3.1.4 Agriculture:

- ✓ CAPRI<sup>29</sup> Common Agricultural Policy Regionalised Impact Modelling System is a global agricultural sector model with a focus on the EU27, Norway, Turkey and Western Balkans, iteratively linking: 1) Supply module (EU27+Norway+Western Balkans+Turkey) and 2) Market module: spatial, global multi-commodity model for agricultural products. The objective is to evaluate exante impacts of the Common Agricultural Policy and trade policies on production, income, markets, trade, and the environment, from global to regional scale.
- ✓ AGLINK-COSIMO<sup>30</sup> is a recursive-dynamic, partial equilibrium, supply demand model of world agriculture, developed by the OECD Secretariat in close co-operation with member countries and certain non-member economies. The model covers annual supply, demand and prices for the main agricultural commodities produced, consumed and traded in each of the regions it covers.
- ✓ Projected Animal population
- ✓ Projected fertiliser input
- ✓ Projected crop areas and yield statistics

# 3.3.1.5 Land use change and Forestry:

- ✓ There are also various models for the LULUCF sector.

  EFISCEN<sup>31</sup> is a forest resource projection model. It is used for the modelling of the forest biomass changes. It gives an insight into the future development of European forests for example: sustainable management regimes; wood production possibilities; nature oriented management; climate change impacts; natural disturbances and carbon balance issues.
- ✓ YASSO<sup>32</sup> is a model frequently used for soil C stock changes of forest land. It is a dynamic model that calculates the amount of soil carbon, changes in soil carbon and heterotophic soil respiration. Applications include land use and climate change effects on soil carbon and GHG inventories.
- ✓ GLOBIOM/G4M<sup>33</sup> is a global recursive dynamic partial equilibrium model integrating the agricultural, bioenergy and forestry sectors with the aim to provide policy analysis on global issues concerning land use competition between the major land-based production sectors.

# 3.3.2 Projection of Activity Data

Change in Activity: Changes in activity occur when we increase or decrease any activity (e.g. economic growth usually increases activities such as transportation which increases vehicle fuel use, increased food production increases use of fertilizer and harvesting activity). On a more

http://www.capri-model.org/dokuwiki/doku.php?

http://agrilife.jrc.ec.europa.eu/AGLINK.htm

EFISCEN model http://www.efi.int/portal/

YASSO model <a href="http://www.ymparisto.fi/default.asp?contentid=250208&lan=en&clan=en">http://www.ymparisto.fi/default.asp?contentid=250208&lan=en&clan=en</a>

http://www.iiasa.ac.at/Research/FOR/globiom.html?sb=12, http://www.euclimit.eu/Models.aspx#GLOBIOM

detailed scale activity can be the consumption of a particular type of fuel (e.g. coal) where use can be increased/decreased based on driving forces such as price and availability of other fuels. Change in activity is usually described by interpreting complex economic models outputs. These complex economic models use input assumptions such as resource availability and price (including fossil fuels), population growth, industrial performance and potential. Examples of these models are discussed in section 3.3.1 above

The output provided by these modules/models includes energy demand by fuel type and sector, transport intensity as demand for vkm/tonnekm by mode (e.g. car, rail, bus, air, ship), industrial material demand and output (by product type e.g. cement or as Gross Value Added ). In addition, the economic production in the country (Gross Domestic Product GDP) can be a useful proxy for projecting some less important emissions activity data.

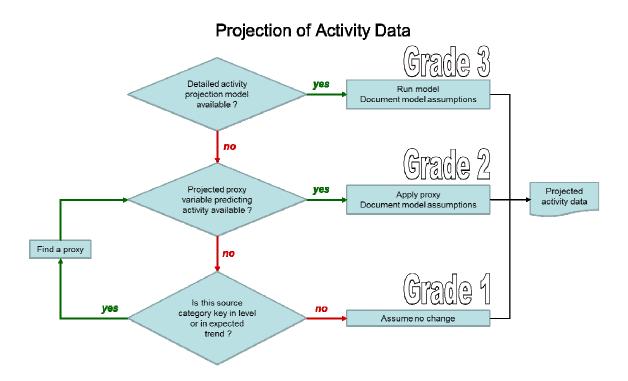


Figure 6 General decision tree for activity projections

The general procedure to select an appropriate activity data projection method is schematically drawn in the decision tree of Figure 6. The approach in this decision tree is:

- If the Member State has a detailed model available: use it and document the assumptions
- o If such a model is not available then:
  - ✓ If projected values for a proxy (population size, energy consumption, GDP or similar)
    variable are available, apply the proxy parameter
  - ✓ If a projected proxy variable is not available then:

If the activity is key in the projected emissions, identify a proxy where projected values are available

If the activity is not key, assume no change.

This methodology selection procedure ensures that all available information is used and that the projection team is directing its efforts and resources to find necessary information for the important or key sources in the first instance.

## 3.3.3 Parameters, variables and indicators

The economy model might use and produce a broad range of parameters, variables and indicators.

# a) Parameters

Parameters determine the behaviour of the economic model. They include:

- ✓ A description of the starting point of the model: in most cases the activity data in the latest year of the historic inventory
- ✓ Growth rates:

either as a constant factor or as a series of activity data increases for each year in the projection; preferably in physical units (volume or mass of production), but in many cases probably in economic units (added value; number of employees or similar)

or as a model with the relevant parameters that influence the growth rate, such as

- o population and population growth
- o (changes in) energy efficiencies
- fuel prices
- o other

# b) Variables

As the economy module is the first one to be run, variables are in this case output variables providing the activity rates for all relevant source categories in the year of the projection.

To a large extent, the developments of the economy are also influenced by policies and measures, both economic and environmental. The implementation of these policies and measures should be seen as input variables in those cases were these effects are effects that are explicitly taken into account in the economy module.

### c) Indicators

Indicators support between Member States a comparable presentation of the results of the economy module. These indicators may include:

- ✓ per capita energy use in different levels of detail (fuel type, sector, source category, etc.)
- ✓ per GDP or added value energy use in the economy or specific economic sectors
- ✓ per dwelling energy use by energy carrier (fuel, electric energy, renewables, etc.)
- ✓ etc.

# 3.4 Policy module

#### 3.4.1 General

The *Policy module* selects the policies assumed to be in place in each scenario. It is a conceptually simple part of the projections model: it merely tells the system which policies and measures are assumed to be implemented in each policy scenario.

A *policy scenario* as used in a projections development is a set of assumptions on the implementation of different policies and measures. These include:

- ✓ without measures (WOM): it is assumed that none of the existing or additional policies and measures are implemented from a chosen base year<sup>34</sup>.
- ✓ with existing measures (WEM): A WEM projection encompasses currently adopted policies
  and measures at the time of the projection compilation and that following these adopted
  policies and measures can be assumed to be implemented in the projected years.
- ✓ with additional measures (WAM): A WAM scenario encompasses in addition to currently
  adopted policies and measures (as in the WEM scenario) also planned policies and
  measures that have not been fully adopted yet.

National and EU level environmental policies include a long list of laws designed to promote efficient, clean technologies (The database of climate change policies and measures in Europe<sup>35</sup> and e.g. BREFs, decisions related to transport equipment etc). National policy makers will have environmental impact assessments and in addition, manufacturing industries and trade associations will have detailed knowledge of new and emerging technologies that could be used but should always be balanced with economic and policy validity.

Each policy will include one or more specific measures that might influence the intensity of one or more activities or might prescribe certain technologies to be applied. A policy scenario therefore can be seen as a set of measures.

There are at least three possible types of measures:

# a) on/off measures

typical examples might be a ban on specific activities or technologies. Such activities or technologies either occur or do not occur

### b) replacement measures

measures that require the introduction of a specific abatement measures as of a certain moment in time. In these measures, the "old" technology will be gradually replaced by a "new" one.

#### c) economic incentives

measures that use economic incentives (taxes, subsidies, carbon pricing, etc) to influence the development of specific activities or technological developments leading to changing activity rates or emission factors within specific (groups of) source categories.

# 3.4.2 Parameters, variables and indicators

The policy model might use and produce a range of parameters, variables and indicators.

WOM scenarios are not requested. Member States that want to use this scenario could choose any year as the base year. It could be for instance the base year of the UNFCCC/KP (1990).

http://pam.eea.europa.eu/

#### a) Parameters

Parameters in the policy module are all relevant policies and measures that in principle could be applied. From the EEA website<sup>36</sup> the database of climate change policies and measures in Europe which includes policies and measures reported by European Member States to the Commission or under the UNFCCC can be derived. Annex A.I provides an overview. The database covers the relevant sectors energy, industrial processes, agriculture, forestry and waste. It also includes cross-cutting policies and provides detailed and complete information on MS actions on climate change.

# b) Variables

The output variables of the policy module will be a list of policies and measures that are assumed to be implemented in each of the policy scenarios. The distinction between EU-level and national policies and measures follows the guidance in section 2.5.

Some policy scenarios might need to modify the economic model to reflect specific measures. Also for simple activities this is sometimes necessary because such measures might have significant effects on the projected activity data. Where this occurs, the clear split between the three different modules will not always be easy to maintain. It is good practice in these situations to clearly describe the mutual dependencies between the policy measures and the development of projected activity data and to ensure that cross-source category consistency is maintained. Examples of such a complex policy might be the introduction of electric vehicles in transport or the large scale introduction of wind, solar and other sustainable energy systems in the Member State's electricity system. Such policies will lead to significant shifts in the MS's energy supply and transformation system that need to be taken into account.

If a MS runs the economic model under different policy assumptions, it is *good practice* to always show a baseline activity projection along the modified projection, directly comparing the resulting energy use indicators between the adapted model and the base run.

#### c) Indicators in the Policy module

Indicators in the policy module would typically reflect the level of implementation of policy and measures or the distribution of national and EU-wide policy and measures.

# 3.5 Technology module

### 3.5.1 Approach

It is good practice to develop the technology model as a combination of definitions of specific technologies and practices with the associated technology dependent emission factors and the penetration of each separate technology into the activity.

A *technology scenario* might include specific assumptions on the introduction of specific technologies into the Member State, including Carbon Capture and storage, electric vehicles, methane recovery on landfills and many more. Several of these will follow specific policies and would be included in specific policy scenarios only. The total emission factor then is the weighted

average of the emission factors of the technologies and practices used in the country for this activity:

$$EF_{activity,gas} = \frac{\sum_{\text{technologies}} (P_{\text{technology}} \times EF_{\text{technology,gas}})}{\sum_{\text{technologies}} P_{\text{technology}}}$$
(2)

where:

 $\mathsf{EF}_{\mathsf{activity},\mathsf{gas}}$  is the emission factor (in mass units per activity unit) for this activity and this gas;  $\mathsf{P}_{\mathsf{technology}}$  is the penetration of a specific terchnology; and  $\mathsf{EF}_{\mathsf{technology},\mathsf{gas}}$  is the technology specific emission factor.

# 3.5.2 Change in technology

A change in technology results from a change in what we use to perform our continued activities (e.g. electric car rather than petrol car, wet cement kiln rather than dry). This change may be in response to a law, agreements (protocols), decision, and directive (e.g. Montreal protocol ban on CFCs forcing other compounds into the market and reducing CFC emissions), as a result of the discovery and development of more efficient and economically viable engines, processes or systems (e.g. more efficient CCGT for burning gas in energy generation) or due to autonomous technological developments leading to higher efficiencies, better abatement or other technical improvements.

The data used to agree these policies are usually included in back ground feasibility studies and assessments and need to be included in projected emission factors for modelling projected emissions. An additional step to include new and emerging technologies would require the activity data to be split so that emissions from new, emerging and increasing technologies can be included along -side the phasing out of old technologies.

### **Projection of Emission Factor** Willnew technology be applied in this activity? yes Are new technologies yes Find appropriate emission factors applied in this activity Provide references known? Projected Define new emission factors technologies no Is this source no ves category key in level Assume no change or in expected trend?

#### Figure 7 General decision tree for emission factor projections

### 3.5.3 Parameters, variables and indicators

The technology model might use and produce a broad range of parameters, variables and indicators. In general terms these include:

## a) Parameters

The parameters in the technology module describe the technical behaviour of all relevant technologies and practices used in the country. They represent in principle the "technology dependent" emission factors as provided in emission inventory guidance documents i.e. IPCC Good Practice Guidance (GPG<sup>37</sup>), Best Available Technology Reference (BREF) documents and many other publications.

An emission factor is the average emission rate of a given pollutant from a given source relative to the intensity of a specific activity. It is used to calculate emissions from activities.

# b) Variables

- ✓ Input variables
  - Activity data by source category (and fuel, where relevant)
  - Penetration of specific technologies in all relevant source categories
  - for each of the years in the projection.
- ✓ Output variables

<sup>37</sup> 

Emissions by source category (and fuel, where relevant) in each of the projected years.

## c) Indicators

Indicators support a between Member States comparable presentation of the results of the technology module. Since this module performs the final steps in the model and calculates emissions these indicators also provide a between Member States comparable way of reporting the results from the projection in terms of projected emissions. These indicators might include:

### ✓ Implied emission factors

Implied emission factors are calculated at any level of aggregation within the source category structure as used in Greenhouse Gas emissions reporting. In some cases they equal the emission factor as used in the calculations, but in many cases they will be a weighted average over all different technologies used in the country. They could also be called "country specific emission factors"

These implied emission factors can be compared across countries and are therefore an important parameter for quality assurance and quality control. Furthermore, the change in implied emission factors over time allows technology improvements to be monitored.

- ✓ Per capita emissions
- ✓ Per GDP emissions
- ✓ Per GVA emissions
- ✓ Per final energy consumption in particular sector emissions
- ✓ Other.

# 3.6 Model quality

# 3.6.1 Model quality criteria

One of the central concepts in understanding *quality* is to clearly define the different aspects of this quality. The QA/QC section (section 8.2.2) and Annex A.III discusses the five aspects or *dimensions* as defined by the *quality criteria* listed in paragraph 4 of the UNFCCC Guidelines.

# 3.6.2 Model uncertainty

An emission projection is not a prediction of the future. Projections are more akin to forward looking "what-if" analyses that investigates what the effects would be of certain assumed developments in the economy, the technology and the behaviour of individuals and institutions. This also means that the concept of *Uncertainty*:

- should not be interpreted in terms of the uncertainty whether or not the projected future will
  indeed come true; the likelihood of the exogenous assumptions in terms of projected
  economic growth, technological developments or policy decisions are in this sense not part of
  the model's uncertainty but discriminate between different scenarios
- should be interpreted as the uncertainties in the model originating from uncertainties in the endogenous parameters and algorithms in the model; these include specific energy

requirements, emission factors and similar related to specific source categories and technologies.

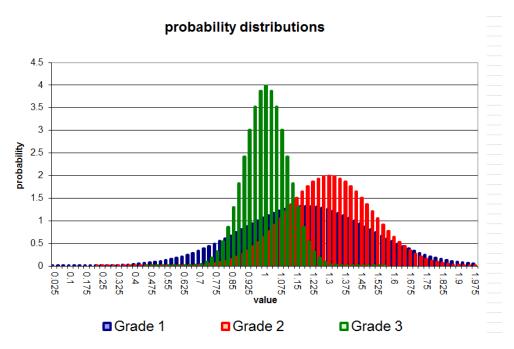


Figure 8 Uncertainty decreases with higher grades

Good modelling practice requires that the modeller provides an evaluation of his/her confidence in the model, possibly assessing the uncertainties associated with the modelling process and with the outcome of the model itself. Uncertainty and Sensitivity Analysis (chapter A.7) offer valid tools for characterizing the uncertainty associated with a model. Uncertainty analysis quantifies the uncertainty in the outcome of a model. Sensitivity Analysis has the complementary role of ordering by importance the strength and relevance of the inputs in determining the variation in the output.

Following the idea that adding complexity to a model should decrease uncertainties, higher tier (grades) methods therefore should produce less uncertain results (see Figure 8. If the uncertainty would not decrease in higher tiers (grades), there would be no reason to use these (see also section 5.2). It is good practice for projection model developers to document improvements in terms of a decreased model uncertainty whenever more complex methods are applied.

In models involving many input variables sensitivity analysis is an essential ingredient (and standard practice) of model building and quality assurance. National and international agencies involved in impact assessment studies (not only in the environmental policy field) have included sections devoted to sensitivity analysis in their guidelines.

In cases where model assumptions deviate significantly from those used at the EU level, it is good practice to use sensitivity analysis to assess the impact of this assumption in comparison with the EU-level assumption.

# A.4 Data Collection

### 4.1 Introduction

This guidance has been expanded from the data collection guidance in the IPCC 2006 Guidelines (IPCC, 2006) and from the elaboration thereof in the European Monitoring and Evaluation Programme / European Environment Agency (EMEP/EEA)) Guidebook<sup>39</sup>. The basic methods and principles are the same unless indicated otherwise. Data collection is an integral part of developing and updating any projection.

Data normally is defined as factual information (e.g. measurements or statistics) used as a basis for reasoning, discussion, or calculation. In emission projection however, prospective data are also needed: expectations of economic, technological and political developments need to be translated into expected information that in principle cannot be "factual".

Data collection is the activity of acquiring and compiling information from different sources. These data include input data and parameter values for any models used to generated projected activity data and emission factors. Formalised data collection activities should be established, adapted to countries' national circumstances, and reviewed periodically as a part of implementing good practice. In most cases generating new source data will be limited by the resources available and prioritisation will be needed, taking into account the results of key category analysis. Data collection procedures are necessary for finding and processing existing data, (i.e. data that are compiled and stored for other statistical uses than the inventory), as well as for generating new data by running models, surveys or measurement campaigns. Other activities include maintaining data flows, improving estimates, generating estimates for new categories and/or replacing existing data sources when those currently used are no longer available.

The methodological principles of data collection that underpin good practice are the following:

- Focus on the collection of data needed to improve estimates of the largest key categories, which have the greatest potential to change or have the greatest uncertainty.
- Choose data collection procedures that iteratively improve the quality of the projection in line with the data quality objectives.
- Put in place data collection activities (resource prioritisation, planning, implementation, documentation etc.) that lead to a continuous improvement of the data sets used in the projection.
- Collect data/information at a level of detail appropriate to the method used.
- Review data collection activities and methodological needs on a regular basis, to guide progressive, and efficient, improvement.
- Introduce agreements with data suppliers to support consistent and continuing information flows.

This chapter provides general guidance for collecting existing national/international data and new data. It is applicable to projecting emission factor, activity, and uncertainty data. It covers:

- Developing a data collection strategy to meet data quality objectives regarding timeliness, as well as consistency, completeness, comparability, accuracy, and transparency.
- Data acquisition activities, generating new source data, dealing with restricted data and confidentiality, and using expert judgement.
- o Turning the raw data into a form that is useful for the projection.

# 4.2 **Collecting Data**

This section provides general guidance for collecting existing data, generating new data, and adapting data for use in a projection. The guidance is applicable to emission factors, activity and uncertainty data collection activities. It discusses separately specific issues relating to new data and existing data. Specific guidance for the collection/calculation of projections of emission factors and the projection of activity and uncertainty data is provided subsequently.

## 4.2.1 Using existing data

Although the list below is not exhaustive, it provides a starting point for possible sources of country specific data

# a) Retrospective (historic) data

- National submission of greenhouse gas inventories to the EU MM and to UNFCCC
  - For the projection the most essential set of data to start the projection procedure is the latest inventory as reported to the EU MM and the UNFCCC. These data are available in one or more databases and spread sheets within the country and are converted into a standardized data format that is used in the reporting process of the UNFCCC. This data set is a specific XML-type of data file, that by means of the CRF Reporter software of the UNFCCC can be generated and converted into the MS Excel tables reflecting the exact format of the reporting tables as defined in the UNFCCC Reporting Guidelines. These tables provide both activity data and implied emission factors for historic years.
- National Statistics Agencies (N.B for European Union countries, activity statistics are also reported to Eurostat).
  - In principle national statistics data are fully consistent with and incorporated into the national inventories as submitted to the EU MM and UNFCCC. Additional data from these sources however can be of value when further stratification would improve the projection estimates.

### b) Prospective data

- Activity data
  - ✓ Energy projections

Greenhouse gas emissions are for a large part directly related to the energy use in a country. Therefore projected energy demand and supply expectation is a very useful set of prospective data that is directly applicable in a greenhouse gas projection.

Member States might have developed their own energy projection models, with country specific information and data or by implementing or developing other energy demand models.

#### ✓ Economic projections

A number of sources of greenhouse gas emissions are not directly dependent on energy use. These include industrial processes, production in agriculture and waste. To project activity data for these sectors, projected production volumes would be very useful. In many cases these type of economic projections will be available from policy studies in other areas (industry, agriculture, etc.), both at national and at EU levels. When national studies are used, it is good practice to compare with EU level projections, where available, and to perform a sensitivity analysis on this assumption. When these are used together with energy projections, it is good practice to assess whether the production volumes in the years of the projection match with the projected energy demand for each of the categories.

#### ✓ Transport demand projections

Since developments in transport are very important in many policy areas, including environment and energy and climate, Member States might have transport demand models in place that project transport systems and transport volumes for future years. Typically these models provide data in vehicle kilometres or similar. When such models are used, it is good practice to ensure consistency with the projected transport energy demand as provided by the energy model.

#### ✓ Population projections

Population projections are available for all EU Member States and more countries at the EUROSTAT website<sup>40</sup>. Many source categories can in first approximation be assumed to be proportional to the population size. If no better information is available, these population projections could be used as a last resort to estimate future activity data.

### o Technological development

No general models are available to predict what types of technologies will be developed and will penetrate the market that will influence the emissions of greenhouse gases. Many different options may exist that in some cases might be mutually exclusive.

In many cases, the new technologies might however already be developed and applied by "early adapters" within each source category. Technology development assumptions than might include assumptions on the level of penetration of such new technologies in future years, possibly dependent on assumptions on policies and measures.

#### Policy developments

Policy developments are the basic discriminators between WOM, WEM and WAM scenarios. Policies and Measures, assumed to be implemented in each scenario must follow the interpretation of and approach to these scenarios as presented in section A.2 above.

# c) General/other

There are several other sources of data and information that may be of value when developing greenhouse gas projections:

- Other country national experts.
- Other international experts.
- o Reference libraries (National Libraries).
- Scientific and technical articles in environmental books, journals and reports.
- Universities.
- Web search for organisations & specialists.
- Projection studies and reports from other Member States.

In most cases it is preferable to use national data since national data sources are typically more up to date and provide better links to the originators of the data. Most international datasets rely on nationally derived data, and in some cases data from reputable international bodies may be more accessible and more applicable. In some cases, groups such as international trade associations or international statistical bodies will have country specific datasets for industries or other economic sectors that are not held by national organisations. Often international data have undergone additional checking and verification and may have been adjusted with the aim of increasing consistency, though this will not necessarily lead to improved estimates if the adjusted data are recombined with national information.

Member States are encouraged to develop and improve national sources of data to avoid being reliant on international data. Crosschecking national data sets with any available international data can help to assess completeness and identify possible problems with either data set.

# 4.2.2 Generating "new" data

### 4.2.2.1 Retrospective (historic) data

Since these Guidelines recommend building the projected GHG emissions on the historic inventories, submitted to EU MM and the UNFCCC, historic data will be complete and will not need any additional data collection effort.

### 4.2.2.2 Prospective activity data

Whenever projected data for either activities (primarily from projection models) or emission factors are not available, such prospective data need to be generated. The following present a general approach to finding such data, in line with the guidance presented in section 2.

# a) Proxy data

In many cases historic activity data within a specific source category will show a sometimes strong correlation with a generally available statistic, where a projection is available. Such a statistic then can be used as a "proxy" variable to estimate the projected activity data if no relevant new policies exists which would significantly change these trends. Candidate proxy variables are:

- ✓ Energy demand in a specific industrial production sector
- ✓ GDP

For non-key categories with a small or negligible contribution to national emissions it is good practice to use a identified proxy to scale the projected activity data. However, proxies should not be used to estimate GHG emissions from the key categories sources.

# b) Expert judgement

In some cases, an acceptable correlation between an available projected statistic and the activity data is not found. In such cases and when it is a non-key category source expert judgement could be applied.

# c) Assume no change

As a final resort the projection can assume that no change takes place between the latest inventory year and the year of the projection. This approach should not be used for a key source.

Obviously, the more important a source category is, the better activity data projection would be needed. See Figure 6.

## 4.2.2.3 Prospective emission factors

Future emission factors depend on two types of information:

- The development of new technologies that lead to different direct and indirect greenhouse gas emissions. Examples are:
  - ✓ Increasing insulation in buildings
  - ✓ Fuel mix and fuel quality changes in combustion source categories
  - ✓ Introduction of carbon capture and storage
  - ✓ Introduction of electric vehicles
  - ✓ Improved technologies and practices in agriculture
  - ✓ Land fill gas recovery systems
- The penetration of these new and modified technologies into the different activities in the country. This leads to a change over time in the mix of technologies, used in a country. This penetration can be autonomic or induced by policies and measures.

Some of the technological developments will have significant impacts on the activity data. Large scale introduction of electric vehicles will decrease gasoline and diesel use significantly and will increase the demand for electrical energy. It is good practice to ensure that these type of developments are reflected in both the prospective activity data and emission factors when calculating projected emissions.

### a) Technology data

Introduction of new technologies and practices will in many cases follow specific policies and measures. When such policies and measures are aiming at quantitative targets in terms of greenhouse gas emissions, it is good practice to translate such targets into specific

technologies<sup>41</sup> with their specific emission factors preferably endogenously by using economic models or, for areas such models do not exist or are not needed, exogenously by assumptions.

# b) **Expert judgement**

When it is not possible to define specific technologies, expert judgment can be used. Such expert judgment can be based on a clear understanding of the literature as reflected in

- ✓ BREF documents
- ✓ Technology outlook reports
- ✓ Scientific papers

# c) Assume no change

When neither technological data, nor expert judgment is available, the emission factors can be kept constant over time.

Obviously, the more important a source category is, the better technology development information would be needed. See Figure 7.

 $<sup>^{\</sup>rm 41}$  Many energy economic models do this translation by specifying (future) technologies.

# A.5 Methodological Choice

### 5.1 Introduction to choice of method

This chapter identifies the approach to choosing and using appropriate methods for estimating emission projections. This chapter builds on experiences with a similar approach in emission inventories of both greenhouse gases (IPCC 2006 Guidelines, IPCC Good Practice Guidelines) and transboundary air pollutants (Guidebook)<sup>42</sup>.

Methodological choice for individual source categories is important in managing the overall quality of and minimising uncertainty in projected emissions. However, as different countries have different priorities (levels of importance for different categories) and limited resources, a range of methods of different complexity (grade 1 least complex and least demanding on data and resources – Grade 2 & 3 (Higher Grade): most complex and most demanding on data and resources) are offered in these guidelines. Higher grade methods (see section 5.2) are designed to lower uncertainties and produce higher quality estimates. Higher grade methods generally require more detail and effort than lower grade methods so it may not be feasible to use more rigorous method for every category of emissions. Prioritising higher grade methods should focus on the most important categories identified through Key Category Analysis (see below). The sectoral volumes of these Guidelines provide a choice of grades according to this approach and a decision tree to help users decide which grade method is most appropriate to use.

# 5.2 Choosing the right method

To achieve the best possible estimates for the available resource and data it is good practice to, as a minimum, use higher grade methods for Key Categories (those contributing most to emissions in a target year, changing across a time series or with high uncertainty). Where data availability limits the use of higher grade methods, the collection of new data should be prioritised for Key Categories especially where significant changes are expected in projected estimates (i.e. where policies or measures are in place or planned or new technologies or products /services/ commodities expected).

# 5.2.1 Key Category Analysis

A key category is one that is prioritised within the national inventory system because it is significantly important for one or a number of gases in a country's national inventory in terms of the absolute level, the trend, or the uncertainty in emissions.

It is good practice for each country to use key category analysis systematically and objectively as a basis for choosing methods of emission calculation. Such a process will lead to improved projection quality, as well as greater confidence in the estimates that are developed.

It is recommended that the IPCC 2006 Key Category Analysis (see chapter 4 of the IPCC 2006 General Guidelines<sup>43</sup> is followed for trend and level approach 1 or approach 2 assessment with the following adaptations for projections:

#### Approach 1:

- For trend assessment the latest year of the historical inventory should be used as the "Base year" and a relatively close (but important) milestone year for the projections (e.g. 2020 in a projection ranging from 2010 2050) used as the latest year.
- For the level assessment, choose a relatively close (but important) milestone year for the projections (e.g. 2020 in a projection ranging from 2010 2050) as the latest year.

#### Approach 2:

- Where uncertainties have been estimated for projections approach 2 could be used applying the same rules for Level and trend assessment as above and following IPCC 2006 approach 2.
- Where projected uncertainties are not available use uncertainties from the latest
  historical inventory year as the basis for a simplified approach 2 key category analysis,
  applying the same rules for Level and trend assessment as above and following IPCC 2006
  approach 2.

In the absence of projection specific Key Category Analysis (e.g. where projections do not currently exist) use the GHG inventory based key category analysis approach 1 or 2 and apply expert judgement to provide additional prioritisation according to the expected impacts of known technologies, policies, measures and economic driving forces on emissions.

Key Category analysis will provide a prioritised list of categories that should be estimated using higher grades (grade 2 or 3).

# 5.2.2 Grades approach

Grade 1: Fall back approach	<ul> <li>A method using simple/limited, generic or no additional parameters to project forward historical estimates:         <ul> <li>Activity projections: Typically projections will, depending on availability, either use the projected activities from EU level models or assume no change, when projected activity data are not available and</li> <li>no additional assumptions applied to future emission factors (assumed the same as historical emission factors)</li> </ul> </li> <li>This assumes, as with historical default emission factors, an average or typical process description. This method is the simplest method, has the highest level of uncertainty and should not be used to estimate emissions from key categories (see below for definition).</li> </ul>
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Grade 2:
More
complex
approach

Uses more specific projected parameters or model results to estimate future activity data and/or emission factors. These projected parameters should be developed on the basis of knowledge of the types of technologies, policies and measures in the country for which the projections are being developed. Grade 2 projections would not use Tier 1 default emission factors. Grade 2 methods are more complex, are chosen to reduce the level of uncertainty and are considered as minimum level for estimating projected emissions for key categories.

# Grade 3: Most complex approach

Grade 3 is defined as any methodology that is more detailed than Grade 2 to capture all technology, policy and measure implications for AD and EFs. This means that there could be a wide range of Grade 3 methodologies based on site by site data or that include detailed analysis of the impacts of technologies and/or policies and measures. At one end of the range, are specific sector methodologies with a greater disaggregation of activity data and differentiated emission factors to accommodate different technologies, policies and measures. At the other end of the range are complex, dynamic models in which the processes leading to emissions and their interactions are modelled in great detail. This approach is particular relevant in case of a range of relevant policies impacting the same activity, as in the energy supply system.

All methodologies and the rationale for their use need to be well documented so that reviewers are able to review the methodology within a reasonable time period.

Grade 3 methodology has important advantages but presupposes the availability of corresponding sophisticated datasets and/or modelling tools. The key criterion to judge if the additional effort to use a Grade 3 methodology to replace a Grade 2 methodology is justified is that it must lead to a more accurate estimation of the relevant emissions, reducing the following common sources of error:

- Model error; the extent to which the mathematical representation of the processes underlying the emissions deviate from reality.
- o Parameter error; the error in the model parameters (e.g. emission factors, coefficients etc)
- o Input error; the error in activity data.
- Process error; error introduced through mistakes in the process of compiling the inventory.
   For complex models, this includes errors in the software implementation of the model.

For small extensions to Grade 2 methodologies, such as the inclusion of abatement measures or refinements of emission factors, it is sufficient to document the QA/QC process by which the revised/additional emission factors and associated activity data were obtained respective document the corresponding sources and assumptions for the model results used .

However, where Member States wish to use own complex simulation models in projection construction, the model is quite likely to have been developed by a third party. If such models are used within a methodology, it is necessary to ensure that QA/QC criteria are met by the complex model, by the process of parameterisation and by the input data necessary to run the model. These criteria need to acknowledge that reviewers will need to be able to review the methodology within a reasonable time period. These criteria are:

- For the projection construction process to be sufficiently transparent, the model documentation has to be clear, correct, concise, comprehensible, and consistent.
- The scientific quality of the model should be documented in peer-reviewed publications.
- The model should have undergone successful testing and validation for the situations that it
  will be used to describe in the projection construction. This implies that model parameters are
  available or can be established for these situations.
- The input data required by the model must be of sufficient quality, at the spatial and temporal scales for which the model is used.

These criteria are valid for all Grade 3 methodologies. However, they may require further interpretation for sector-specific applications and additional criteria may also be appropriate. For example, where it is appropriate, models intended to be used as Grade 3 methods should demonstrate that they obey the law of conservation of mass.

#### 5.2.3 Decision Tree

Each category specific chapter in the sectoral guidance presents a decision tree that signposts the appropriate graded method according to availability of projection parameters and whether the category is a key category (see above for analysis guidance).

Decision trees will prioritise higher grade methods where possible and strongly recommend grade 2 or 3 methods for key categories.

The steps in the decision tree will focus on the availability of the appropriate parameters for estimating projections (according to these guidelines) and on the need for additional data collection (for key categories where current data is not available).

# A.6 Time Series Consistency

## 6.1 Introduction

The basic principles and methods for GHG projections are the same as for GHG inventory<sup>44</sup> unless indicated otherwise.

The time series is an important component of the greenhouse gas projections because it connects GHG projections with GHG inventory, provides information on historical emissions trends and tracks the effects of PAMs to reduce emissions at the national level. As is the case with estimates for individual years, emission trends should be neither over nor underestimated as far as can be judged. It is good practice that GHG projections start from the most recent GHG inventory and that GHG projections are estimated in a consistent way. All emissions estimates in a time series should be estimated consistently, which means that as far as possible, the time series should be calculated using the same method, parameters and data sources (i.e. models) in all years. Different methods and/or different data in a time series could introduce bias because the estimated emission trend will reflect not only real changes in emissions or removals but also the pattern of methodological refinements.

This section describes good practice in ensuring time series consistency.

# 6.2 Ensuring consistency of the time series

### 6.2.1 Consistency with GHG inventories

The consistency of future trends with past greenhouse gas inventory trends is a crucial criteria of the quality of GHG emission projections. It is good practice to start GHG projections from the most recent inventory and explain all changes in trends.

# 6.2.2 Consistency of methods

All GHG emissions estimates in a time series should be estimated consistently, which means that as far as possible, the time series should be calculated using the same method, parameters and data sources (i.e. models) in all years. Different methods and/or different data in a time series could introduce bias because the estimated emission trend will reflect not only real changes in emissions or removals but also the pattern of methodological refinements. However, it is good practice to improve GHG estimates quality and develop new methodologies and source of data.

A *methodological change* in a category is a switch to a different grade from the one previously used. Methodological changes are often driven by the development of new and different data sets. An example of a methodological change is the new use of a higher grade method instead of a Grade 1 default method for an industrial category because a country has obtained site-specific

The latest adopted guidelines under UNFCCC. At the moment (IPCC, 1996) (<a href="http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html">http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html</a>) and (GPG,2001) (<a href="http://www.ipcc-nggip.iges.or.jp/public/gp/english/">http://www.ipcc-nggip.iges.or.jp/public/gp/english/</a>), starting in 2015 it will be (IPCC, 2006) (<a href="http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html">http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html</a>)

emission measurement data that can be used directly or for development of national emission factors.

A *methodological refinement* occurs when an inventory/projection compiler used the same grade to estimate emissions but applies it using a different data source or a different level of aggregation.

Both methodological changes and refinements over time are an essential part of improving GHG estimates. It is good practice to change or refine methods when:

- Available data have changed. The availability of data is a critical determinant of the
  appropriate method, and thus changes in available data may lead to changes or
  refinements in methods. Countries gain experience and devote additional resources to
  preparing greenhouse gas projections. Moreover, MS may develop and/or improve their
  National-Source-Specific-Models and this will improve the quality and availability of data.
- A category has become key category. A category might not be considered key in a GHG inventory but depending on the assumptions and scenarios it could become key in a projected future year.
- The previously used method is insufficient to reflect the impact of specific PAM in a transparent manner.
- The capacity for GHG estimations has increased. If the human or financial capacity has
  increased, it is good practice to change or refine methods so as to produce more accurate,
  complete, consistent and transparent estimates, particularly for key categories.
- New methods or models become available. In the future, new methods may be developed that take advantage of new technologies or improved scientific understanding.
- Correction of errors. It is possible that the implementation of the QA/QC procedures
  described in Chapter A.8 will lead to the identification of inconsistency or other mistakes
  and then it is good practice to correct them.

# A.7 Uncertainties

The 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines describe an uncertainty as a lack of knowledge of the true value of a variable that can be described as a probability density function (PDF) characterising the range and likelihood of possible values. Uncertainty depends on the analyst's state of knowledge, which in turn depends on the quality and quantity of applicable data as well as knowledge of underlying processes and inference methods.

Any projection of GHG emissions will be uncertain. There will be uncertainties in both the future activity and future emission factors. Each of these variables must be assessed. For some source categories, a lack of specific projected growth, or a poor understanding of future emission factors, will increase the uncertainty associated with the estimates presented. Acquiring a better understanding of the uncertainty associated with projected estimates is an important step in helping to prioritize future work and improving the overall quality of the projections.

Further information on uncertainty methodologies can be found at the IPCC website<sup>45</sup>. A guidance document on good practice guidance and uncertainty management was published in 2000<sup>46</sup>.

The uncertainties in an emission projection could be seen as very similar to those in an inventory, assuming that we have perfect foresight of the future developments. Which is not the case. Uncertainties, induced by the fact that we cannot predict any of the economic, technological or legislative developments with absolute certainty, confuse the picture if we do not work on these in terms of sensitivities. This is the major reason to run different policy scenarios (and possibly different economic scenarios and different assumptions on technological developments, for that matter). These different scenarios essentially show the sensitivity of the projection to these different possible future developments and incorporated in the different assumptions.

http://www.ipcc.ch/

http://www.ipcc-nggip.iges.or.jp/public/gp/english/

# A.8 Quality Assurance and Quality Control (QA/QC) for Projections

### 8.1 Introduction

QA/QC activities should be applied to projections and projection parameters used in compiling projected emissions by MS (in planning, preparing and reporting) and the Commission/EEA (in checking quality of submissions) to provide clear assurances in relation to the quality of the data being compiled, reported and used for analysis and policy decisions.

MS use projections for national policy making, reporting to the EUMM as well as to underpin National Communication reporting to the UNFCCC.

The EC/EEA compiles MS projections in order to obtain an EU-wide projection based on individual MS projections. EU-wide projections are needed for tracking the progress toward GHG reduction targets both domestic and international and for fulfilling the EU's reporting obligations to the UNFCCC in the form of national communications. The EU-wide projections are separate to EU level PRIMES/GAINS projections developed by the Commission (also used by the EC to assess future policies) and are built up of individual MS projections based on MS own assumptions, data sources and methods.

The following sections contain guidance on the general principles, quality objectives and activities for QA/QC of projections and draws on material from IPCCC, 1996&2006<sup>47</sup>, IPCC Good Practice Guidance<sup>48</sup>, UNFCCC Article 8 review<sup>49</sup>, UNECE stage 1,2 and 3 review activities and QC activities being developed by the Commission and EEA to assess MS submissions of projections under the Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (EUMM).

It is recommended that projections QA/QC fit within the timeline in Figure 9 which focussed, for MS on their national submission and for the Commission for the finalisation of the EU wide projections.

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<sup>(</sup>IPCC, 1996) (http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html)

<sup>(</sup>IPCC, 2006) (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)

http://www.ipcc-nggip.iges.or.jp/public/gp/english/

http://unfccc.int/files/meetings/cop\_11/application/pdf/cmp1\_08\_guidelines\_for\_review\_art8.pdf

Actors		QA/QC Events	Timing		
		1.1: As needed for new estimates			
	MS Sector	Collecting new raw data	12- 3 months prior to		
	Experts	Revising methods	submission (e.g. April -		
		Updating Parameters	December)		
		Incorporating PAMs			
MS		1.2: Projections Compilation: Before 15 March Every two years			
IVIO	MS Sector	Estimating projection estimates	3 months prior to submission		
	Experts	Compiling national totals	(e.g. December/January)		
		Compiling PAMs			
	MS	1.3: Submission Checks: By 15 March every two years	1-2 months prior to		
	QA/QC	Entering data into reporting formats	sdubmission: (By		
	Manager	Description of methods, assumptions and data sources	January/February)		
		Submission of Projections (e.g. 15th March)			
	ETC-ACM	2.1: Submission Completeness Checks with questions to MS	1 month after submissions		
		Completeness of the submission	(e.q. April)		
		Completeness of the EU Projections			
		2.2: Submission Consistency Checks with questions to MS	2 months afret submissions		
	=======================================	, ,	(e.g. May)		
	ETC/ACM + additional	2.3: Submission Accuracy Checks: with questions to MS	3 months after submissions		
EEA/EC	Experts	2.3. Submission Accuracy Checks. With questions to M3	(e.g. June)		
			3 months after submissions		
	MS	MS response to questions arising from 2.1 - 2.3 above	(e.g. June)		
	ETC/ACM + additional Experts	2.4: EU Wide Aggregated Projection Checks			
		All gases, MS, categories and years are included	4 months after submissions		
		There is consistency with EU wide assumptions on energy use and	(e.g. July)		
		production/consumption			
		Finalisation of EU wide Projections (e.g. July)	_		

Figure 9: Timeline for Projections QA/QC

The timelines for MS and EC/EEA are discussed in more detail in the relevant sections below and included in the detailed QA/QC activity tables 1 & 2 below.

# 8.1.1 Definition of QA/QC

Figure 10 illustrates the components of a projections QA/QC system with some examples of the differences for MS and the EC/EEA. The QA/QC Plan (see section 8.1.2 below) should include details of the quality objectives (see section 8.1.2 below) and QA/QC activities (see section 8.1.4 below). QA/QC implementation is undertaken in accordance with the plan and produces documentation of the undertaken QA/QC activities and whether the defined quality objectives have been met.

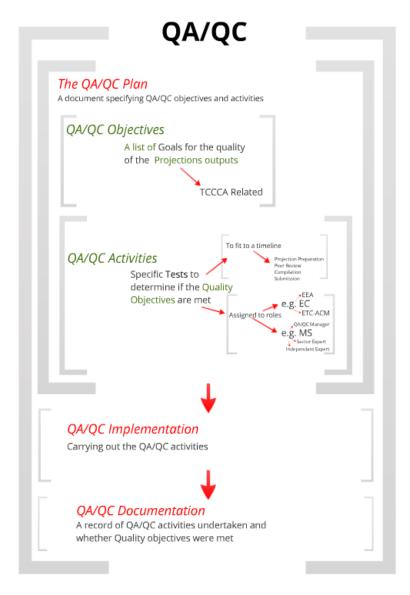


Figure 10: Components of QA/QC for emissions Projections

BOX 6.1 of Chapter 6: QA/QC and Verification from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 1 General Guidance and Reporting defines QA/QC and has been adapted to apply to projections for these guidelines as follows:

Quality Control (QC) is a system of routine technical activities to assess and maintain the quality of the emission projections as they are compiled. It is performed by personnel compiling and or aggregating the projections. The QC system is designed to:

- (i) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- (ii) Identify and address errors and omissions;
- (iii) Document and archive projection material and record all QC activities.

QC activities include general methods such as accuracy checks on data acquisition and calculations, and the use of approved standardised procedures for emission and removal calculations,

measurements, estimating uncertainties, archiving information and reporting. QC activities also include technical reviews of categories, activity data, emission factors, other estimation parameters, and methods.

Quality Assurance (QA) is a planned system of review *procedures conducted by personnel not directly involved in the projections compilation/development process*. Reviews, preferably by independent third parties, are performed on completed estimates following the implementation of QC procedures. Reviews verify that measurable objectives quality objectives were met, ensure that the projections represent the best possible<sup>50</sup> estimates of emissions and removals given the current state of scientific knowledge and data availability.

## 8.1.2 Definition of a QA/QC Plan:

A projections QA/QC Plan should be established and maintained by each MS (for the compilation and reporting of projections) and by the EC/EEA (for ensuring quality of EU wide projections). The Plan should define the specific Quality Objectives and QA/QC activities needed. The plan should also assign roles and responsibilities and a timeline for completion of QA/QC activities.

- A QA/QC plan for MS will include specific QA/QC activities for data gathering, compilation and reporting and involve a QA/QC manager responsible for all QA/QC and QA/QC of the compilation and submission and Sector Experts responsible for the projections for different sectors.
- A QA/QC plan for EC/EEA will include specific QA/QC activities for assessing MS submissions and ensuring the correct compilation of the EU wide projections and involve a QA/QC co-ordinator (ETC-ACM) the EC/EEA to provide an overview of the scope of QA/QC needed as well as additional sectoral experts for detailed sectoral analysis.

### 8.1.3 Definition of Quality Objectives:

The quality objectives provide the basis for definition and implementation of the QA/QC activities. Table 3 and Table 4 provide detailed recommended quality objectives for projections QA/QC for MS and the EC/EEA. At a MS level Quality Objectives can be further elaborated from this list according to the specific national requirements for the quality of projections for a variety of purposes including National reporting under the EUMM and to incorporate sector specific QA/QC. At a European Commission level the Quality Objectives are set to enable compilation of EU wide projections based on MS submissions of known quality and where necessary with gap filling.

Each QA/QC activity will be directed towards assessing whether the projection estimates and reported data meets one or several quality objectives.

### 8.1.4 Definition of QA/QC Activities

QA/QC activities include specific data analysis, reviews and checks needed to assess whether Quality Objectives are met (e.g. the data are compiled in accordance with agreed methods and

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procedures, without errors and include the required assumptions and data appropriately. Specific MS and EC/EEA QA/QC activities are elaborated in sections 8.2 and 8.3 below.

### 8.1.5 Definition of QA/QC Documentation

All planning and implementing of QA/QC activities should be documented. This includes task specifications and outputs for specific QA/QC implementation (including expert review activities, checking for detailed calculations and communications around assumptions and data sources). QA/QC documentation should be kept with archives of all material used for each version of projections estimates and submissions.

# 8.2 QA/QC for Member States

### 8.2.1 QA/QC Plan

The MS projections QA/QC Plan should contain a list of specific Quality Objectives and the QA/QC activities used to assess whether the quality objectives are met. QA/QC activities should include data collection, method development, emissions compilation and reporting. Each QA/QC activity in the plan should be assigned to specific roles and responsibilities and include a timeline for completion that fits with the timescales for production and reporting of projected estimates.

## 8.2.2 Quality Objectives

Any emission estimate (historic or projected) must be Transparent, Consistent, Comparable, Complete and Accurate (*TCCCA*)<sup>51</sup>. For a detailed description of these concepts see Annex A.III.<sup>52</sup>

The key objectives of the MS QA/QC for projections are to ensure that the principles of TCCCA are met and that the projections are characterised by:

- ✓ Transparency: in the methods, assumptions, data sources used to compile projections and
  on the inclusion of policies and measures, split EUETS/non EUETS and other national and
  EU wide assumptions (e.g. population, GDP, energy prices, carbon prices etc). Transparency
  in the QA/QC activities (documentation of) and their implementation.
- ✓ *Completeness:* of the projected emissions and that they include all emission/removals from all UNFCCC categories, socio-economic assumptions and policies and measures for all required years, categories, gases and scenarios.
- ✓ *Consistency:* for the trends in emissions and parameters between the historic and projected estimates and that there is internal consistency in aggregation of emissions.
- ✓ Comparability: with other reported projections through use of reporting templates, the
  correct IPCC category level, EUETS/non EUETS splits, scenarios, units for parameters and of
  input parameters with EU assumptions on (e.g. energy prices, energy demand, carbon
  price, population etc).
- ✓ Accuracy: in the application of methods, use of data sources and inclusion of national and EU wide assumptions (on energy prices, socio-economic trends etc).

The TCCCA criteria are the 5 key indicators to be monitored following *good practice* standards (IPCC, 2006; IPCC GPG, 2000).

The detailed description of these concepts are equal important to inventory and projection compilers

More specific Quality Objectives in line with the above principals are elaborated for MS in Table 3 below aligned with the QA/QC activities.

# 8.2.3 Roles and Responsibilities:

There should be clear assignment of individual/roles to different QA/QC activities. A QA/QC manager should co-ordinate all QA/QC activities and contributions from data suppliers, sector experts and independent experts. As a default the following are defined here.

- QA/QC Manager: maintains the QA/QC plan, sets quality objectives and defines, coordinates QA/QC activities and undertakes cross cutting QA/QC activities.
- Sectoral Experts: Perform sector specific QA/QC activities and report to the QA/QC Manager. Sector Experts should also collaborate with Data suppliers and other key stakeholders to review estimates and perform QA/QC on supplied material.
- External Review experts: Provide expert/peer review of projections for specific sectors and report to the QA/QC Manager.

The Roles above are also presented against the detailed QA/QC activities listed in Table 3 MS QA/QC Activities.

#### 8.2.4 Timeline:

The QA/QC plan should include a timeline (for example as illustrated in Figure 11) showing when QA/QC activities need to be performed. This timeline should fit in with compilation and reporting requirements.

Ac	ctors	QA/QC Events	Timing				
	MS Sector Experts	1.1: As needed for new estimates					
		Collecting new raw data	12- 3 months prior to				
		Revising methods	submission (e.g. April -				
	Experts	Updating Parameters	December)				
		Incorporating PAMs					
MS		1.2: Projections Compilation: Before 15 March Every two years					
IVIS	MS Sector Experts	Estimating projection estimates	3 months prior to submission				
		Compiling national totals	(e.g. December/January)				
		Compiling PAMs					
	MS	1.3: Submission Checks: By 15 March every two years	1-2 months prior to				
	QA/QC	Entering data into reporting formats	sdubmission: (By				
	Manager	Description of methods, assumptions and data sources	January/February)				
Submission of Projections (e.g. 15th March)							

Figure 11: Timeline for MS projections QA/QC

It is good practice for MS to develop elaborated internal, country-specific timeline which will ensure submission by 15<sup>th</sup> March.

These timelines are included in table 3 against the detailed QA/QC activities.

### 8.2.5 Member State QA/QC Activities

Table 3 presents details of proposed MS QA/QC activities for preparing and reporting GHG projections estimates. Activities are listed alongside MS role/responsibilities, outline timelines and quality objectives. The QA/QC Activity description column provides a detailed explanation of each activity to be undertaken. A template tool for QA/QC (see accompanying spread sheet) also provides the full detail of QA/QC activities and Quality Objective descriptions as well as a checklist for recording QA/QC progress and issues. MS are expected to elaborate this list to fit with specific processes and organisational structures and to add specific sectoral QA/QC activities.

Specific and detailed sectoral QA/QC activities focussed on key datasets and important parameters are elaborated in each of the "Sectoral QA/QC" sub-chapters in part B of the sectoral guidance.

#### 8.2.5.1 Documentation

In addition to the specific QA/QC activities, the methodology and data sources used in compiling an emission projection scenario should be appropriately documented. It should include enough information to allow readers to understand the underlying assumptions and to reconstruct the calculations for each of the estimates included.

The following information should be included in GHG projection-specific documentation:

- detailed data to aid transparency including: values and sources of activity data used, growth factors used, emission factors, details of grades, sector definitions, sector stratification, assumptions made in deriving future EFs;
- description of the methodology followed for each sector;
- information on the QA / QC undertaken;
- any major issues regarding the quality of input data, methods or processing and how they were addressed or are planned to be addressed;
- identify areas where further improvements would be beneficial;
- contact information for obtaining the data sources, where applicable.

Documentation of estimation methods for GHG projections should follow the same general guidance as for GHG inventory. It is good practice to include a description of the reasons for trends, revisions, policies and measures included, methods, data sources and assumptions as part of the projections QA/QC documentation or published as part of a national projections report (NPR) ( more information can be found in Reporting section A.9 ).

Table 3 MS QA/QC Activities for Projections

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Ouality Objective Description
External Review Experts	1.1: As needed for new estimates	Peer/Expert analysis of methods, assumptions and data sources	A1	Review accompanying reports and underlying material to check that descriptions of methods, data sources and assumptions in estimates and underlying models are clear and understandable.	1. Transparency:	QO1	There is transparency in descriptions of methods, data sources and assumptions in estimates and underlying models.
			A2	Review sensitivity analysis and descriptions to ensure that sensitivities are described clearly and completely.	1. Transparency:	QO2	Sensitivities are described clearly and completely.
			A3	Review the QA/QC plan and QA/QC activity records to assess the transparent documentation of QA/QC activities	1. Transparency:	QO3	There is transparent documentation of QA/QC activities
			A31	Review the models emission calculations/assumptions and analysis of sensitivities. Highlight any areas where sensitivities or uncertainties have not been assessed or are incorrectly prioritised. Compare sensitivities and uncertainties with projected and historical data reported by other MS to determine if they are provided at a comparable level of detail and highlight similar priorities.	5. Accuracy:	QO31	Sensitivities and uncertainties are reasonable compared with other MS and historic emissions inventories.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
			A32	Review methods and models used to ensure that they are appropriate, incorporate all relevant policies and measures, use appropriate parameters and socio-economic assumptions and provide non biased estimates that neither under nor over estimate as far as can be judged. Countries could set-up peer review groups to do this as bilateral or group review activities.	5. Accuracy:	QO32	Projection estimation methods including complex models do not under or over estimate emissions as far as can be judged.
Sector Experts	1.1: As needed for new estimates	Peer/Expert analysis of methods, assumptions and data sources	A33	Ask data suppliers to review and comment on assumptions used when incorporating their information into projection estimates.	5. Accuracy:	QO33	Data suppliers agree with assumptions and projected estimates derived using their input datasets
	1.2: Projections Compilation: Before 15 March Every two years	Analysis of Categories, subcategories	A16	Compare historical categories with projected categories to ensure that all historical categories are included in the projections. Check this for all years, gases and scenarios (e.g. WOM, WM and WAM). Highlight where there are aggregations and where historic categories may not be included in projections.	2. Completeness:	QO16	All relevant IPCC categories, especially categories for which there are historical activities, are included in the estimates for all years, gases and scenarios (e.g. WOM, WM and WAM).
			A28	Check the level of category detail provided in the projections and that it is comparable to that requested in	4. Comparability:	QO28	Suitable category and subcategory detail (e.g. IPCC level 3 or 4) is provided.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
				the template.			
		Analysis of Energy Balances and assumptions	A21	Compare national future energy demand and supply assumptions (Parameters) used as input to the emissions projections with other EU assumptions/modelled datasets (See section 4.2.1).  Check for differences and explanations for differences in total energy supply/demand and energy supply/demand by type of fuel/renewable source.	2. Completeness:	QO21	Projected emissions estimates include all relevant projected energy balance data (if available) from energy projection models, including assumptions on import/exports.
			A34	Compare national future energy demand and supply assumptions (Parameters) used as input to the emissions projections with other EU assumptions/modelled datasets (see section 4.2.1). Check for differences and explanations for differences in total energy supply/demand and energy supply/demand by type of fuel/renewable source.	5. Accuracy:	QO34	Energy demand and supply are complete and portray a realistic future share of different fuels and renewable energy sources.
		Analysis of EUETS	A38	Assess whether data on future changes in EUETS energy demand by fuel type is accurate reflected in the projected energy balance and that energy demand assumptions can be subtracted from total projected energy balances to provide unbiased data for non EUETS consumption.	5. Accuracy:	QO38	Inclusion of separate EUETS and non EUETS estimates does not lead to over or under estimation of projected emissions.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
		Analysis of Implied EFs	A18	Compile IEFs from projection emissions divided by parameters or use reported indicators to analyse whether IEFs for a specific year, gas and category/indicator are within or outside the range of a group of similar MS (similar analysis will be needed to prepare the data for other MS), (Low category or subcategory IEFs may be indicative of missing estimates for subcategories or fuels).	2. Completeness:	QO18	All category IEFs are within the expected ranges for a group of similar MS,
			A19	Compile IEFs from projection emissions divided by parameters or use reported indicators to analyse whether IEFs for a specific gas and category/indicator and analyse the trend for anomalies (dips/jumps/flat lines) against knowledge of expected abatement/fuel switching, highlight and investigate outliers (Low category or subcategory IEFs may be indicative of missing estimates for subcategories or fuels). (see EC/EEA QA/QC).	2. Completeness:	QO19	All category IEFs show expected % reductions taking into account assumptions on abatement/fuel switching included in the projection estimates.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
			A36	Compile IEFs from projection emissions divided by parameters or use reported indicators. Calculate the average of the change in IEF for each projected year between the reference year e.g. 2010 and the projected years e.g. 2011, 2015 and 2020 and compare it with the average change in the same IEF historically (e.g. For 2011 compare 2010-2011 with 2009 - 2010 and for all other projected years compare the average of 2004 - 2010 with 2010 - 2015 and 2010 - 2020). Highlight and seek justification where there the change is significantly different from the historical change (e.g. +- 10% for 2010, +- 20% for 2015 and +- 25% for 2020) or IEFs are level/flat. (see section 6.1.1 of EC QA/QC GHG Projections v1.)	5. Accuracy:	QO36	The average annual change in IEFs/Indicators are comparable to the average annual % change for historic IEFs/Indicators.
		Analysis of non energy parameters and assumptions	A35	Compare Non Energy parameters used as input to national emission projections with projected EU/international data (e.g. Eurostat and EU GVA Agriculture, Transport and Economic models (DG Economic and Financial Affairs for GDP, population, ECB for GVA, GAINS for agricultural and waste statistics). Check for differences and explanations for differences in values for specific projected years and trends.	5. Accuracy:	QO35	Non Energy parameters are consistent with historic trends and projected EU/international expectations.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
		Analysis of Notation Keys	A29	Analyse the number and use of notation keys blank cells, "0"s in the reporting template and make sure blank cells, "0"s are NOT used and suitable justification is provided for NEs.	4. Comparability:	QO29	Blank cells and "0"s are NOT used in the reporting template and NE's are justified.
			A30	Analyse the % of IEs used in reporting template. If it is > 5% of the total data entries highlight as a problem of transparency and comparability.	4. Comparability:	QO30	The number of IE's used in reporting is < 5% of the total data entries.
		Sector specific QA/QC	A63	Implement sector specific checks in accordance with the QA/QC in the sector specific sections of the Projections Guidelines.	All	QO63	Sectoral emissions estimates are TCCCA
		Trend consistency	A24	Calculate the average of the change in emissions for the projections for each projected year between the reference year e.g. 2009 and the projected years e.g. 2010, 2015 and 2020 and compare it with the average change in emissions historically. (e.g. For 2010 compare 2008-2009 with 2009 - 2010 and for all other projected years compare the average of 2003 - 2009 with 2009 - 2015 and 2009 - 2020). Highlight and seek justification where there the change is significantly different from the historical change (e.g. +- 10% for 2010, +- 20% for 2015 and +- 25% for 2020) or projections are level/flat. (see	3. Consistency:	QO24	The average annual change for the projections are comparable to the combination of average annual % change in the historic inventory, and the expected impact of policies inducing trend breaks.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
				EC QA/QC GHG Projections)			
			A25	Calculate the average of the change in emissions for the projection parameters for each projected year between the reference year e.g. 2009 and the projected years e.g. 2010, 2015 and 2020 and compare it with the average change in the same parameters historically. (e.g. For 2010 compare 2008-2009 with 2009 - 2010 and for all other projected years compare the average of 2003 - 2009 with 2009 - 2015 and 2009 - 2020). Highlight and seek justification where there the change is significantly different from the historical change (e.g. +- 10% for 2010, +- 20% for 2015 and +- 25% for 2020) or projections are level/flat. (see EC QA/QC GHG Projections)	3. Consistency:	QO25	The average annual change for the projection parameters are comparable to the combination of average annual % change for historic parameters and the stringency of new policies impacting on the parameters .

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Ouality Objective Description
			A26	Compare independently derived parameter data (see table 5.4 of section 5.5 of EC QA/QC GHG Projections.) with parameters used un the projections estimates. Highlight and seek justification where there are differences of more than 15%. (see EC QA/QC GHG Projections)	3. Consistency:	QO26	Parameters do not deviate from independently derived data by more than 15%
			A62	Compare the reference year data with the historic inventory data and analyse differences	3. Consistency:	QO62	Differences between projection "Reference Year" and historic national statistics and inventory emissions are reduced as much as possible and remaining differences are explained
	1.3: Submission Checks: By 15 March every two years	Submission check	A15	Check if there is a clear description of the methods, models, data sources and assumptions used to estimate projections for each sector/category. (see EC QA/QC GHG Projections)	2. Completeness:	QO15	The submission includes a clear description of methodologies, models and underlying assumptions.
QA/QC Manager	1.2: Projections Compilation: Before 15	Analysis of Notation Keys	A20	Analyse the number and use of notation keys blank cells, "0"s in the reporting template and make sure blank cells, "0"s are NOT used and suitable justification is provided for NEs.	2. Completeness:	QO20	Blank cells, "0"s, and NE are NOT used in the reporting template.

MS Role Detail	March Every two years	Activity Group QA/QC Activity Reference		QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
		Peer/Expert analysis of methods, assumptions and data sources	A17	Check whether the policy saving accounted for in the Policies & Measures sheet of the template are consistent with the emissions reductions presented in the projections sheet for each scenario.	2. Completeness:	QO17	All identified policies and measures are included in projected estimates.
	1.3: Submission Checks: By 15 March every two years	Analysis of Categories, subcategories	A4	Check the level of category detail provided in the projections and that it is comparable to that requested in the reporting template and includes the required level of detail. Compare historical categories with projected categories to ensure that all historical categories are included in the projections. Check this for all years, gases and scenarios (e.g. WOM, WM and WAM). Highlight where there are aggregations and where historic categories may not be included in projections.	1. Transparency:	QO4	Sufficient Category and subcategory detail are provided to separate Key Category, IPCC subcategory, national and international and EUETS and non EUETS emissions.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Ouality Objective Description
		Analysis of CCPM	<b>A</b> 6	Analyse the "Policies & Measures" sheet in the completed reporting template "MM Article 3(2) Reporting Template" to determine the CCPMs included in the projections and compare those with the completed list of CCPMs in sheet "List CCPM" of the reporting template "MM Article 3(2) Reporting Template". Or compare MS own list of CCPMs included in projections with the completed list of CCPMs in sheet "List CCPM" of the reporting template "MM Article 3(2) Reporting Template".	1. Transparency:	QO6	It is clear which EU common and coordinated policy or measures (CCPMs) are included in the projected estimates.
		Analysis of Notation Keys	A5	Analyse the number and use of notation keys used in the template (especially IE, NE and NO) and make sure all uses are explained and justified in accompanying datasets and reports.	1. Transparency:	QO5	All notation keys (especially IE, NE and NO) are explained and justified in accompanying datasets and reports. (See also Comparability Tests)
		Submission check	A7	Analyse the projection parameters in the reporting template and verify that the correct projections parameter units (e.g. the types of electricity, fuels, waste treatment) or that a full definition is provided for units if different from those suggested in the template.	1. Transparency:	Q07	There is transparency in projections parameter units (e.g. the types of electricity, fuels, waste treatment) that a parameter comprises (if different from the requirements).
			A8	Check that all GHGs are included in the reporting template (see EC QA/QC GHG Projections.)	2. Completeness:	QO8	The submission includes projections reported as the six GHG covered under the

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
							UNFCCC separately.
			A9	Check that all there are estimates or notation keys for all high level IPCC sector categories in the reporting template: (see EC QA/QC GHG Projections)	2. Completeness:	QO9	The submission includes projections reported by high level IPCC sector categories:
			A10	Check that projections are all reported by detailed IPCC sector categories and provide a split into EUETS and non-ETS sectors. (see EC QA/QC GHG Projections)	2. Completeness:	QO10	The submission includes projections reported by sector identified by the detailed IPCC sector categories and split into ETS and non-ETS sectors.
			A11	Check that the submission includes projections scenarios 'with measures' and 'with additional measures' in the reporting template. (see EC QA/QC GHG Projections)	2. Completeness:	QO11	The submission includes projections scenarios 'with measures' and 'with additional measures' such as mentioned in the guidelines of the UNFCCC.
			A12	Check that the submission (Policies & Measures sheet) includes clear identification of all of the policies and measures included in the projections scenarios including EU policies (CCPMs); (see EC QA/QC GHG Projections )	2. Completeness:	QO12	The projections include relevant policies and measures including EU policies .
			A13	Check that all EU Policies are included in the recommended format provided in the reporting template.	2. Completeness:	QO13	The submission includes EU Policies in the recommended format.

MS Role Detail	Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
				(see EC QA/QC GHG Projections)			
			A14	Check the submissions accompanying report includes a detailed description of sensitivity analysis highlighting key parameters and emission factors that affect the estimates for each category. (see EC QA/QC GHG Projections)	2. Completeness:	QO14	The submission includes results of sensitivity analysis performed for the projections.
			A22	Check that the reporting template includes data for all Mandatory parameters or that exclusions are fully justified and documented. (see section 4 of EC QA/QC GHG Projections v1.)	2. Completeness:	QO22	The Submission includes all required mandatory parameters.
			A23	Check that the reporting template includes data for all Non Mandatory parameters or that exclusions are fully justified and documented. (see EC QA/QC GHG Projections)	2. Completeness:	QO23	The Submission includes all required non mandatory parameters.
			A27	Check that the submission has been made using the most up-to-date reporting templates.	4. Comparability:	Q027	The most up-to-date reporting templates are used.

The template tool for QA/QC (see accompanying spread sheet) provides the full detail of QA/QC activities and linked Quality Objective descriptions.

## 8.3 QA/QC For the European Commission (EC/EEA)

This guidance, for EC/EEA QA/QC of MS projections, draws from and elaborates the existing "Quality Assurance / Quality Control procedure for the reporting of projections under Decision 280/2004/EC (the EU Monitoring Mechanism Decision)" Version 1 – March 2011 (name shortened for this report to: *QA/QC procedures for EUMM projections March 2011*). *QA/QC procedures for EUMM projections March 2011* provides details of the QA/QC performed by the ETC-ACM on behalf of the EEA and the European Commission. It focuses on procedures which check the completeness of the submission and the consistency and accuracy of data and information reported by MS using tests to identify outliers. Further extensions of QA/QC activities have been included here.

## 8.3.1 QA/QC Plan

The EC/EEA Plan for the QA/QC of MS projections contains a list of specific Quality Objectives and the QA/QC activities used to assess whether the quality objectives are met. QA/QC activities include assessment of MS submissions as well as the compilation/aggregation of EU wide projected estimates. Each QA/QC activity in the plan should be assigned to specific roles and responsibilities within the EC/EEA/ETC-ACM team responsible for gathering the MS data and compiling the EU wide projections. The plan includes a timeline for completion of QA/QC activities that fits with the production process of the EU wide projected estimates.

## 8.3.2 Key Objectives

The key objectives of EC/EEA QA/QC for projections are to ensure that the principles of TCCCA are met by the MS projections and for the compiled EU wide projections<sup>53</sup>. These objectives focus on:

#### Transparency<sup>54</sup>:

- 1. To ensure that all methods, data sources and assumptions provided in material accompanying projections submissions for each sector are transparent.
- 2. To ensure that material and activities associated with the compilation and QA/QC of EU wide projections are fully documented.

#### Completeness:

The objectives of the EC/EEA QA/QC are constrained by the practicalities of timescale for analysis (which is quite short) and burden on MS in responding to questions (which needs to be kept to a minimum). It therefore focuses on activities which can be performed over a short period of time.

Where feasible (and expert resources allow) more detailed analysis of MS submissions could be undertaken

- 3. To ensure there are no gaps in the information and request further information from the Member States if not reported.
- 4. To ensure that the compiled EU wide projections are complete for gases, categories and vears.

#### Consistency:

- 5. To ensure that the projections submitted are internally consistent, recalculations documented and represent improvements, and trends are consistent with historic data.
- To ensure that figures provided for the projection parameters are agreeable with the historic trend of the parameter and equivalent data from other sources (such as for example EU models) or differences are well explained.
- 7. To ensure that variation in MS "assumptions" on Carbon price/GDP/International fuel prices and international energy balances (imports/exports) are well founded and justified.
- 8. To check that EU wide assumptions on energy production and demand and manufacturing and agriculture are consistent with the aggregated MS parameters and emissions.
- 9. To ensure (check if) that mandatory/recommended EU-wide assumptions are followed.

#### Accuracy:

- 10. To ensure that MS projections are not under or over estimated.
- 11. Expert analysis<sup>55</sup> to assess that all methods, data sources and assumptions provided in material accompanying projections submissions for each sector are appropriate, consistent with good practice and do not lead to underestimates or overestimates in the reported emissions estimates.

Specific Quality Objectives are elaborated for the EC/EEA in Table 3 below and aligned with the QA/QC activities.

#### 8.3.3 Roles and Responsibilities:

It is suggested to follow the roles and responsibilities for EC/EEA QA/QC of the EU wide projections as elaborated in QA/QC procedures for EUMM projections March 2011 which assigns:

- The definition of QA/QC scope and quality objectives to the EC who will also ensure that
  there is sufficient QA/QC, that it is consistent across MS and that there is follow-up for
  improvements (by MS or with gap filling) to the final EU wide projections.
- QA/QC co-ordination to the EEA's European Topic Centre on Air and Climate Mitigation
  who will maintain the QA/QC plan, co-ordinate all QA/QC activities, contributions from
  experts and communication with MS.

Where feasible (and expert resources allow) more detailed analysis of MS submissions could be undertaken.

#### 8.3.4 Timeline:

The timeline for the EU/EEA QA/QC activities is presented in Figure 12 below.

Ac	tors	QA/QC Events	Timing		
		Submission of Projections (e.g. 15th March)	_		
	ETC ACM	2.1: Submission Completeness Checks with questions to MS Completeness of the submission Completeness of the EU Projections	1 month after submissions (e.g. April)		
	LTO-AGW	2.2: Submission Consistency Checks with questions to MS	2 months afret submissions (e.g. May)		
EEA/EC	ETC/ACM + additional Experts	2.3: Submission Accuracy Checks: with questions to MS	3 months after submissions (e.g. June)		
		MS response to questions arising from 2.1 - 2.3 above	3 months after submissions (e.g. June)		
	ETC/ACM + additional Experts	2.4: EU Wide Aggregated Projection Checks All gases, MS, categories and years are included There is consistency with EU wide assumptions on energy use and production/consumption	4 months after submissions (e.g. July)		
		Finalisation of EU wide Projections (e.g. July)			

Figure 12: Timeline for EC/EEA projections QA/QC

This timeline reflects the timeline for QA/QC elaborated in QA/QC procedures for EUMM projections March 2011 (Table 3) with the addition of timings for the final QC of EU wide projections (July). The timeline includes feedback in June from MS on questions arising from the EC/EEA QA/QC activities.

These timeline elements are also included in table 2 against the QA/QC activates.

## 8.3.5 Detailed EC QA/QC Activities

Table 4, below builds on the QA/QC activities elaborated in the document described above (QA/QC procedures for EUMM projections March 2011) and includes proposals for further enhancements. QA/QC activities in Table 4 are listed alongside timelines for the activities and specific quality objectives.

A template tool for QA/QC (see accompanying spread sheet) provides the full detail of QA/QC activities and linked Quality Objective descriptions.

#### 8.3.5.1 Communications with MS

EC/EEA QA/QC activities will generate questions of clarification for MS to answer. Part of the EC/EEA QA/QC will involve resolving questions, identified during the QA/QC activities, with MS. The EC/EEA through the ETC-ACM will manage this process by providing questions for each MS at the end of each QA/QC event. MS will be required to respond by the end of June as indicated in Figure 12. Any unresolved issues relating to completeness may result in gap-filling by the EC/EEA.

## 8.3.5.2 Gap-filling

EC/EEA activities that assess "Completeness" (see activities A39 – A48 in table 2) may identify gaps in MS data that need filling to provide complete EU wide projections. In cases where the EC/EEA identifies clear gaps in data in MS submissions the EC/EEA will highlight this to the MS during its communication and provide details of the proposed methodology for filling the gaps. Unless MS can provide updated or alternative data, the EC/EEA may use its own methods to fill gaps.

## 8.3.5.3 Documentation

In addition to the specific QA/QC activities listed in Table 4, all material used for and produced in the EC/EEA projections should be fully documented. This includes documentation of the QA/QC activities and communications between the EC/EEA and MS.

Table 4: EC/EEA Activities for QA/QC of MS Projections

Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
2.1: Submission Completeness Check: April every two years	Submission check	A39	Check that all six GHGs are included in the reporting template (see EC QA/QC GHG Projections)	2. Completeness:	QO39	The submission includes projections reported as the six GHG covered under the UNFCCC separately.
		A40	Check that all there are estimates or notation keys for all high level IPCC sector categories in the reporting template: (see EC QA/QC GHG Projections)	2. Completeness:	QO40	The submission includes projections reported by high level IPCC sector categories:
		A41	Check that projections are all reported by detailed IPCC sector categories and provide a split into EUETS and non-EUETS sectors. (see EC QA/QC GHG Projections)	2. Completeness:	QO41	The submission includes projections reported by sector identified by the detailed IPCC sector categories and split into EUETS and non-EUETS sectors, appropriately accounting for scope differences and changes between UNFCCC and EU internal legislation.
		A42	Check that the submission includes projections scenarios 'with measures' and 'with additional measures' in the reporting template. (see EC QA/QC GHG Projections)	2. Completeness:	QO42	The submission includes projections scenarios 'with measures' and 'with additional measures' such as mentioned in the guidelines of the UNFCCC, including if and how EC/EEA recommended harmonised data have been used.

Timeline (when)	Activity Group  QA/QC Activity	Reference QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
	A4 	Check that the submission (Policies & Measures sheet) includes clear identification of all of the policies and measures included in the projections scenarios including EU policies (CCPMs); (see EC QA/QC GHG Projections)	2. Completeness:	QO43	The submission includes clear identification of the policies and measures included in the projections scenarios including EU policies.
	A4	Check that all EU Policies are included in the recommended format provided in the reporting template. (see EC QA/QC GHG Projections)	2. Completeness:	QO44	The submission includes EU Policies in the template format.
	A4 	Check the submissions accompanying report includes a detailed description of sensitivity analysis highlighting key parameters and emission factors that affect the estimates for each category. (see EC QA/QC GHG Projections)	2. Completeness:	QO45	The submission includes results of sensitivity analysis performed for the projections.
	A4	Check there is a clear description of the methods, models, data sources and assumptions used to estimate projections for each sector/category. (see EC QA/QC GHG Projections)	2. Completeness:	QO46	The submission includes a clear description of methodologies, models and underlying assumptions, including if and how EC/EEA recommended harmonised data have been used.
	A4	Check that the reporting template includes data for all Mandatory parameters or that exclusions are	2. Completeness:	QO47	The Submission includes all required mandatory parameters.

Timeline (when)	Timeline (when) Activity Group		QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
			fully justified and documented. (see EC QA/QC GHG Projections)			
		A48	Check that the reporting template includes data for all Non Mandatory parameters or that exclusions are fully justified and documented. (see EC QA/QC GHG Projections)	2. Completeness:	QO48	The Submission includes all required non mandatory parameters.
2.2: Submission Consistency Check May every two years	Harmonised Assumptions	A66	Analysis of the variation in "assumptions" on Carbon price/GDP/International fuel prices and international energy balances (imports/exports).	3. Consistency:	QO66	All basic assumptions on energy and carbon price, imports/exports within Europe are consistent between MS.
	Internal sums in reporting template	A53	Check that all categories/sub-categories and gases in the reporting template sum to the reported/headline totals. (see EC QA/QC GHG Projections)	3. Consistency:	QO53	All sectors/categories/sub-categories/gases sum up to the reported/headline totals.
	Recalculations	A54	Compare the current and previous submissions projected emissions by category/subcategory and gas. If differences for any category/sub category are > 10% seek an explanation justifying the change as improvements to methodology or updated activity data assumptions or sources. (see	3. Consistency:	QO54	Recalculations by category/subcategory/gas are <10%

Timeline (when)	Activity Group  QA/QC Activity  Reference  Compared to the com			TCCCA	Quality Objective	Aeference Quality Objective Description
			EC QA/QC GHG Projections)			
	Reference year consistency	A52	For each parameter and emission category/gas, compare the projection "Reference Year" data for parameters and projections with the appropriate historic year of national statistics and emission estimates. If there is a difference of > 3% highlight and seek justification for the difference. (see EC QA/QC GHG Projections)	3. Consistency:	QO52	Projection "Reference Year" and historic national statistics and inventory emissions do not differ by more than 3%.
	Trend consistency	A49	Calculate the average of the change in emissions for the projections for each projected year between the reference year e.g. 2009 and the projected years e.g. 2010, 2015 and 2020 and compare it with the average change in emissions historically. (e.g. For 2010 compare 2008-2009 with 2009 - 2010 and for all other projected years compare the average of 2003 - 2009 with 2009 - 2015 and 2009 - 2020). Highlight and seek justification where there the change is significantly different from the	3. Consistency:	QO49	The average annual change for the projections are comparable to the average annual % change in the historic inventory and the expected impact of policies inducing trend breaks.

Timeline (when) Activity Group	QA/QC Activity QA/QC Activity Description	TCCCA	Objective Reference Quality Objective Description
	historical change (e.g. +- 10% for 2010, +- 20% for 2015 and +- 25% for 2020) or projections are level/flat. (see EC QA/QC GHG Projections)		
	Calculate the average of the change in emissions for the projection parameters for each projected year between the reference year e.g. 2009 and the projected years e.g. 2010, 2015 and 2020 and compare it with the average change in the same parameters historically. (e.g. For 2010 compare 2008-2009 with 2009 - 2010 and for all other projected years compare the average of 2003 - 2009 with 2009 - 2015 and 2009 - 2020). Highlight and seek justification where there the change is significantly different from the historical change (e.g. +- 10% for 2010, +- 20% for 2015 and +- 25% for 2020) or projections are level/flat. (see section	3. Consistency: QO	The average annual change for the projection parameters are comparable to the average annual % change for historic parameters and the stringency of new policies impacting on the parameters.

Timeline (when)	Activity Group QA/QC Activity	Neterence QA/QC Activity Description	TCCCA	Quality Objective	Quality Objective Description
		5.5 of EC QA/QC GHG Projections v1.)			
		Compare independently derived parameter data			
		(see table 5.4 of section 5.5 of EC QA/QC GHG			
	A51	Projections v1.) with parameters used un the	3. Consistency:	QO51	Parameters do not deviate from independently derived
		projections estimates. Highlight and seek justification where there are differences of more			data by more than 15%
		than 15%. (see EC QA/QC GHG Projections)			

Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective	Guality Objective Description
2.3: Submission Accuracy Check June every two years	Analysis of CCPM	A58	Analyse the "Policies&Measures" sheet in the completed reporting template "MM Article 3(2) Reporting Template" to determine the WEM CCPMs that are included in the projections and compare those with the completed list of CCPMs in sheet "List CCPM" of the reporting template "MM Article 3(2) Reporting Template". Or compare MS own list of WEM CCPMs included in projections with the completed list of CCPMs in sheet "List CCPM" of the reporting template "MM Article 3(2) Reporting Template".	5. Accuracy:	QO58	All required "With Existing Measures" EU policy common and coordinated policy or measure (CCPMs) are included in the projected estimates
		<b>A</b> 59	Analyse the "Policies&Measures" sheet in the completed reporting template "MM Article 3(2) Reporting Template" to determine the WAM CCPMs that are included in the projections and compare those with the completed list of CCPMs in sheet "List CCPM" of the reporting template "MM Article 3(2) Reporting Template v 5_2". Or compare MS own list of WAM CCPMs included in projections with the completed list of CCPMs in sheet "List CCPM" of the reporting template "MM Article 3(2) Reporting Template".	5. Accuracy:	QO59	All required "With Additional Measures" EU policy common and coordinated policy or measure (CCPMs) are included in the projected estimates

Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective	Heterence Quality Objective Description
	Analysis of Implied EFs	A56	Compile IEFs from projection emissions divided by parameters or use reported indicators. Calculate the average of the change in IEF for each projected year between the reference year e.g. 2009 and the projected years e.g. 2010, 2015 and 2020 and compare it with the average change in the same IEF historically. (e.g. For 2010 compare 2008-2009 with 2009 - 2010 and for all other projected years compare the average of 2003 - 2009 with 2009 - 2015 and 2009 - 2020). Highlight and seek justification where there the change is significantly different from the historical change (e.g. +- 10% for 2010, +- 20% for 2015 and +- 25% for 2020) or IEFs are level/flat. (see EC QA/QC GHG Projections)	5. Accuracy:	QO56	The average annual change in IEFs/Indicators are comparable to the average annual % change for historic IEFs/Indicators.
		<b>A</b> 57	Compile IEFs from projection emissions divided by parameters or use reported indicators. Compare IEF for each of the sectoral indicators and MS with an average for all MS for each projected year (2010, 2015 and 2020) and gas. Highlight and seek justification for any large divergence from the average (see EC QA/QC GHG Projections) e.g. Five Member States with biggest divergence will be	5. Accuracy:	QO57	There are no IEF outliers for indicators and gases compared to an average for all MS for each projected year (2010, 2015 and 2020).

Timeline (when)	Activity Group QA/QC Activity Reference		Activity Group QA/QC Activity Description		TCCCA	Quality Objective Reference	Quality Objective Description
			contacted to provide a reason for the divergence.)				
	lysis of ation Keys	A55	Analyse the % of IEs used in reporting template. If it is > 1% of the total data entries highlight as a problem of completeness.	5. Accuracy:	QO55	The number of NOs used in reporting is < 1% of the total data entries.	
anal <sub>y</sub> meth	umptions data	A60	Review reports and the projections system to determine if there is evidence of independent review (peer review) involving stakeholders for the major sectors and categories (e.g. energy projections) for emissions and parameters and the implementation of recommendations and conclusions of review.	5. Accuracy:	QO60	There is evidence of independent review (peer review)	
		A64	Expert analysis of methods, data sources and assumptions provided in material accompanying projections submissions for each sector to assess for transparency in the reported emissions	1. Transparency:	QO64	All methods, data sources and assumptions provided in material accompanying projections submissions for each sector are transparent.	

Timeline (when)	Activity Group	QA/QC Activity Reference	QA/QC Activity Description	TCCCA	Quality Objective Reference	Quality Objective Description
			estimates.			
		A65	Expert analysis of methods, data sources and assumptions provided in material accompanying projections submissions for each sector to assess for underestimates or overestimates in the reported emissions estimates.	5. Accuracy:	QO65	All methods, data sources and assumptions provided in material accompanying projections submissions for each sector are appropriate, consistent with good practice and do not lead to underestimates or overestimates in the reported emissions estimates.
	Trend consistency	A61	Compare the reference year data with the historic inventory data and analyse differences	3. Consistency:	QO61	Differences between projection "Reference Year" and historic national statistics and inventory emissions are reduced as much as possible and remaining differences are explained
2.4: EU Wide Projection Checks	EU wide Completeness	A68	Check that all GHGs and subcategories are included from all MS into the EU wide projections.	2. Completeness:	QO68	The EU wide estimate includes all MS years, category, gas and scenarios.
	Harmonised Assumptions	A67	Analysis to check that EU wide assumptions and projections on energy production and demand and manufacturing and agriculture are consistent with the aggregated MS parameters	3. Consistency:	QO67	There is consistency between the aggregated MS assumptions and projections with EU wide assumptions on energy demand and production.

The template tool for QA/QC (see accompanying spread sheet) provides the full detail of QA/QC activities and linked Quality Objective descriptions.

# A.9 Reporting

Reporting an emission projection consists of two parts:

#### a) A completed tabular template

including a quantitative description of the projection and the main underlying assumptions and parameters

## b) A National Projections Report (NPR)

providing an overview of the methods and approaches used.

## 9.2 **Template**

Numerical information is reported using a predefined template (see Annex A.IV)

## 9.3 National Projections Report

The proposal on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (Draft MMR) sets out the requirements for the reporting on projections of anthropogenic greenhouse gas emissions by sources and removals by sinks (Chapter 5, articles 13 to 15).

According to these articles the methodology and data sources used in compiling an emission projection scenario should be well documented and made available to the public and the Commission. These reports should include enough technical underpinning information to allow readers to understand the underlying assumptions and to reconstruct the projections calculations for each of the estimates included.

As there is no specific guidance on how to structure the required information this section gives an example for the possible structure of a National Projection Report. Please note this is not an requirement but can be helpful for MS who wish to document the projection background information in a structured report. Following the inventory management, improvement & QA/QC section A.8 good practice guidance for QA the following information could be included in a National Projection Report:

- Detailed data to aid transparency including: values and sources of activity data used, growth factors used, emission factors, details of Grades, sector definitions, sector stratification, assumptions made in deriving future EFs and any national circumstances that influence the projections.
- Description of the methodology followed for each sector.
- o Information on the QA / QC undertaken.
- Any major issues regarding the quality of input data, methods or processing and how they were addressed or are planned to be addressed.
- Identify areas where further improvements would be beneficial
- o Contact information for obtaining the data sources, where applicable.

Below a proposed outline for this National Projections Report is given (Figure 13). Please note that it is not nescecarry to copy information of background reports in such a NPR. Including the links to public available reports would be sufficient.

A report as outlined in this figure could be submitted together with the completed template as mentioned above.

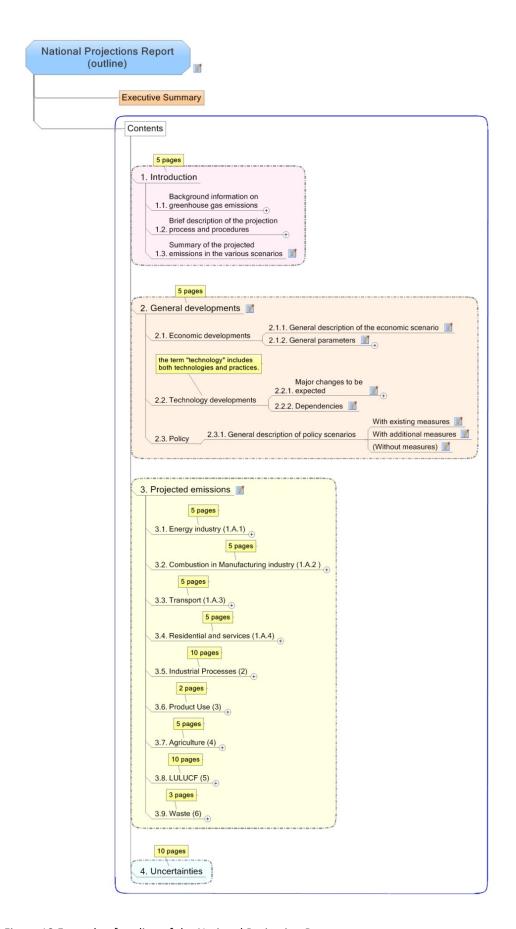


Figure 13 Example of outline of the National Projection Report

# **ANNEXES**

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# Annex A.I List of EU Policies and Measures, relevant for Greenhouse Gas emissions

Policy Area	Legislation Types	Number	Short Title	Date	Title
	Directive	2000/25/EC	Emission by engines to power agricultural or forestry	22/05/2000	DIRECTIVE 2000/25/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2000 on action to be taken against the emission of gaseous and particulate pollutants by engines intended to power agricultural or forestry tractors
		2006/144/EC	Common Agricultural Policy (CAP) Reform	20/02/2006	COUNCIL DECISION of 20 February 2006 on Community strategic guidelines for rural development (programming period 2007 to 2013)
		91/676/EEC	Nitrates Directive	12/12/1991	COUNCIL DIRECTIVE of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)
ture		86/278/EEC	Sewage Sludge Directive	12/06/1986	COUNCIL DIRECTIVE 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
Agriculture	Regulation	1782/2003	Common rules for direct support schemes under CAP	29/09/2003	COUNCIL REGULATION (EC) No 1782/2003 of 29 September 2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers and amending Regulations (EEC) No 2019/93, (EC)
		1783/2003	Support for rural development, amending a number of other Regulations	29/09/2003	COUNCIL REGULATION (EC) No 1783/2003 of 29 September 2003 amending Regulation (EC)  No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF)
		2078/92	Agricultural production methods compatible with environment	30/06/1992	COUNCIL REGULATION (EEC) No 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2080/92	Aid scheme for forestry measures in agriculture	30/06/1992	Council Regulation (EEC) No 2080/92 of 30 June 1992 instituting a Community aid scheme for forestry measures in agriculture
		2603/1999	Transition to rural development support	09/12/1999	COMMISSION REGULATION (EC) No 2603/1999 of 9 December 1999 laying down rules for the transition to the rural development support provided for by Council Regulation (EC) No 1257/1999
		73/2009	CAP "Health Check" 2008 and the "Set aside" regulation	19/01/2009	COUNCIL REGULATION (EC) No 73/2009 of 19 January 2009 establishing common rules for direct support schemes for farmers under the common agricultural policy and establishing certain support schemes for farmers, amending Regulations (EC) No 1290/2005, (
		1268/1999	Pre-accession measures for agriculture and rural development	21/06/1999	COUNCIL REGULATION (EC) No 1268/1999 of 21 June 1999 on Community support for pre- accession measures for agriculture and rural development in the applicant countries of central and eastern Europe in the pre-accession period
		2003/2003	EC Fertiliser	13/10/2003	REGULATION (EC) No 2003/2003 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 October 2003 relating to fertilisers
Climate Action	Decision	406/2009/EC	Effort Sharing Decision	23/04/2009	DECISION No 406/2009/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020
Climate		280/2004/EC	MM Decision	11/02/2004	DECISION No 280/2004/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol
	Directive	2004/101/EC	KP project mechanisms	27/10/2004	DIRECTIVE 2004/101/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2008/101/EC	to include aviation activities in the scheme for greenhouse gas emission allowance	19/11/2008	DIRECTIVE 2008/101/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community
		2009/28/EC	Biofuels directive	23/04/2009	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC
		2009/29/EC	improve and extend the greenhouse gas emission allowance trading scheme of the Community	23/04/2009	DIRECTIVE 2009/29/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community
		2009/31/EC	Geological storage of CO2	23/04/2009	DIRECTIVE 2009/31/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2
		2003/87/EC	Emissions trading scheme	13/10/2003	DIRECTIVE 2003/87/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC
	Other	COM(2005) 35 final	Winning the Battle Against Global Climate Change	09/02/2005	COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Winning the Battle Against Global Climate Change {SEC(2005) 180}

Policy Area	Legislation Types	Number	Short Title	Date	Title
	Regulation	219/2009		11/03/2009	REGULATION (EC) No 219/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 March 2009 adapting a number of instruments subject to the procedure referred to in Article 251 of the Treaty to Council Decision 1999/468/EC with regard to the regulatory
Con	Regulation	842/2006	F-gas regulation	17/05/2006	REGULATION (EC) No 842/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on certain fluorinated greenhouse gases
	Directive	2001/77/EC	Electricity from Renewables	27/09/2001	DIRECTIVE 2001/77/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market
Energy		2002/31/EC	Energy labelling of household appliances (air conditioners)	22/03/2002	COMMISSION DIRECTIVE 2002/31/EC of 22 March 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household air-conditioners
		2002/40/EC	Energy labelling of household appliances (electric ovens)	08/05/2002	COMMISSION DIRECTIVE 2002/40/EC of 8 May 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric ovens
		2003/54/EC	Internal electricity market, incl. third package	26/06/2003	DIRECTIVE 2003/54/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC
		2003/66/EC	Energy labelling of household appliances (fridges and freezers)	03/07/2003	COMMISSION DIRECTIVE 2003/66/EC of 3 July 2003 amending Directive 94/2/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2003/96/EC	Taxation of energy products and electricity	27/10/2003	COUNCIL DIRECTIVE 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity
		2004/8/EC	Promotion of cogeneration	11/02/2004	DIRECTIVE 2004/8/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC
		96/60/EC	Energy labelling of household appliances (washer- driers)	19/09/1996	COMMISSION DIRECTIVE 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers
		96/89/EC	Energy labelling of household appliances (washing machines)	17/12/1996	Commission Directive 96/89/EC of 17 December 1996 amending Directive 95/12/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines
		98/11/EC	Energy labelling of household appliances (lamps)	27/01/1998	COMMISSION DIRECTIVE 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps
		99/9/EC	Energy labelling of household appliances (dish washers)	26/02/1999	COMMISSION DIRECTIVE 1999/9/EC of 26 February 1999 amending Directive 97/17/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers
		2002/91/EC	Energy performance of buildings	06/12/2002	DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16  December 2002 on the energy performance of buildings

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2000/55/EC	energy efficiency requirements for ballasts for fluorescent lighting	18/09/2000	DIRECTIVE 2000/55/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 September 2000 on energy efficiency requirements for ballasts for fluorescent lighting
		2005/32/EC	framework for the setting of ecodesign requirements for energy-using products	06/07/2005	DIRECTIVE 2005/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55
		92/42/EEC	efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels	21/05/1992	COUNCIL DIRECTIVE 92/42/EEC of 21 May 1992 on efficiency requirements for new hotwater boilers fired with liquid or gaseous fuels
		92/75/EC	labelling and standard product information of the consumption of energy and other resources by household appliances	22/09/1992	COUNCIL DIRECTIVE 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances
		98/30/EC	common rules for the internal market in natural gas	22/06/1998	DIRECTIVE 98/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 June 1998 concerning common rules for the internal market in natural gas

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2006/32/EC	End-use efficiency and energy services	05/04/2006	DIRECTIVE 2006/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC
		2008/28/EC	framework for the setting of ecodesign requirements for energy-using products	11/03/2008	DIRECTIVE 2008/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 March 2008 amending Directive 2005/32/EC establishing a framework for the setting of ecodesign requirements for energy-using products, as well as Council Directive 92/42/EEC and
		2010/30/EU	Labelling and standard product information of the consumption of energy and other resources by energy related products (recast)	19/05/2010	DIRECTIVE 2010/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (recast)
	Other	2006/1005/EC	Energy-efficiency labelling programmes for office equipment	18/12/2006	COUNCIL DECISION of 18 December 2006 concerning conclusion of the Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficiency labelling programmes for office equipment (2006/1
	Regulation	2009/663/EC	European Energy programme for Recovery	13/07/2009	REGULATION (EC) No 663/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 establishing a programme to aid economic recovery by granting Community financial assistance to projects in the field of energy

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2422/2001	Community energy efficiency labelling programme for office equipment	06/11/2001	REGULATION (EC) No 2422/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 November 2001 on a Community energy efficiency labelling programme for office equipment
		761/2001	Community eco- management and audit scheme (EMAS)	19/03/2001	REGULATION (EC) No 761/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 March 2001 allowing voluntary participation by organisations in a Community ecomanagement and audit scheme (EMAS)
	Directive	1999/31/EC	Landfill directive	26/04/1999	Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
		2000/60/EC	Water Framework Directive	23/10/2000	DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy
Environment		2001/80/EC	Emissions from large combustion plants	23/10/2001	DIRECTIVE 2001/80/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants
ū		2001/81/EC	NEC Directive	23/10/2001	DIRECTIVE 2001/81/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2001 on national emission ceilings for certain atmospheric pollutants
		2004/12/EC	Packaging and packaging waste	11/02/2004	DIRECTIVE 2004/12/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste
		2005/20/EC	Packaging and packaging waste	09/03/2005	DIRECTIVE 2005/20/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2005 amending Directive 94/62/EC on packaging and packaging waste
		2006/12/EC	Waste Framework Directive	05/04/2006	DIRECTIVE 2006/12/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on waste

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2008/1/EC	IPPC	15/01/2008	DIRECTIVE 2008/1/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 January 2008 concerning integrated pollution prevention and control
		2008/98/EC	Waste Management Framework Directive	19/11/2008	DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19  November 2008 on waste and repealing certain Directives
		94/62/EC	Packaging and packaging waste	(blank)	EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE 94/62/EC of 20 December 1994 on packaging and packaging waste
		96/61/EC	IPPC	24/09/1996	COUNCIL DIRECTIVE 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control
		88/609/EEC	Emissions from large combustion plants	24/11/1988	COUNCIL DIRECTIVE of 24 November 1988 on the limitation of emissions of certain pollutants into the air from large combustion plants
		2010/75/EU	IED Directive	24/11/2010	DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast)
Transpor t	Directive	1999/94/EC	Labelling of new passenger car	13/12/1999	DIRECTIVE 1999/94/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13  December 1999 relating to the availability of consumer information on fuel economy and  CO2 emissions in respect of the marketing of new passenger cars
		2001/12/EC	Shifting the balance between modes of transport, in particular towards rail	26/02/2001	DIRECTIVE 2001/12/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2001 amending Council Directive 91/440/EEC on the development of the Community's railways
		2001/13/EC	Shifting the balance between modes of transport, in particular towards rail	26/02/2001	DIRECTIVE 2001/13/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2001 amending Council Directive 95/18/EC on the licensing of railway undertakings

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2001/14/EC	Shifting the balance between modes of transport, in particular towards rail	26/02/2001	DIRECTIVE 2001/14/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2001 on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification
		2001/50/EC	Shifting the balance between modes of transport, in particular towards rail	29/04/2004	DIRECTIVE 2004/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament
		2001/51/EC	Shifting the balance between modes of transport, in particular towards rail	29/04/2004	DIRECTIVE 2004/51/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 amending Council Directive 91/440/EEC on the development of the Community's railways
		2003/30/EC	Biofuels directive	08/05/2003	DIRECTIVE 2003/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport
		2006/38/EC	Eurovignette	17/05/2006	DIRECTIVE 2006/38/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures
		2006/40/EC	Mobile Air Conditioning Directive	17/05/2006	DIRECTIVE 2006/40/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC
		2009/30/EC	Fuel Quality Directive	23/04/2009	DIRECTIVE 2009/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions

Policy Area	Legislation Types	Number	Short Title	Date	Title
		2009/33/EC	Promotion of clean and energy efficient road transport vehicles	23/04/2009	DIRECTIVE 2009/33/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles
		2004/49/EC	Shifting the balance between modes of transport, in particular towards rail	29/04/2004	DIRECTIVE 2004/49/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 on safety on the Community's railways and amending Council Directive 95/18/EC on the licensing of railway undertakings and Directive 2001/14/EC on the allocation of railway
	Other	Other COM(2002)18 Integrated European 13/01/200 final railway area (2nd + 3rd Railway package)			COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT Towards an integrated European railway area
		Marco Polo Programme	Environmental performace freight transport	(blank)	Marco Polo - New ways to a green horizon
	Regulation	1222/2009	Labelling of tyres	25/11/2009	REGULATION (EC) No 1222/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters
		2007/715/EC	Regulation EURO 5 and 6	20/06/2007	REGULATION (EC) No 715/2007 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 June 2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and
		2009/595/EC	Regulation Euro VI for heavy duty vehicles	18/06/2009	REGULATION (EC) No 595/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance infor

Policy Area	Legislation Types	Number	Short Title	Date	Title
		443/2009	Strategy for cars CO2	23/04/2009	REGULATION (EC) No 443/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles
		881/2004	Shifting the balance between modes of transport, in particular towards rail	29/04/2004	REGULATION (EC) No 881/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 establishing a European railway agency
	Voluntary agreement	ACEA, KAMA, JAMA	Voluntary agreement to reduce specific CO2 emissions from cars	(blank)	

# Annex A.II Check list for documenting the grade 3 model based projection

Example of check list for documenting the Grade 3 Model-Based Projections developed adopted from the Guidance for inventories from the 2006 IPCC Guidelines<sup>56</sup>

#### Model Selection and Development

- ✓ Selection and applicability of model and adaptation to the situation in which the model is used for GHG projection purposes.
- ✓ Document choice of model based on published studies using the model for the conditions in your country and/or how the model has been adapted to represent the conditions in your country.
  - Supplemental documentation may be needed to describe the adaptation of the model to the conditions in a country if publications are not available with this information.
- ✓ Basis and type of model (statistical, deterministic, process-based, empirical, top-down, bottom-up etc.)

Document the conceptual approach (e.g. model represents statistical relationships or processes), and the mathematical formulation in general terms, such as the model is process-based with a bottom-up approach to estimate emissions.

#### Identify main processes and equations

- ✓ Document the main processes and describe the driving variables for those processes.
- ✓ List the main equations if feasible (may not be feasible with highly complex models or not necessary with simple book-keeping models).
- ✓ Also cite publications that describe the model in detail if they exist. It may be necessary to develop supplemental information documents if the model description has not been published or to provide regional parameter values that are too detailed to be publishable in a scientific journal.

#### Key assumptions in model

✓ Document key assumptions to the extent possible (it may not be possible to list all assumptions for highly complex models) e.g., first order approximation was assumed to represent soil organic matter decomposition for three kinetically-defined pools with a short, medium and long turnover time.

Copied from: <a href="http://www.ipcc-nggip.iges.or.jp/meeting/pdfiles/1008">http://www.ipcc-nggip.iges.or.jp/meeting/pdfiles/1008</a> Model and Facility Level Data Report.pdf

#### Domain of application

✓ Provide information about the extent of the model application to systems in the country, e.g., all agricultural lands with arable crops grown on upland soils.

#### Document the model evaluation

- ✓ May also compare performance to other models if other models were evaluated.
- ✓ Include references to published articles with more detail on the calibration and/or evaluation if available. Supplemental documentation may be needed if this information is not published.

#### **Identify Model Inputs**

- ✓ Describe key inputs to the model.
- ✓ Include references to publications of the input data or online publication of the data.
- ✓ List any key assumptions that were necessary to use these data, such as representativeness of management data.
- ✓ Are there special considerations with regards to the domain of the projection application using the model given input data.
   e.g., were different input data sets used in different parts of the domain,
- ✓ Or was the application of the model limited to specific parts of the country due to the domain of the input data.

#### Assess Uncertainties

- ✓ Provide a description of any sensitivity analysis conducted and a summary of findings in terms of key parameters influencing the model results.
- ✓ Describe the derivation of uncertainties in the model inputs and model structure, as well as any other key uncertainties.
- ✓ Provide references to articles that provide additional detail on sensitivity or uncertainty analysis from your application. Supplemental documentation may be needed if this information is not published.

#### Implement Model

✓ Briefly describe computing framework including the hardware, databases and programs that were used to execute the projection.

- ✓ Description of key outputs variables from the model and any conversions or modifications made to derive the final emissions and removal estimates.
  - Summary of QA/QC procedures adopted to ensure the modelling systems
    performed appropriately, such as conservation of land area through the analysis,
    unit conversions are correct, and input from experts not involved with the
    inventory, but reviewed the procedures, inputs and/or outputs. List any critical
    errors, their magnitude and implications, and corrective actions.
  - Optionally provide examples of simple model calculations, such as emissions and removals by forest stands or landscapes in response to different forest management, natural disturbance, or mitigation scenarios. Examples of model performance may be easier to understand than lengthy and complex descriptions of intended model behaviour.

#### Evaluation of projection results

- ✓ Evaluating projection results which are determined by both the model and the input data.
- ✓ Estimating implied emissions factors and comparing to lower grade emission factors and/or expected ranges. Out of range values may require further explanation.
- ✓ Compare to lower grade methods if projection also estimated with lower tiers.

# Annex A.III TCCCA Principles

#### A.III.1 TCCCA Quality criteria

One of the central concepts in QA/QC is *quality*. The concept of quality can be seen from different pespectives:

- Scientific perspective: from the scientific perspective the quality of data is high when the data is true. In fact, following common scientific practice, data are true as long as they are not falsified (proven to be wrong)
  - In the case of a projection this *truth* does not refer to whether or not the projected future will come true, but whether or not a set of assumptions on the economy, the policy and the technology would indeed lead to the projected emissions
- Policy perspective: from the policy perspective, the quality of data is high when all actors
  involved agree that these are the data that are needed: they are compiled and reported in
  compliance with the procedures as agreed and hence they are fit for use in the policy processes
  under the relevant political decisions
- Legal perspective: from the legal perspective the quality of data is high when they provide proof for a judge, jury (including compliance committees and similar) that the Party reporting did (or did not, depending on the position in the legal procedure) comply with its policy targets. [As for the reporting of annual emission inventories under the EUMM and under UNFCCC the second perspective is the most important one: the projections submitted by the Member States must comply with the provisions of the relevant EU legislation. These Guidelines translate these into practical guidance for Member States to prepare their projections.

This annex discusses the five quality criteria or dimensions of a GHG estimates as defined by the principles listed in section B 4 of the UNFCCC reporting guidelines on annual inventories<sup>57</sup>. They are equally applicable in GHG projection submissions<sup>58</sup>. Any GHG estimate, including *projected GHG emission estimates* must be *Transparent*, *Consistent*, *Comparable*, *Complete* and *Accurate* (TCCCA).

For each of these five quality criteria we provide:

 the definition as provided in the Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11.; [some thoughts on the interpretation and the implementation of it in the context of reviewing higher grade methods and complex models estimates, with additional explanations on some of the concepts used within these definitions

Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11, FCCC/SBSTA/2006/9, 18 August 2006 footnote text

A "emission Projection" is an inventory for a future year, assuming some well defined changes in economic activity, technological developments and policies and measures. Because of that, the methods are very similar to those for emission inventories.

the key handles that will make the difference between compliance and non-compliance with each of the quality criteria.

More details for each of the TCCCA criteria can be found below:

#### A.III.2 Transparency

*Transparency* is of the highest importance for any GHG projection submission. Without transparency, none of the other quality criteria (i.e. CCCA) can be assessed and the quality of the estimates cannot be assured[.Transparency is more difficult to achieve (and assess) for more complex higher tier methods and models.

#### Definition

Transparency is defined in the UNFCCC reporting guidelines<sup>59</sup> on annual inventories<sup>58</sup> as follows: Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information

#### Objective and Interpretation

Given the inherent complexity of higher grade method and complex models, transparency is of outmost importance to allow reviewing higher grade estimates.

From the definition above it emerges that the final objective of the transparency is to facilitate the assessment and the replication of the GHG projections.

With regard to Replication, for grade 1 and grade 2 approaches replication of the inventory of GHG projections would be possible if both the activity data and the emission factors or parameters are provided in the National Projection Report (NPR) or any of the underlying reports. In the latter case, such reports should be easily available, either via the open scientific literature or via a stable internet link.

In the case of higher grade estimates full replication might be more difficult, if possible at all. When models are used, these will in many cases look like "black boxes" to the users. Some inventory teams simply use models that are provided by external suppliers and some might agree to use the results of models run by other institutes in the country or even abroad. The replication of the estimate in such cases should be interpreted as follows:

It should be possible to understand the model structure/functioning: the description/documentation of the model should be such that it, in principle, can be reconstructed from scratch. Although in most cases it is highly unlikely that a review team will be able to reconstruct the whole model during the review (due to time/resource constraints), it is important that the ERT has enough confidence that any expert not involved in the model development would be indeed able to rebuild the model from scratch. This information is not necessarily needed within the NPR, but the NPR should provide sufficient information for the ERT to find and have access to the documents and publications that provide such information

It should be possible to understand the model inputs: the information on the input data should be such that, starting from the available data and existing model, the same outputs may be generated; in some case, this independent replication of the model runs could be seen as a concrete possibility

<sup>59</sup> 

during the review (at least for some model's outputs), and in this case the model itself and the input data should be made available to the review team upon request.

It should be possible to compare the model results (outputs) with other estimation methods, especially lower grade methods and/or an independent set of data.

#### Assessing Transparency

In line with the above, assessing transparency of a higher grade estimation method/model essentially means: checking if the Party has provided adequate information and documentation to understand the method and check the accuracy of its outputs. The questions to be addressed by the reviewer are:

Is it sufficiently clear what the method/model does? (i.e. can the method/model and its results be replicated, at least in principle?)

Is it sufficiently clear what input data have been used and why?

Is it possible to assess the outputs against independent estimates (e.g. lower grade approach)? These questions should be seen as independent from the appraisal of the suitability of the method/model for the purpose of compilation of a GHG projection and from the appraisal of the numerical results. These appraisals will be addressed under accuracy.

Note that, as a general rule, there are no national circumstances (i.e. a lack of resources or technical capacity), which may impede a Party to provide a fully transparent estimate.

#### A.III.3 Consistency

## Definition

The UNFCCC reporting guidelines<sup>59</sup> on annual inventories define consistency as follows: *Consistency* means that an inventory<sup>58</sup> should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Under certain circumstances an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner, in accordance with the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories<sup>60</sup> and the Good Practice Guidance for Land Use, Land-Use Change and Forestry<sup>61</sup>.

#### Objective and Interpretation

Consistency in this definition is strongly linked to time series consistency. This should be understood in relation to the final application of the GHG projections: the assessment on whether or not the targets, set under the UNFCCC and its protocols, are met. These targets are set in relative terms (trend), rather than absolute terms. This is related to the understanding that the trend will be less sensitive to possibly imperfect estimation methods than the absolute level of emissions/removals, provided that the methods do not change over the time series, or are consistent to each other. Using different methods and data in a time series could introduce bias because the estimated GHG trend could reflect not only actual changes in emissions or removals but also the pattern of methodological refinements.

Models may improve time series consistency of GHG emission projections, for example, by providing

http://www.ipcc-nggip.iges.or.jp/public/gp/english/

http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

annual estimates even where only occasional measurements exist. On the other hand, the development of complex methods/models is a process subject to frequent improvements, which may lead to recalculations in subsequent submissions of the estimates submitted earlier. In this case, the revised method/model should in principle be applied to all years in the time series. In circumstances where this is not feasible due to availability of data, the UNFCCC definition requires the Party to apply the methods provided by the IPCC Good Practice Guidance (section 7.3.2.2) and IPCC Good Practice Guidance for LULUCF (section 5.6.2) to ensure time series consistency.

#### Establishing Consistency

The first step when checking the time series consistency is analysing the quantitative assessment of the time series for the category in question available in the Synthesis and Assessment report part II for the Party, along with the answers provided by the Party concerned on the identified issues ("review transcript").

However, the analysis of time series consistency should go beyond the findings of the Synthesis and Assessment report part II, and should at least address the following questions:

Has the time series been recalculated in the last GHG projection inventory? Are the reasons for recalculations clearly explained? It is especially important to check for time series consistency when emissions/removals are recalculated, e.g. if changes occurred to the data inputs or mathematical relationships in a model. If the recalculated estimates show a different trend as compared to previous one, reasons for these changes should be carefully reported by the Party. The reviewer should assess the reasoning and request further information whenever needed.

Has the same method/model been applied to all years in the time-series? In cases where it was not feasible (e.g. due to lack of available data), the ERT should carefully check if the techniques to ensure time series consistency suggested by the IPCC have been applied in a correct way.

More detailed consistency checks are described in the sector-specific sections (e.g. mass conservation and land conservation checks in the LULUCF sector).

#### A.III.4 Comparability

#### Definition

The UNFCCC reporting guidelines<sup>59</sup> on annual inventories<sup>58</sup> define comparability as follows: *Comparability* means that estimates of emissions and removals reported by Annex I Parties in inventories should be comparable among Annex I Parties. For this purpose, Annex I Parties should use the methodologies and formats agreed by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance for LULUCF, at the level of its summary and sectoral tables.

#### Objective and Interpretation

Comparability is strongly linked to the common reporting format (CRF) and the allocation to different categories within the UNFCCC reporting. Using the same reporting format and the same allocation is a necessary condition for comparability. It allows comparison of the absolute level/trend of emissions/removals among Parties, and using the implied emission factors (IEFs) or implied carbon-stock-change factors in comparing the submissions between Parties and between successive submissions.

The UNFCCC reporting guidelines allow Parties, when is not possible otherwise, to deviate from the required allocation in special cases and to use the notation key "IE" (included elsewhere). When a Party uses this approach, obviously comparability will decrease since for a category estimates are not provided (it is indeed IE) while another category includes emissions/removals coming from other

category/ies (and those emissions/removals cannot be disaggregated). In most cases, however, we would expect higher grade methods to be more detailed than lower grade methods, so generally the higher grade methods should be able to provide GHG estimates at the most detailed level of reporting in the CRF and there will be no need to report "IE" for any of the categories that are estimated using a higher grade method or specific model.

#### **Establishing Comparability**

In line with the above, establishing the comparability of the estimate includes two steps: Assess whether the reporting indeed is at the most disaggregated level as required by the CRF tables and identify any included elsewhere (IE) that could hamper comparison with other reporting Parties. Look at the Implied Emission Factors (IEFs) and implied carbon-stock-change factors (ICSFs) for the Party under review and compare these with those of other Parties. The results of the Synthesis and Assessment (part II) should in principle be sufficient for this. If the Party's IEFs or ICSFs are within the range of those of other Parties with similar condition, you as a reviewer can conclude that comparability generally is OK. If this is not the case the reviewer should identify whether the Party can explain the deviating IEF or ICSFs in their estimates.

The comparison of ICSFs in LULUCF may be problematic (under either UNFCCC or KP reporting) for a number of reasons, e.g.:

comparison of ICSFs for land use changes is often meaningless due to the fact that most Parties report aggregated areas that have been converted during a potentially different time-period; several models built for estimating carbon stock changes from soils do not usually follow the aggregation in pools provided by the IPCC for dead organic matter and soil organic matter; most models usually do not estimate changes in carbon stocks in soils on the basis of a constant volume of soils as IPCC default method does.

In cases where comparability is difficult to assess, due to either the use of "IE" notation keys in significant categories or the problems indicated above for LULUCF, the ERT should discuss with the Party's experts how to solve this issue and request further information that will allow you as a reviewer to ensure that identified comparability issues are not affecting the quality of the estimates, in particular their accuracy.

## A.III.5 Completeness

#### Definition

Completeness is defined in the UNFCCC reporting guidelines<sup>59</sup> on annual inventories<sup>58</sup> as follows: *Completeness* means that an inventory covers all sources and sinks, as well as all gases, included in the IPCC Guidelines as well as other existing relevant source/sink categories which are specific to individual Annex I Parties and, therefore, may not be included in the IPCC Guidelines. Completeness also means full geographic coverage of sources and sinks of an Annex I Party.

#### Objective and Interpretation

Note that completeness is, in addition to geographical coverage, linked to the categories/gases as defined in the IPCC Guidelines and reflected in the categories used in the CRF tables. If information is provided for each category for which IPCC provides an estimation method, then the inventory is complete. Note that Completeness does not necessarily mean that a quantitative estimate is provided for all relevant gases for all categories. Since the UNFCCC Guidelines define the use of notation keys for particular cases (see paragraph 29 of UNFCCC reporting guidelines on annual inventories), this information could also be non-numerical.

#### **Establishing Completeness**

Establishing completeness is in first instance relatively straight forward. The initial check (status report prepared by the Secretariat) provides a list of any category and gas combination where neither a numerical value nor a notation key is provided.

In addition, the ERT should pay particular attention to the correct implementation by the Party of any notation key used and to the geographical coverage of the estimate i.e. whether all sources/sinks present within the national boundaries and pertaining to the category have been included in the estimate.

## A.III.6 Accuracy

#### Definition

Accuracy is defined in the UNFCCC reporting guidelines<sup>59</sup> on annual inventories<sup>58</sup> as follows:

Accuracy, is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable.

Appropriate methodologies should be used, in accordance with the IPCC good practice guidance, to promote accuracy in inventories.

#### Objective and interpretation

Accuracy is the most tricky criterion among IPCC and UNFCCC reporting principles, because of the words "as far as can be judged" in its definition. This addition reflects the scientific understanding that a proof that a GHG estimate perfectly matches the true value can never be given. Its aim is to ensure that, as far as can be judged, the Party does not over- or underestimate the emissions/removals as reported and hence that the values are "good enough" to represent the GHG national totals for the purposes of meeting their commitments under the Convention and the Kyoto Protocol. In practice, Accuracy is a measure of the confidence may be assigned by any user of the data in data that they are fit for use in GHG inventories.

#### Establishing Accuracy

Although a detailed understanding of the higher grade methods and complex models used (e.g. model's structure and functioning) may be very useful in increasing reviewer's confidence on the credibility of the method's results, at the end the proof of the pudding is in the eating, i.e. in the evaluation of GHG projection results. This evaluation is possible using results of the verification activities (as defined by the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories -annex 2- and the IPCC Good Practice Guidance for LULUCF -section 5.7-). Verification activities provide information for Parties to improve their inventories and are part of the overall QA/QC and verification system. At the same time, verification activities provide essential information allowing the ERTs to assess the accuracy of the inventory estimates. The ERT shall consider that:

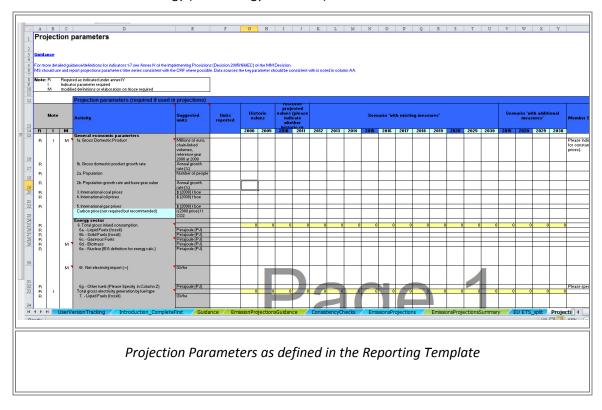
As illustrated by the IPCC Guidelines, there are a number of practical verification techniques that do not require specialised modelling expertise or extended analyses. Essentially, all verification activities involve the comparison of the Party's estimates with independent estimates, either lower grade estimates and/or with measurements or estimates from other sources of information. This comparison may occur at different levels, e.g. for total GHG fluxes of specific gases, at national or regional level, for entire sectors or categories or for any subset of these. In some cases also single parameters used in the estimation method, or intermediate models' outputs, can be assessed and compared with what is known from literature, from independent measurements and/or from other Parties' GHG projection inventories.

Where discrepancies between GHG projections estimates and data compiled using alternative methods are found, these do not necessarily imply that the GHG projection estimates are not correct. When analysing discrepancies, it is important to consider that there may be large uncertainties associated with the alternative calculations themselves. In cases where there is a problem in this comparison (i.e. significant and unexplained discrepancies), the ERT with the support of the Party could dive into the details of the method/model and assess the quality and values of important parameters in the method/model.

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# Annex A.IV MM Article 3(2) Reporting Template v6.2 62

The MM Article 3(2) Reporting Template v6.2 provides a list of parameters in worksheet "Projection Parameters". Please also take into account the links between these parameters and the IPCC codes and fuel definitions as provided in the model parameters (see section 3.2.2 and especially the spread sheet with the links for energy (Excel Energy Indicators)



Here we will place our proposed Reporting template based on the v6.2

# Annex A.V Checklist: QA/QC Quality Objectives and QA/QC activities for MS and Commission Projections.

Key for checklist below: [x] denotes a QA/QC activity is required and [d] denotes a requirement for documentation of QA/QC activities.

TCCCA	Key for checklist below: [x] denotes a QA/QC activity is re [d] denotes a requirement for documentation of QA/QC E] Requires an Expert checking by the Commission/EEA							
#. Quality Objective		MS Ensui	Commission Ensuring quality of EU wide projections					
Guidance on specific QA/QC Activities	QA/QC Activity	Data	Data	Estimation	Pre	Ad-hoc	Commission	
		selection	collection		Submission	Peer	Checks	
					Checks	review		
		[2]	[3]	[4]	[5]	[6]	[7]	
1. Transparency:								
1.1. There is transparency in the national projection syste	ms.							
Confirm transparency in descriptions of methods, data sources and assumptions in estimates and underlying models, documentation of QA/QC plans and activities, sensitivities etc. Check that all data are referenced, calculations clearly presented and assumptions documented. On projections parameters: is there transparency in units (e.g. the types of electricity, fuels, waste treatment) that a parameter comprises (if different from the requirements).	Peer/Expert analysis of methods, assumptions and data sources	d	d	xd	xd	xd	x-E	

#. Quality Objective		MS Ensui [1]	ring Count	tions	Commission Ensuring quality of EU wide projections		
Guidance on specific QA/QC Activities	QA/QC Activity	Data selection	Data collection	Estimation [4]	Pre Submission Checks [5]	Ad-hoc Peer review [6]	Commission Checks [7]
The projections systems (includingresponsible institutions are responsive to questions about the methods, data sources and assumptions underpinning the estimates	Peer/Expert analysis of methods, assumptions and data sources					xd	x-E
1.2. There is transparency in reported data.		l					
Make sure use of all notation keys (especially IE, NE and NO) are explained explained and justified in accompanying datasets and reports. (See also Comparability Tests)	Peer/Expert analysis of methods, assumptions and data sources			d	xd		х
Make sure scenarios are appropriately labeled and defined and explained.	Peer/Expert analysis of methods, assumptions and data sources			d	xd		x-E
Make sure that important Categories especially Key Categories (e.g. EUETS and non-EUETS, important transport modes) are reported separately at IPCC category or subcategory level and it is clear which emissions (e.g. international and/or domestic transport) are included in national total projections to support transparent presentation of data and methods.	Analysis of Categories, subcategories and use of notation keys	х	х	xd	xd		×

#. Quality Objective		MS Ensur [1]	tions	Commission Ensuring quality of EU wide projections			
Guidance on specific QA/QC Activities	QA/QC Activity	Data	Data	Estimation	Pre	Ad-hoc	Commission
		selection	collection		Submission	Peer	Checks
		[2]	[2]	[4]	Checks	review	[7]
1.3. It is clear which Policies add Measures (PAMs) are inc	luded and which	[2]	[3] are being i	[4]	[5]	[6]	[7]
Check all CCPMs are included and that their inclusion is transparent.	CCPM analysis		 	xd	X		x
2. Completeness:	CCPIVI analysis			xu	X		Х
2.1. All required Data, report and additional material are	provided.						
Check that all required Mandatory and recommended material is	Submission check						
available. Ensure all documents (reports) data files, annexes, analysis	Submission check						
(e.g. sensitivity analysis) etc.are provided and templates are					xd		x
completed.							
Check all material for all MS are together to support the MS	Submission check						
projections.							X
2.2. Projected emissions are provided for all required comcomponents to consider)	binations of year	, category	, gas and s	cenarios (N	landatory an	id non-M	andatory
Check that all relevant IPCC categories, especially categories for which	Peer/Expert						
there are historical activities, are included for all years, gases and	analysis of						
scenarios (e.g. MOM, WM and WAM).	methods,			xd	xd		x-E
	assumptions and						
	data sources						
Check that all identified policies and measures are included in	Peer/Expert						
projected estimates.	analysis of						
	methods,			xd	xd		X
	assumptions and						
	data sources						

#. Quality Objective		MS Ensur [1]	ring Count	ctions	Commission Ensuring quality of EU wide projections		
Guidance on specific QA/QC Activities	QA/QC Activity	Data selection	Data collection	Estimation	Pre Submission Checks	Ad-hoc Peer review	Commission Checks
		[2]	[3]	[4]	[5]	[6]	[7]
Check that blank cells or "0" are not used and that and use of NA and	Analysis of						
NE s are fully justified.	Categories,						
	subcategories and use of notation				х	х	x-E
	keys						
Check that low IEFs are not indicative of missing estimates for subcategories.	Analysis of Implied EFs			xd	х	х	x-E
Check that time series inconsistencies (dips/jumps) are not indicative	Analysis of dips and						
of missing estimates.	Jumps			xd	x	х	x-E
2.3. Projection Parameters are provided for all years, cate	<u> </u>	ios (Mand	latory and	non Manda	atory compo	nents to	consider)
Check that all required parameters are reported and exclusions are	Analysis of				,		
fully justified and documented. [8]	Parameters				xd		x
3. Consistency:							
3.1. The full time series is consistent for years, pollutants,	scenarios emissio	ns and pa	rameters.				
Check that dips and jumps in the timeseries are not due to changes in	Analysis of dips and						
methodology. Any specific dips and jumps between the latest historic	Jumps			d	xd	х	x
inventory and the projection years should be clearly justified.			'				
3.2. The projected trends (for both emissions and parame	ters) are realistic	(annual ch	nanges not	too big or	small) and ju	ıstified.	•
Check that the average annual change for the projections are	Analysis of trends						
comparable to the average annual % change for the last 5 years of the				] .			fo1
historic inventory for 2010, 2015 and 2020. Provide justification				d	xd	Х	x [9]
where there are particularly high or low reductions. Also, ensure that							

#. Quality Objective		MS Ensuring Country level quality of projections [1]					Commission Ensuring quality of EU wide projections
Guidance on specific QA/QC Activities	QA/QC Activity	Data selection	Data collection	Estimation	Pre Submission Checks	Ad-hoc Peer review	Commission Checks
		[2]	[3]	[4]	[5]	[6]	[7]
justifications are given for projections that are constant.							
Check that historic "Reference Year" data for parameters and	Analysis of trends						
projections are consistent with national statistics and historic							
emission estimates. > 3% difference in projection starting year and		X	xd	xd	xd		X
historical data requires an explanation and investigation.							
3.3. Emissions are internally consistent and the sum of car	tegories add to er	mission to	als.				
Do all sectors/categories/sub-categories and pollutants sum up to the	Internal sums						
reported/headline total. Do all scenarios start from the same historic				xd	xd		x
basis?							
3.4. Recalculations have been undertaken which are trans	parent and impro	ve the est	imates.				
Compare emissions by category and subcategory with previously estimated projections and make sure differences are a result of transparent improvements to methodology or updated activity data assumptions or sources. Where differences are greater than 10% significant QA/QC and peer review should be undertaken.	Recalculations			xd	xd	xd [10]	x
3.5. Consistency between MS projections							
consistent use of IPCC categories and sub categories, notation keys	Analysis of						
and assumptions on PAMs and scenarios.	Categories,						
	subcategories and						x-E
	use of notation						
	keys						
4. Comparability:							

#. Quality Objective		MS Ensur [1]	ring Counti	tions	Commission Ensuring quality of EU wide projections				
Guidance on specific QA/QC Activities	QA/QC Activity	Data	Data	Estimation	Pre	Ad-hoc	Commission		
		selection	collection		Submission	Peer	Checks		
					Checks	review			
		[2]	[3]	[4]	[5]	[6]	[7]		
4.1. The correct reporting template and level of categorisation (Nomenclature) are used.									
Check that the most up-to-date reporting templates and categories	Analysis of								
are used.	Categories,								
	subcategories and				×		x		
	use of notation								
	keys								
4.2. There is a suitable category detail level (e.g. IPCC leve	l 3/4) used for rep	porting.							
Check (e.g. IPCC 3 or 4) category and subcategory detail cells with	Analysis of								
values in compared to higher levels provided. Is justification provided	Categories,								
where aggregated data are provided only?	subcategories and			xd	Х		x		
	use of notation								
	keys								
4.3. Appropriate notation keys are used instead of 0 and b	olanks.								
Check for blank cells "0", and use of IE, NO, NA or NE in reporting	Analysis of								
template.	Categories,								
	subcategories and				xd		x		
	use of notation								
	keys								
4.4. The use of IE minimised									
Test the number of IEs used in reporting if significant e.g. < 5% of the	Minimisation of IEs								
total data entries could indicate a problem of transparency and				d	xd		x		
comparability.									

#. Quality Objective		MS Ensui	tions	Commission Ensuring quality of EU wide projections			
Guidance on specific QA/QC Activities	QA/QC Activity		Data collection	Estimation	Pre Submission Checks	Ad-hoc Peer review	Commission Checks
A.E. Appropriate use of units		[2]	[3]	[4]	[5]	[6]	[7]
4.5.Appropriate use of units  Check that the correct units and types of e.g. electricity, fuels etc. are used for parameters	Submission check				xd		х
4.6 Common use of assumptions for scenarios and inclusion	on of PAMs						
Assess PAMs included and excluded.	Expert analysis of methods, assumptions and data sources						x-E
5. Accuracy:	,		•				
5.1. Suitable quantitative Sensitivity/Uncertainty analysis	is undertaken an	d Sensitivit	ty/Uncerta	inty is unde	erstood and	drives im	provements.
Check there is evidence of an understanding of the sensitivities and uncertainties.	Peer/Expert analysis of methods, assumptions and data sources	x	xd	xd	x		x-E
5.2. Levels of Sensitivity/uncertainty are acceptable.							
Check that sensitivities and uncertainties are reasonable compared with other MS and historic emissions inventories.	Peer/Expert analysis of methods, assumptions and data sources		d	xd	x	x	x-E
5.3. All methods are consistent with good practice in estin	nating emissions	and emiss	ion project	ions guidar	nce. [11]		

#. Quality Objective		MS Ensur [1]	ing Counti	tions	Commission Ensuring quality of EU wide projections		
Guidance on specific QA/QC Activities	QA/QC Activity	Data	Data	Estimation	Pre	Ad-hoc	Commission
		selection	collection		Submission	Peer	Checks
		[2]	[3]	[4]	Checks [5]	review [6]	[7]
Check methodology descriptions and models used. Countries could	Peer/Expert						
set-up peer review groups to do this as bilaterals or group review	analysis of						
activities. Remember to document the QA/QC activity, plans and any	methods,	x	d	xd	d	х	
findings and recommendations coming out of the activity.	assumptions and						
	data sources						
Check all MS methods are consistent with projections guidance							x-E
5.4. No estimates are underestimated or overestimated. [	12]						
Get data suppliers to check projected estimates and use of input	Peer/Expert						
datasets are appropriate. (Record checking activity). This could be	analysis of						
part of Country Peer review groups see above.	methods,		xd	xd			
	assumptions and						
	data sources						
Check future energy balances: Assessing the shares of different fuels	Energy Balance						
compare with reference approach, EU models and with different				d	xd	х	x
Member States look for big changes.							
Comparison of emissions and parameters with historic trends from	Independant data						
Eurostat and EU Energy, Agriculture, Transport and Economic models	comparison						
(e.g. PRIMES for carbon/energy prices and energy demand and							
transport projection, DG Economic and Financial Affairs for GDP,				xd	xd	×	x
population, ECB for GVA, GAINS for agricultural and waste statistics).							
Look for noticeable step changes between historic statistics and							
projected parameters.). Can differences be explained by changes in							

#. Quality Objective		MS Ensur [1]	ring Count	ry level qua	lity of projec	tions	Commission Ensuring quality of EU wide projections
Guidance on specific QA/QC Activities	QA/QC Activity	Data	Data collection	Estimation	Pre Submission	Ad-hoc Peer	Commission Checks
		Selection	Collection		Checks	review	CHECKS
		[2]	[3]	[4]	[5]	[6]	[7]
emission factors or different activity data assumptions justified? [13]							
Assessment of implied emission factors (e.g. using indicators such as	Analysis of Implied						
emissions per GDP, capita, GVA, pvkm, tvkm, livestock, fertilizer use	EFs						
final energy demand etc). Compare with historic indicators and for							
projections compared to a group of similar MS or across all MS.					xd	х	х
Assessments should be done at a suitable category or subcategory							
level of detail or aligned with reported parameters and indicators							
(e.g. EUMM). [14]							
Check that models used for complex calculations are using relevant	Peer/Expert						
input parameters and methods and assumptions are consistent with	analysis of						
guidelines.	methods,	х	xd	xd	Х		x-E
	assumptions and						
	data sources						
Are EUETS and non EUETS emissions estimated separately using	Analysis of						
appropriate methods and activity data reconciled with national	Categories,						
projections.	subcategories and	x	xd	xd	X		x
	use of notation						
	keys						
5.5. There is independent validation of projections and parameters.							
Set-up QA process and plan for regular independent review.	Peer/Expert						
	analysis of			d		х	
	methods,						

#. Quality Objective		MS Ensur [1]	ring Count	ry level qua	lity of projec	ctions	Commission Ensuring quality of EU wide projections
Guidance on specific QA/QC Activities	QA/QC Activity	Data selection	Data collection	Estimation [4]	Pre Submission Checks [5]	Ad-hoc Peer review [6]	Commission Checks [7]
	assumptions and data sources	[-]	[5]	[-]	[0]	[0]	1,1
Check for independent review (peer review) involving stakeholders for the major sectors and categories (e.g. energy projections) and check the implementation of recommendations and conclusions of reviews	Peer/Expert analysis of methods, assumptions and data sources					х	x-E

## Notes:

[1]	Activities being undertaken by MS/Countries at a national level
[2]	Early phase of looking for data for the estimates.
[3]	Formally arranging data flows and collecting data for use in estimates.
[4]	Developing estimates using collected data and agreed methods and assumptions.
[5]	To be performed by the MS following good practice.
[6]	Ad-Hoc Peer review can be performed at any time by the MS but should generally follow a major revision.
[7]	This QA/QC builds on the elaborated automated tests done by the EEA in checking MS EUMM submissions.
	See Quality assurance / quality control procedure for the reporting of projections under Decision 280/2004/EC
[8]	Possible reference to annex listing required parameters under EUMM (but need to keep this generic and flexible)
[9]	See EUMM tests for projections.
[10]	Where differences between latest and previous estimates are > 10% for a category.
[11]	See individual sector chapters for specific guidance on minimum requirements on methods.
[12]	See individual sector chapters for sector and category specific guidance on avoiding over and underestimation.
[13]	Could refer to EEA QA/QC table 5-4 of Quality assurance / quality control procedure for the reporting of projections

under Decision 280/2004/EC (the EU Monitoring Mechanism Decision)

[14] Could refer to EEA QA/QC table 6-1 of Quality assurance / quality control procedure for the reporting of projections under Decision 280/2004/EC (the EU Monitoring Mechanism Decision)

# Annex A.VI Terminology

## A.VI.1 General concepts

0	Projection	0	The UNFCCC Guidelines <sup>63</sup> (paragraph 27) state: The primary objective of the projections section of the national communication is to give an indication of future trends in GHG
			emissions and removals, given current national circumstances and implemented and adopted policies and measures, and to give an indication of the path of emissions and removals without such policies and measures.
0	With Measures projection	0	A 'with measures' projection shall encompass currently implemented and adopted policies and measures (UNFCCC Guidelines, paragraph 29)
0	With Additional Measures projection	0	a 'with additional measures' projection also encompasses planned policies and measures (UNFCCC Guidelines, paragraph 29).
0	Without Measures projection	0	a 'without measures' projection (WOM) excludes all policies and measures implemented, adopted or planned after the year chosen as the starting point for this projection. In reporting, Parties may entitle their 'without measures' projection as a 'baseline' or 'reference' projection, for example, if preferred, but should explain the nature of this projection (UNFCCC Guidelines, paragraph 29)
0	Parameter	0	a constant or variable term in a function that determines the specific form of the function but not its general nature, as $a  ext{ in } f(x) = ax$ , where $a  ext{ determines only the slope of the line described by } f(x)$ .
0	Variable	0	Is a value that may change within the scope of a given problem or set of operations.
0	Indicator	0	An indicator is a measure, generally quantitative, that can be used to illustrate and communicate complex phenomena simply, including trends and progress over time.
0	TCCCA	0	The five quality criteria for a submission to UNFCCC, as defined in the <i>UNFCCC Guidelines</i> , paragraph 4: Transparency, Consistency, Comparability, Completeness and Accuracy

ii. guidelines for the preparation of national communications by parties included in annex I to the convention part ii: unfccc reporting guidelines on national communications

o Transparency	<ul> <li>means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information</li> </ul>
<ul> <li>Consistency</li> </ul>	o means that an inventory should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Under certain circumstances referred to in paragraphs 15 and 16, an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner, in accordance with the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Good Practice Guidance for Land Use, Land-Use Change and Forestry.
o Comparability	o means that estimates of emissions and removals reported by Annex I Parties in inventories should be comparable among Annex I Parties. For this purpose, Annex I Parties should use the methodologies and formats agreed by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories,2 and the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, at the level of its summary and sectoral tables
o Completeness	o means that an inventory covers all sources and sinks, as well as all gases, included in the IPCC Guidelines as well as other existing relevant source/sink categories which are specific to individual Annex I Parties and, therefore, may not be included in the IPCC Guidelines. Completeness also means full geographic coverage of sources and sinks of an Annex I Party
o Accuracy	<ul> <li>is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable. Appropriate methodologies should be used, in accordance with the IPCC good practice guidance, to promote accuracy in inventories.</li> </ul>
Notation Key	<ul> <li>The UNFCCC Guidelines allow Parties to use the so-called Notation Keys NO, NE, NA, IE and C in specific cases instead of a</li> </ul>

			numerical value.
0	NO (not occurring)	0	notation key used for activities or processes in a particular source or sink category that do not occur within a country;
0	NE (not estimated)	0	notation key used for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where "NE" is used in an inventory for emissions or removals of $CO_2$ , $N_2O$ , CH4, HFCs, PFCs or SF6, the Annex I Party should indicate in both the NIR and the CRF completeness table why emissions or removals have not been estimated;. Even if emissions are considered to negligible, Parties should either report the emission estimate if calculated or use the notation key "NE".
0	NA (not applicable)	0	notation key used for activities in a given source/sink category that do not result in emissions or removals of a specific gas. If categories in the CRF for which "NA" is applicable are shaded, they do not need to be filled in
0	<i>IE</i> (included elsewhere)	0	notation key used for emissions by sources and removals by sinks of greenhouse gases estimated but included elsewhere in the inventory instead of the expected source/sink category. Where "IE" is used in an inventory, the Annex I Party should indicate, using the CRF completeness table, where in the inventory the emissions or removals from the displaced source/sink category have been included and the Annex I Party should explain such a deviation from the expected category;
0	C (confidential)	0	notation key used for emissions by sources and removals by sinks of greenhouse gases which could lead to the disclosure of confidential information, given the provisions of paragraph 2764above.
0	QA/QC	0	Quality Assurance/Quality Control;
0	QA	0	is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Reviews, preferably by independent third parties, are performed upon a completed inventory following the implementation of QC procedures;
0	QC	0	is a system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled. It is performed

Emissions and removals should be reported at the most disaggregated level of each source/sink category, taking into account that a minimum level of aggregation may be required to protect confidential business and military information.

	by personnel compiling the inventory. The QC system is designed to:
	<ul> <li>provide routine and consistent checks to ensure data integrity, correctness, and completeness;</li> </ul>
	o identify and address errors and omissions;
	o document and archive inventory material and record all QC activities. : QC activities include general methods such as accuracy checks on data acquisition and calculations, and the use of approved standardised procedures for emission and removal calculations, measurements, estimating uncertainties, archiving information and reporting.
o Stratification	<ul> <li>The process of deriving estimates based on a detailed breakdown of sub categories in order to apply sub category specific assumptions to improve accuracy in estimation.</li> </ul>

# A.VI.2 Terminology: Scenario definitions (see also (UNFCCC Guidelines, paragraph 29)

		_	
0	Without measures (WOM)	0	(Business-as-usual), providing an estimate of emissions trends without planned environmental policies in place. This scenario excludes all policies and measures implemented, adopted or planned after the year chosen as the starting year.
0	With existing measures (WEM)	0	('Policies in Place'); includes implemented and adopted policies and measures. This should include the most likely economic/energy projections and the impacts of existing policies and measures irrespective of whether their primary objective was the mitigation of air emissions or not. It is usually good practice for the starting point of the 'with measures' scenarios to be the latest year of the historic inventory.
0	With additional measures (WAM)	0	('Policies in the pipeline') include planned but not yet adopted policies and measures. 'With additional measures' presents a picture of the expected outcome of emissions if, on top of with-measures planned policies and measures with a realistic chance of being adopted and implemented are included. As with the 'With Measures' scenario it is good practice for the starting point of the 'with additional measures' scenario to be the latest year of the historic inventory.

A.VI.3 Terminology: Legislation

International legislation

# UNFCCC The United Nations Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. Under the Convention, governments: gather and share information on greenhouse gas emissions, national policies and best practices launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries cooperate in preparing for adaptation to the impacts of climate change National Under the Convention, all Parties should report on the steps they Communication are taking to implement the Convention (Articles 4.1 and 12). Most of the 41 Annex I Parties submitted their first report (known as a "national communication") in 1994 or 1995, their second in 1997-1998 and the third after 30 November 2001. The fourth national communications were due on 1 January 2006 and the fifth on 1 January 2010. Decision 9/CP.16 calls for submission of the sixth national communications on 1 January 2014. Annual submission The UNFCCC reporting guidelines on annual inventories require Annex I Parties, by 15 April each year, to provide annual national GHG inventories covering emissions and removals of direct GHGs (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>) from six sectors (Energy, Industrial processes, Solvents, Agriculture, LULUCF, Waste), and for all years from the base year or period to the most recent year. Under the UNFCCC reporting guidelines for Annex I Parties, inventory submissions are in two parts: Common reporting format (CRF) – a series of standardized data tables containing mainly numerical information and submitted electronically National Inventory Report (NIR) – a comprehensive description of the methodologies used in compiling the inventory, the data sources, the institutional structures and quality assurance and control procedures Well-constructed annual inventories should include sufficient documentation and data to enable the reader to understand the underlying assumptions and calculations of the reported emission estimates.

# EU legislation

0	Monitoring Mechanism Directive	0	Decision 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol
0	Article 3(2)	0	Article under Monitoring Mechanism Directive identifying Member States reporting obligations
0	Effort Sharing Decision	0	DECISION No 406/2009/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020
		0	ESD establishes annual binding greenhouse gas emission targets for Member States for the period 2013–2020. These targets concern the emissions from sectors not included in the EU Emissions Trading System (EUETS)– such as transport, buildings, agriculture and waste. It is part of a package of policies and measures on climate change and energy that will help transform Europe into a low-carbon economy and increase its energy security
0	EU ETS	0	DIRECTIVE 2003/87/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC
0	Biofuel Directive	0	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC