

Projections in hindsight

An assessment of past emission projections reported by Member States under EU air pollution and GHG legislation

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Executive summary

Over the past decade, European Union (EU) Member States were required to regularly compile and report official estimates of their projected (future) emissions for the year 2010 under two complementary pieces of legislation:

- for greenhouse gases (GHGs), the Monitoring Mechanism Decision (MMD), i.e. 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;
- for air pollutants (specifically four atmospheric pollutants responsible for acidification, eutrophication and ground-level ozone pollution), the National Emission Ceilings (NEC) Directive, i.e. Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants.

The mandatory reporting of projections plays an important part in the policy process: it is designed to provide Member States, the European Commission and other stakeholders with a reliable early indication of the expected trend of future emissions, and thus with information on whether implementation of national and EU-wide policies and measures is helping countries meet their emission commitments.

The year 2010 was the target year for which the NEC Directive set upper limits (ceilings) for each Member State for total emissions of certain air pollutants. Under the MMD, Member States were required to report future estimates of GHGs for the years 2005, 2010, 2015 and 2020. Actual emission inventory data for the year 2010 is now available (EEA, 2014c) and it is possible to compare reported emission projections with historic emission inventory data for 2010⁽¹⁾. The current assessment compares the successively reported past projections for 2010

with the latest emissions inventory data for that year, as officially reported by Member States and made available to the EEA.

In performing this comparison, two key questions are addressed:

- How do the past emission projections for 2010 reported by Member States over the last decade compare with the actual emission inventory data reported for that year?
- To what extent have national projections, as they were compiled and reported in the past, proven to be 'fit for purpose', in the sense of adequately addressing their intended purposes as specified in the MMD and NEC Directive?

Based on this assessment and on observations made in the process of monitoring, reporting and interpreting emission projections over the last decade, several shortcomings and quality issues have been identified. An overview of these shortcomings and quality issues is presented in this report, together with recommendations on how these might be overcome in future reporting under a revised NEC Directive and the new GHG Monitoring Mechanism Regulation (MMR) (i.e. Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC). It is recognised that overall, the reported national projections lack detailed information on methodologies, consistent information on exogenous key parameters and explanations on the link between policies and measures and projections. Hence, this report does not review the underpinning methodologies or models used by Member States to develop their projections, nor does it provide an in-depth review of the past reported projections scenarios.

⁽¹⁾ Air pollutant and GHG emission inventory data for the year 2010 became first available in 2012.

Results

Figure ES.1 shows the aggregated, average differences between reported projection, 'with existing measures' (WEM) scenarios, and 2010 emission inventory data for the four air pollutants addressed in the NEC Directive and for total GHGs reported under the MMD. It is clear there are systematic differences between projections reported over past years, and the emission inventory data for 2010 eventually produced. For both air pollutants and GHGs, there was a common trend: the reported projections overestimated the eventual 2010 emissions, albeit to a greater extent for air pollutants than for GHG projections. Even in years immediately preceding 2010, when good agreement between reported projections and final emissions inventory data might be expected, there were several instances for which the difference exceeded 100% in certain Member States.

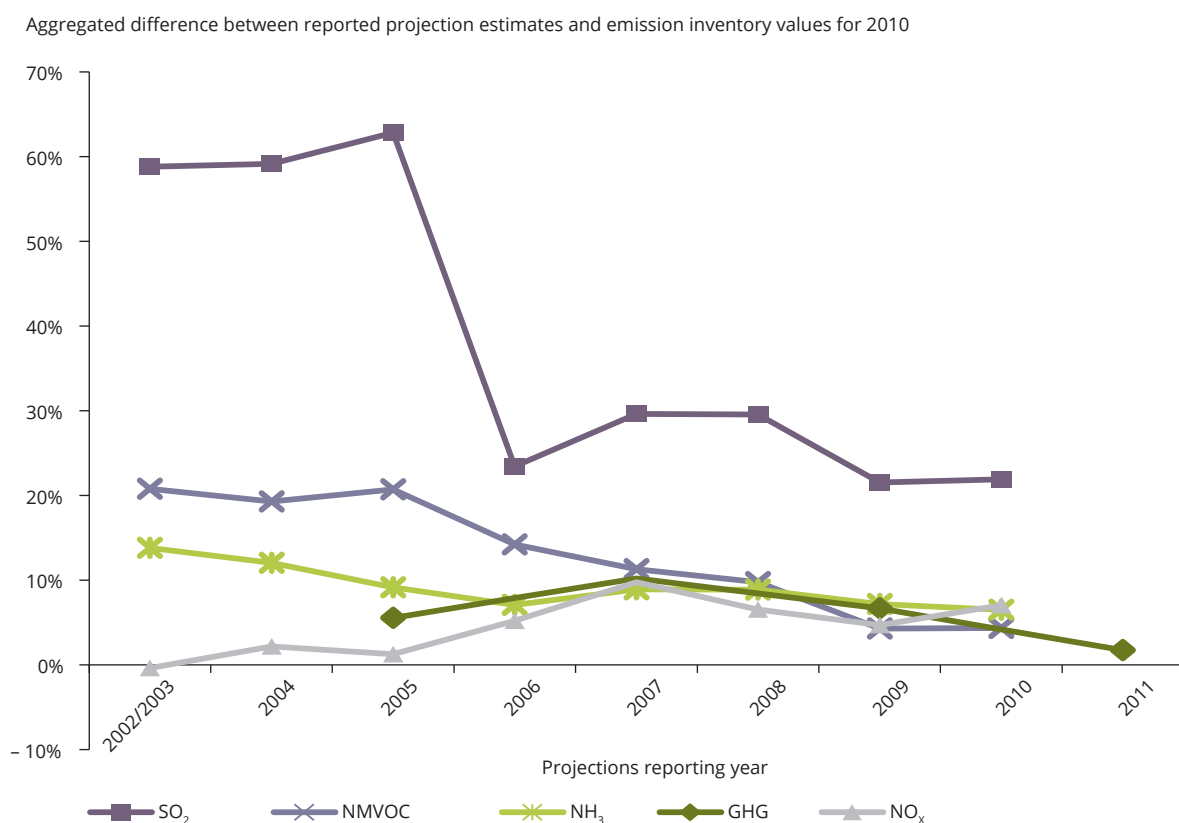
On a more positive note, however, the average aggregated underestimation or overestimation did decrease, which means that projections mostly

converge over time towards the value of the actual 2010 emissions. A successively reported WEM scenario for a specific year should ideally converge to the emission inventory value ultimately reported, since reduction effects of adopted and implemented policies and measures become increasingly visible in the trend of the reported projections.

The reliability of the reported projections, in terms of their ability to inform distance-to-target assessments, has therefore improved over the period, even if substantial differences still occurred often in the years close to 2010 for certain Member States.

A number of observations were made concerning the reported projections. For GHGs, it was assumed that there were significant quality issues in Member States' emission projections frameworks if the year 2010 was overestimated or underestimated by more than the country-specific uncertainty of the respective emission inventory for two submissions close to 2010, i.e. 2009 and 2011. These countries were Lithuania, Portugal and Romania. Bulgaria did not report projections in

Figure ES.1 The average aggregated underestimation or overestimation of projections reported by EU Member States



Note: 2010 GHG projections were reported biennially under the MMD, i.e. in 2005, 2007, 2008, 2009 and 2011, whereas air pollutions had to be reported annually under the NEC Directive. The average aggregated underestimation or overestimation does not include all 28 Member States for each year, but only for those countries that submitted national projections in that specific year. Croatia only joined the EU in 2013, and therefore did not report emission projections under the MMD or NEC Directive before, it is not included in this report.

2009, but exceeded the country-specific inventory uncertainty in its 2011 submission. Poland did not report projections in 2009 and 2011.

For air pollutants, in certain years a third of the Member States have simply reported the value of their 2010 emission ceiling as their 'with measures' scenario. This is not in line with the good practice requirements for the compilation and reporting of projections as laid out in the *EMEP/EEA air pollutant emission inventory guidebook 2013* (EMEP/EEA, 2013, and earlier editions). For sulphur dioxide, a difference of more than 200% was observed for one or more years in the cases of Denmark, Hungary, Latvia, Lithuania and Portugal. In 2009, close to the target year 2010, three Member States reported overestimations of more than 100% (Hungary, Portugal and Romania). For NO_x, Bulgaria, Lithuania and Romania showed differences higher than 50% at least in one of the later submission years (2008, 2009 and 2010). Bulgaria, Malta and Slovakia showed overestimates above 50% in at least one of the submission years of 2008, 2009 and 2010 for non-methane volatile organic compounds (NMVOC). For NH₃ and the same submission years, Bulgaria and Lithuania overestimated their projected emissions for the year 2010 by more than 100%.

A significant transparency issue noted in this assessment was that it was not possible, on the basis of the information reported by Member States under either the NEC Directive or GHG MMD legislation, to identify the reasons for past changes in the reported projections. In particular, more consistent and complete information on national policies and measures and the links between measures and projections would have been needed to identify reasons related to policies and measures, which are ultimately the main driving factors of interest in the WEM, WAM and WOM set of scenarios when it comes

to monitoring Member States' progress in meeting targets.

Reasons for differences between projected scenarios and the inventory value may include:

- policies introduced in addition to those planned, and not included in earlier WEM or WAM scenarios (e.g. change in climate strategy due to changes in government, for instance);
- policies included in the scenarios that fail on the ground;
- overestimated or underestimated reduction effects and/or penetration rates of policies and measures included in projections;
- rebound effects or interactions between policies and measures that are overestimated, underestimated or not considered in scenarios;
- changing trends or misinterpreted trend expectations for key parameters, or poor quality of statistical inputs (e.g. concerning the economy, energy, fuel-prices, traffic forecasts);
- uncertainties intrinsic to the modelling used to project model parameters;
- outdated emission projections;
- unforeseeable events that cause differences between rates of economic activities compared to what was originally projected, e.g. the economic recession in recent years, or political decisions affecting fuel use such as the closure of nuclear plants;
- errors in the reported data.

Box ES.1 Types of reported emission projections

The set of projections scenarios that Member States have been required to report under EU legislation fall into the following categories:

- **projections scenario 'with measures' (WM) or 'with existing measures' (WEM)** means projections of anthropogenic GHG or air pollutant emissions by sources that encompass the effects of currently implemented or adopted policies and measures;
- **projections scenario 'with additional measures' (WAM)** means projections of anthropogenic GHG or air pollutant emissions by sources that encompass the effects of policies and measures which have been adopted and implemented, as well as planned policies that are judged to have a realistic chance to be adopted and implemented in the future;
- **projections scenario 'without measures' (WOM)** means projections of anthropogenic GHG or air pollutant emissions by sources that exclude the effects of all policies and measures which are planned, adopted or implemented after the year allocated as the starting point for the relevant projection.

To help improve the fitness for purpose of projections information from Member States, the report identifies a number of actions addressing both GHG projections and air pollutant projections.

- **Improving overall quality of national projections.** The significant differences between projected values for 2010 in the submission years 2009 and 2011 for GHGs, and in the submission years 2008, 2009 and 2010 for air pollutants, indicate that some countries are still facing major problems in developing reliable projections. This means that targeted capacity-building efforts for the development of GHG and air pollutant projections should be further continued. Furthermore, Member States must also allocate sufficient resources in order to ensure a functioning national system for the development of emission projections.
- **Improving the implementation of existing reporting requirements for WEM and projections information.** Despite formal requirements that Member States regularly report projections data, in practice not all Member States reported data in each of the years for which reporting was required. While the completeness did improve over the time period, even by 2010, various Member States had not reported the mandatory background parameters and indicators underpinning the reported projections, despite it being mandatory to do so. A renewed focus on enforcing the relevant reporting requirements under the NEC Directive and the new MMR would greatly support progress assessments.
- **Improving the implementation of existing reporting requirements for WAM and WOM scenarios.** If emission projections are to properly inform policymakers of progress being made in achieving policy targets, the projected trends of a set of scenarios should be taken into consideration together with background information on how implemented and planned policies and measures have been integrated in the different scenarios. A WOM and a WAM scenario should complement the interpretation of the projected progress to target assessment of a WEM scenario, as differences in these scenarios provide insight into the sum of policy effects of either implemented measures (WEM–WOM) or additional measures (WAM–WEM). A renewed focus on Member States making such information available is essential in order to appropriately inform distance-to-target assessments.
- **Increasing the transparency of reported projections and the link to policies and measures.** There remains a very wide variety in the consistency and level of detail of information reported by Member States, especially when it comes to quantification of expected policy effects. Clearer guidance for Member States in this area would result in a deeper understanding of the progress being made to policy targets. Most importantly, information concerning the manner and degree to which national and EU-wide policies and measures are incorporated into the national projections is generally poor, with detailed information on the timing and expected implementation rates of different policies generally not reported by Member States.
- **Exercising caution in interpreting reported projections.** Over the past decade, projections reported by Member States have generally been overestimated for different reasons, even in years immediately preceding 2010. However, the reliability of the reported projections, in terms of their ability to inform distance-to-target assessments, has improved over the period. Policymakers should remain aware of the high degree of uncertainty inherent in projections, especially in years distant from a target year; they should insist on the provision of information regarding uncertainty of methodologies and models, e.g. sensitivity analyses together with projection results, as explicitly encouraged in the MMD and again promoted in the new MMR. A renewed focus on Member States making available such information is essential.
- **Improving reporting to better understand the uncertainties associated with projection estimates.** Reporting requirements under the NEC Directive did not inherently require projections to address uncertainty, focusing instead on the provision of a central WM scenario based upon existing and future policy measures and also reporting of key projection parameters. For GHG projections, Member States were required to provide sensitivity analyses of their projections, and were encouraged to develop and report a high, central and low scenario. If policymakers consider it desirable to better understand the likely impact upon future emissions of 'unforeseeable' events (e.g. a significant reduction of gross domestic product (GDP) which might occur in a period of unexpected economic recession), implementing measures to enhance the reporting of a meaningful sensitivity analysis would be beneficial.

- **Promoting complementary methods for assessing progress to policy targets.** The assessment presented in this report shows that although the reliability of projection estimates improved over time, in a number of instances the reported projections provided a significantly overestimated picture of the emissions finally reported in 2010. The uncertainty intrinsic to projections can hamper the robustness of (additional) policy decisions being considered on the basis of these values alone, particularly if based upon a single scenario reported in years in a relatively short time period preceding a target year or period. One illustration of a complementary system for monitoring 'distance-to-target', compared to a system based solely upon projected values, is using

analyses based upon current emission inventory values relative to a target trajectory.

Projections are important for tracking progress towards policy targets, and especially for longer term evaluation of progress, such as for 2030 or 2050, projections will remain the main tool. Target trajectories will not be universally rolled out across all policies, but it is recommended that the evaluation process place more emphasis on the years preceding a target year, and apply an approach combining current and projected progress. Policymakers need to become aware of the uncertainties inherent in projections, but countries can do more to make their projections more robust and transparent.

1 Introduction

1.1 Air pollution and GHG projections reporting within the EU

Over the past decade, EU Member States have been required to regularly compile and report official estimates of their projected (future) emissions for the year 2010 under two complementary pieces of legislation:

- for GHGs, the MMD, i.e. 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 (EU, 2004);
- for air pollutants (specifically four atmospheric pollutants responsible for acidification, eutrophication and ground-level ozone pollution), the NEC Directive, i.e. Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants (EU, 2001).

The mandatory reporting of projections under EU legislation plays an important part in the policy process by providing Member States, the European Commission and other stakeholders with an early indication of the expected trend of future emissions and the perceived effectiveness of implemented or planned policies and measures. Such information allows policymakers and other stakeholders to undertake regular assessments of 'progress to targets' for the respective thematic areas, for instance, whether Member States are likely to fulfil GHG emission commitments under EU climate and energy legislation (e.g. EEA, 2013a) and the emission ceiling commitments for air pollutants under the NEC Directive. Aggregated GHG and air pollutant projections based on submissions received from Member States also serve to fulfil the EU's own international reporting requirements as a party to the United Nations Framework Convention on Climate

Change (UNFCCC) (UNFCCC, 1992) and the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (LRTAP) (UNECE, 1979).

The year 2010 was the target year for which the NEC Directive set upper limits (ceilings) for each Member State for total air emissions of the certain pollutants. Under the MMD, Member States were required to report future estimates of GHGs for the years 2005, 2010, 2015 and 2020. It is now possible to compare the successively reported past estimates of emission projections with the historic emission inventory data for 2010^(?). Such a comparison provides some general insights into the reliability of the past projection estimates in a general policy evaluation context.

This report addresses two key questions:

- How do the past emission projections for 2010 reported by Member States over the last decade compare with the actual emission inventory data for that year?
- To what extent have national projections, as they were compiled and reported in the past, proven to be 'fit for purpose', in the sense of adequately addressing their intended purposes as specified in the MMD and NEC Directive?

The GHG Monitoring Mechanism Decision (MMD)

GHG emission projections have been reported by EU Member States biennially under Article 3.2(b) of the MMD. One of the MMD's core objectives was to establish a mechanism for monitoring and evaluating progress in meeting commitments regarding emissions (Article 1). More explicitly, the decision required the European Commission, in consultation with Member States, to assess the projected progress of the EU and its Member States towards fulfilling their commitments under the UNFCCC (1992) and the Kyoto Protocol

^(?) GHG and air pollutant emission inventory data for the year 2010 became first available in 2012 (EEA, 2012).

(UNFCCC, 1997) every two years, by requiring that information on projections be taken into account in informing this progress report. The MMD thus envisaged the role of projections both as fulfilling an internal need to assess progress in EU objectives, and as allowing the EU as a party to the UNFCCC to fulfil its own international reporting obligations. The European Environment Agency (EEA) has supported the Commission and Member States by monitoring reported information and assisting with the analysis of progress towards the fulfilment of the Commitment under the UNFCCC and the Kyoto Protocol.

The MMD specifically required reporting of national projections for WM and WAM scenarios (Box 1.1) for the years 2005, 2010, 2015 and 2020 by GHG and sector, as well as information for three associated elements:

- i 'clear identification of the policies and measures included in the projections;
- ii results of sensitivity analysis performed for the projections;
- iii descriptions of methodologies, models, underlying assumptions and key input and output parameters'.

To help illustrate the uncertainty inherent in national projections, Member States were further encouraged to define high, central and low scenarios for key projection input variables, and to quantify projected emissions for these scenarios.

Reporting guidance was made available, and quality criteria were established for Member States to promote reported GHG projections with a consistent and comparable level of quality. For example, the implementing provisions to the MMD (EU, 2005) required Member States to report projections information in line with UNFCCC reporting guidelines for the preparation of national communications (UNFCCC, 1999), and the Guidelines under Article 7 of the Kyoto Protocol (UNFCCC, 2005). The application of a quality assurance and quality control procedure applied by the ETC/ACM to Member States' reported projections since the beginning of the reporting period aimed at facilitating a continuous improvement of national emission projections.

The European Commission further coordinated a number of capacity-building initiatives over the past decade, aiming to improve the quality of national projections in terms of their completeness,

Box 1.1 Types of reported emission projections

The projections scenarios ^(?) that Member States have been required to report under EU legislation generally fall into the following categories.

- **The projections scenario 'with measures' (WM) or 'with existing measures' (WEM)** means projections of anthropogenic GHG or air pollutant emissions by sources that encompass the effects of currently implemented or adopted policies and measures. These types of projection scenario are also often referred to as baseline or 'current legislation' (CLE) scenario. The terminology of the baseline scenario as well as the 'business as usual' (BaU) scenario has in the past sometimes been used interchangeably to refer to a WEM or WOM scenario. It is therefore considered good practice to clearly document whether a baseline or a BaU scenario refers to a WEM or a WOM scenario.
- **'Projections with additional measures' (WAM)** means projections of anthropogenic GHG or air pollutant emissions by sources that encompass the effects of policies and measures which have been adopted and implemented, as well as planned policies that are judged to have a realistic chance of being adopted and implemented in the future. This scenario type is sometimes also referred to as a 'policies in the pipeline' scenario.
- **Projections 'without measures' (WOM)** means projections of anthropogenic GHG or air pollutant emissions by sources (and removals by sinks) that exclude the effects of all policies and measures which are planned, adopted or implemented after the year allocated as the starting point for the relevant projection. This scenario is also sometimes known as BaU, baseline or reference scenario.

Formal requirements for the type of scenarios required from Member States were defined in the MMD's implementing provisions (EU, 2005), and for the NEC Directive, indirectly by reference to the methodologies agreed upon by the LRTAP Convention. Requirements for projections reporting under the LRTAP Convention were set out in successive versions of the UNECE EMEP emission reporting guidelines for reporting emissions and projections data, and the EMEP/EEA guidebook.

^(?) A scenario is a coherent, internally consistent and plausible description of a possible future state [...]. It is not a prediction; rather, each scenario is one alternative image of how the future can unfold. A projection may serve as the raw material for a scenario, but scenarios often require additional information. A set of scenarios is often adopted to reflect, as well as possible, the range of uncertainty in projections (IPCC, 2014).

comparability, consistency, accuracy and transparency, including, in 2012, the development of additional non-binding methodological guidelines for Member States (TNO et al., 2012; VITO et al., 2008). In 2014, an online discussion platform (wiki) was set up for the GHG projections community as part of an ongoing capacity-building project commissioned by the European Commission.

In 2013, the MMD was replaced by a new, revised regulation on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level that is relevant to climate change from 2014 onwards (the MMR) (EU, 2013).

The National Emission Ceilings (NEC) Directive

The 2001 NEC Directive sets pollutant-specific emission ceilings for each Member State, and the EU as a whole, for four pollutants: nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), sulphur dioxide (SO₂), and ammonia (NH₃). To help protect human health and the environment, the legally binding emission ceilings were to be met by 2010 and in following years (EU, 2001). As for the MMD, the NEC Directive contains reporting provisions designed to allow the anticipated progress of Member States in achieving their ceilings to be monitored. Unlike the MMD, the NEC Directive, while recognising international policy developments (namely the Gothenburg Protocol to the LRTAP Convention), was not an implementing instrument designed to ensure that Member States make available all necessary information to allow the EU itself to fulfil its own international reporting requirements.

In years prior to 2010, the NEC Directive required Member States to update annually and report, for each pollutant, national emission projections for 2010. It was required that projections include information to enable a quantitative understanding of the key socio-economic assumptions used in their preparation. Member States were further obliged to draw up and report national programmes in 2002 and 2006, including provision of 'information on adopted and envisaged policies and measures and quantified estimates of the effect of these policies and measures on emissions of the pollutants in 2010' [i.e. projections].

With respect to guidance and quality criteria for the reported NEC Directive projections, Member States were required to carry out their national projections using the methodologies agreed upon by the LRTAP

Convention, and were requested to use the joint EMEP/CORINAIR ⁽⁴⁾ guidebook in preparing these projections. Since the late 1990s, successive editions of the guidebook have all contained recommended methodological guidance and quality criteria for the preparation of national projections, purposely aligned with EU reporting guidance prepared for the compilation of GHG projections under the MMD. The methodologies provided for the development of projections is significantly less detailed in comparison to the emission inventory guidance. Guidance for Member States concerning the required contents of the national programmes was developed separately (e.g. CAFE, 2006).

Objectives and scope of this report

The year 2010 was the target year for which the NEC Directive set upper limits for each Member State for total air emissions of the certain pollutants. Under the MMD, Member States were required to report future estimates of GHGs for the years 2005, 2010, 2015 and 2020. Historic emission inventory data for the year 2010 is now available (first reported in 2012 and updated in each subsequent year). It is therefore possible to compare the reported projections data with the reviewed emission inventory data for 2010, in order to address the two aforementioned questions:

- How do the past emission projections for 2010 reported by Member States over the last decade compare with the actual emission inventory data for that year?
- To what extent have national projections, as they were compiled and reported in the past, proven to be 'fit for purpose' in the sense of adequately addressing their intended purposes as specified in the MMD and NEC Directive?

The current assessment compares past projections and emissions inventory information officially reported by Member States and made available to the EEA. It does not review the underpinning methodologies or models used by Member States to estimate their projections, nor does it provide a quality in-depth review of the past reported projection scenarios. Chapter 2 describes the data sources and methodology used in the assessment, and Chapter 3 presents the main results of the comparison of the past reported emission projections with historic emission inventory data. Finally, Chapter 4 makes general observations and draws conclusions.

⁽⁴⁾ Since renamed the EMEP/EEA air pollutant emission inventory guidebook (EMEP/EEA, 2013).

Box 1.2 Compiling emission projections and their applications

National emission projections are typically based upon a range of underlying variables and data reflecting the emission sources of a country. Such variables are the expected growth in population (demographic change), social and economic development including assumed rates of GDP development, supply and demand of energy, the expected rate and direction of technological change, and livestock numbers (IPCC, 2000). The future trends of these underlying variables are often developed using complex models, and emission inventory data are taken as a starting point for the modelling, in order to assure time series consistency with historic emission trends.

Part of the assumptions made to describe the development of these main driving forces of future scenarios reflect the potential reduction effect and the degree of implementation of policies and measures. 'Policies and measures' may include specific laws, agreements and/or incentives to reduce emissions. They either affect the release of future rates of emissions per unit activity or change the underlying activity itself. The extent to which policy effects are accounted for in future scenarios is ultimately an issue of political judgement, and is often not a transparently presented assumption.

WEM, WAM and WOM scenarios are to provide an indication of a future path of emissions, given current national circumstances with and without policies and measures. These scenarios are not predictions of the future, because some policies might be initiated and implemented without long-term planning or due to a change in government, and may therefore contribute to differences between the reported scenarios and the inventory value, especially for years further away from the target year. Emission projection scenarios can only serve as a snapshot of the policy and measure framework at the time when the scenarios were developed. It follows that in order to interpret emission projections for monitoring purposes, it is essential to additionally analyse effects of policies and measures, as well as whether and how they are reflected in the WEM and WAM scenarios reported by Member States.

Also reflected within assumptions of the main driving forces are autonomous changes, for example technological progress or structural changes that are expected to take place even without specific policies and measures, e.g. the industrial consolidation that took place in the early 1990s following German reunification.

2 Methods

This chapter describes the sources of data and methodology used in the comparison of past emission projections with historic emission inventory data. A summary of the data availability is provided.

2.1 Data sources

The comparison of the projections information reported in successive years prior to 2010 and historic

emission inventories for that year was based on official submissions of GHG and air pollutant emission inventories and projections information reported under the MMD (EU, 2004) and the NEC Directive (EU, 2001). Data uploaded by Member States to the Eionet Reportnet Central Data Repository (CDR)⁽⁵⁾ or available in published national programme reports (NEC Directive) were used in the assessment. In some instances, Member States may have separately provided information directly to the European

Table 2.1 Data sources used

Information on GHGs reported under the MMD	
Projections	Projections (WEM and WAM scenarios) reported biennially by EU Member States from 2005 to 2011 ^(a) under the MMD. The aggregated sum of GHGs expressed in CO ₂ -equivalent emissions was used in the assessment. Data sets as originally reported by each Member State were used, with no gap-filling or adjustment procedures applied. Projected emissions or removals from the land use, land use change and forestry (LULUCF) sector were excluded.
Inventories	National GHG inventories are reported annually by Member States. The GHG emission inventories submitted in 2014 were used to obtain emission inventory estimates for the year 2010. Inventory data are documented in EEA, 2014a.
Projection parameters and indicators	Key input and output parameters from projections and derived indicators (WEM and WAM scenarios) as reported by EU Member States referred to in Article 3(2) of the MMD.
Information on air pollutants reported under the NEC Directive	
Projections	Projections (WEM and WAM scenarios) for 2010 reported annually by EU Member States from 2002 until 2010 under the NEC Directive for the four air pollutants NO _x , NMVOC, SO ₂ and NH ₃ . Particularly for earlier years, not all Member States reported projections data under the NEC Directive. To improve the completeness of information, projections reported under the LRTAP Convention and available on the Eionet Reportnet were used (if available), to fill gaps in reporting under the NEC Directive.
Inventories	The emission inventory data for 2010 reported by Member States under the NEC Directive at the end of 2014 were used. The inventory data are documented in EEA, 2014b.
National programmes	The NEC Directive required EU Member States to prepare and report national programmes in 2002 and 2006 ^(b) . It was requested that these national programmes include information on adopted and envisaged policies and measures (WAM), the quantified estimates of the effect of these policies and measures on emissions in 2010 and background information on projection parameters and indicators. The projections information reported in the submitted national programmes was used in instances where projections data had not been separately reported. Published evaluations of the two national programme reporting rounds (ENTEC, 2005; AEAT, 2008) provided additional information on the quality of projections reporting by Member States.
Projection parameters	Key socio-economic assumptions provided by Member States with their annual data submissions. For Member States providing data using the latest LRTAP Convention reporting template, the requested underpinning parameters are consistent with those requested under the GHG MMD. Where required, further information from national programme reports of 2002 and 2006 and additional literature published by individual Member States was accessed.

Note: ^(a) Projections for 2010 were still being submitted in 2011; complete historic emission inventory data were not yet available from Member States at that point.

^(b) The national programme reports of Member States reported under the NEC Directive for 2002 and 2006 are available at http://ec.europa.eu/environment/air/pollutants/nationalprogr_dir200181.htm.

⁽⁵⁾ See <http://cdr.eionet.europa.eu>.

Commission. Unless these data were also made available on Eionet Reportnet, they have not been taken into account. Data were compiled for each Member State. Of course, fewer data were available for those Member States that joined the EU more recently (e.g. in 2004 or 2007).

2.2 Comparison of past GHG and air pollutant projections with emission inventories for 2010

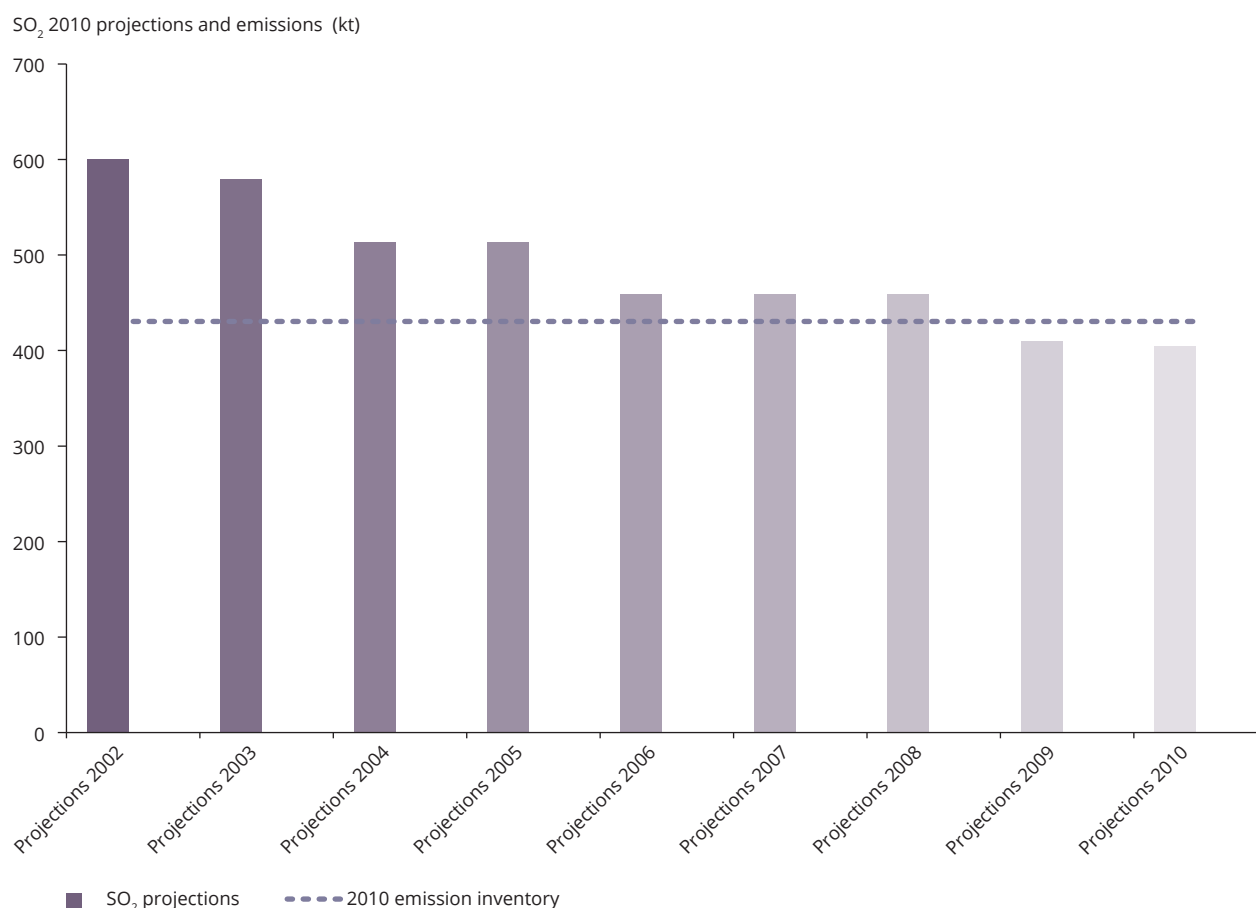
If emission projections are to inform policymakers about the progress being made in meeting policy targets, the projected trend of a WEM scenario reported by Member States should ideally converge over time to the emission inventory value ultimately reported, in this case, for 2010, since reduction effects of adopted and implemented policies and measures become increasingly visible in the trend of the reported projections. However, WEM and WAM scenarios can only reflect the policy and measure framework up to a certain cut-off date. Some policy

measures might be initiated and implemented after this cut-off date or without long-term planning and may therefore contribute to differences between the reported scenario and the inventory value, especially for years further away from the target year. That is why 'converging to' instead of 'being equal to' the eventual inventory value was defined as quality criteria for a WEM scenario in this report.

Available projection scenarios for 2010 reported under the MMD and the NEC Directive were compared with the respective emission inventory data for 2010. Differences between the projections and inventories were explored, as was any evidence of systematic changes over time, to address the question of whether differences between projections and inventory values decreased, increased or remained broadly stable as 2010 approached (e.g. Figure 2.1).

Time series changes (relative and absolute differences) between projections and inventory were compared for the 27 EU Member States as of 2010. For the sum of GHGs, this assessment was performed

Figure 2.1 Indicative example of emission projections for the year 2010 reported between 2002 and 2010, to illustrate a WEM scenario converging to the historic emission inventory



for the WEM scenario of all sectors (i.e. national totals, CO₂-equivalent, excluding LULUCF).

For the four NEC Directive pollutants (NO_x, NMVOC, SO₂ and NH₃), projected national totals according to the reported WEM scenario were compared with the 2010 emission inventory values. A comparison at sector level could not be carried out for air pollutions, due to lack of reported sectoral projections data.

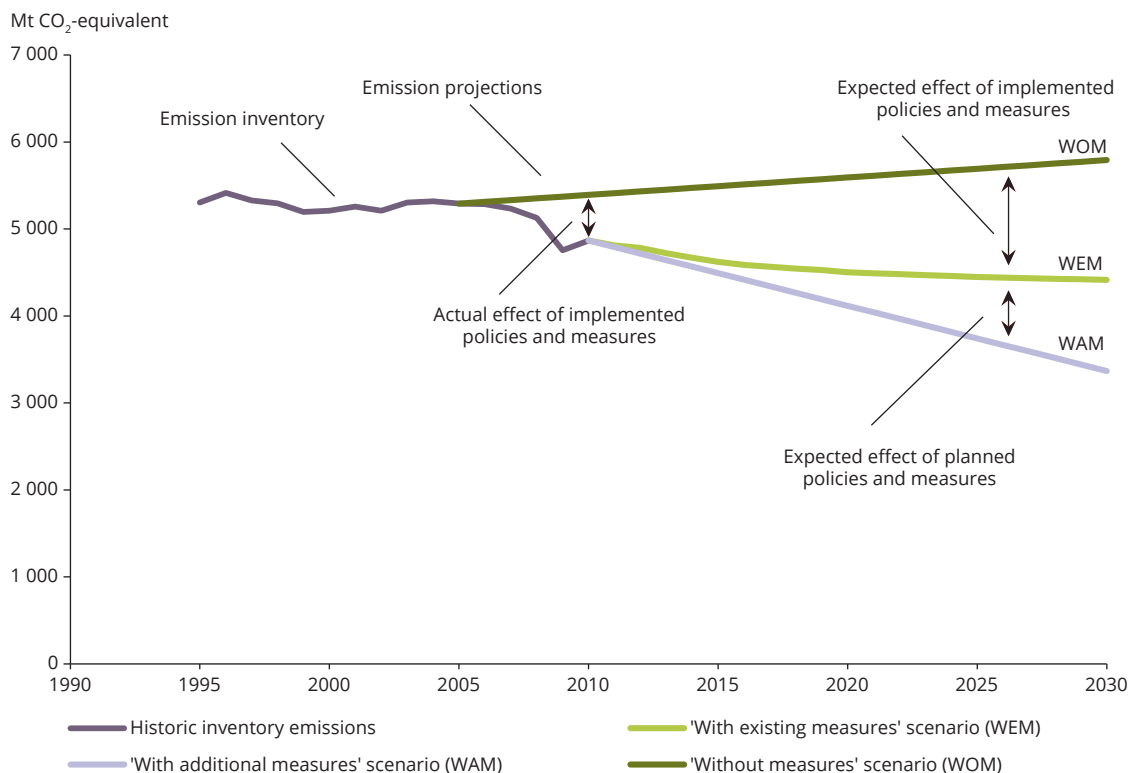
2.3 Overview of data availability

Interpreting the projected progress to target assessment on the basis of a WEM scenario should be complemented by a WOM and a WAM scenario, preferably on a sectoral or per gas level. The WAM scenario would eventually be expected to converge to the WEM scenario as more additionally planned measures become adopted and implemented over time. The relative differences in trends of WEM and WAM scenarios and the relation of these differences to policy and measure effects should also be considered in the 'distance-to-target' assessment. The WOM scenario could attribute to a

better understanding of policy effects in providing information on the sum of potential future effects of existing measures, when compared to the WEM scenario. The following chart shows the relationship between the different scenario types and policy effects. It shows the importance of the availability of more than just a WEM scenario in order to be 'fit for purpose' in the context of this assessment. The chart is based on definitions in the 'Guidelines for the preparation of national communications by Parties included in Annex I to the Convention' (UNFCCC, 1999).

So ideally, a full set of reported projections data (including all requested scenarios and information at sectoral and/or per gas level) and a consistent set of socio-economic parameters and policy and measures assumptions used to prepare the projections, would be available for each Member State. This would allow a robust ex post analysis on the quality of reported projections to be performed. However, the past incompleteness of data reported by Member States, in particular in earlier submission years, coupled with an often insufficiently detailed background information, significantly limited the extent to which any assessment could be performed.

Figure 2.2 Illustration of the relationship between WEM, WAM, WOM and effects of policies and measures



GHGs

Table 2.2 shows the availability of the submitted WEM GHG projection scenarios successively reported in four mandatory submission years: 2005, 2007, 2009 and 2011. Projected emissions for the year 2010 were also reported in 2011, since the historic emission inventory for 2010 only became available in 2012. Had all Member States reported projections in each of these years, a total of 106 submissions would have been received (Bulgaria and Romania joined the EU

on 1 January 2007, and so were not required to report information in 2005).

However, incomplete reporting by Member States meant only 83 of the expected 106 WEM submissions were available for use (i.e. 78%). Just 11 Member States reported the expected number of projections on Eionet Reportnet (Belgium, the Czech Republic, Denmark, Finland, Lithuania, the Netherlands, Romania, Slovakia, Slovenia, Sweden and the United Kingdom), with 10 Member States reporting 3 out of 4 submissions. For

Table 2.2 Number of reported GHG projections as submitted by EU-27 * Member States under the MMD

Member State	With existing measures (WEM)						With additional measures (WAM)
	National total *	Energy	Industrial processes	Solvent use	Agriculture	Waste	National total **
Austria	3	2	2	3	4	4	3
Belgium	4	4	4	4	4	4	3
Bulgaria	2	3	3	0	3	3	3
Cyprus	3	3	3	0	3	3	3
Czech Republic	4	4	4	4	4	4	4
Denmark	4	4	4	4	4	4	1
Estonia	2	2	2	0	2	2	2
Finland	4	4	4	3	4	4	4
France	3	2	2	2	3	3	3
Germany	3	3	3	3	3	3	3
Greece	3	3	3	3	3	3	3
Hungary	1	1	1	1	1	1	1
Ireland	3	2	2	2	3	3	3
Italy	3	3	3	2	3	3	3
Latvia	3	3	3	3	3	3	3
Lithuania	4	4	4	2	4	4	3
Luxembourg	2	2	2	2	2	2	2
Malta	2	2	2	1	2	2	2
Netherlands	4	4	4	1	4	4	3
Poland	1	1	1	1	1	1	0
Portugal	3	3	3	3	3	3	3
Romania	3	3	3	3	3	3	3
Slovakia	4	4	4	3	4	4	4
Slovenia	4	4	4	4	4	4	4
Spain	3	3	3	3	3	3	3
Sweden	4	4	4	4	4	4	2
United Kingdom	4	4	4	0	4	4	0
Total submissions	83	81	81	61	85	85	71

Note: * Croatia only joined the EU in 2013, and therefore did not report emission projections under the MMD or NEC Directive before, it is not included in this report.

** excluding Land Use, Land Use Change and Forestry sector (LULUCF).

□ (White): 3–4 submissions.

■ (Dark purple colour): 0–2 submissions.

Member States should each have reported four sets of projections for 2010 corresponding to the mandatory reporting years of 2005, 2007, 2009 and 2011. As Bulgaria and Romania joined the EU later, only three sets were expected.

WAM scenarios, 71 submissions were received (i.e. 67% of the expected number).

In 2005, just over half (13) of the then 25 Member States submitted GHG projections. However, the completeness of reporting has improved over time. Two Member States (Hungary and Poland) provided just one set of projections information on Eionet Reportnet during the period, for the years 2011 and 2007, respectively.

Together with national projection estimates, most Member States also reported sectoral GHG projections (i.e. energy, industrial process, solvent use, agriculture and waste), although a number did not report separate projections for the solvent use sector (61 WEM solvent projections were received, compared to the 83 submissions overall). The lack of reported information for this sector most likely reflects the relatively insignificant size of the sector in many national GHG inventories — around 0.2% of total EU-27 GHG emissions in 2010. The provision of sectoral projections has improved considerably over time.

With respect to the availability of the key socio-economic parameters, indicators or explanatory reports that underpin the reported projections, in general, the provision of such information in the earlier years 2005 and 2007 was significantly more limited than in 2009 and 2011. The identification and interpretation of information is also not straightforward, as there was wide variety in the consistency and level of detail of information reported across Member States. The lack of detailed relevant explanatory data throughout the reporting period hampered subsequent analysis and comparison of the reported projections.

Air pollutants

Under the NEC Directive, Member States have been obliged to annually update and report 2010 projections using the same official reporting templates as those used under the LRTAP Convention. The format of these templates has changed across the period. Originally, only the provision of national total projections was required, but this was followed in later years by requirements to also provide sectoral projections as well as more detailed projected activity and socio-economic data.

Table 2.3 shows the number of submitted projections, by Member State. A greater number of reported projections are available under the NEC Directive than under the MMD, both because of the increased frequency of reporting (annual versus two-yearly for

the GHG projections) and because of the earlier date of the NEC Directive (i.e. 2001 compared to 2004). For practical purposes, the first year of reporting under the NEC Directive was 2002, which means the then EU-15 Member States should have submitted nine sets of projections in total, up to and including 2010. For the 12 Member States joining the EU on 1 May 2004, 7 projections submissions should have been made, and for Bulgaria and Romania, both of which joined the EU on 1 January 2007, 4 submissions were expected.

The proportion of reported versus expected number of projections is similar to that under the MMD. In total, 191 sets of projections were reported of an expected 227 submissions (84%, cf. 78% for GHGs). For most Member States, projections were available for all the expected years, except for Cyprus, Hungary, Malta, and Poland, each of which reported only five of the expected seven submissions. Projections from all Member States were available for 2008 onwards. In contrast, the reporting of WAM projections was significantly lower than under the MMD, with Member States submitting on average only two WAM projections across the time period.

The transparency of the NEC Directive projections, as indicated by the availability of the provision of key socio-economic parameters, is relatively poor. Projections reported between 2002 and 2010 often lacked supporting information concerning key parameters, or the information submitted was incomplete. Availability of the key parameters was more limited in the earlier sets of projections submitted from 2002, but this improved over time. The most complete set of explanatory information, in terms of information being available for the greatest number of Member States, was found in the reporting of the national programmes of 2006; bearing in mind also that specific guidance on completing the national programme reports was made available for Member States (CAFE, 2006). The number of Member States reporting projection parameters has decreased since.

In order to interpret emission projections for monitoring purposes in the context of the MMD and the NEC Directive, it is essential to additionally receive background information on key socio-economic parameters, as well as qualitative and quantitative information on effects of policies and measures, and whether and how these are reflected in the WEM and WAM scenarios reported by Member States.

As was observed for the information reported under the MMD, the lack of complete background data hampers any detailed evaluation or understanding of the reasons for changes observed in the reported time series of projections reported by Member States.

Table 2.3 Number of reported air pollutant projections as submitted by EU-27 * Member States under the NEC Directive

Member State	Number of projections		Availability of socio-economic assumptions		
	WEM	WAM	National programme 2002	National programme 2006	Projections 2010
Austria	8	0	✓	✓	✓
Belgium	7	2	n/a	✓	✗
Bulgaria	4	3	n/a	✓	✗
Cyprus	5	0	n/a	✓	✗
Czech Republic	7	0	n/a	✓	✗
Denmark	9	0	✓	✓	✗
Estonia	7	0	n/a	✓	✓
Finland	9	0	✓	✓	✓
France	9	4	✗	✓	✗
Germany	8	4	✓	✓	✗
Greece	8	3	n/a	✗	✓
Hungary	5	0	n/a	✓	✗
Ireland	8	5	n/a	✓	✓
Italy	8	0	✗	✓	✗
Latvia	7	0	n/a	✓	✓
Lithuania	7	3	n/a	✓	✓
Luxembourg	6	2	n/a	✗	✗
Malta	5	2	n/a	✓	✗
Netherlands	9	4	✗	✓	✓
Poland	5	0	n/a	✗	✓
Portugal	8	4	✓	✓	✓
Romania	4	3	n/a	✓	✗
Slovakia	6	2	n/a	✗	✓
Slovenia	7	4	n/a	✓	✓
Spain	7	0	✗	✓	✗
Sweden	9	0	✗	✗	✗
United Kingdom	9	0	✗	✓	✓
Total submissions	191	45	5	22	13

Note: * Croatia only joined the EU in 2013, and therefore did not report emission projections under the MMD or NEC Directive before, it is not included in this report.

n/a: no report submitted

✗: no socio-economic assumptions reported

✓: socio-economic assumptions reported

□ (White): 8–9 submissions for EU-15; 7 submissions for EU-12; 4 submissions for Bulgaria and Romania.

■ (Light purple colour): 3–7 submissions for EU-15; 3–6 submissions for EU-12; 3 submissions for Bulgaria and Romania.

■ (Dark purple colour): 0–2 submissions for all Member States.

EU-15 Member States should each have reported nine sets of projections for 2010, EU-12 Member States joining the European Union on 1 May 2004, seven sets, and Bulgaria and Romania, four sets.

3 Results and discussion

3.1 Comparison of reported GHG projections with emission inventory data for 2010

One of the main objectives of this report is to consider how past emission projections for 2010 reported over the last decade compared with actual emission inventory data for that year. Figure 3.1 and Table 3.1 show the absolute and relative values, respectively, of the projected total GHGs successively reported by Member States, compared with the emission inventory values for 2010.

The first, clearly evident observation concerns the incompleteness of reported projections over the reporting period under the MMD. As noted in Section 2.3, in 2005, just over half of the then 25 Member States submitted a WEM scenario. In 2007, 20 of 27 Member States reported a WEM, and the completeness of reporting has improved further over time. However, two Member States, Poland and Hungary, both reported just one set of projections information during the entire reporting period. Poland and the United Kingdom did not provide WAM scenarios, and Denmark and Hungary reported only one WAM between 2005 and 2011.

It is also apparent that many Member States tended to systematically overestimate their projections for GHG emissions, across the first three rounds of mandatory reporting (in 2005, 2007 and 2009), compared to the values subsequently reported in the emission inventory for the year 2010. To illustrate, the first projection data sets reported by Member States show the majority (24) of Member States reported initial projections higher than the value finally reported for 2010. In percentage terms, between 2005 and 2011, the overestimation of projections exceeded 50% for three Member States (Bulgaria, Lithuania and Romania) (Table 3.1). By the final year of projection reporting, the picture had changed, with half the Member States underestimating their projections (albeit slightly in a number of cases), compared to the final emissions inventory data.

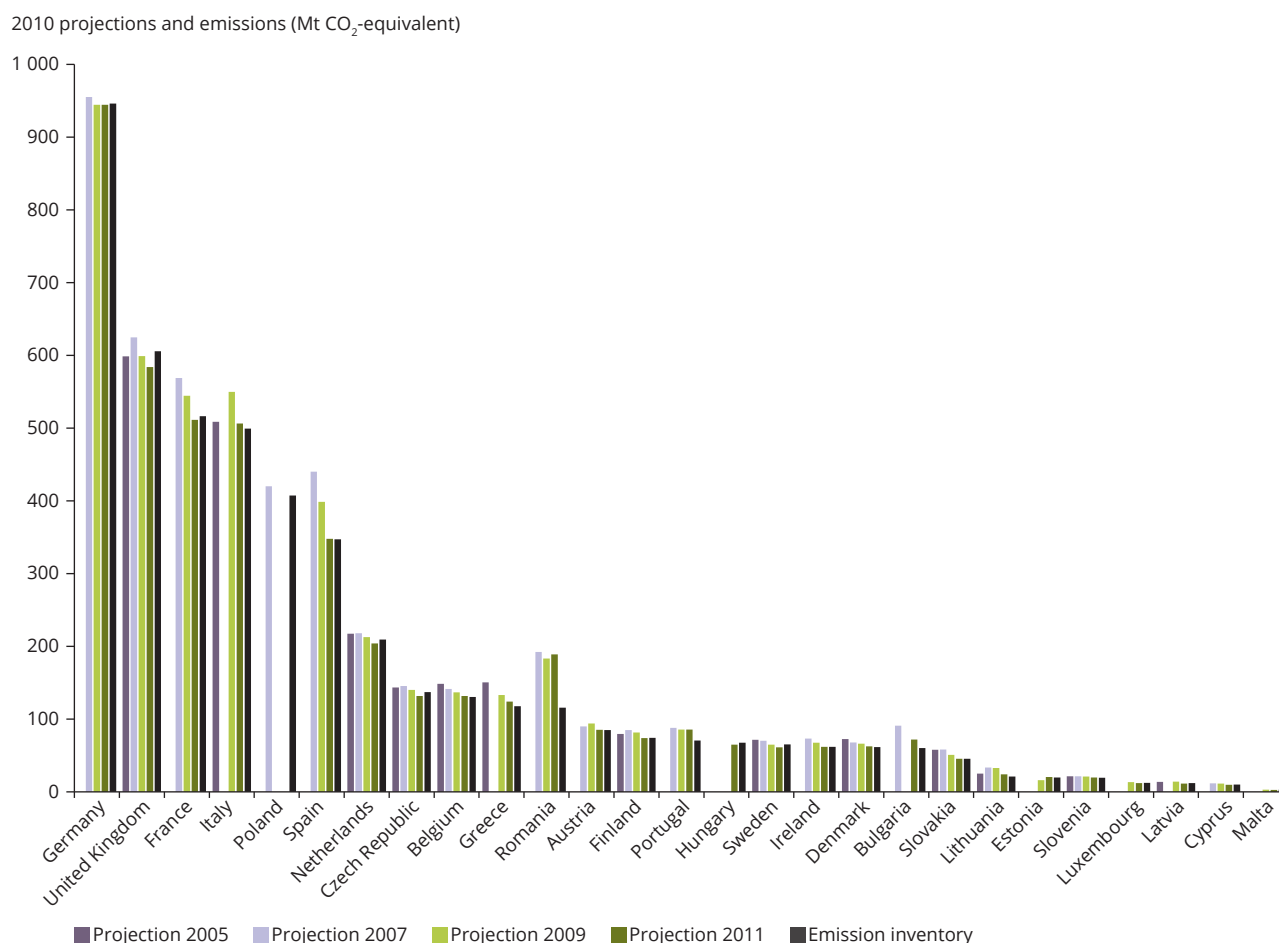
At least one important factor contributing to the general overestimation has been the economic recession that occurred in many countries in the years immediately

preceding and including 2010. In other words, assumed higher rates of economic activity than those that transpired in reality may have been used in the early sets of projections for 2010. The largest differences were observed for Bulgaria, Cyprus, Lithuania, Romania, Slovakia and Spain, each of which overestimated the 2010 GHG projections by more than 25% in their submissions for the year 2007. These overestimations may be explained by excessively high GDP estimations or by a relatively poor quality national projections framework. By the final projections data reported in 2011, only Romania still reported grossly overestimated projections (by more than 60%), which at least partly reflected too high estimates (17%) for national GDP used in projections, compared to the situation that transpired in reality (ETC/ACM, 2011).

More positively for around two-thirds of the Member States, the reported projections typically converged towards the value of the emissions inventory data, as 2010 approached. Denmark, for example, reported initial projections in 2005 that were 18% higher than its eventual 2010 emission inventory value. For the projections reported in 2007, the difference was 10%, in 2009 it was 8% and in 2011 the reported projections were just 2% higher than the final emission inventory data reported. A main explanatory factor for the initially higher projections in the case of Denmark were overestimated assumptions for gross energy consumption of fossil fuels in each of the 2005, 2007 and 2009 reporting years projections. Aggregating the Member States' data, the average overestimation for all countries that reported data in the 2005 reporting round was 5.5%; in 2007 it was 10.2%, in 2009 it was 6.7% and in 2011 it dropped to 1.7%. The increase in the gap between projections and emission inventory in 2007 was mainly caused by significant overestimations (in absolute terms) made by Bulgaria, France, Romania and Spain; these countries had not reported projections information in 2005. In addition, it was influenced by an increase of projected United Kingdom emissions between 2005 and 2007.

Ideally, projections would typically be expected to converge over time towards the emission inventory value ultimately reported for a specific future year. Different factors contribute to such expected

Figure 3.1 National total GHG projections (WEM) for 2010 successively reported by Member States, and final emission inventory data for that year



convergence. Firstly, the successive incorporation of new policies into successive WEM scenarios means that later projections should reflect changes of the policy landscape by the time the target year arrives. Similarly, knowledge of underpinning socio-economic information and related trends becomes more certain as the gap between the projection year and target year closes, i.e. knowledge of the potential activity and economic data become more reliable, and projections become less uncertain as 2010 approaches.

Tables showing a comparison of reported WEM sectoral projections and emissions inventory data are provided in Annex I. With the exception of the waste sector, the reported sectoral projections show broadly the same trends as observed for the national totals, i.e. a general convergence to the final emission inventory values over time.

However, relative differences between the projections and the emission inventory data were much greater in the industrial processes and solvent use sectors

than in the energy sector, for instance, with many Member States having differences exceeding 50% and in some instances greater than 200%. The reasons for this, and the reliability of projections in these sectors, may benefit from closer assessment. The greatest observed differences in relative terms were for Bulgaria, Lithuania, the Netherlands and Romania. A number of significant differences in certain Member States were also observed in the waste sector. Both Bulgaria and Ireland significantly overestimated their waste emissions in at least one projections submission by more than 100%, with a number of others overestimating by more than 50% (Latvia, Malta and Romania). In contrast, Belgium underestimated its waste emissions by almost 50%, even in the submissions closest to 2010.

In other instances, overestimated projections in one sector were balanced by underestimates in others. For example, Slovakia's overestimations in the energy sector were to some extent balanced out by underestimations in the industrial sector in 2005, 2007 and 2009.

Table 3.1 Percentage difference between the national total GHG projections (WEM) for 2010 successively reported by Member States, and emission inventory data for 2010

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011
Austria	—	6%	11%	1%
Belgium	14%	8%	5%	1%
Bulgaria	—	51%	—	20%
Cyprus	—	19%	13%	- 2%
Czech Republic	5%	6%	2%	- 4%
Denmark	18%	10%	8%	2%
Estonia	—	—	- 20%	3%
Finland	7%	14%	10%	- 1%
France	—	10%	5%	- 1%
Germany	—	1%	0%	0%
Greece	28%	—	13%	5%
Hungary	—	—	—	- 4%
Ireland	—	18%	9%	0%
Italy	2%	—	10%	1%
Latvia	14%	—	17%	- 4%
Lithuania	19%	59%	55%	14%
Luxembourg	—	—	10%	- 1%
Malta	—	—	- 1%	- 8%
Netherlands	4%	4%	2%	- 2%
Poland	—	3%	—	—
Portugal	—	25%	21%	21%
Romania	—	66%	58%	63%
Slovakia	28%	28%	12%	0%
Slovenia	10%	11%	9%	2%
Spain	—	27%	15%	0%
Sweden	10%	8%	0%	- 6%
United Kingdom	- 1%	3%	- 1%	- 4%

Note: — : no submission

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A value of zero indicates no difference between the reported projection and emission inventory. A value below zero means that the projected emission was lower than the realised emissions in 2010. Empty cells indicate that the country did not submit emission projections to the EU in that year.

In view of the assessment of completeness and converging trends, the order of magnitude of the differences in the two submission years closest to 2010 (i.e. 2009 and 2011) should be noted. The national projections for the submission in March 2009 from Member States were developed in the course of the year 2008. The high divergence of some countries in this submission shows that the national framework

in which projections are developed did not allow for inclusion of the latest developments (such as the economic recession) in their projections. Similarly, the submission of projections in March 2011 would have been prepared during the course of 2010, when historic inventory data for 2010 were not yet available, but the recession effects were even more apparent than in 2008. Some Member States were clearly still

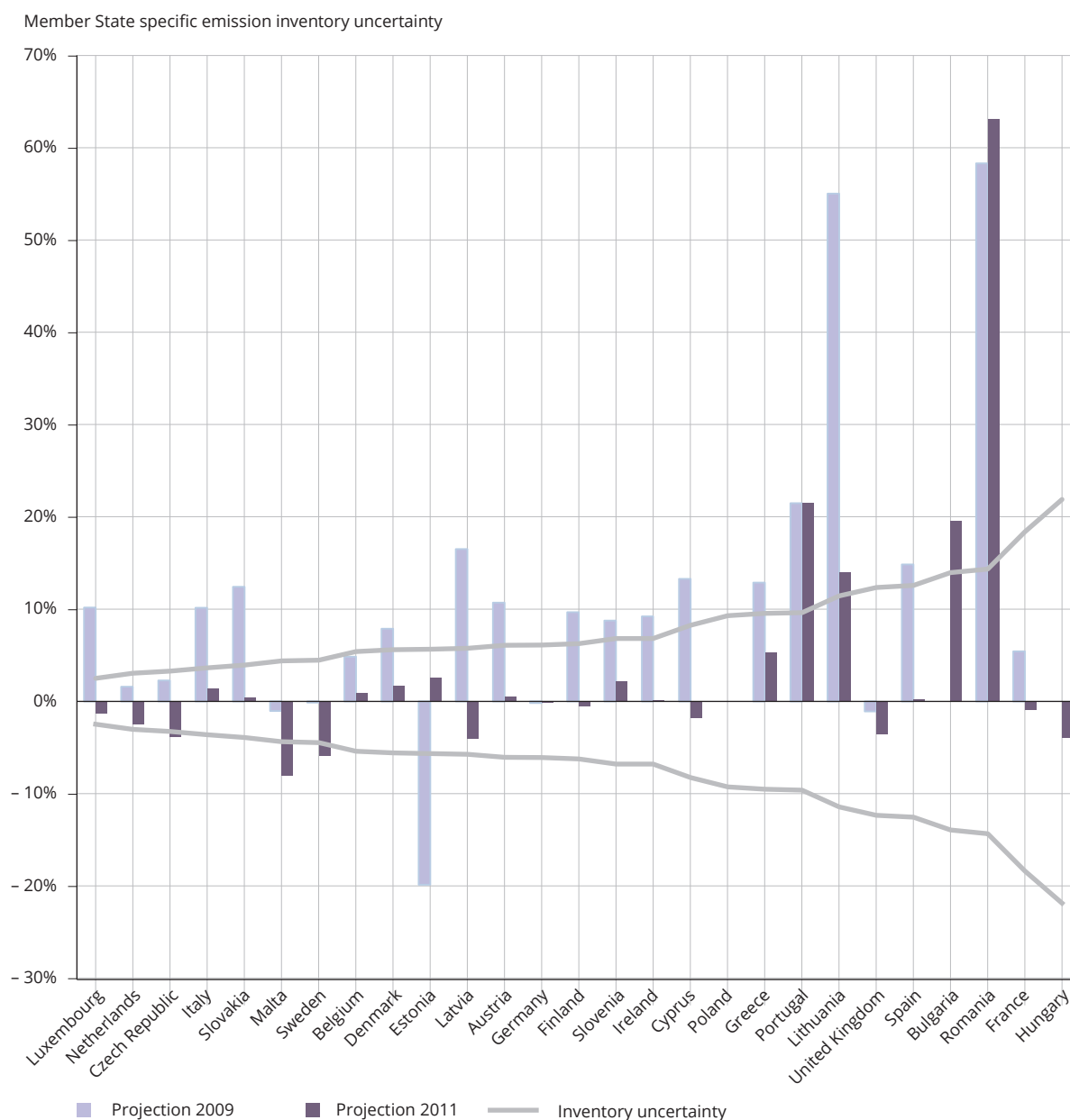
not able to reflect these circumstances at the time when projections were developed. Countries with a difference above a certain threshold in both of these closest years suggest that these Member States have issues in preparing their projections at an appropriate level of quality.

It was not possible to determine an uncertainty threshold based on the method of uncertainty of national emission projections, since the reporting of uncertainty and sensitivity analyses from Member States was too fragmental under the MMD. However, the uncertainty of national emission inventories

may illustrate the order of magnitude of differences, in terms of their significance. Emission projection scenarios are considered inherently much less certain than historic emission inventory data, as they normally rely extensively on modelled information and assumptions concerning future events that may or may not be realised (EMEP/EEA, 2013).

Figure 3.2 shows Member States' specific emission inventory uncertainties in relation to the difference of 2010 projected values in their 2009 and 2011 submissions. Lithuania, Portugal and Romania are Member States whose difference between their

Figure 3.2 Member States' specific emission inventory uncertainties in relation to the difference of 2010 projected values in their 2009 and 2011 submissions



projected WEM scenario for the year 2010 and their inventory of 2010 exceeds the country-specific emission inventory uncertainty in both years, 2009 and 2011. Bulgaria did not report projections in 2009, and exceeded the threshold in its 2011 submission. Poland did not report projections in 2009 and 2011. Thirteen other Member States showed significant differences in their 2009 submissions, but not in 2011. Three Member States showed overestimations and underestimations bigger than their inventory uncertainty in 2011, but not in 2009.

3.2 Observations concerning 'fitness for purpose' of reported GHG projections

It is clearly important that the quality of reported projections should allow them to fulfil their intended purposes as specified in legislation. In particular, the MMD foresaw use of projections to facilitate reliable assessments of progress being made by the European Union and its Member States towards fulfilling their commitments, and to ensure the availability of information to allow the EU itself to meet its international reporting obligations under the UNFCCC and the Kyoto Protocol.

The lack of projection information reported by certain Member States has in several years prevented a reliable assessment of progress based on reported data alone, particularly in early years of the 2005–2011 period under consideration. On a more positive note, by 2011, the great majority of Member States were reporting projections, and in that sense alone there was improvement in the fitness for purpose of projections information available under the MMD.

Earlier assessments, for example the series of annual EEA reports on trends and projections of GHGs have flagged a number of more technical issues regarding the quality of reported projections data (e.g. EEA, 2013a). These particularly concern issues that affect the comparability of data across different Member States, and which also complicate the process of aggregating reported information into a consistent EU data set suitable for progress assessment and international reporting. Examples of such issues include missing WAM scenarios, sectoral projections, and inconsistencies between the starting year of projections and the latest emission inventory data. For such reasons, the data projections received under the MMD have each year typically required adjusting and/or gap-filling in order to facilitate its use for assessment purposes at European level. There should be no such need to adjust data reported by Member States in these ways, as it is the responsibility of the countries to report information that satisfies the required internationally

agreed quality criteria. It is also noted that, unlike the MMD, the subsequent MMR (EU, 2013) now contains explicit provisions to allow gap-filling of Member States' projection data, in instances when data are not provided.

In fact, progress towards meeting or surpassing policy targets was in general greater than was indicated by the reported projections of the time. In this respect, estimates from some Member States had a greater impact on the EU's projections than others, as described in the preceding section. As noted earlier, the MMD did encourage Member States to define high, central and low scenarios for key projection input variables, and to quantify projected emissions for these scenarios. The general intention of this recommendation was, to ensure a better understanding of the uncertainty inherent in the Member State projections. Nevertheless, as far as can be ascertained, there has never been any provision of such information from countries. However the convergence of projections data with that of the final emission inventory observed for most Member States provides a strong indication that the overall reliability of projections increased as 2010 approached. There are a few Member States, though, who need to step up their efforts in developing better quality emission projections.

On the basis of the projections data and associated information reported under the MMD, it is not generally possible to disentangle the reasons for past discrepancies between projections and final emissions inventory data, nor to clearly identify reasons for the convergence of projections. Often the accompanying information reported by Member States was not sufficiently detailed or complete to allow a detailed decomposition of factors to be performed. More importantly, information on the manner and degree to which policies are incorporated in national projections is generally poor. More specifically, information on the timing and expected implementation rates of different policies was not clearly reported by Member States overall.

3.3 Comparison of reported air pollutant projections with emission inventory data for 2010

Trends in the successive 2010 projection values for NO_x, NMVOC, SO₂ and NH₃ reported under the NEC Directive are shown in Figure 3.3 through to Figure 3.7, together with the final emission inventory data for that year.

A third of Member States have in certain years simply reported the value of their 2010 emission ceilings as their national projection (see Figure 3.4).

This occurred in the following instances:

- Bulgaria (2007–2010) (NH₃)
- Estonia (2004–2005)
- Finland (2010)
- France (2005)
- Greece (2004–2008) and for SO₂ (2007–2008)
- Lithuania (2004–2008)
- Slovenia (2004)
- Spain (2004–2005)
- Sweden (2004–2006)
- United Kingdom (2002–2006).

This occurred more often for NVMOCs and NH₃, and mainly in the early years of reporting under the NEC Directive, although Greece and Lithuania continued to report projections identical to the ceiling values until 2008, and Bulgaria until 2010 for NH₃. While reporting national ceilings as projections may in past years have perhaps reflected a certain political sentiment that the future ceiling would be met, it does not follow good practice requirements for the compilation and reporting of projections as laid out in the EMEP/EEA guidebook (EMEP/EEA, 2013 and earlier editions), as required in the NEC Directive. It is therefore positive that no Member State has continued this practice in recent years, except Bulgaria for NH₃ projections.

There are also a number of repeated values for the reported projections across the time series, indicating that Member States do not seem to have always respected the requirement of the NEC Directive that projections be prepared and annually updated.

i Sulphur dioxide (SO₂)

Figure 3.3 and Table 3.2 show the respective change in absolute and relative terms for the reported projections of SO₂ compared with the emission inventory data for 2010. Most Member States overestimated their national projections compared to the level of emissions reported in the emission inventory for 2010. Prior to 2010, just six Member States (Bulgaria, Estonia, Poland, Slovakia, Spain and the United Kingdom) reported projections that were lower than the eventual final emission inventory data for 2010.

In many instances, the magnitude of the overestimation was very high, by more than 200% for one or more years in the cases of Denmark, Hungary, Latvia, Lithuania and Portugal (although the overestimation in the case of Lithuania occurred as a result of their reporting of the emission ceilings value, as noted above). Even in years immediately prior to 2010, a number of Member States continued to report projections significantly higher than the final value of the emissions inventory data. In 2009 for example, 14 Member States (Austria, Belgium, the Czech Republic, Denmark, Finland, Greece, Hungary, Italy, Latvia, Malta, the Netherlands, Portugal, Romania and Slovenia) reported projections that were 20% or higher than the emission inventory data finally reported for the following year. In particular, three of these Member States (Hungary, Portugal and Romania) reported projections that were more than 100% higher than the 2010 inventory data.

Of the four pollutants regulated under the NEC Directive, emissions and projections of SO₂ would arguably be considered the least uncertain and the easiest to estimate. In general terms, this is due to the amount of SO₂ emitted to the atmosphere primarily being a simple function of the amount of fuel combusted and its sulphur content. Both are parameters for which relatively good projected statistical data and assumptions should be available. Clearly, many Member States were using incorrect or outdated assumptions within their projections concerning the amount, or shares of future fuel used (solid, gas, renewables, etc.) across the period. For the annual reporting at the end of the period (i.e. 2008–2010), the reporting of highly overestimated projections is especially surprising, as knowledge of the likely national economic activity and fuel use should have been relatively certain by that time. It is clear that the impacts of the economic recession in Europe may not have been adequately factored in, leading to many Member States overestimating the national projections, even in these latter years.

Despite the generally overestimated projections, there is evidence that the SO₂ projections did converge over time towards the value of the final emission inventory, as shown by the shift in colour-shading from dark to light in Table 3.2, particularly from 2007 onwards. Aggregating the Member States' data, the average overestimation for all countries that reported data in the 2002 or 2003 reporting round was 59%; in 2007 it was 30%, and in 2009 and 2010 it was just under 22%. In every Member State, the reported 2010 emission inventory data for SO₂ lay well below the value of the respective ceilings. Removing instances where Member States simply reported the value of the emission ceiling as their national projection does not change these values significantly.

Figure 3.3 SO₂: past projections, emission inventory data for 2010

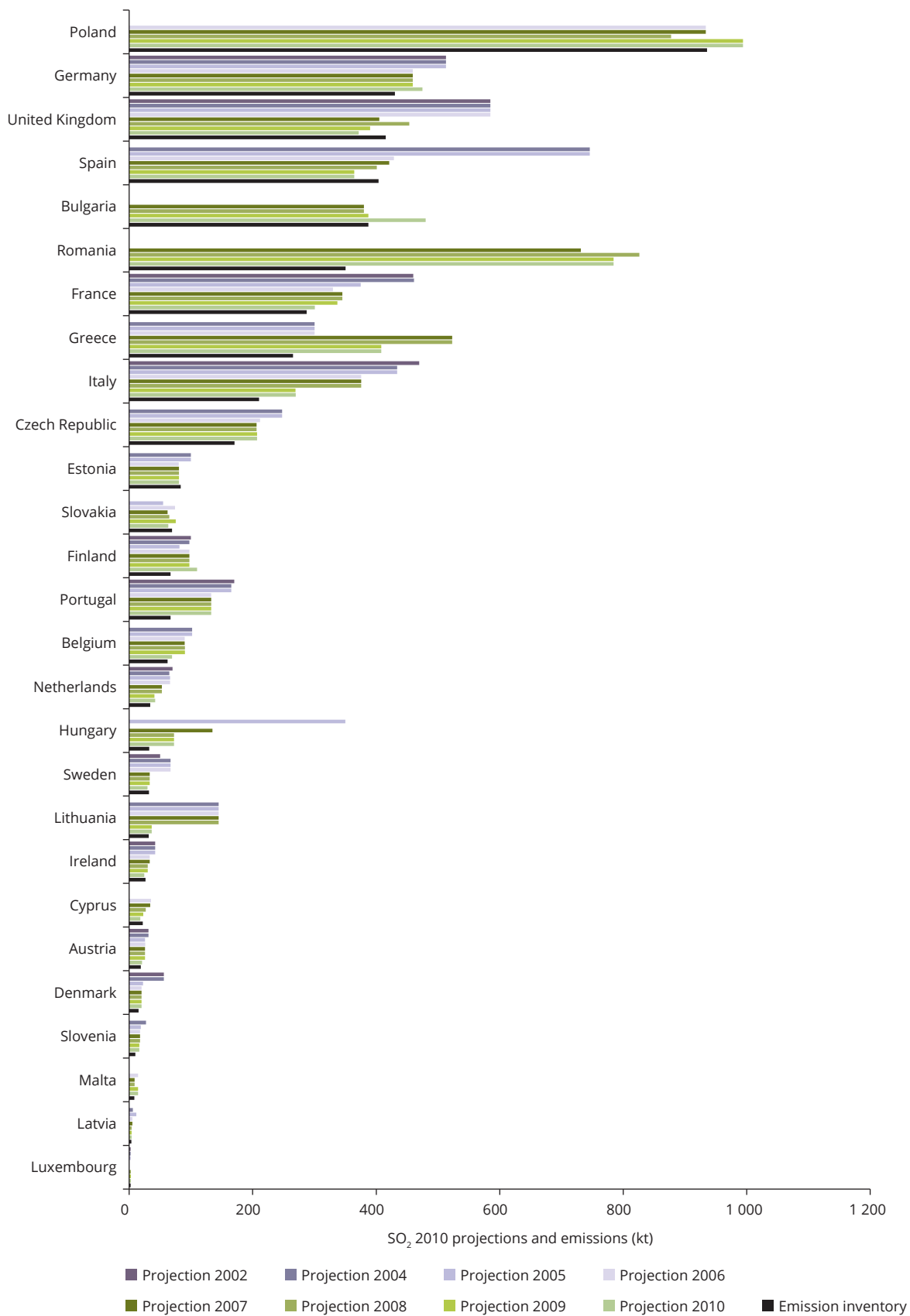


Figure 3.4 SO₂: Member State examples of reporting national emission ceilings as projections for 2010

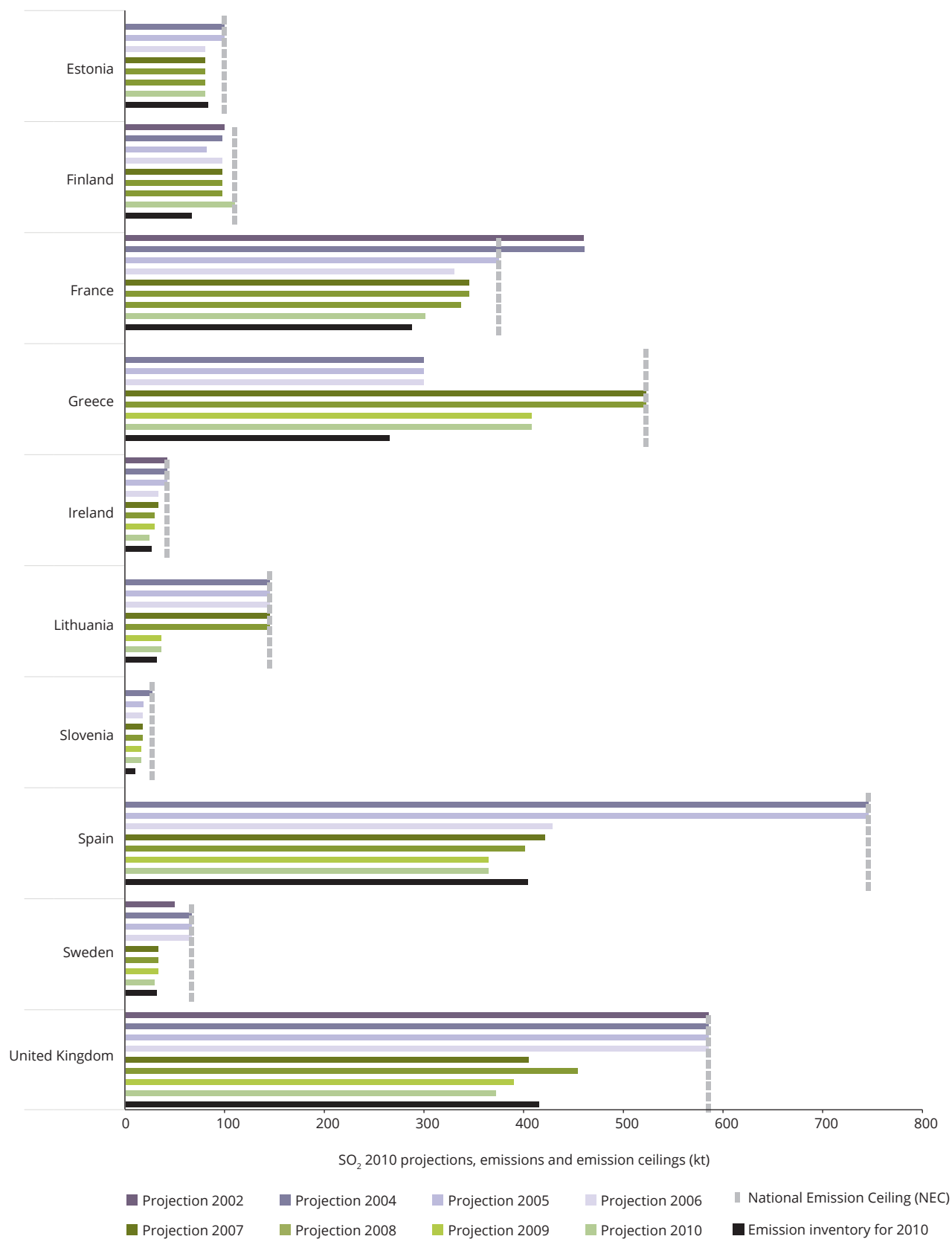


Table 3.2 SO₂: percentage difference between reported projections WEM and the emission inventory for 2010

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010
Austria	66%	66%	38%	40%	38%	38%	38%	12%
Belgium	—	64%	64%	44%	44%	45%	45%	11%
Bulgaria	—	—	—	—	- 2%	- 2%	0%	24%
Cyprus	—	—	—	59%	54%	22%	3%	- 18%
Czech Republic	—	45%	45%	24%	21%	21%	22%	22%
Denmark	275%	275%	51%	33%	33%	33%	34%	34%
Estonia	—	20% (*)	20% (*)	- 4%	- 3%	- 3%	- 3%	- 3%
Finland	50%	46%	22%	46%	46%	46%	46%	65% (*)
France	60%	60%	30% (*)	15%	20%	20%	17%	5%
Germany	19%	19%	19%	7%	7%	7%	7%	10%
Greece	—	13%	13%	13%	97% (*)	97% (*)	54%	54%
Hungary	—	—	984%	—	317%	124%	124%	124%
Ireland	60% (*)	60% (*)	60% (*)	26%	26%	14%	14%	- 7%
Italy	123%	106%	106%	79%	79%	79%	28%	28%
Latvia	—	76%	252%	56%	60%	23%	23%	23%
Lithuania	—	360% (*)	360% (*)	360% (*)	360% (*)	360% (*)	16%	16%
Luxembourg	5%	5%	5%	- 100%	- 100%	14%	14%	14%
Malta	—	—	—	75%	8%	8%	75%	75%
Netherlands	106%	91%	94%	94%	56%	56%	21%	24%
Poland	—	—	—	0%	0%	- 6%	6%	6%
Portugal	155%	147%	147%	99%	99%	99%	99%	99%
Romania	—	—	—	—	109%	136%	124%	124%
Slovakia	—	—	- 21%	7%	- 11%	- 6%	8%	- 9%
Slovenia	—	176% (*)	91%	78%	78%	78%	66%	66%
Spain	—	85% (*)	85% (*)	6%	4%	- 1%	- 10%	- 10%
Sweden	56%	110% (*)	110% (*)	110% (*)	3%	3%	3%	- 7%
United Kingdom	41% (*)	41% (*)	41% (*)	41% (*)	- 2%	9%	- 6%	- 10%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

ii Nitrogen oxides (NO_x)

The reported projections of NO_x were also generally overestimated over the period from 2001 compared with the emission inventory values for 2010, but significantly less so than for SO₂. The overall higher reliability of NO_x projections compared to SO₂ is surprising, given the generally acknowledged higher difficulty and greater uncertainty associated with estimating NO_x emissions — for which emissions are highly dependent on technological and process conditions rather than knowledge of the pollutant concentration in the fuel, as is the case for sulphur. It should be noted however, that this might be due to revisions of NO_x in a single year, which can be in either direction, and which can result in a great deal of cancellation. In contrast, the SO₂ emissions from different sources are strongly correlated, and a revision in the sulphur content of a fuel means that many sources are revised in the same direction.

Unlike all other NEC Directive pollutants, prior to 2008 the aggregated NO_x projections actually diverged from the 2010 emission inventory value, although as for SO₂, the projections converged to the final inventory emission value from 2007 onwards. For NO_x, the differences between the aggregated projections and inventories amounted on average to – 1% underestimated for the 2002 to 2003 projections, 1.3% overestimated for the 2005 projections, 10% for the 2007 projections and 5% for the 2009 projections. Before 2007, the relative differences for Member States tended to fluctuate without clear patterns over the years. In contrast to SO₂, however, around one-half of the Member States underestimated their NO_x emissions at some point, particularly in the cases of Finland, Germany and Luxembourg, each of which underestimated their emissions over most or all of the years preceding 2010.

Case study: SO₂ and NO_x projections reported by Germany

SO₂ projections

Early SO₂ projections reported by Germany overestimated the eventual 2010 emissions by around 19%, and for the years 2006 and following, by 7%. The air pollutant projections submitted in 2006 overestimated the actual gross energy consumption (by around 9%) and freight transport (by over 90%) compared to the 2014 inventory. Furthermore, oil use was overestimated by 50% and coal use underestimated by 40% in the 2006 projection. Despite the substantial difference in coal use, there was only a 7% difference in the SO₂ emissions per unit gross energy consumption between 2006 and 2010. Following 2006, the assumptions used in the national projections improved, resulting in much improved projection estimates for 2010.

NO_x projections

All reported projections prior to 2010 underestimated the eventual NO_x emissions, by as much as 16%. The underestimation in 2006 of 16% may be explained by the underestimated coal use in combustion processes in energy and industry. The NO_x projection for the transport sector made in 2006 was similar to the emissions inventory for 2010, despite the fact that freight transport activities (i.e. tonne-kilometres) were overestimated in the 2006 projection by more than 90%, and oil use by over 50%. This implies that the NO_x emissions in the transport sector per unit oil use were lower in the 2006 projection, compared to the final inventory. This is at least partly explained by the observed lower effectiveness of reducing NO_x by vehicle Euro standards, for which the differences in assumed effectiveness compared to the situation on the ground are well documented (e.g. EEA, 2013b).

Table 3.3 NO_x: percentage difference between reported projections WEM and the emission inventory for 2010

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010
Austria	1%	6%	17%	- 7%	4%	4%	- 1%	- 3%
Belgium		17%	17%	- 11%	- 11%	14%	14%	3%
Bulgaria					111% (*)	111% (*)	111% (*)	111% (*)
Cyprus				5%	5%	4%	3%	6%
Czech Republic		40%	40%	13%	15%	15%	14%	14%
Denmark	10%	11%	7%	3%	3%	- 5%	- 5%	- 5%
Estonia		63% (*)	63% (*)	6%	5%	5%	5%	5%
Finland	- 7%	- 9%	22%	- 9%	- 9%	- 9%	- 9%	2%
France	- 7%	- 7%	- 24% (*)	1%	4%	4%	0%	2%
Germany	- 15%	- 15%	- 15%	- 16%	- 16%	- 16%	- 16%	4%
Greece		8%	8%	8%	8%	0%	0%	19%
Hungary			22% (*)		30%	1%	1%	1%
Ireland	23%	23%	23%	28%	28%	34%	34%	11%
Italy	10%	11%	11%	10%	10%	-10%	1%	- 1%
Latvia		5%	16%	28%	33%	24%	24%	24%
Lithuania		83% (*)	83% (*)	83% (*)	83% (*)	83% (*)	-27%	- 27%
Luxembourg	- 21%	- 21%	- 21%			-29%	- 29%	- 29%
Malta				12%	- 3%	- 3%	12%	12%
Netherlands	6%	6%	6%	2%	- 4%	- 4%	- 10%	- 3%
Poland				- 1%	- 1%	4%	- 4%	- 4%
Portugal	40%	33%	33%	29%	29%	29%	29%	29%
Romania					41%	54%	61%	61%
Slovakia			8%	46%	30%	2%	23%	- 1%
Slovenia		1%	6%	10%	10%	10%	4%	4%
Spain		- 4%	- 4%	32%	37%	29%	22%	22%
Sweden	5%	0%	0%	21%	4%	1%	1%	- 5%
United Kingdom	4%	4%	4%	4%	16%	12%	8%	1%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

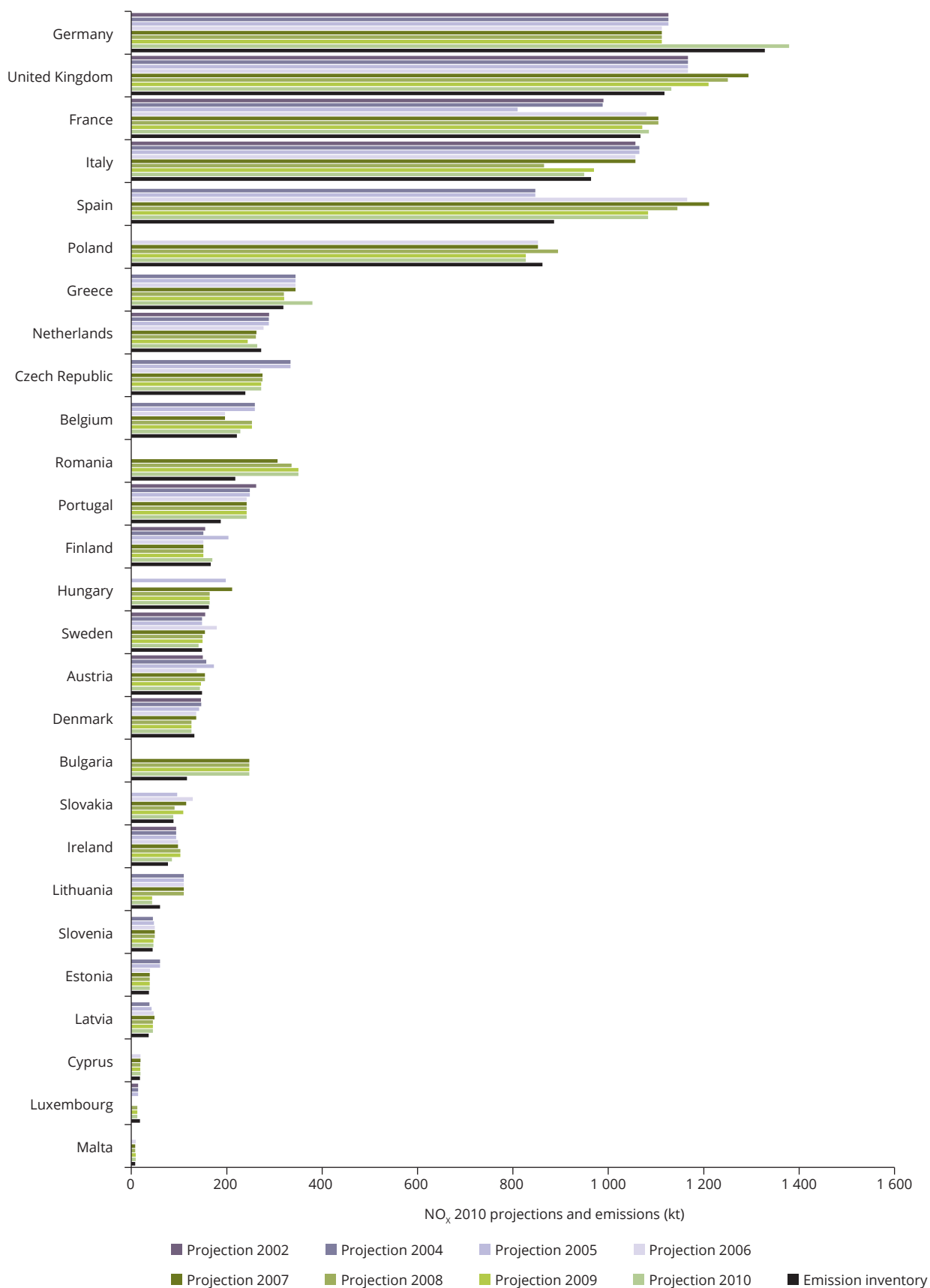
■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Figure 3.5 NO_x: past projections, emission inventory data and national emission ceilings for 2010



iii Non-methane volatile organic compounds (NMVOC)

The past reporting of NMVOC projections (Table 3.4 and Figure 3.6) again shows a general overestimation of the projections compared to the 2010 emission inventory values. However, the convergence of the past projections over time to the emission inventory value

for 2010 is less pronounced for NMVOC than for NO_x and SO₂, although the average overestimation between NMVOC projections and the emission inventory data for 2010 does converge from 19.3% in the 2004 projections to a 4.4% overestimation in the 2010 projections. For around half of the Member States, the differences between projections and inventories have tended to fluctuate over time without a clear trend.

Table 3.4 NMVOC: percentage difference between reported projections WEM and the emission inventory for 2010

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010
Austria	22%	15%	16%	14%	6%	6%	25%	17%
Belgium	—	27%	27%	12%	12%	16%	16%	- 3%
Bulgaria	—	—	—	—	88% (*)	88% (*)	88% (*)	88% (*)
Cyprus	—	—	—	- 14%	- 16%	- 32%	3%	- 6%
Czech Republic	—	35%	35%	10%	8%	8%	13%	13%
Denmark	- 4%	- 4%	- 4%	5%	2%	- 2%	- 2%	4%
Estonia	—	40% (*)	40% (*)	17%	16%	16%	16%	16%
Finland	12% (*)	12% (*)	19%	12% (*)	12% (*)	12% (*)	12% (*)	12% (*)
France	17%	17%	28% (*)	30%	30%	30%	28% (*)	- 4%
Germany	16%	16%	16%	- 4%	- 4%	- 4%	- 4%	30%
Greece	—	41% (*)	41% (*)	41% (*)	41% (*)	41% (*)	32%	32%
Hungary	—	—	26% (*)	26%	24%	14%	14%	14%
Ireland	44%	44%	44%	20% (*)	20% (*)	17%	17%	7%
Italy	3%	3%	3%	- 13%	- 13%	- 13%	- 15%	- 14%
Latvia	—	27%	12%	16%	23%	5%	5%	5%
Lithuania	—	49% (*)	49% (*)	49% (*)	49% (*)	49% (*)	- 9%	- 9%
Luxembourg	- 15%	- 15%	- 15%	—	—	5%	5%	5%
Malta	—	—	—	52%	41%	41%	52%	52%
Netherlands	47%	34%	18%	8%	3%	8%	- 4%	- 3%
Poland	—	—	—	- 2%	44%	45%	- 8%	- 8%
Portugal	49%	35%	35%	9%	9%	9%	9%	9%
Romania	—	—	—	—	- 5%	- 5%	- 6%	- 6%
Slovakia	—	—	35%	38%	38%	56%	11%	7%
Slovenia	—	16% (*)	6%	7%	7%	7%	10%	10%
Spain	—	5%	5%	41%	33%	21%	24%	24%
Sweden	44%	28% (*)	28% (*)	28% (*)	- 3%	- 11%	- 11%	- 12%
United Kingdom	39% (*)	39% (*)	39% (*)	39% (*)	- 6%	- 9%	- 6%	- 10%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

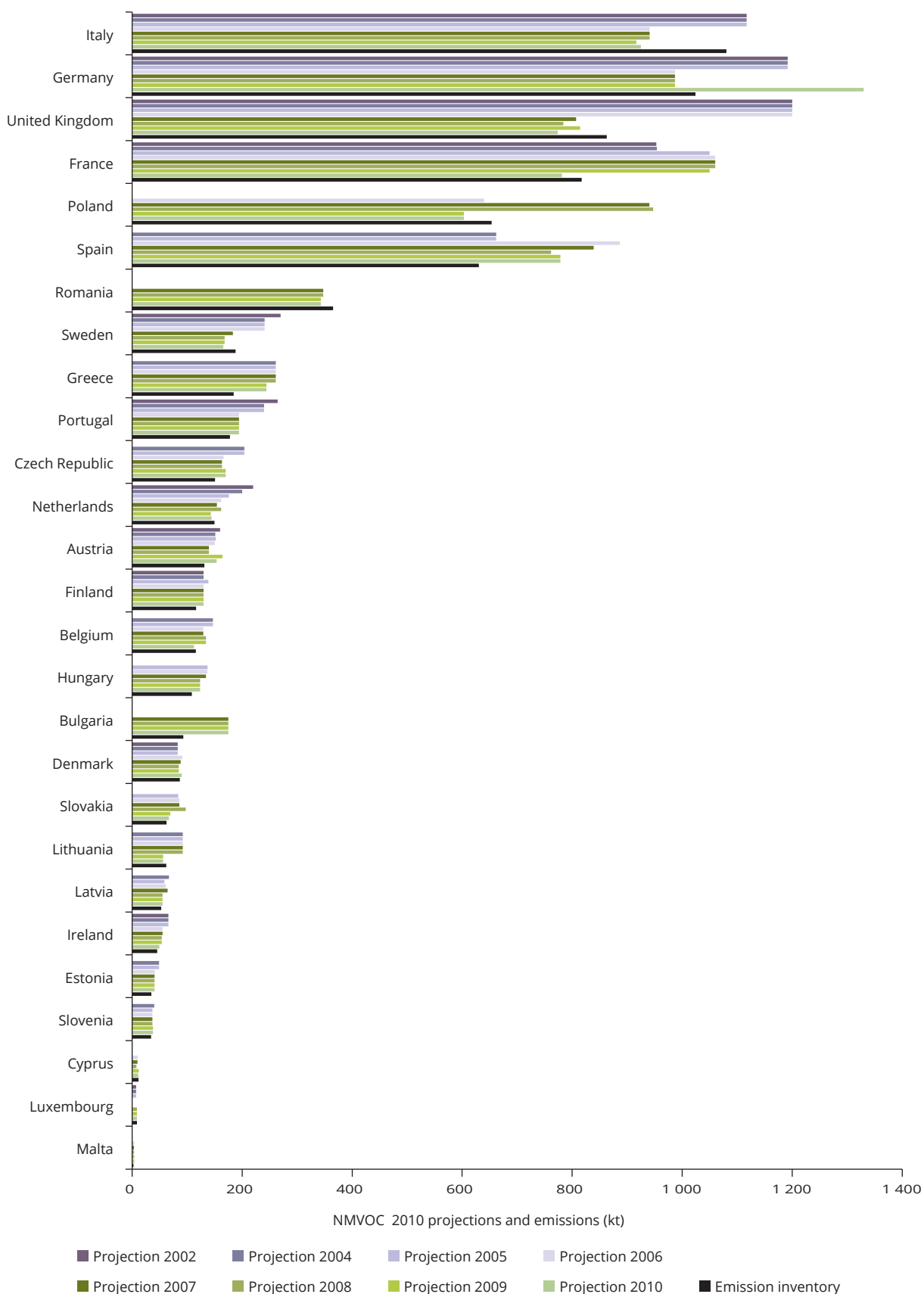
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■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Figure 3.6 NMVOC: past projections, emission inventory data for 2010



iv Ammonia (NH₃)

On average, the differences between NH₃ projections and the 2014 inventory (Table 3.5 and Figure 3.7) range from 12% in the 2004 projections to 6.5% in the 2010 projections. For NH₃, most Member States show a good correspondence between inventory and projections, even in the early projection years. Only a few Member States show larger differences (> 25%) in projected NH₃ emissions over the time series, including Bulgaria

and Lithuania (both of which reported the value of the emission ceilings as their national projection), Estonia, Hungary, Malta, Portugal and Romania. The vast majority of NH₃ emissions are released by the agriculture sector, 94% in 2010 (EEA, 2014b). As the national NH₃ projection estimates are largely dependent on the reliability of assumptions and data for just this one sector, there is a lesser degree of complexity for NH₃ projections compared to the other NEC Directive pollutants that are emitted across a greater number of sectors.

Table 3.5 NH₃: percentage difference between reported projections WEM and the emission inventory for 2010

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010
Austria	- 17%	- 17%	- 16%	- 3%	- 2%	- 2%	- 2%	- 1%
Belgium	—	22%	22%	1%	1%	- 1%	- 1%	- 4%
Bulgaria	—	—	—	—	113% (*)	113% (*)	113% (*)	113% (*)
Cyprus	—	—	—	- 9%	- 18%	9%	13%	- 3%
Czech Republic	—	18%	18%	- 8%	- 12%	- 13%	- 13%	- 13%
Denmark	13%	14%	- 14%	- 11%	- 11%	- 11%	- 11%	- 6%
Estonia	—	183% (*)	183% (*)	- 12%	- 14%	- 14%	- 14%	- 14%
Finland	- 25%	- 18% (*)	- 14%	- 18% (*)	- 18% (*)	- 18% (*)	- 18% (*)	- 18% (*)
France	24%	24%	13% (*)	6%	6%	6%	6%	6%
Germany	7%	7%	7%	11%	11%	11%	11%	6%
Greece	—	13% (*)	13% (*)	13% (*)	13% (*)	- 2%	- 7%	- 7%
Hungary	—	—	7%	—	33%	19%	19%	19%
Ireland	2%	2%	2%	- 5%	- 5%	- 3%	- 3%	- 2%
Italy	14%	14%	14%	10%	10%	10%	8%	8%
Latvia	—	- 15%	- 25%	- 22%	- 19%	- 24%	- 24%	- 24%
Lithuania	—	121% (*)	121% (*)	121% (*)	121% (*)	121% (*)	45%	45%
Luxembourg	19%	19%	19%	—	—	1%	1%	1%
Malta	—	—	—	48%	48%	48%	48%	48%
Netherlands	19%	- 6%	- 1%	- 1%	- 2%	- 4%	1%	3%
Poland	—	—	—	11%	11%	11%	5%	5%
Portugal	89%	83%	83%	44%	44%	44%	44%	44%
Romania	—	—	—	—	28%	28%	29%	29%
Slovakia	—	—	20%	- 4%	- 4%	9%	6%	6%
Slovenia	—	15% (*)	17%	10%	10%	10%	13%	13%
Spain	—	- 9%	- 9%	2%	- 4%	0%	- 2%	- 2%
Sweden	0%	10% (*)	10% (*)	10% (*)	- 3%	- 3%	- 3%	- 8%
United Kingdom	6%	6%	6%	6%	4%	5%	3%	3%

Note: — : no submission

(*): projections correspond to national ceiling amount

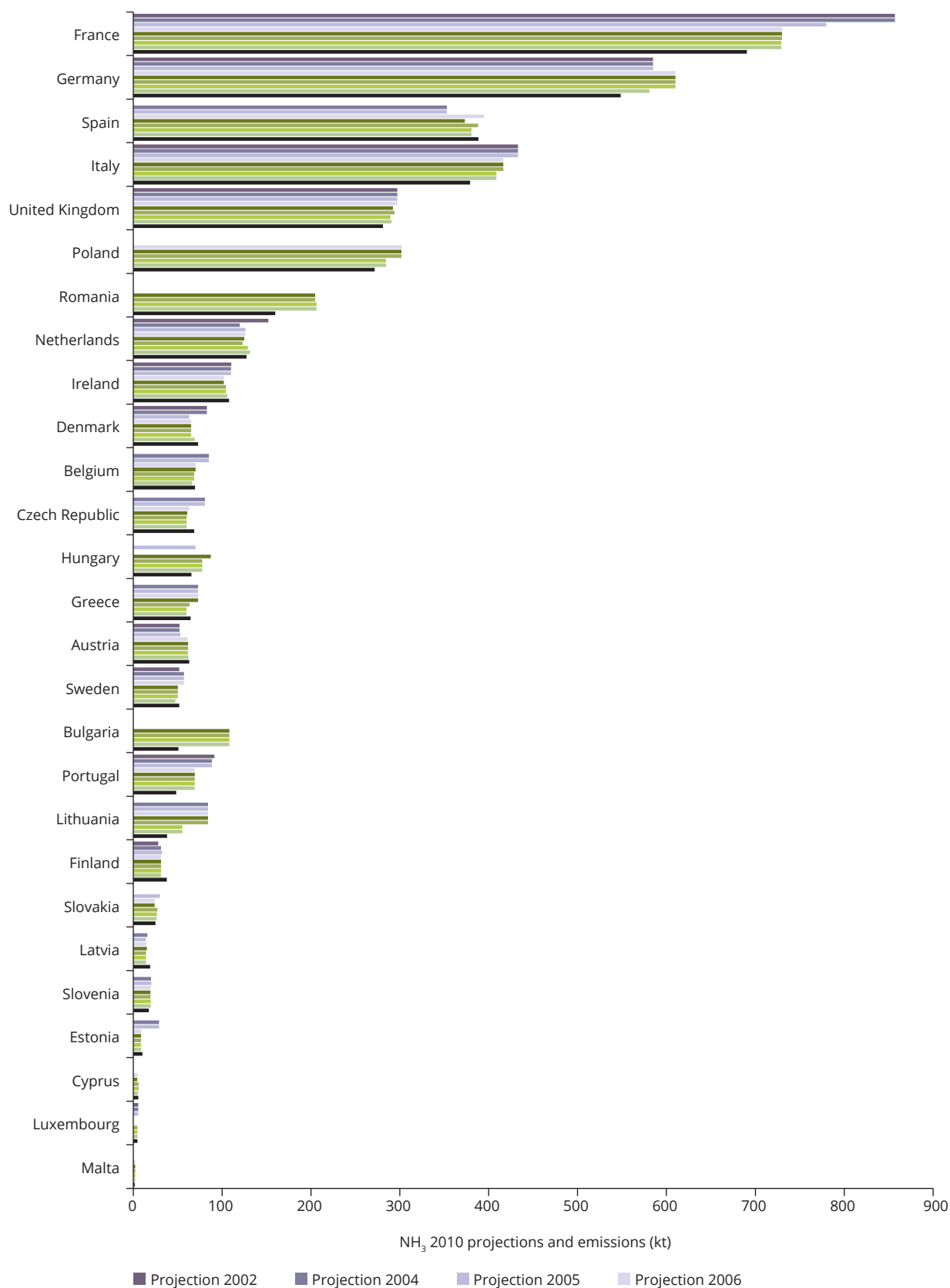
□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

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■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Figure 3.7 NH₃: past projections, emission inventory data for 2010

3.4 Observations concerning 'fitness for purpose' of reported air pollutant projections

Unlike the MMD, the NEC Directive does not make any explicit reference to the intended purpose of the reported projections. It may be assumed that their main purpose is for the monitoring of progress in meeting emission ceilings, as the directive specifies, for emission inventories.

On this basis, the generally consistently overestimated projected emissions, also in years immediately prior to 2010 for which an improved accuracy might have been expected, will have contributed to potentially incorrect assumptions being made concerning the overall progress in meeting the ceilings. As was observed for GHGs, the NEC Directive projections did generally converge over time towards the value of the final 2010 emissions inventory, with the exception of NO_x, for which convergence only started from 2007 onward — just two years before the target year. At the level of individual Member States, the overall trends of reported projections were often rather unclear.

In terms of being able to make an early assessment of the impacts of the NEC Directive upon national emissions, it is cause for concern that even in 2010, the final year in which 'projections' were reported, many Member States were greatly overestimating their projections compared to the values in the emission inventories first reported just one year later. For example, aggregated SO₂ projections for 2010 were 22% higher than the final emission inventory data for

that year, but in some Member States the difference was more than 100%, and in four others more than 50% higher (Finland, Greece, Malta and Slovenia) (Table 3.2). Aggregated NH₃ projections reported in 2010 were 6.5% higher, NO_x 7% higher and NMVOC 4.4%.

Limited accompanying information was provided by Member States, often differing in detail and completeness, which hindered any detailed assessment of the reasons for past discrepancies between projections and the final emissions inventory data. Without improved information from countries, understanding the reasons for changes in the reported projections over time is difficult. The annual projections data reported cannot therefore be considered transparent. In particular, and as in the case of GHGs, there was very little information available on the link between policies and measures and projections. However, this situation was somewhat improved with respect to the information available in the national programme reports submitted in 2002 and 2006. While earlier assessments of the national programmes (ENTEC, 2005; AEAT, 2008) highlighted the sometimes incomparable and inconsistent nature of information reported by Member States, in general the level of information available in these years was much improved. The availability of specific guidance for the development of the national programmes (e.g. CAFE, 2006) will have contributed to this. It is clear, however, that the explanatory information on annual projection submissions by Member States does not easily facilitate a proper assessment of the monitoring of progress towards meeting the emission ceilings.

4 Conclusions and recommendations

The objectives of this report included comparing differences between past emission projections reported by Member States under the GHG MMD and the NEC Directive and the latest emission inventory. Based on this assessment and on observations made in the process of monitoring, reporting and interpreting emission projections over the last decade, this chapter presents a series of general recommendations to help improve the 'fitness for purpose' of projections information being reported under the NEC Directive and the new GHG MMR.

Improving overall quality of national projections

Despite the fact that reporting guidance was made available and quality criteria were defined for Member States, so that projections could be reported with a consistent and comparable level of quality, the quality of projections reported under the NEC Directive and the MMD varied widely across different Member States.

For GHGs, significant quality issues of Member States' emission projections framework were assumed to exist if the year 2010 was overestimated or underestimated by more than the country-specific uncertainty of the Member States' emission inventory for both submissions close to 2010, i.e. 2009 and 2011. The national framework in which projections are developed was for some Member States not capable of reflecting the most recent circumstances and developments in the preparation of their emission projections of the year 2010 for reporting in 2009 and 2011. These countries were Lithuania, Portugal and Romania. Bulgaria did not report projections in 2009, and exceeded the threshold in its 2011 submission. Poland did not report projections in 2009 and 2011. Under the new MMR, the role of quality control and quality assurance systems for GHG projections is strengthened, as Member States and the EU are formally required to set up, operate and seek to improve national and EU systems for reporting on policies and measures and projections.

For air pollutants, in certain years a third of the Member States have simply reported the value of their 2010 emission ceiling as their WM scenario; this is not in line

with good practice requirements for the compilation and reporting of projections as laid out in the EMEP/EEA guidebook (EMEP/EEA, 2013, and earlier editions). For SO₂, a difference of more than 200% was observed for one or more years in the cases of Denmark, Hungary, Latvia, Lithuania and Portugal. In 2009, immediately before the target year 2010, three Member States reported overestimations of more than 100% (Hungary, Portugal and Romania). For NO_x, Bulgaria, Lithuania and Romania showed differences higher than 50% in at least one of the later submission years 2008, 2009 and 2010. Bulgaria, Malta and Slovakia showed overestimates above 50% in at least one of the submission years 2008, 2009 and 2010 for NMVOC. For NH₃ and the same submission years, Bulgaria and Lithuania overestimated their projected emissions for the year 2010 by more than 100%.

The significant differences between projected values for 2010 in submission years 2009 and 2011 for GHGs, and in submission years 2008, 2009 and 2010 for air pollutants show that some countries are still facing major problems in developing reliable projections. This means that targeted capacity-building efforts should be further continued. Furthermore, Member States must also allocate sufficient resources in order to ensure a functioning national system for the development of emission projections.

Improving the implementation of existing reporting requirements for WEM and projections information

Despite the formal requirements that Member States regularly report projections data, in practice, not all Member States reported data in each of the years for which reporting was required. For example, for GHGs in 2005, less than half of Member States submitted a WEM scenario. In 2007, more than two-thirds of the Member States reported a WEM, and the completeness of reporting further increased significantly over the years.

While the completeness of reporting projection scenarios has improved, various Member States were still not reporting background parameters, key socio-economic parameters, indicators or explanatory reports

underpinning the reported projections in 2010, despite it being mandatory to do so. For example, the availability of key socio-economic parameters for NEC Directive projections was extremely poor. Only 13 Member States provided information on socio-economic assumptions alongside their 2010 air pollutant projections.

The shortage of detailed underpinning explanatory data severely hampers a more in-depth analysis and cross-comparison of reported projections. For both GHGs and air pollutants, if detailed understanding of the information projections reported by Member States is to be achieved, then an increased focus on the implementation of and compliance with reporting obligations is needed.

Improving the implementation of existing reporting requirements for WAM and WOM scenarios

If emission projections are to properly inform policymakers about the progress being made towards achieving policy targets, the projected trends of a set of scenarios should be taken into consideration, together with background information on how implemented and planned policies and measures have been integrated in the different scenarios. A WOM and a WAM scenario should complement the interpretation of the projected progress to target assessment of a WEM scenario, as differences in these scenarios, shed light on the sum of policy effects of either implemented measures (WEM-WOM) or additional measures (WAM-WEM).

Under the MMD as well as under the NEC Directive, only WEM and WAM scenarios were requested from Member States. Under the NEC Directive, reporting of WAM projections tends (somewhat implicitly) to be required only where WEM projections indicate a future exceedance or non-attainment of policy objectives, i.e. in situations where the onus is on the country to show that policy objectives can be met by implementing additional policies and measures. Consequently, 13 Member States did not report WAM scenarios between 2002 and 2010 under the NEC Directive. For GHGs, two Member States, Poland and Hungary, both reported just one set of projections during the entire reporting period. Poland and the United Kingdom did not provide WAM scenarios, and Denmark and Hungary reported only one WAM between 2005 and 2011. The new MMR still requests that Member States report a WEM scenario, whereas WAM and WOM scenarios only need to be reported 'where available'. A renewed focus on Member States making such information available would be essential in order to appropriately inform distance-to-target assessments, and to track the extent to which policies are being incorporated in national projections.

Increasing the transparency of reported projections and the link to policies and measures

The identification and interpretation of projections scenarios is not straightforward, as there remains a very wide variety in the consistency and level of detail of information reported across Member States. More generally, the continuing lack of a comparable set of background data reported at a sufficient level of detail by each Member State constrains a more exhaustive assessment of the reported projections.

Clearer reporting guidance for Member States in this area would greatly assist a thorough understanding of the reported progress being made to targets, especially for air pollutants and the NEC Directive, which includes less detailed guidance than the MMD for GHGs. Most importantly, information concerning the manner and degree to which policies and measures are incorporated in different national projection scenarios is generally poor. Detailed information on the timing of implementation plans and assumptions around conditions for implementation of different policies is not reported satisfactorily by Member States. The MMD required Member States to separately report information on policies and measures, together with a clear identification of policies and measures included in the projections. The standard of this information has varied greatly over past years (e.g. EEA, 2013a). The new MMR asks more explicitly for the link to be made between policies and measures and their impact in projections. There is no such comparable reporting required under the NEC Directive.

Exercising caution in interpreting reported projections

For both the MMD and NEC Directive, the core purpose of reporting projections is to provide an early assessment of progress being made in achieving policy targets. In this context, the WEM scenario should ideally converge to the eventual emission inventory value ultimately reported for that year.

Such convergence would have occurred as a result of two factors (or a combination thereof):

- inclusion of the foreseen impacts arising from newly implemented policies will reduce the projected emissions and lead to a convergence over time with the emission inventory data;
- inclusion of more reliable assumptions and underpinning socio-economic forecasts into the national projection models as the 2010 reporting

year approached, i.e. knowledge of the potential activity and economic data should have become more reliable and the projections less uncertain as 2010 approached.

It is clear that there are systematic differences between the projections reported over past years and the eventual emission inventory data for 2010. For all air pollutants and GHGs, there was a common trend: the reported projections overestimated the eventual 2010 emissions, albeit to a greater extent for air pollutants than for GHG projections. Even in years immediately prior to 2010, there were several instances for which the difference between reported projections and final emissions inventory data exceeded 100% in certain Member States.

In terms of assessing the reasons for past changes in the trend of projection values, the major problematic issue is that it is not possible, on the basis of the information reported by Member States under either the NEC Directive or GHG MMD legislation, to properly ascertain the reasons for such convergence. More consistent and complete information on national policies and measures and the links between measures and projections would have been needed to identify the policies- and measures-related reasons which are ultimately the main driving factors of interest in the WEM, WAM and WOM set of scenarios, when it comes to monitoring Member States' progress in meeting targets.

There are, of course, a number of possible causes of discrepancies between projections and the final value of emissions reported in a target year.

Such reasons include:

- policies introduced in addition to those planned, and not included in the WEM or WAM scenarios (e.g. change in climate strategy due to changes in government, for instance);
- policies included in the scenarios that fail on the ground;
- overestimated or underestimated reduction effects and/or penetration rate of policies and measures included in projections;
- rebound effects or interactions between policies and measures overestimated, underestimated or not considered in scenarios;

- changing trends or misinterpreted trend expectations for key parameters or poor quality of statistical inputs (e.g. concerning the economy, energy, fuel-prices, traffic);
- uncertainties intrinsic to the modelling used to project model parameters;
- outdated emission projections;
- unforeseeable events that cause differences between rates of economic activities compared to what was originally projected, e.g. the economic recession in recent years, or political decisions affecting fuel use such as the closure of nuclear plants;
- errors in the reported data.

For the EU-27 ⁽⁶⁾ as a whole, and in a number of Member States, however, the reported projections have, to some extent, converged towards the final reported emission inventory data. The reliability of the reported projections, in terms of their ability to inform distance-to-target assessments, has therefore improved over the period. This picture of general convergence of projections towards emissions in the target year implies that policymakers should remain aware of the high degree of uncertainty inherent in projections, especially in years distant from a target year. It is cause for some concern that even in years immediately preceding the target year of 2010, many Member States continued to significantly overestimate their projections.

Improving reporting to better understand uncertainties associated with projection estimates

The reporting of a WEM scenario alone does not inherently allow the communication of information concerning their associated intrinsic uncertainty — they present only a single perspective on the future, based upon a fixed set of assumptions for key projection parameters. Reporting requirements under the NEC Directive did not inherently require projections to address uncertainty, focusing instead on the provision of a central WM scenario, based upon existing and future policy measures and also upon a fixed set of assumptions for key projection parameters. For GHG projections, Member States were required to address uncertainty and provide sensitivity analyses of their

⁽⁶⁾ Croatia only joined the EU in 2013, and therefore did not report emission projections under the MMD or NEC Directive before, it is not included in this report.

projections. Moreover, they were encouraged to develop and report high, central and low scenarios, which were not provided by Member States. A detailed provision of sensitivity scenarios is again strengthened within the new MMR.

If policymakers wish to better understand the likely impact upon future emissions of 'unforeseeable' events (e.g. a significant reduction of GDP which might occur in a period of unexpected economic recession), strengthening compliance measures that help enhance the reporting of a meaningful sensitivity analysis would be beneficial.

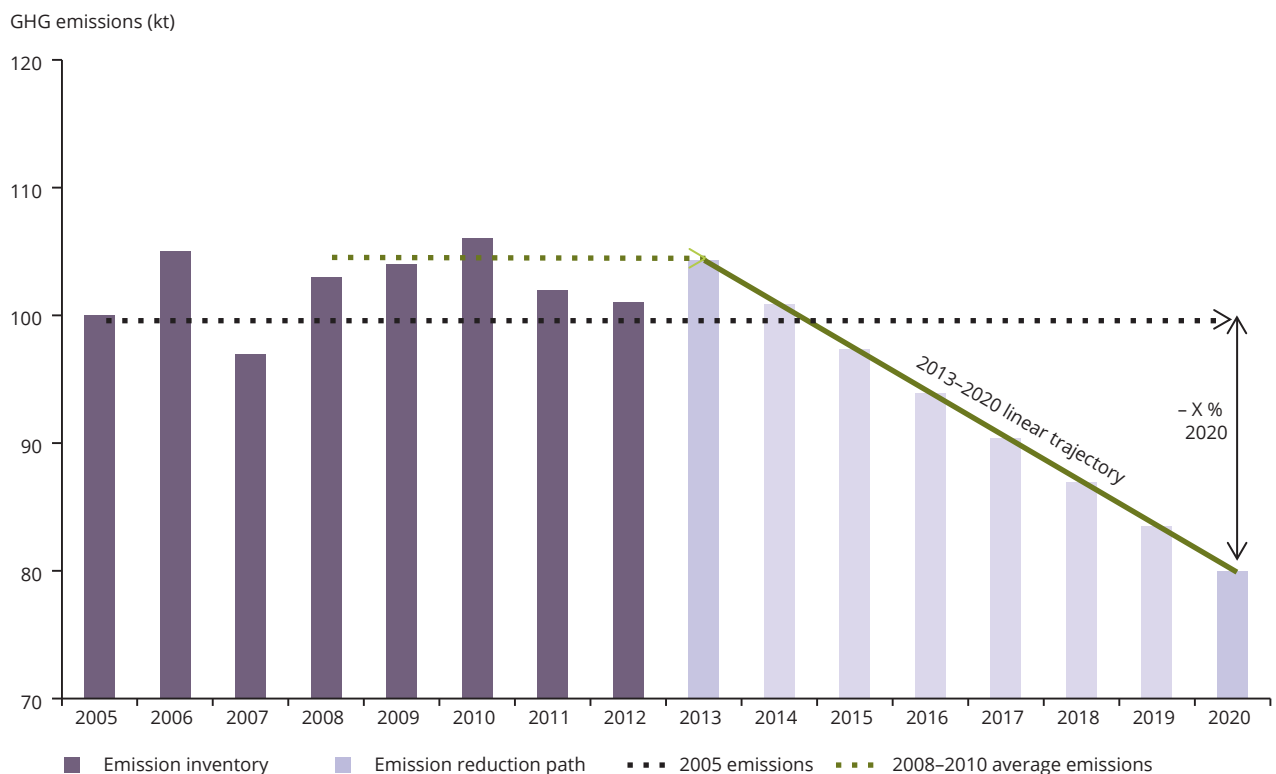
Promoting complementary methods for assessing progress to policy targets

This assessment has shown that although the reliability of projection estimates did improve over time, in a number of instances, the reported projections provided a significantly overestimated picture of the emissions, even in years immediately preceding 2010. The uncertainty intrinsic to projections can hamper the robustness of (additional) policy decisions being considered on the basis of these values alone, particularly if based upon a single scenario.

One illustration of a complementary system for monitoring 'distance to target', compared to a system based solely upon projected scenarios, is using analyses based upon current emission inventory values relative to a target trajectory. An example where this approach has been incorporated into EU legislation is provided by the EU Effort Sharing Decision (ESD) for GHGs (EU, 2009): national limits or a target trajectory that Member States must meet are defined in tonnes for each year from 2013 to 2020. The use of a target trajectory towards the compliance date very much reduces the reliance upon projections alone in the policy decision framework, although higher costs associated with the reviewing of emissions for the annual compliance cycle are likely to be incurred.

Projections are important for tracking progress towards policy targets, and especially for longer term evaluation of progress, such as for 2030 or 2050, projections will remain the main tool. Target trajectories will not be universally rolled out across all policies, but it is recommended that the evaluation process place more emphasis on the years preceding a target year, and apply an approach combining current and projected progress. Policymakers need to acknowledge the uncertainties inherent in projections, but countries can do more to make their projections more robust and transparent.

Figure 4.1 Illustration of the required ESD emissions trajectory for a Member State with a negative GHG emission limit in 2020, compared to 2005 emission levels



Units and abbreviations

BaU	Business as usual (projections)
CAFE	Clean Air For Europe
CDR	Eionet Central Data Repository
CLE	Current legislation (projections)
CO ₂	Carbon dioxide
CO ₂ -equivalent	Carbon dioxide equivalent
DG	Directorate-General
EEA	European Environment Agency
Eionet	European Environment Information and Observation Network of the EEA
EMEP	Cooperative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe
ESD	EU Effort Sharing Decision (406/2009/EC)
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation.
EU	European Union
EU-27	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, the United Kingdom
GDP	Gross domestic product
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
kt	kilo (thousand) tonnes
LRTAP Convention	UNECE Convention on Long-range Transboundary Air Pollution
LULUCF	Land Use, Land Use Change, and Forestry sector
Mg	1 megagram = 10 ⁶ g = 1 tonne (t)
MMD	EU Monitoring Mechanism Decision (280/2004/EC)

Units and abbreviations

MMR	EU Monitoring Mechanism Regulation (No 525/2013)
Mt	Mega (million) tonnes
NEC	National Emission Ceilings (Directive) (2001/81/EC)
NH ₃	Ammonia
NMVOG	Non-methane volatile organic compound(s)
NO _x	Nitrogen oxides
PBL	Netherlands Environmental Assessment Agency
QA/QC	Quality assurance/quality control
RIVM	Netherlands National Institute for Public Health and the Environment
SO ₂	Sulphur dioxide
t	1 tonne (metric) = 1 megagram (Mg) = 10 ⁶ g
TNO	Netherlands Organisation for Applied Scientific Research
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VITO	Flemish Institute for Technological Research
WAM	With additional measures (projection)
WEM	With existing measures (projection)
WM	With measures (projection)
WOM	Without measures (projection)

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Annex 1 Differences between sectoral GHG projections and emission inventory data for 2010

The following tables illustrate the relative differences (%) between WEM sectoral projections and the GHG emission inventory data reported for the year 2010.

Comparisons were performed for the following aggregated sectors:

- energy
- industrial processes
- solvent use
- agriculture
- waste.

Values indicate the percentage underestimation or overestimation of the projection compared to the emission inventory value. For example, projections for the industrial processes sector compiled by Belgium in 2005 are 23% higher compared to the inventory; by contrast, Slovakia underestimated their emissions for industrial processes by 42% in the same reporting year.

Table A1.1 GHGs: relative difference between reported WEM projections and emissions inventory data for 2010 for the energy sector

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011
Austria	—	—	13%	0%
Belgium	12%	7%	2%	0%
Bulgaria	—	50%	50%	10%
Cyprus	—	31%	16%	6%
Czech Republic	3%	4%	- 2%	- 8%
Denmark	21%	11%	7%	2%
Estonia	—	—	- 26%	- 1%
Finland	8%	17%	10%	0%
France	—	—	7%	- 2%
Germany	—	0%	- 1%	- 1%
Greece	29%	—	20%	11%
Hungary	—	—	—	- 3%
Ireland	—	—	11%	2%
Italy	18%	—	10%	1%
Latvia	25%	—	24%	- 8%
Lithuania	73%	73%	71%	13%
Luxembourg	—	—	11%	0%
Malta	—	—	0%	- 10%
Netherlands	- 20%	- 19%	- 1%	- 4%
Poland	—	7%	—	—
Portugal	—	32%	25%	25%
Romania	—	64%	46%	51%
Slovakia	50%	49%	25%	- 10%
Slovenia	6%	8%	8%	1%
Spain	—	28%	15%	- 2%
Sweden	13%	10%	- 1%	- 9%
United Kingdom	2%	7%	2%	- 2%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Table A1.2 GHGs: relative difference between reported WEM projections and emissions inventory data for 2010 for the industrial processes sector

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011
Austria	—	—	3%	3%
Belgium	11%	10%	21%	0%
Bulgaria	—	99%	99%	57%
Cyprus	—	- 20%	14%	- 10%
Czech Republic	14%	23%	25%	15%
Denmark	54%	59%	52%	6%
Estonia	—	—	24%	- 2%
Finland	- 13%	23%	14%	- 12%
France	—	—	12%	2%
Germany	—	45%	37%	37%
Greece	32%	—	- 19%	- 21%
Hungary	—	—	—	- 34%
Ireland	—	—	51%	- 7%
Italy	32%	—	12%	- 4%
Latvia	- 48%	—	13%	- 3%
Lithuania	- 82%	125%	125%	63%
Luxembourg	—	—	35%	4%
Malta	—	—	- 30%	- 40%
Netherlands	310%	315%	8%	- 7%
Poland	—	- 18%	—	—
Portugal	—	25%	51%	51%
Romania	—	113%	101%	102%
Slovakia	- 41%	- 33%	- 26%	32%
Slovenia	47%	40%	0%	- 11%
Spain	—	31%	18%	- 2%
Sweden	- 10%	- 10%	- 9%	- 7%
United Kingdom	37%	- 8%	- 8%	2%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Table A1.3 GHGs: relative difference between reported WEM projections and emissions inventory data for 2010 for the solvents and other product use sector

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011
Austria	—	175%	26%	- 2%
Belgium	20%	17%	2%	0%
Bulgaria	—	—	—	—
Cyprus	—	—	—	—
Czech Republic	- 1%	1%	2%	2%
Denmark	177%	44%	56%	30%
Estonia	—	—	—	—
Finland	—	50%	134%	14%
France	—	—	- 14%	- 15%
Germany	—	- 40%	- 40%	- 40%
Greece	- 49%	—	- 49%	0%
Hungary	—	—	—	31%
Ireland	—	—	19%	0%
Italy	—	—	29%	12%
Latvia	377%	—	51%	- 44%
Lithuania	—	—	- 3%	- 2%
Luxembourg	—	—	33%	14%
Malta	—	—	5 332%	—
Netherlands	—	—	—	- 21%
Poland	—	- 62%	—	—
Portugal	—	27%	44%	44%
Romania	—	357%	124%	116%
Slovakia	—	- 74%	- 70%	6%
Slovenia	15%	15%	38%	2%
Spain	—	- 47%	- 42%	- 13%
Sweden	- 22%	- 10%	- 7%	- 6%
United Kingdom	—	—	—	—

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Table A1.4 GHGs: relative difference between reported WEM projections and emissions inventory data for 2010, for the agriculture sector

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011
Austria	- 3%	3%	5%	1%
Belgium	14%	5%	- 8%	- 5%
Bulgaria	—	35%	36%	- 4%
Cyprus	—	10%	27%	3%
Czech Republic	- 2%	1%	0%	0%
Denmark	- 1%	- 1%	4%	1%
Estonia	—	—	- 7%	- 3%
Finland	12%	- 20%	- 5%	- 2%
France	—	- 4%	1%	4%
Germany	—	- 12%	- 11%	- 11%
Greece	32%	—	9%	- 6%
Hungary	—	—	—	4%
Ireland	—	- 1%	- 3%	- 2%
Italy	7%	—	9%	1%
Latvia	- 29%	—	- 16%	- 4%
Lithuania	- 62%	9%	- 7%	- 1%
Luxembourg	—	—	5%	- 2%
Malta	—	—	- 11%	22%
Netherlands	52%	58%	11%	12%
Poland	—	1%	—	—
Portugal	—	15%	16%	16%
Romania	—	- 10%	26%	26%
Slovakia	- 10%	- 12%	- 27%	- 4%
Slovenia	12%	11%	7%	8%
Spain	—	9%	9%	- 5%
Sweden	3%	3%	3%	3%
United Kingdom	- 5%	- 9%	- 5%	2%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Table A1.5 GHGs: relative difference between reported WEM projections and emissions inventory data for 2010, for the waste sector

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011
Austria	54%	22%	6%	1%
Belgium	59%	- 10%	- 17%	- 19%
Bulgaria	—	- 4%	- 4%	87%
Cyprus	—	- 66%	- 60%	- 75%
Czech Republic	- 17%	- 22%	1%	1%
Denmark	32%	36%	39%	31%
Estonia	—	—	36%	39%
Finland	7%	8%	7%	2%
France	—	- 31%	- 50%	- 42%
Germany	—	- 16%	- 19%	- 19%
Greece	- 24%	—	- 43%	- 25%
Hungary	—	—	—	- 3%
Ireland	—	106%	129%	37%
Italy	- 35%	—	- 7%	- 2%
Latvia	40%	—	20%	31%
Lithuania	- 22%	18%	- 24%	16%
Luxembourg	—	—	- 11%	6%
Malta	—	—	- 20%	- 2%
Netherlands	- 6%	- 6%	- 4%	- 6%
Poland	—	19%	—	—
Portugal	—	- 18%	- 17%	- 17%
Romania	—	55%	86%	86%
Slovakia	- 7%	- 7%	8%	2%
Slovenia	13%	22%	16%	12%
Spain	—	- 12%	- 29%	7%
Sweden	- 34%	- 20%	- 20%	- 5%
United Kingdom	- 51%	32%	30%	6%

Note: — : no submission

(*): projections correspond to national ceiling amount

□ (White): [0%/10%] overestimation or [0%/- 10%] underestimation

■ (Light purple): [10%/50%] or [- 10%/- 50%]

■ (Dark purple colour): [50%/100%] or [- 50%/- 100%]

■ (Dark grey): [100%/200%] or [- 100%/- 200%]

A negative value means that the projected emission is lower than the realised emissions according to the 2014 inventory.

Annex 2 Data used in this report

Table A2.1 GHGs: successively reported WEM projections for 2010, and the reported 2010 emission inventory (Mt CO₂-equivalent)

Member State	Projection 2005	Projection 2007	Projection 2009	Projection 2011	Emission inventory
Austria	—	89.9	93.9	85.2	84.8
Belgium	148.4	141.6	136.9	131.8	130.6
Bulgaria	—	91.0	—	72.1	60.3
Cyprus	—	11.9	11.3	9.8	10.0
Czech Republic	143.5	145.7	140.1	131.7	137.0
Denmark	72.5	67.8	66.2	62.5	61.4
Estonia	—	—	15.9	20.4	19.9
Finland	79.7	85.0	81.6	74.0	74.4
France	—	569.0	544.5	511.6	516.4
Germany	—	955.4	944.7	944.7	946.4
Greece	150.4	—	133.1	124.2	117.9
Hungary	—	—	—	65.0	67.6
Ireland	—	73.2	67.6	62.0	61.9
Italy	508.9	—	550.0	506.4	499.4
Latvia	13.7	—	14.0	11.5	12.0
Lithuania	25.2	33.5	32.7	24.1	21.1
Luxembourg	—	—	13.5	12.1	12.2
Malta	—	—	3.0	2.8	3.0
Netherlands	217.3	218.1	212.6	204.2	209.3
Poland	—	42—	—	—	407.5
Portugal	—	88.0	85.8	85.8	70.6
Romania	—	192.5	183.3	188.8	115.8
Slovakia	57.9	58.3	51.0	45.6	45.4
Slovenia	21.3	21.6	21.1	19.8	19.4
Spain	—	440.2	398.7	348.0	347.2
Sweden	71.5	70.3	65.0	61.2	65.1
United Kingdom	598.8	624.9	599.0	584.0	605.6

Note: — : not reported.

Table A2.2 SO₂: successively reported WEM projections for 2010 and the reported 2010 emission inventory (kt)

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010	Emission inventory	NEC Directive ceiling
Austria	31.0	31.0	25.6	26.0	25.6	25.6	25.8	20.9	18.6	39
Belgium	—	102.0	102.0	89.8	89.8	90.2	90.2	69.3	62.3	99
Bulgaria	—	—	—	—	380.0	380.0	387.2	480.0	387.2	856
Cyprus	—	—	—	35.0	34.0	26.9	22.8	18.0	22.1	39
Czech Rep.	—	247.4	247.4	212.0	206.4	206.4	207.0	207.0	170.3	265
Denmark	56.0	56.0	22.5	19.9	19.9	19.9	20.0	20.0	14.9	55
Estonia	—	100.0	100.0	80.0	80.4	80.4	80.4	80.4	83.2	100
Finland	100.0	97.5	81.5	97.5	97.5	97.5	97.5	110.0	66.8	110
France	460.0	461.0	375.0	330.0	345.0	345.0	337.0	300.7	287.5	375
Germany	513.0	513.0	513.0	459.0	459.0	459.0	459.0	475.0	430.4	520
Greece	—	300.0	300.0	300.0	523.0	523.0	408.0	408.0	265.2	523
Hungary	—	0.0	350.0	0.0	134.6	72.4	72.4	72.4	32.3	500
Ireland	42.1	42.0	42.0	33.0	33.0	29.8	29.8	24.5	26.3	42
Italy	469.5	434.0	434.0	375.5	375.5	375.5	269.1	269.7	210.2	475
Latvia	—	5.8	11.6	5.1	5.3	4.0	4.0	4.0	3.3	101
Lithuania	—	145.0	145.0	145.0	145.0	145.0	36.5	36.5	31.5	145
Luxembourg	2.3	2.3	2.3	—	—	2.5	2.5	2.5	2.2	4
Malta	—	—	—	14.2	8.8	8.8	14.2	14.2	8.1	9
Netherlands	70.0	65.0	66.0	66.0	53.0	53.0	41.0	42.1	34.0	50
Poland	—	0.0	0.0	933.6	933.6	877.7	994.0	994.0	935.6	1397
Portugal	170.0	165.1	165.1	132.9	132.9	132.9	132.9	132.9	66.8	160
Romania	—	—	—	—	731.5	826.0	784.5	784.5	350.4	918
Slovakia	—	—	55.0	74.0	62.0	65.0	75.3	63.2	69.4	110
Slovenia	—	27.0	18.7	17.4	17.4	17.4	16.3	16.3	9.8	27
Spain	—	746.0	746.0	428.5	421.0	400.8	364.3	364.3	403.9	746
Sweden	50.0	67.0	67.0	67.0	33.0	33.0	33.0	29.6	32.0	67
United Kingdom	585.0	585.0	585.0	585.0	405.0	453.7	390.1	371.7	415.3	585

Note: — : not reported.

Table A2.3 NO_x: successively reported WEM projections for 2010 and the reported 2010 emission inventory (kt)

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010	Emission inventory
Austria	150.0	157.0	172.9	137.0	154.3	154.3	146.2	143.9	147.9
Belgium	—	259.0	259.0	196.3	196.2	252.5	252.5	228.3	221.0
Bulgaria	—	—	—	—	247.0	247.0	247.0	247.0	116.9
Cyprus	—	—	—	19.0	19.0	18.7	18.6	19.2	18.0
Czech Rep.	—	333.9	333.9	270.0	274.9	274.9	272.0	272.0	239.1
Denmark	146.0	146.4	142.0	136.0	136.0	126.0	126.0	126.0	132.3
Estonia	—	60.0	60.0	39.0	38.6	38.6	38.6	38.6	36.7
Finland	155.0	151.0	203.6	151.0	151.0	151.0	151.0	170.0	166.5
France	990.0	988.0	810.0	1080.0	1105.0	1105.0	1071.0	1085.2	1067.1
Germany	1126.0	1126.0	1126.0	1112.0	1112.0	1112.0	1112.0	1379.0	1328.1
Greece	—	344.0	344.0	344.0	344.0	320.0	320.3	379.5	318.8
Hungary	—	—	198.0	—	211.3	164.2	164.2	164.2	162.5
Ireland	94.0	94.0	94.0	98.0	98.0	102.7	102.7	85.0	76.7
Italy	1056.5	1065.0	1065.0	1056.8	1056.8	865.0	969.8	949.6	963.6
Latvia	—	38.1	42.4	46.6	48.5	45.1	45.1	45.1	36.4
Lithuania	—	110.0	110.0	110.0	110.0	110.0	43.7	43.7	60.2
Luxembourg	14.2	14.2	14.2	—	—	12.7	12.7	12.7	17.9
Malta	—	—	—	9.1	7.9	7.9	9.1	9.1	8.1
Netherlands	289.0	288.0	288.0	277.0	262.0	261.0	244.0	263.8	271.9
Poland	—	—	—	852.5	852.5	894.7	827.1	827.1	862.1
Portugal	261.5	248.6	248.6	242.0	242.0	242.0	242.0	242.0	187.2
Romania	—	—	—	—	306.4	336.0	350.4	350.4	217.9
Slovakia	—	—	96.0	129.0	115.0	90.4	108.6	87.8	88.6
Slovenia	—	45.0	47.4	49.1	49.1	49.1	46.4	46.4	44.7
Spain	—	847.0	847.0	1165.5	1211.0	1144.8	1083.2	1083.2	886.2
Sweden	155.0	148.0	148.0	179.0	154.0	149.0	149.0	141.0	148.0
United Kingdom	1167.0	1167.0	1167.0	1167.0	1294.0	1250.5	1210.1	1132.1	1117.4

Note: — : not reported.

Table A2.4 NMVOC: successively reported WEM projections for 2010 and the reported 2010 emission inventory (kt)

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010	Emission inventory
Austria	160.0	151.0	152.2	150.0	139.7	139.7	164.3	153.8	131.5
Belgium	— .	147.0	147.0	129.2	129.2	134.0	134.0	112.2	115.8
Bulgaria	— .	— .	— .	— .	175.0	175.0	175.0	175.0	93.1
Cyprus	— .	— .	— .	10.0	9.8	8.0	12.1	11.0	11.7
Czech Rep.	— .	204.1	204.1	166.0	163.5	163.5	170.0	170.0	150.9
Denmark	83.0	82.8	83.0	91.2	88.0	85.0	85.0	90.0	86.6
Estonia	— .	49.0	49.0	41.0	40.7	40.7	40.7	40.7	35.0
Finland	130.0	130.0	138.8	130.0	130.0	130.0	130.0	130.0	116.2
France	953.0	954.0	1050.0	1060.0	1060.0	1060.0	1050.0	781.3	817.5
Germany	1192.0	1192.0	1192.0	987.0	987.0	987.0	987.0	1330.0	1024.2
Greece	— .	261.0	261.0	261.0	261.0	261.0	244.4	244.4	184.6
Hungary	— .	0.0	137.0	136.6	134.3	123.3	123.3	123.3	108.6
Ireland	65.9	66.0	66.0	55.0	55.0	53.6	53.6	49.2	45.8
Italy	1117.2	1117.0	1117.0	941.0	941.0	941.0	916.5	924.9	1080.3
Latvia	— .	67.0	58.9	61.1	64.6	55.5	55.5	55.5	52.7
Lithuania	— .	92.0	92.0	92.0	92.0	92.0	56.2	56.2	61.8
Luxembourg	7.2	7.2	7.2	— .	— .	9.0	9.0	9.0	8.5
Malta	— .	— .	— .	3.9	3.6	3.6	3.9	3.9	2.5
Netherlands	220.0	200.0	176.0	162.0	154.0	162.0	143.0	144.5	149.7
Poland	— .	— .	— .	639.9	940.3	947.0	603.0	603.0	653.4
Portugal	264.7	239.9	239.9	194.2	194.2	194.2	194.3	194.3	177.7
Romania	— .	— .	— .	— .	347.4	347.4	342.8	342.8	365.4
Slovakia	— .	— .	84.0	86.0	86.0	97.4	69.2	66.9	62.4
Slovenia	— .	40.0	36.8	37.0	37.0	37.0	38.0	38.0	34.6
Spain	—	662.0	662.0	886.7	839.0	761.4	778.5	778.5	630.3
Sweden	270.0	241.0	241.0	241.0	183.0	168.0	168.0	165.5	187.9
United Kingdom	1200.0	1200.0	1200.0	1200.0	807.0	784.0	814.4	773.6	863.1

Note: — : not reported.

Table A2.5 NH₃: successively reported WEM projections for 2010 and the reported 2010 emission inventory (kt)

Member State	Projection 2002	Projection 2004	Projection 2005	Projection 2006	Projection 2007	Projection 2008	Projection 2009	Projection 2010	Emission inventory
Austria	52.0	52.0	52.9	61.0	61.6	61.6	61.3	62.0	62.9
Belgium	— .	85.0	85.0	70.2	70.2	68.5	68.5	66.4	69.4
Bulgaria	— .	— .	— .	— .	108.0	108.0	108.0	108.0	50.8
Cyprus	— .	— .	— .	5.0	4.5	6.0	6.2	5.3	5.5
Czech Rep.	— .	80.7	80.7	63.0	60.7	60.0	60.0	60.0	68.6
Denmark	82.8	83.0	63.0	65.0	65.0	65.0	65.0	69.0	73.0
Estonia	— .	29.0	29.0	9.0	8.8	8.9	8.9	8.9	10.3
Finland	28.0	31.0	32.4	31.0	31.0	31.0	31.0	31.0	37.6
France	857.0	857.0	780.0	730.0	730.0	730.0	729.0	729.4	690.6
Germany	585.0	585.0	585.0	610.0	610.0	610.0	610.0	581.0	548.5
Greece	— .	73.0	73.0	73.0	73.0	63.1	59.7	59.7	64.4
Hungary	— .	— .	70.0	— .	87.3	77.7	77.7	77.7	65.4
Ireland	110.2	110.0	110.0	102.0	102.0	104.3	104.3	105.9	107.7
Italy	432.8	433.0	433.0	416.4	416.4	416.4	408.7	408.7	379.0
Latvia	— .	16.0	14.1	14.7	15.2	14.3	14.3	14.3	18.8
Lithuania	— .	84.0	84.0	84.0	84.0	84.0	55.3	55.3	38.1
Luxembourg	5.5	5.5	5.5	— .	— .	4.6	4.6	4.6	4.6
Malta	— .	— .	— .	2.3	2.3	2.3	2.3	2.3	1.5
Netherlands	152.0	120.0	126.0	126.0	125.0	123.0	129.0	131.4	127.5
Poland	— .	0.0	0.0	302.0	301.9	301.9	284.3	284.3	271.5
Portugal	91.2	88.3	88.3	69.2	69.3	69.3	69.2	69.2	48.2
Romania	— .	— .	— .	0.0	204.6	204.6	206.1	206.1	159.8
Slovakia	— .	— .	29.8	24.0	24.0	27.1	26.5	26.3	24.9
Slovenia	— .	20.0	20.4	19.2	19.2	19.2	19.7	19.7	17.4
Spain	— .	353.0	353.0	394.9	373.0	388.2	380.7	380.8	388.2
Sweden	51.7	57.0	57.0	57.0	50.0	50.0	50.0	47.5	51.8
United Kingdom	297.0	297.0	297.0	297.0	292.0	294.0	289.3	290.6	280.9

Note: — : not reported.

European Environment Agency

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