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NATIONAL COMMUNICATIONS FROM PARTIES INCLUDED IN ANNEX I TO THE CONVENTION

COMPILATION AND SYNTHESIS OF THIRD NATIONAL COMMUNICATIONS

Compilation and synthesis report on third national communications

Addendum

PROJECTIONS*

Summary

This document provides detailed information on the greenhouse gas (GHG) projections presented by Parties included in Annex I to the Convention in their latest national communications. It complements the information on projections presented in FCCC/SBI/2003/7/Add.1 with respect to the following issues: submission of information on projections by Parties; methods and approaches used by Parties for projections; the assumptions used; numerical information on the projected GHG emissions by Parties, (presented by gas and sector, and as GHG totals); sectoral projections of GHG emissions and the projected effects of policies and measures; information on projected GHG emissions/removals by sinks; sensitivity analyses for projections presented by Parties; and projected GHG emissions from international bunker fuels.

* Please note that this document will be available in all six official languages before the ninth session of the Conference of the Parties.

CONTENTS

I. SUBMISSION OF INFORMATION ON PROJECTIONS BY PARTIES

1. Table 1 summarizes the information on greenhouse gas (GHG) projections submitted by the 32 Parties considered in this report, in their latest national communications, and compares the submitted information with the requirements set out in the UNFCCC reporting guidelines.[1]

Table 1. Summary of information on projections submitted by Parties

	Scenarios[a]			Projection	GHG emissions	
Party	NM	WM	WAM	period	By gas	By sector[b]
AUS	Yes	Yes	No	to 2020	All 6 gases	All sectors
AUT	No	Yes	Yes	to 2020	All 6 gases	TRN and LUCF not available
BEL	No	Yes	Yes	to 2020	All 6 gases	All sectors
BGR	Yes	Yes	Yes	to 2020	CO_2, CH_4, N_2O	TRN not available
CAN	Yes	Yes	Yes	to 2020	All 6 gases	LUCF not available
CHE	No	Yes	Yes	to 2020	All 6 gases	All sectors
CZE	No	Yes	Yes	to 2020	All 6 gases	All sectors
DEU	No	Yes	No	to 2010	All 6 gases	All sectors
EC	No	Yes	Yes	to 2010	All 6 gases	LUCF not available
ESP	No	Yes	Yes	to 2010	CO_2	Only ENERGY and TRN
EST	No	Yes	Yes	to 2020	CO_2, CH_4, N_2O	TRN not available
FIN	No	Yes	Yes	to 2020	All 6 gases	All sectors
FRA	Yes	Yes	Yes	to 2020	All 6 gases	All sectors
GBR	No	Yes	Yes	to 2020	All 6 gases	All sectors
GRC	No	Yes	Yes	to 2020	All 6 gases	All sectors
HRV	No	Yes	Yes	to 2020	na	All sectors
HUN	Yes	Yes	No	to 2020	CO_2, CH_4	IND and WASTE not available
ITA	No	Yes	Yes	to 2010	na	All sectors
JPN	Yes	Yes	Yes	to 2010	All 6 gases	TRN and LUCF not available
LIE	No	Yes	No	to 2010	CO_2, CH_4, N_2O	IND and LUCF not available
LTU	No	No	No	to 2012[c]	CO_2[c]	Only ENERGY[c]
LVA	No	Yes	No	to 2020	All 6 gases	TRN not available
MCO	No	No	No	na	na	na
NLD	No	Yes	Yes	to 2020	All 6 gases	LUCF not available
NOR	No	Yes	Yes	to 2010	All 6 gases	All sectors
NZL	No	Yes	Yes	to 2020	CO_2, CH_4, N_2O	TRN not available
POL	No	Yes	No	to 2020	CO_2, CH_4,[c] N_2O[c]	TRN and WASTE not available
RUS	No	Yes	No	to 2020	CO_2	na
SVK	Yes	Yes	Yes	to 2015	All 6 gases	All sectors
SVN	No	Yes	Yes	to 2020	All 6 gases	LUCF not available
SWE	No	Yes	No	to 2020	All 6 gases	All sectors
USA	No	Yes	No	to 2020	All 6 gases	All sectors
Total:	**7**	**30**	**21**	**22 Parties: to 2020**	**20 Parties: all 6 gases**	**15 Parties: all sectors**

Note 1: For simplicity, some details relating to the submissions are omitted in this table; full information is provided in table 2.
Note 2: na means "not available in the third national communication".
Note 3: For an explanation of country codes, please refer to the annex.
[a] The scenarios are abbreviated as: NM for "without measures", WM for "with measures", WAM for "with additional measures".
[b] The sectors are abbreviated as TRN for transport, IND for industry, ENERGY for energy, LUCF for land-use change and forestry and WASTE for waste management.
[c] An estimate is available but a consistent scenario is not provided.

2. Reporting on key issues by the 32 Parties considered here can be summarized as follows:

(a) Thirty of the 32 Parties submitted a "with measures" projection, calculated in most cases until 2020 (sometimes until 2010, 2012 or 2015). Most Parties (21 of 32) also submitted a "with additional measures" projection (information on this projection was sometimes less complete than that for the "with measures" projection). Some Parties (7 of 32) presented a "without measures" projection. In some cases (Croatia, Hungary), the scenarios were not defined as "with measures", "without measures" or "with additional measures" but it was possible to interpret them in line with the UNFCCC guidelines. One Party (Monaco) provided a discussion of future GHG emissions but not a quantitative projection. The

[1] Document FCCC/CP/1999/7, paragraphs 27–48.

projections of Lithuania were not presented in accordance with the UNFCCC reporting guidelines and the interpretation of these projections consistently with the approaches used by other Parties appeared to be difficult.

(b) A projection for carbon dioxide (CO_2) was available in 29 communications. Projections for methane (CH_4) and nitrous oxide (N_2O) were, as a rule, also available. Twenty Parties provided projections for hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

(c) A breakdown of the projected GHG emissions by sectors was presented in most of the communications. Sometimes the sectoral information was not complete; most often, either the emissions from transport or the GHG removals through land-use change and forestry (LUCF) were missing (Austria, Bulgaria, Canada, Estonia, Hungary, Japan, Latvia, Liechtenstein, Netherlands, New Zealand, Poland, Russian Federation, Slovenia, Spain).

(d) A few Parties provided projections for CO_2 only (Russian Federation, Spain) and/or projection of the GHG (or CO_2) total without a sectoral breakdown (Russian Federation) or without a breakdown by gas (Croatia, Italy).

3. The national communications, and their in-depth reviews conducted before 31 March 2003, indicate the following common reasons for incomplete compliance with the UNFCCC reporting guidelines: (i) lack of the policy information necessary to support preparation of a meaningful long-term GHG scenario, especially for the period 2010–2020; (ii) methodological difficulties, in particular for LUCF projections; (iii) lack of time and/or resources.

4. Overall, the reporting on projections has improved in comparison with the previous national communications. Nevertheless, table 1 shows that the submissions of 19 of the 32 Parties had at least one deficiency. The typical deficiencies are the absence of a GHG projection for transport and LUCF, the absence of a projection for HFCs, PFCs and SF_6, and the limitation of the projection period to 2010 instead of 2020. The absence of a GHG projection for transport for 10 of the 32 Parties should be noted.

5. Table 2 provides details on the submission of information on key issues. The notes to the table give additional explanations, particularly with respect to the interpretation of those parts of the national communications where the information submitted appeared incomplete or inconsistent with the UNFCCC guidelines.

6. **On the basis of the information in tables 1 and 2, the secretariat considered that GHG projections of 30 Parties can be included in the compilation and synthesis of GHG projections. These 30 Parties are the Parties listed in table 1, excluding Lithuania[2] and Monaco.[3]** Information submitted by Lithuania and Monaco on projections is discussed, but these Parties are not included in the tables and graphs containing the projected GHG emissions.

[2] The NC2 of Lithuania mentions several emissions scenarios (see pages 29, 31, 54 of the NC2) but a UNFCCC-compliant definition of scenarios is not provided. Emission projections (available for CO_2 only) are presented in the NC2 only graphically (in figure 3.9, page 33) and they relate to the different shutdown options for the nuclear units at the Ignalina power plant. The secretariat was unable to interpret this information in a way consistent with the projections of the other Parties.

[3] Monaco provided a discussion of future trends in GHG emissions but not a quantitative projection.

Table 2. Summary of information on projections submitted by the Parties ("Yes" = submitted, "No" = not submitted)

	Scenarios			Information on GHG emissions by gas					Information on GHG emissions by sector						Information by projected period				
Party	NM	WM	WAM	GHG total	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6	Energy	Transport	Industry	Agriculture	Waste	Forestry	2005	2010	2015	2020	Information sources
AUS	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[a]	Yes[a]	NC3
AUT	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No[b]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	NC3, IDR3
BEL	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
BGR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes[c]	Yes	Yes	Yes	Yes[d]	NC3
CAN	Yes	Yes	Yes[e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	NC3, IDR3
CHE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
CZE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
DEU	No	Yes	No[i]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NC3
EC	No	Yes	Yes[aa]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	NC3
ESP	No	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes	No	No	NC3
EST	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
FIN	No	Yes	Yes[h]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[h]	Yes[h]	NC3, IDR3
FRA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	NC3, IDR3
GBR	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
GRC	No	Yes	Yes[j]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[h]	Yes[h]	NC3
HRV	No	Yes[f]	Yes[f]	Yes[g]	No	No	No	No	Yes[g]	Yes[g]	Yes[g]	Yes[g]	Yes[g]	Yes[g]	Yes	Yes	Yes	Yes	NC1, IDR1
HUN	Yes[k]	Yes[k]	No	Yes[l]	Yes	Yes	No	No	Yes[k]	Yes[m]	No	Yes[k]	No[n]	Yes[o]	No[p]	Yes	No[p]	Yes	NC3
ITA	No	Yes	Yes[e]	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NC3
JPN	Yes[q]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	No	No	NC3, IDR3
LIE	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	No	No	NC3
LTU	No[r]	No[r]	No[r]	No	Yes	No	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No	NC2
LVA	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
MCO	No[s]	No[s]	No[s]	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	NC3
NLD	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes[t]	Yes[t]	NC3, IDR3
NOR	No	Yes	Yes[e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	NC3, IDR3
NZL	No	Yes	Yes[u]	Yes	Yes	Yes	Yes	No	Yes	No[b]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
POL	No	Yes[v]	No[w]	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
RUS	No	Yes[x]	No	No	Yes	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	NC3
SVK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	NC3, IDR3
SVN	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	NC1, IDR1
SWE	No[y]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[z]	No	Yes	No	Yes	NC3
USA	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC3, IDR3
Total:	**7**	**30**	**21**	**28**	**29**	**26**	**25**	**20**	**30**	**22**	**26**	**28**	**26**	**21**	**24**	**31**	**20**	**22**	

Note 1: The scenarios in this table are abbreviated as NM for "without measures", WM for "with measures", WAM for "with additional measures".

Note 2: The information sources in this table are abbreviated as: NC1 for the first national communication, NC2 for the second national communication, NC3 for the third national communication; IDR1 for the in-depth review of the NC1, IDR3 for the in-depth review of the NC3.

Note 3: For an explanation of country codes, please refer to the annex.

Notes to table 2:

[a] For some sectors, the projection is made only until 2010.

[b] Information on the GHG emissions from transport was provided at the in-depth review of the NC3.

[c] Two scenarios relating to LUCF are provided in the NC3: optimistic and pessimistic. These scenarios are for carbon storage and not for GHG emissions/removals. The NC3 does not define how these scenarios relate to the three scenarios (NM, WM, WAM) used for the emission projections.

[d] The 2020 data in the NC3 are obtained by extrapolation of the 2010–2015 trend.

[e] For the projection "with additional measures", only a GHG total is provided; estimates by gas and sector are not available.

[f] The definition of scenarios in the NC1 differs from the definition required by the UNFCCC guidelines. Instead of the "without measures", "with measures" or "with additional measures" scenarios, a "baseline scenario" and a "mitigation scenario" are presented. In this report, the "baseline scenario" from the NC1 is interpreted as a "with measures" scenario and the "mitigation scenario" is interpreted as a "with additional measures" scenario.

[g] The NC1 provide only little numerical information relating to the projected GHG emissions (the projections are presented in graphs and exact numbers are not available in most cases). Therefore, the quantitative information used in this report had to be obtained by measuring the graphs in the NC1, which adds inaccuracy to the estimates.

[h] The scenario "with additional measures" is calculated only until 2010.

[i] Estimates of the effects of additional measures are provided only for HFCs, PFCs and SF_6.

[j] The "with additional measures" scenario is calculated only until 2010 and this projection is presented only by sector and not by gas.

[k] The projection scenarios in the NC3 are defined differently for energy and agriculture. The "baseline" (or "without measures") and "with measures" scenarios are used for energy whereas scenarios A, B, C are defined for agriculture. In this report, scenario C (which is an average of scenarios A and B) is used.

[l] In the NC3, the GHG total is given as an average number for 2008–2012 (figure V.15, page 81). Annual totals are not provided. Therefore, this report uses the separate projections for CO_2 and CH_4, given for 2000–2010 as the basis for the 2000–2020 projections; the GHG total is calculated as the sum of CO_2 and CH_4 emissions in the corresponding sectors.

[m] The CO_2 emissions from the combustion of motor fuels, given in the NC3, are interpreted as the emissions from transport.

[n] CH_4 emissions from waste management are mentioned on page 80 of the NC3 but the communication does not show a related projection.

[o] A projection for carbon storage in 2000–2100 is provided for three afforestation scenarios, but not a projection of LUCF for the "baseline" and "with measures" scenarios.

[p] For this year, a projection is available for agriculture but not for energy.

[q] Information on the "without measures" scenario in the NC3 is not complete.

[r] The NC2 mentions several emissions scenarios ("rapid development", "moderate development", "slow development" on page 29; scenario I and scenario II on page 54; closure of the Ignalina unit 1 in 2010 or closure of the Ignalina unit 1 after 2010 on page 31) but a UNFCCC-compliant definition of scenarios ("with measures", "without measures", "with additional measures") is not provided. Emission projections (for CO_2 only) are presented in the NC2 only graphically (in figure 3.9, page 33) and they relate only to the different shutdown options of the nuclear units at the Ignalina power plant.

[s] The NC3 provide a qualitative discussion of future emission trends but a quantitative GHG projection is not provided.

[t] The "with additional measures" scenario is calculated only until 2010; the 2015 data for the "with measures" scenario are interpolated between 2010 and 2020.

[u] Several "with additional measures" scenarios are provided in the NC3; they differ in their assumptions on the type and scope of additional measures.

[v] Several scenarios are presented in the NC3. On the basis of the results of the in-depth review, this report uses the "baseline" projection from table 5.8, page 49 as a "with measures" projection. This projection relates to CO_2 emissions from energy supply and use.

[w] Some information on the effects of additional measures is provided but a consistent scenario is not available.

[x] The NC3 provides three alternative "with measures" scenarios without specifying whether any of them could be considered a "reference" scenario.

[y] The scenario presented in the framework of the analysis of the efficiency of policies and measures (page 134, chapter 4.2 of the NC3) has some features of a "without measures" scenario, but is not presented in the NC3 as a full "without measures" scenario.

[z] The LUCF projection is calculated only until 2010.

[aa] For the "with additional measures" scenario, GHG emissions by gas are provided but estimates by sector are not available.

II. METHODS AND APPROACHES USED

7. In their NC3 Parties provided **more detailed information on the models and approaches used to prepare projections** of the GHG emissions by source and removals by sink than in the previous two communications. A few Parties (e.g. Germany,[4] Lithuania) did not provide any information on the models used or modelling approaches. In many cases, models used to project emissions in the NC3 have been also used on an annual or periodic basis to prepare and report on economic and energy projections, e.g. the NEMS model used by the United States of America or the SADEM model used by New Zealand.

8. **Three sets of models have been used**: models to project energy-related emissions (except for fugitive emissions from fuels), models to project non-CO_2 emissions (including fugitive CH_4 emissions from fuels) and models to project removals from LUCF. Results from these three sets of models are usually integrated at the national level in a set of national projections, covering emissions by gas and by sector. Most Parties provided a detailed explanation of the models they used to project energy-related emissions (exceptions are Bulgaria, Croatia, Hungary). Conversely, methods used for non-CO_2 emission projections and projections of removals from LUCF were rarely identified.

9. The analysis of the models and modelling approaches suggests that **most Parties used a more integrated approach for projecting energy-related emissions,** compared to the approaches used in the previous national communications, and rarely relied on a single model or a single approach. This implied in most cases coupling macroeconomic (top-down) and engineering (bottom-up) models (Australia, Austria, Belgium, Canada, Czech Republic, Estonia, Finland, France, Latvia, Poland, Sweden, United Kingdom of Great Britain and Northern Ireland). The macroeconomic models, or macroeconomic part of the models when an integrated model was used, were either general equilibrium models, e.g. CGE-PL (Poland), VATT and KESU (Finland), KEO (Japan), MULTIMAC (Austria), GTEM (Australia) and MSG (Norway), or partial equilibrium models, e.g. the SADEM model (New Zealand). Macroeconomic models or relevant parts of the integrated models estimated relationships between energy demand, economic activities and energy prices. The major advantage of using single integrated models was that this allowed simulations of the effects of fuel switching, emission taxes, and competition of supply and demand options within a single modelling framework. Poland linked its macroeconomic scenarios to possible scenarios for climate change in two sectors, agriculture and forestry.

10. In addition to the macroeconomic models, some Parties (e.g. Australia, Slovakia, Sweden) used as part of their projections package **detailed models for different energy end-use sectors to represent in more detail changes in the useful energy demand** as well as competition between different technologies and fuels to meet this demand. This approach is of a particular relevance for transport, given that this is one of the most important and fastest-growing sectors in terms of emissions, for example, in Australia and Sweden. Some Parties used a single model for their energy-related projections; for example, New Zealand used a partial equilibrium model for this purpose, Italy used a bottom-up dynamic model, and Russia used a simple trend analysis linking projections of CO_2 emissions with energy intensity of GDP and carbon intensity of the fuel supply mix.

11. Most of the Parties included modelling of the energy supply part of the energy system in their projections. Many used dynamic optimization models, such as EFOM (Finland) and MARKAL, which allow for a direct modelling of marginal cost pricing and for ranking mitigation options and measures using marginal cost criteria (Belgium, Canada, Czech Republic, Estonia, Latvia, Slovenia, Sweden). Other Parties used simulation models which simulate the balance between supply and demand with price competition between fuels and sectors, such as ENPEP (Bulgaria, Greece and Slovakia),

[4] The NC3 of Germany noted that the Federal Government did not officially endorse the projections and scenarios, and contained no reference to the models used.

PRIMES (European Community) and NEMS (United States). Optimization techniques have been used in the parts of the ENPEP model representing the electricity system, the MESAP model used by Slovenia and the DTI model used by the United Kingdom. In both cases attention is paid to modelling various existing and future energy technologies. This permits carbon mitigation policies to be analysed because in most cases models allowed for an explicit representation of vintaged (time-dependent) energy equipment and structures (e.g. building shells, power plants) and for tracking of vintaged capital stock turnover rates. the Netherlands used the market simulation models GASTALE and POWERS, which allowed it to simulate the effect of liberalization of the electricity market and its impact on future energy and emission levels.

12. A few Parties used **different models for their short-, medium- and long-term projections**. For example, Belgium used the HERMES and EPM models for medium-term projections, and GEM-E3 and MARKAL for long-term projections.

13. Almost all Parties used spreadsheet models to project emissions from **non-energy sources other than LUCF**. These models were based on activity data, emission factors and sector-specific growth assumptions. The sector-specific growth assumptions were produced either by expert estimates, time series or regressional analysis, which in turn were linked to activity data statistics and business plans for major industries in the relevant sector. Emission factors were usually consistent with the factors used for emission inventories, but they may change in the future depending on different sector-specific assumptions or on changes in regulations or standards (Greece, United Kingdom, United States). In some cases, projections from these sources were derived on the basis of activity data projections using the same set of macroeconomic projections used for projections of emissions from energy-related sources; this approach was used by Norway, for example.

14. Several Parties used an approach to project **emissions and removals from the LUCF sector** which is linked to the national carbon accounting systems and to relevant models used in their inventory estimate systems to simulate carbon fluxes and carbon pools (Australia, Austria, Hungary, New Zealand). Examples of such models are the National Carbon Accounting System of Australia and the Austrian Carbon Balance Model. New Zealand developed a model for monitoring the terrestrial carbon cycle based on a carbon monitoring system for indigenous forests and scrublands and a monitoring programme for carbon storage in soils. The forest scrubland monitoring programme is based on remote sensing combined with ground truthing, and will provide a five-yearly check on afforestation, reforestation and deforestation activities. This allows for more robust estimates of the future emission trends for both emissions and removals from this sector. Australia noted the difference in accounting for emissions and removals from the LUCF and, in particular, from the forestry subsector between the UNFCCC inventory guidelines and the rules under the Kyoto Protocol and implications for modelling approaches and future trends.[5] The United States used a timber assessment market model, which projects the level of emissions by linking them to the projections of timber supply and availability and supply of other forest products.

15. The improved quality of reporting on projections compared to the previous national communications is explained by the availability of longer time series of economic, energy and emission data for the preparation of the NC3. These long time series allowed better relationships to be established between the key drivers behind the emission trends, and also allowed the models to be better calibrated. Moving towards more comprehensive models and sets of models also contributed to improved quality. Finally, several Parties provided data and analysis of ex-post evaluation of their projections, comparing them with actual emission estimates and also comparing projections from the second and third national

[5] According to decision 11/CP.7, land use, land-use change and forestry (LULUCF) activities in meeting the Kyoto Protocol target are measured as verifiable changes in carbon stocks, and non-CO_2 GHG emissions during the period 2008 to 2012 resulting from afforestation, reforestation, deforestation and forest management activities that have taken place since 1990.

communications. This comparison not only allowed the models to be better calibrated and to produce more robust results, but also made it possible to study the impact of the assumptions on the main drivers of the emission projections, compared to the actual performance of these drivers and emission trends.

III. ASSUMPTIONS USED IN PREPARING EMISSIONS PROJECTIONS

16. The assumptions used by Parties in preparing their emissions projections differ from country to country, and not all assumptions were given in some communications. For example, table 3 summarizes the assumptions on three key parameters: the average GDP growth from 2000 to 2010, the average population growth from 2000 to 2010, and the assumed price of crude oil on the international market in 2010. Information on these three parameters is available in most communications.

Table 3. Summary of key assumptions for GHG projections

GDP growth from 2000 to 2010[a]	Below 2%/year	NOR, SWE **(2 Parties)**
	2–4%/year	AUS, AUT, BEL, CAN, CZE, EC, EST, FIN, FRA, GRC, ITA, JPN, LIE, NLD, NZL, SVK, SVN, CHE, GBR, USA **(20 Parties)**
	Above 4%/year	BGR, HRV, HUN, LVA, POL, RUS[b] **(6 Parties)**
	Not available	DEU, ESP. LTU, MCO **(4 Parties)**
Population growth from 2000 to 2010	Below 0 (negative)	BGR, CZE, EST, HUN, LVA **(5 Parties)**
	0–1%/year	AUS, AUT, BEL, CAN, CHE, EC, FRA, GRC, HGV, JPN, LIE, NLD, NOR, NZL, POL, USA **(16 Parties)**
	Not available	DEU, ESP, FIN, GBR, ITA, LTU, MCO, RUS, SVK, SVN, SWE **(11 Parties)**
Oil price in 2010[c]	Below 20 US$/barrel	AUT, CHE, EC, FRA, GBR, GRC, LIE, NOR, SWE **(9 Parties)**
	20–25 US$/barrel	CAN, CZE, EST, ITA, NZL, USA **(6 Parties)**
	Above 25 US$/barrel	BEL, JPN, NLD **(3 Parties)**
	Not available	AUS, BGR, ESP, FIN, DEU, HRV, HUN, LVA, LTU, MCO, POL, RUS, SVK, SVN **(14 Parties)**

Note: For an explanation of country codes, please refer to the annex.

[a] Some Parties did not present an average GDP growth for 2000–2010 but provided absolute GDP numbers or annual growth rates. In such cases, the average for 2000–2010 was calculated using the information available. A similar approach was used for population growth.

[b] In two of the three scenarios provided in the NC3 of Russia, the assumed GDP growth rates is above 4 per cent per year.

[c] The comparison for oil price is not quite consistent because a conversion of the oil prices presented in the communications to US$ of a single reference year was not done (the selected reference year for US$, used for oil price, varies from Party to Party). However, this inconsistency is unlikely to influence the shown distribution by country very much.

17. Table 3 shows that most Parties expect a population growth of less than 1 per cent per year in 2000–2010. For five Parties, a decrease in population is projected for this period. The assumptions for GDP growth are less homogeneous but are still relatively close. Most Parties expect an average GDP growth rate of 2–4 per cent per year, and six EIT Parties project higher growth rates.

18. In contrast, assumptions on oil prices differed considerably among Parties – from a relatively low price (for example, several Parties assumed US$17/barrel in 2010) to a price well above US$25/barrel (some Parties assumed about US$30/barrel in 2010). Such large differences occur despite the fact that these assumptions usually come from well-known international studies.[6] This reflects the high uncertainty associated with oil prices on the international market and also indicates that GHG projections for Annex I Parties as a whole (a sum of national GHG projections) should be regarded as a crude indicator of a possible future course of events, rather than a consolidated scenario.

19. In addition to the assumptions shown in table 3, Parties used assumptions on the expected development of GDP components; on technological progress (for energy supply and use, and for existing and future technologies); on the expected rate of use of renewable energy sources and co-generation of electricity and heat; on the level of imported and/or exported energy resources; on expected revenues

[6] References to the following information sources on oil price projections are often made: the World Energy Outlook series (published annually by the International Energy Agency), "European Union Energy Outlook to 2020" (published in 1999 by the European Commission) and the Annual Energy Outlook series (published annually by the Energy Information Administration of the US Department of Energy, USA).

from exports; on international gas and coal prices; on activity levels for typical GHG drivers (such as cattle numbers for agriculture); and some others. Some Parties analysed the impact of assumptions on GHG projections (see the discussion of sensitivity analysis later in this document).

20. Table 3 also shows that, even for the three general parameters selected, related information was sometimes not available, although the assumptions were probably made. In some communications, the absence of information on assumptions led to a lack of transparency in the GHG projections presented.

IV. GREENHOUSE GAS PROJECTIONS FOR ANNEX I PARTIES

21. Table 4 provides detailed numerical information on the GHG projections of Annex I Parties. The data for 1990 and 2000 are, as a rule,[7] from the latest submissions of the national GHG inventories; data for 2010 and 2020 are projections. The notes to the table give explanatory information, in particular for the cases where the original projection (as provided in the Party's national communication) was not in full compliance with the UNFCCC guidelines and had to be interpreted by the secretariat for consistency.

22. Tables 5–8 provide detailed information on GHG emission projections by gas and sector. For the projection "with additional measures", information is presented only for the Parties that provided sufficient details for this scenario. In particular, the Parties that provided only a GHG total for this scenario without a breakdown by gas and/or sector are not included. The explanatory notes by Party, given for table 4, are also relevant for these tables and should be taken into account when reviewing the information in the tables.

23. For some Parties the sum of sectoral GHG projections may differ from the sum of the projections by gas. The reason is that sometimes the information by sector presented in the communications is not completely consistent with the information by gas. However, such cases are not numerous and the difference is usually small.

[7] There are several exceptions, because some Parties (Bulgaria, Croatia, Russian Federation, Slovenia) have not yet submitted the 2000 GHG inventory and also because, for some Parties, the modelled emissions of 2000 differ from the 2000 emissions presented in the GHG inventory. In such cases, data from modelling were used for the year 2000 for the projections to be internally consistent, (Belgium, Hungary, Netherlands, Poland) (see footnotes to tables 4–8).

Table 4. GHG projections for Annex I Parties

	Actual emissions		GHG emissions for "with measures" scenario					GHG emissions for "with additional measures" scenario				Kyoto Protocol target
	Tg CO_2 equivalent		Tg CO_2 equivalent		Change from 1990[a] (%)			Tg CO_2 equivalent		Change from 1990[a] (%)		
Party	1990	2000	2010	2020	2000	2010	2020	2010	2020	2010	2020	(%)
AUS	427.28	507.30	540.70	607.90	18.7	26.5	42.3	na	na	na	na	8[b]
AUT	77.39	79.76	86.05	89.34	3.1	11.2	15.4	71.60	68.98	–7.5	–10.9	–13
BEL	144.50	157.88[d]	171.18	na[e]	9.3	18.5	na[e]	153.58	na[e]	6.3	na[e]	–7.5
BLG	157.09	77.49[d]	133.81	155.03	–50.7	–14.8	–1.3	125.45	146.09	–20.1	–7.0	–8
CAN	607.19	726.25	769.70	852.00	19.6	26.8	40.3	704.70	765.00	16.1	26.0	–6
CHE	53.24	52.74	52.69	51.24	–0.9	–1.0	–3.8	50.09	47.64	–5.9	–10.5	–8[b]
CZE	192.02	147.68	128.29	121.18	–23.1	–33.2	–36.9	121.87	114.77	–36.5	–40.2	–8
DEU	1 222.76	991.42	812.08	na	–18.9	–33.6	na	na	na	na	na	–21
EC	4 215.67	4 067.77	4 189.00	na	–3.5	–0.6	na	3 950.00	na	–6.3	na	–8
ESP	208.92	285.26	307.40	na	36.5	47.1	na	265.40	na	27.0	na	15
EST	43.50	19.74	18.86	17.91	–54.6	–56.6	–58.8	17.43	15.49	–59.9	–64.4	–8
FIN	77.09	73.96	89.90	95.40	–4.1	16.6	23.7	75.80	na	–1.7	na	0
FRA	549.34	537.03	582.50	652.80	–2.2	6.0	18.8	524.00	537.10	–4.6	–2.2	0
GBR	742.50	649.11	630.67	660.67	–12.6	–15.1	–11.0	564.85	572.00	–23.9	–23.0	–12.5
GRE	104.89	130.04	147.21	167.73	24.0	40.3	59.9	132.91	na	26.7	na	25
HRV	31.95	28.90[d]	38.00	44.60	–9.5	18.9	39.6	31.70	32.50	–0.8	1.7	–5[b]
HUN	84.47	59.48[d]	65.91	67.18	–29.6	–22.0	–20.5	na	na	na	na	–6
ITA	520.58	546.90	540.10	na	5.1	3.7	na	496.25	na	–4.7	na	–6.5
JPN	1 246.73	1 386.30	1 317.40	na	11.2	5.7	na	1 221.40	na	–2.0	na	–6
LIE	0.22	0.22	0.22	na	0.0	0.0	na	na	na	na	na	–8[b]
LVA	31.06	10.68	12.81	15.44	–65.6	–58.8	–50.3	na	na	na	na	–8
NLD	217.00	242.00[d]	256.00	285.00	11.5	18.0	31.3	230.00	na	6.0	na	–6
NOR	51.96	55.25	63.20	na	6.3	21.6	na	57.90	na	11.4	na	1
NZL	73.16	76.95	88.09	98.20	5.2	20.4	34.2	84.14	83.37	15.0	14.0	0
POL[c]	463.05	370.00[d]	394.00	439.00	–20.1	–14.9	–5.2	na	na	na	na	–6
RUS	2 360.00	1 510.00[d]	2 098.04	2 692.76	–36.0	–11.1	14.1	na	na	na	na	0[b]
SVK	72.94	49.17	53.19	na	–32.6	–27.1	na	48.14	na	–34.0	na	–8
SVN	20.18	20.75[d]	22.15	22.75	2.8	9.8	12.7	19.90	19.87	–1.4	–1.6	–8
SWE	70.56	69.36	70.88	72.80	–1.7	0.5	3.2	na	na	na	na	4
USA	6 130.72	7 001.22	8 115.00	9 290.00	14.2	32.4	51.5	na	na	na	na	–7[b]
Total	**15 982.26**	**15 862.86**	**17 606.01**	**–**	**–0.7**	**10.2**	**–**	**–**	**–**	**–**	**–**	**–5**

Note 1: The GHG total used in this table is calculated based on the level of detail in the national projections. For those Parties that projected only some of the six GHG gases, only those gases that were projected are included in the total (see table 1).

Note 2: na means "not available in the national communication".

Note 3: For an explanation of country codes, please refer to the annex.

[a] The change is calculated as [(2000 – 1990) / 1990] × 100 or [(2010 – 1990) / 1990] × 100 or [(2020 – 1990) / 1990] × 100.

[b] At the time this report was prepared, the Party had not ratified the Kyoto Protocol.

[c] The comparison is with a particular base year instead of 1990 (decisions 9/CP.2 and 11/CP.4).

[d] The information for 2000 was taken from the projections, because the inventory submission for 2000 was either not available or not fully consistent with the projections.

[e] Belgium provided estimates for 2020 in its NC3, but these estimates are for "long-term" projections that are not fully consistent with the "medium-term" projections used here.

Table 5. Projections of GHG emissions by gas (the "with measures" scenario)

	CO_2 Tg CO_2 equivalent			CH_4 Tg CO_2 equivalent			N_2O Tg CO_2 equivalent			Sum of HFCs, PFCs and SF_6 Tg CO_2 equivalent		
Party	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**
AUS	279.04	348.47	373.90	118.86	121.05	124.90	23.18	31.91	28.80	6.19	5.87	13.10
AUT	62.30	66.10	72.54	11.30	9.41	8.49	2.31	2.51	2.02	1.49	1.74	3.00
BEL[a]	118.30	131.10	140.00	14.10	12.30	14.30	12.10	13.20	14.30	0.00	1.28	2.58
BLG[a]	103.86	48.44	78.56	28.01	10.14	23.63	25.22	18.91	31.62	na	na	na
CAN	471.56	571.43	599.30	73.46	91.50	92.20	53.32	53.94	64.20	8.85	9.39	14.00
CHE	44.42	43.85	44.70	5.08	4.54	3.67	3.52	3.62	3.20	0.22	0.73	1.12
CZE	163.99	127.90	109.61	16.76	10.71	9.86	11.27	8.17	8.02	0.00	0.89	0.79
EC	3 341.80	3 324.80	3 376.00	426.51	341.78	380.00	400.95	338.11	317.00	46.41	63.09	116.00
EPA	208.92	285.26	307.40	na	na	na	na	na	na	na	na	na
EST	38.11	16.85	15.84	4.37	2.48	2.54	1.02	0.42	0.48	na	na	na
FIN	62.47	62.31	76.40	6.14	3.93	3.50	8.41	7.18	8.30	0.07	0.54	1.70
FRA	384.07	388.92	427.60	66.56	60.29	46.70	91.08	76.89	82.20	7.64	10.92	26.00
GBR	583.71	542.74	532.77	76.55	50.97	42.53	67.87	43.88	43.27	14.38	11.52	12.10
GER	1 014.50	857.91	694.00	110.73	60.59	45.54	88.59	60.08	45.19	8.93	12.85	27.36
GRE	84.34	103.73	120.82	8.74	10.88	7.94	10.62	11.01	11.15	1.19	4.43	7.31
HRV[a]	23.31	na	na	3.82	na	na	3.88	na	na	0.94	na	na
HUN[a]	80.09	57.20	62.80	4.38	2.28	3.11	na	na	na	na	na	na
ITA	439.48	463.38	na	39.40	37.82	na	40.78	43.18	na	0.92	2.52	na
JPN	1 119.32	1 237.11	1 204.40	26.73	22.03	24.00	38.83	36.87	16.00	61.84	90.29	73.00
LIE	0.20	0.20	0.20	0.02	0.01	0.01	0.01	0.01	0.01	na	na	na
LVA	23.53	6.85	9.36	4.12	2.54	1.88	3.41	1.29	1.57	0.00	0.00	0.00
NLD[a]	161.00	189.00	207.00	27.00	20.00	14.00	20.00	23.00	21.00	9.00	10.00	14.00
NOR	35.16	41.27	47.60	6.45	6.80	7.10	5.13	5.16	6.00	5.22	2.02	2.50
NZL	25.27	30.85	34.78	35.39	33.20	37.19	11.90	12.65	16.12	0.61	0.24	na
POL[a]	463.05	370.00	394.00	na	na	na	na	na	na	na	na	na
RUS[a]	2 360.00	1 510.00	2 098.04	na	na	na	na	na	na	na	na	na
SLV[a]	15.55	16.31	17.36	2.53	2.46	2.40	1.82	1.63	1.74	0.28	0.34	0.65
SVK	59.75	41.47	44.06	6.78	4.52	4.27	6.14	3.08	4.63	0.27	0.10	0.23
SWE	56.07	55.86	57.74	6.80	5.88	4.66	7.17	6.92	7.41	0.52	0.71	1.06
USA	4 998.52	5 840.04	6 813.00	651.29	614.51	630.00	387.30	425.34	464.00	93.62	121.33	208.00

Note 1: na means "not available in the national communication".

Note 2: For an explanation of country codes, please refer to the annex.

[a] The information for 2000 is from projections (the inventory submission for 2000 was either not available or not fully consistent with the projections).

Table 6. Projections of GHG emissions by sector (the "with measures" scenario)

	Energy Tg CO_2 equivalent			Industry Tg CO_2 equivalent			Agriculture Tg CO_2 equivalent			Transport Tg CO_2 equivalent			Waste management Tg CO_2 equivalent		
Party	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**
AUS	237.27	295.49	326.90	12.01	10.29	24.20	91.35	98.44	94.80	61.46	76.33	90.70	15.29	16.69	14.90
AUT	37.87	37.35	38.74	14.59	14.10	16.40	5.60	4.81	4.76	12.32	17.53	21.32	6.26	5.33	4.84
BEL[a]	89.57	96.37	94.51	13.29	17.35	23.33	15.35	14.80	14.36	20.48	24.59	31.48	4.95	3.81	2.77
BGR[a]	105.83	49.75	79.94	10.84	4.71	7.19	23.51	18.02	22.31	na	na	na	16.90	5.05	7.24
CAN	320.13	396.94	423.42	53.00	51.16	50.36	59.00	60.50	72.53	152.87	190.42	198.51	20.00	24.29	24.18
CHE	26.05	24.92	25.72	3.69	3.21	2.41	6.03	5.46	5.14	14.53	16.25	15.81	2.83	2.79	2.37
CZE	167.43	117.31	103.38	6.64	3.36	3.73	4.90	7.84	7.96	8.37	12.19	11.82	2.21	2.89	2.94
DEU	868.67	672.60	505.25	64.22	44.09	58.95	82.40	66.50	43.94	166.81	188.46	193.51	41.01	17.91	8.53
EC	1 908.30	na	1 912.20	893.00	na	759.40	417.00	na	398.00	753.00	na	985.00	167.00	na	138.00
ESP	151.26	200.14	202.40	na	na	na	na	na	na	57.66	85.12	105.00	na	na	na
EST	38.83	17.31	16.12	0.61	0.35	0.34	2.44	0.89	1.39	na	na	na	1.61	1.20	1.03
FIN	46.41	47.63	62.30	2.85	2.95	4.50	10.17	7.70	6.80	13.18	13.13	13.90	3.79	1.77	1.60
FRA	251.85	239.78	265.80	54.26	38.12	57.49	89.95	86.83	85.01	121.55	142.02	151.00	21.74	20.26	11.49
GBR	476.67	416.90	403.70	56.83	24.20	20.17	55.73	50.97	47.67	130.53	138.23	160.60	25.30	15.77	9.17
GRC	62.12	78.55	89.94	9.59	12.87	15.90	10.45	10.23	9.67	18.67	22.52	26.95	3.75	5.32	2.54
HRV[a]	22.46	21.00	29.00	4.23	3.00	3.60	4.32	4.00	4.30	na	na	na	0.93	0.90	1.10
HUN[a]	72.35	47.40	52.10	na	na	na	4.38	2.28	3.11	7.74	9.80	10.60	na	na	na
ITA	321.40	327.60	309.80	35.90	33.90	30.40	43.40	42.60	41.00	103.50	124.70	134.70	13.70	14.20	7.50
JPN	1 057.14	1 170.49	1 137.61	64.16	93.04	136.75	37.58	33.02	20.44	na	na	na	25.66	34.69	27.15
LIE	0.14	0.15	0.14	na	na	na	0.02	0.02	0.02	0.05	0.05	0.06	0.00	0.00	0.00
LVA	24.63	7.63	9.96	0.56	0.10	0.12	5.34	1.93	2.01	na	na	na	0.49	1.14	0.72
NLD[a]	89.28	99.12	108.98	72.57	78.30	87.09	17.47	17.30	14.03	30.72	37.54	40.01	13.35	9.17	5.31
NOR	17.89	21.46	25.00	13.86	11.02	12.80	4.95	4.71	5.10	11.32	13.79	16.50	3.95	4.16	4.10
NZL	14.93	16.77	15.32	2.99	3.07	3.71	43.31	41.98	51.40	8.92	12.64	16.87	2.90	2.39	2.52
POL[a]	463.05	370.00	394.00	na	na	na	na	na	na	na	na	na	na	na	na
RUS[a]	2 360.00	1 510.00	2 098.04	na	na	na	na	na	na	na	na	na	na	na	na
SVK	52.62	33.96	36.61	4.73	3.71	4.23	7.86	3.78	5.75	5.16	4.65	5.35	2.09	1.56	1.25
SVN[a]	13.14	11.30	10.99	1.24	1.26	1.78	2.60	2.30	2.30	2.00	4.61	5.80	1.00	1.23	1.23
SWE	34.60	33.30	33.21	5.64	6.01	6.97	7.99	7.47	7.37	19.67	20.44	22.35	2.55	2.03	0.97
USA	3 614.30	4 110.42	4 503.00	295.72	312.84	415.00	448.36	485.15	566.00	1 527.64	1 852.18	2 411.00	244.70	240.64	213.00

Note 1: na means "not available in the national communication".

Note 2: For an explanation of country codes, please refer to the annex.

[a] The information for 2000 is from projections (the inventory submission for 2000 was either not available or not fully consistent with the projections).

Table 7. Projections of GHG emissions by gas (the "with additional measures" scenario)

	CO_2 Tg CO_2 equivalent			CH_4 Tg CO_2 equivalent			N_2O Tg CO_2 equivalent			Sum of HFCs, PFCs and SF_6 Tg CO_2 equivalent		
Party	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**
AUT	62.30	66.10	60.92	11.30	9.41	7.22	2.31	2.51	1.88	1.49	1.74	1.58
BEL[a]	118.30	131.10	126.20	14.10	12.30	10.50	12.10	13.20	14.30	0.00	1.28	2.58
BLG[a]	103.86	48.44	72.76	28.01	10.14	21.69	25.22	18.91	31.00	na	na	na
CHE	44.42	43.85	42.10	5.08	4.54	3.67	3.52	3.62	3.20	0.22	0.73	1.12
CZE	163.99	127.90	103.20	16.76	10.71	9.86	11.27	8.17	8.02	0.00	0.89	0.79
EC	3 341.80	3 324.80	3 166.00	426.51	341.78	380.00	400.95	338.11	317.00	46.41	63.09	87.00
ESP	208.92	285.26	265.40	na	na	na	na	na	na	na	na	na
EST	38.11	16.85	15.20	4.37	2.48	1.83	1.02	0.42	0.40	na	na	na
FIN	62.47	62.31	64.70	6.14	3.93	2.80	8.41	7.18	7.40	0.07	0.54	0.90
FRA	384.07	388.92	398.40	66.56	60.29	46.60	91.08	76.89	67.90	7.64	10.92	11.10
GBR	583.71	542.74	466.95	76.55	50.97	42.53	67.87	43.88	43.27	14.38	11.52	12.10
JPN	1 119.32	1 237.11	1 108.40	26.73	22.03	24.00	38.83	36.87	16.00	61.84	90.29	73.00
NLD[A]	161.00	183.00	190.00	27.00	20.00	14.00	20.00	23.00	20.00	9.00	7.00	6.00
NZL	25.27	30.85	30.83	35.39	33.20	37.19	11.90	12.65	16.12	0.61	0.24	na
SVK	59.75	41.47	40.32	6.78	4.52	3.83	6.14	3.08	3.75	0.27	0.10	0.23
SVN[a]	15.55	16.31	16.25	2.53	2.46	1.90	1.82	1.63	1.68	0.28	0.34	0.06

Note 1: na means "not available in the national communication".

Note 2: For an explanation of country codes, please refer to the annex.

[a] The information for 2000 is from projections (the inventory submission for 2000 was either not available or not fully consistent with the projections).

Table 8. Projections of GHG emissions by sector (the "with additional measures" scenario)

	Energy Tg CO_2 equivalent			Industry Tg CO_2 equivalent			Agriculture Tg CO_2 equivalent			Transport Tg CO_2 equivalent			Waste management Tg CO_2 equivalent		
Party	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**	**1990**	**2000**	**2010**
AUT	37.87	37.35	31.31	14.59	14.10	14.93	5.60	4.81	4.62	12.32	17.53	16.98	6.26	5.33	3.76
BEL[a]	89.57	96.37	81.47	13.29	17.35	23.23	15.35	14.80	14.36	20.48	24.59	29.91	4.95	3.81	2.77
BLG[a]	105.83	49.75	73.44	10.84	4.71	7.19	23.51	18.02	22.31	na	na	na	16.90	5.05	5.54
CHE	26.05	24.92	23.62	3.69	3.21	2.41	6.03	5.46	5.14	14.53	16.25	14.91	2.83	2.79	2.37
CZE	167.43	117.31	96.97	6.64	3.36	3.73	4.90	7.84	7.96	8.37	12.19	11.82	2.21	2.89	2.94
ESP	151.26	200.14	176.40	na	na	na	na	na	na	57.66	85.12	89.00	na	na	na
EST	38.83	17.31	15.41	0.61	0.35	0.33	2.44	0.89	1.02	na	na	na	1.61	1.20	0.67
FIN	46.41	47.63	51.30	2.85	2.95	2.60	10.17	7.70	6.70	13.18	13.13	13.70	3.79	1.77	0.80
FRA	251.85	239.78	244.50	54.26	38.12	31.18	89.95	86.83	82.28	121.55	142.02	143.30	21.74	20.26	11.49
GBR	476.67	416.90	358.78	56.83	24.20	20.17	55.73	50.97	47.67	130.53	138.23	139.70	25.30	15.77	9.17
GRE	62.12	78.55	109.40	9.59	12.87	11.25	10.45	10.23	9.60	18.67	22.52	na	3.75	5.32	2.47
JPN	1 057.14	1 170.49	1 055.92	64.16	93.04	136.75	37.58	33.02	20.44	na	na	na	25.66	34.69	25.90
NLD[A]	89.28	99.12	95.89	72.57	78.30	77.29	17.47	17.30	13.72	30.72	37.54	37.08	13.35	9.17	5.31
SVK	52.62	33.96	32.71	4.73	3.71	4.23	7.86	3.78	4.83	5.16	4.65	5.33	2.09	1.56	1.04
SVN[a]	13.14	11.30	9.76	1.24	1.26	1.30	2.60	2.30	2.21	2.00	4.61	5.80	1.00	1.23	0.79

Note 1: na means "not available in the national communication".

Note 2: For an explanation of country codes, please refer to the annex.

[a] The information for 2000 is from projections (the inventory submission for 2000 was either not available or not fully consistent with the projections).

Explanatory notes to tables 4–8 by Party:

Party	Explanatory note
AUS	▪ Some emissions defined as "confidential" are included in CO_2 emissions. ▪ The emissions of HFCs, PFCs and SF_6 are preliminary estimates taken from the projection models; the official GHG inventory does not yet include these gases.
AUT	▪ Transport emissions are included in energy (not separated in the NC); the separate emissions from transport are taken from the IDR report (for 2010 – the other years are inter/extrapolated).
BEL	▪ The medium-term projections are used (they are for all sectors), not the set of long-term projections (which are available for energy emissions only).
BLG	▪ For 2000, modelling data are used (no inventory data are available for this year).
CAN	▪ For the "with additional measures" scenario, the total of GHG emissions is estimated from the aggregated effects given in the NC3.
CHE	▪ For HFCs, PFCs and SF_6, the projections are presented to 2010 only. ▪ The additional measures relate only to CO_2 from energy and transport.
CZE	▪ The data for 1990 and 2000 used in the projections slightly differ from the 1990 and 2000 data used in the projection modelling; however, the difference is not meaningful.
DEU	▪ Additional measures are available only for HFCs, PFCs and SF_6.
EC	▪ Sectoral estimates are not available for the "with additional measures" scenario.
ESP	▪ Only energy-related CO_2 is projected.
EST	▪ Projections for transport are not available.
FIN	▪ The scenario "with additional measures" is calculated until 2010 only.
FRA	▪ The projections do not include the emissions in the French overseas territories. Accordingly, the inventory data used in the table have been modified by deducting the emissions from these territories from the national total.
GBR	▪ The "with measures" scenario is modelled. The "with additional measures" scenario is not modelled but built by deducting the estimated effects of policies and measures.
GRE	▪ The "with additional measures" scenario is calculated to 2010 only.
HRV	▪ Results are presented in the NC1 by sector on a CO_2 equivalent basis only, not on a gas-by-gas basis. ▪ Results only are presented, as graphs and the tables of numerical information required by the guidelines are not used. To obtain numerical information one has to measure the graphs, which is not very accurate. ▪ The "baseline" scenario from NC1 is interpreted as a "with measures" scenario; the "mitigation" scenario is interpreted as a "with additional measures" scenario. ▪ For 2000, modelling data are used (no inventory data are available for this year).
HUN	▪ The definition of scenarios differs for the energy sector and agriculture. "Baseline" and "with measures" are used for the energy sector whereas scenarios A, B, C are defined for agriculture. The C scenario (which is an average of A and B) is used for the projections here. ▪ Only CO_2 emissions from energy and CH_4 emissions from agriculture are considered here. Information on the other emissions in the NC3 is either incomplete or absent.
ITA	▪ The "trend" scenario presented in detail in the NC3 is something between the "without measures" and "with measures" scenarios. The "with measures" scenario is presented in much less detail, as reflected in the summary of submission (no information by gas, no 2015–2020 estimates).
JPN	▪ The effect of technology innovation (4 Tg) is deducted from CO_2 emissions as well as the 3 Tg difference in non-energy emissions (footnote 3 to Table 4.2, p.134 of NC3).
LIE	▪ Several key projection assumptions are taken from studies in Switzerland.
LVA	▪ Projections for transport are not available.
NLD	▪ Data for 1990 and 2000 are from the models and not from the inventory. The 2000 inventory data are not fully compatible with the projections.
NOR	▪ Only the GHG total in 2010 is given for the "with additional measures" scenario.
NZL	▪ The scenario with the highest CO_2 reductions (the scenario entitled 1% and 1.5% efficiency) is taken to reflect the maximum reductions possible. ▪ A projection for transport is not given in the NC3 but is available (CO_2 only) in the Energy Outlook to 2020 (2000); this information was referred to at the in-depth review of the NC3.
POL	▪ Some effects of additional policies and measures are provided but the information submitted does not allow a consistent scenario to be built. Therefore, only CO_2 emissions from the energy sector are used here (table 5.8, page 49 of NC3) – other sectoral estimates appear to be inconsistent or incomplete. Accordingly, only energy-related CO_2 emissions are used for 1990 and 2000 in this table.
RUS	▪ Of the three scenarios presented in NC3, the scenario with a 4.5% GDP growth is taken here. ▪ Only a CO_2 total is projected.
SVK	▪ The projections are presented to 2015 only.
SVN	▪ For the base year (1986) and 2000, the information from the NC1 is used (the national GHG inventory submission with 2000 data is not available).
SWE	▪ Two "with measures" scenarios are defined: Scenario 1: possibility of reinvestment in nuclear power and Scenario 2: the lifespan of existing nuclear reactors is limited to 40 years. This means that reactors (apart from Barsebäck No. 2, which will be shut down before 2005) would begin to shut down in 2012. Six reactors would be shut down during the period. ▪ Scenario 1 is used as the "with measures" scenario here; the difference between the two scenarios appears only after 2012.
USA	▪ The "adjustments" to emissions relating to US territories are assumed to be CO_2 emissions.

V. PROJECTED OVERALL EFFECTS OF POLICIES AND MEASURES

24. The effects of implemented policies and measures are discussed in FCCC/SBI/2003/7/Add.2. This chapter provides detailed information on two additional aspects that are relevant to GHG projections. The first is the change of sectoral emissions from 2000 to 2010 in the "with measures" scenario. By comparing this change with the corresponding change from 1990 to 2000, one could estimate the total impact of the continuation of existing policies and measures in 2000–2010.[8] The second aspect is the total effect of additional measures, which can be estimated as the difference between the GHG emissions projected under the "with measures" scenario and the GHG emissions projected under the "with additional measures" scenario. Such an estimate can be considered reasonably accurate but it can be used only for those Parties that presented a "with additional measures" scenario.

A. Change in sectoral emissions from 2000 to 2010 (the "with measures" projection)

25. Figure 1 shows the change in total emissions of CO_2, CH_4, N_2O and the sum of HFCs, PFCs and SF_6 for Annex I Parties from 1990 to 2000 compared with the projected change for the same gases in the period from 2000 to 2010. These figures are for the "with measures" projection and include data for 29 Parties (the 32 Parties considered in this report, excluding the European Community to avoid double counting, and Lithuania and Monaco). Only CH_4 and N_2O emissions are projected to decrease from 2000 to 2010. Although CO_2 emissions decreased in 1990–2000, an increase is projected for 2000–2010. The growth in HFC, PFC and SF_6 emissions, observed in the 1990s, is expected to continue in 2000–2010.

26. Figure 2 provides a similar comparison for the sum of the sectoral emissions of Annex I Parties.[9] Emission growth in all sectors, with the exception of waste management, is projected for 2000–2010 (under the "with measures" scenario). For transport, the projected growth in 2000–2010 is higher than the observed growth in 1990–2000.

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[8] Such an estimate is not quite accurate because the emissions in 2000–2010 under the "with measures" scenario depend not only on the implemented policies and measures but also on a number of general factors, such as the assumed GDP growth (relatively to its actual development in the 1990s), and the assumed pace of technology development. The effects of the implemented measures could be more accurately evaluated as the difference between the "with measures" and "without measures" scenarios. However, as only a few Parties provided a "without measures" projection, the amount of data for such a comparison is not sufficient.

[9] Only the Parties that provided detailed sectoral projections are included here.

Figure 1. Change in GHG emissions by gas from 1990 to 2000 and projected change in GHG emissions by gas from 2000 to 2010 (for Annex I Parties as a whole)

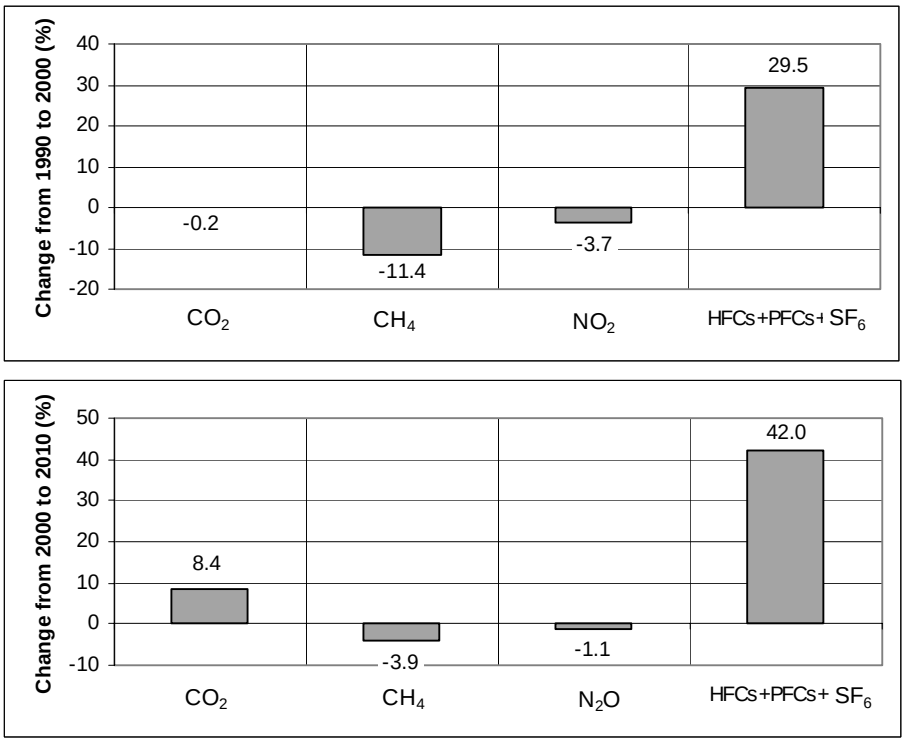
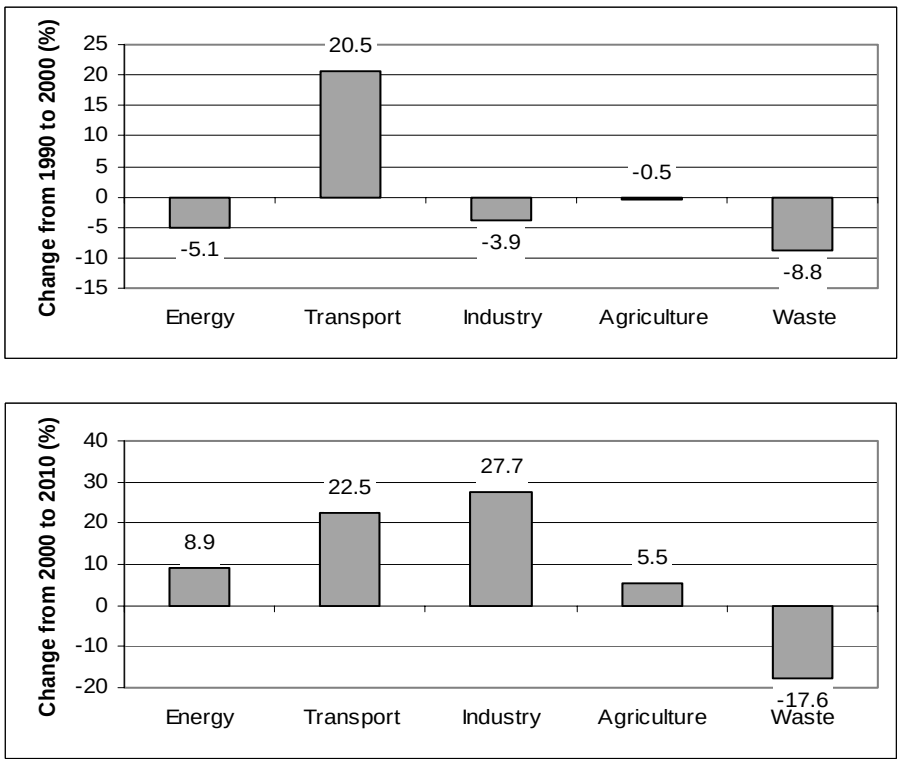


Figure 2. Change in GHG emissions by sector from 1990 to 2000 and projected change in GHG emissions by sector from 2000 to 2010 (for Annex I Parties as a whole)



B. Overall effects of additional measures

27. Figures 3–5 show the difference in the change in total emissions of CO_2, CH_4, N_2O and the sum of HFCs, PFCs and SF_6 for Annex I Parties between the "with measures" and "with additional measures" projections. These figures are based on the data only for those 16 Annex I Parties that presented a complete projection "with additional measures" (Austria, Belgium, Bulgaria, Czech Republic, Estonia, Finland, France, Greece, Japan, Netherlands, New Zealand, Slovakia, Slovenia, Spain, Switzerland, United Kingdom).[10] To demonstrate the change from 1990 to 2000, figure 3 presents the change for the same gases in the period from 1990 to 2000 for these 16 Parties only (that is why figure 3 differs from figure 1, which is based on data for all Parties). The comparison shows that additional measures have an impact on all gases – either the reductions become greater (CH_4) or the increase under the "with measures" scenario is replaced by a decrease (CO_2, N_2O and the sum of HFCs, PFCs and SF_6). However, **the behaviour of the sum of the emissions for the 16 Parties which submitted a complete "with additional measures" scenario differs noticeably from the behaviour of the sum of the emissions of all Annex I Parties** (this can be seen by comparing figures 1, 3 and 4). Therefore, the demonstrated impact of additional measures cannot be generalized to all Annex Parties.

Figure 3. Change in GHG emissions by gas from 1990 to 2000

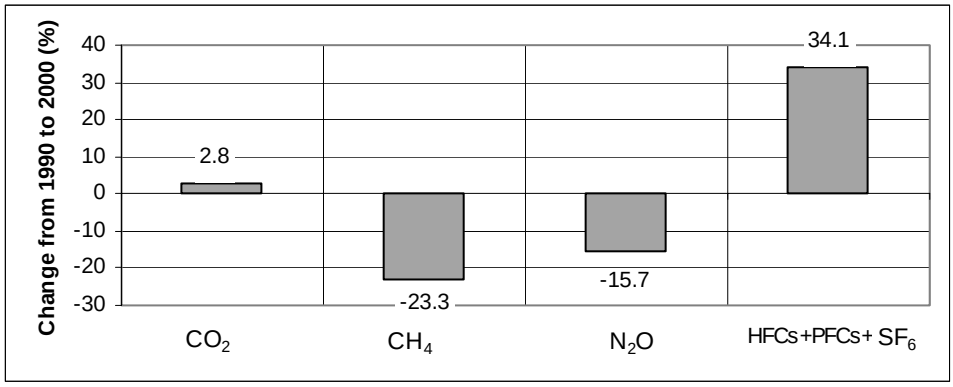
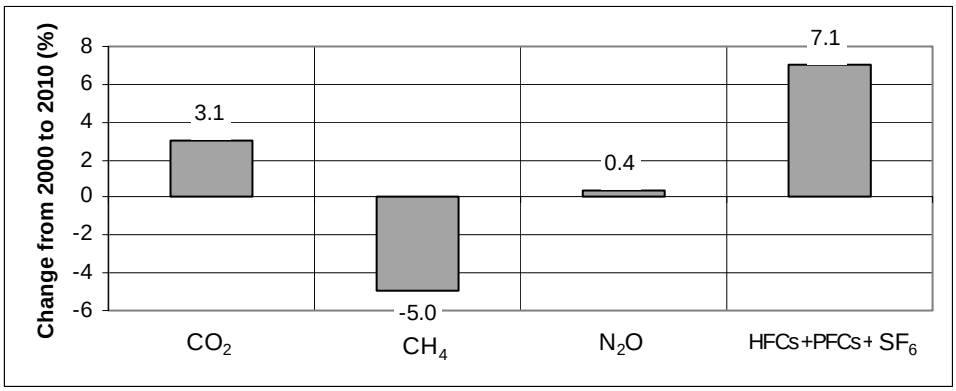
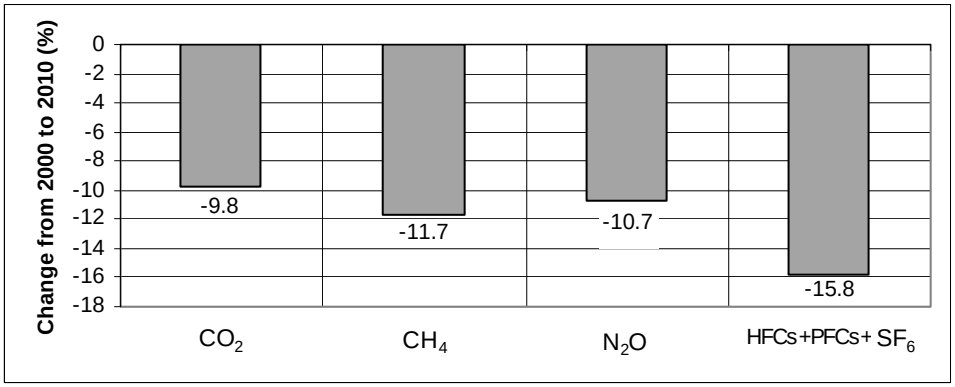


Figure 4. Projected change in GHG emissions by gas from 2000 to 2010 ("with measures")



[10] Altogether, 21 Annex I Parties presented a "with additional measures" projection. However, Canada, Croatia, Italy and Norway presented only a GHG total, so sectoral data and/or projections by gas are not available. The projections of the European Community are not considered here in order to avoid double-counting of national emissions.

Figure 5. Projected change in GHG emissions by gas from 2000 to 2010, "with additional measures"



28. The sectoral impacts of additional measures are shown in figures 6–8. The additional measures lead to emission reductions in all sectors. As described in the previous paragraph, these observations cannot be generalized; the emission behaviour by sector for the 16 Parties covered in figures 6–8 differs from the emission behaviour by sector for the total number of Annex I Parties, as comparison between figures 2, 6 and 7 indicates.

Figure 6. Change in GHG emissions by sector from 1990 to 2000

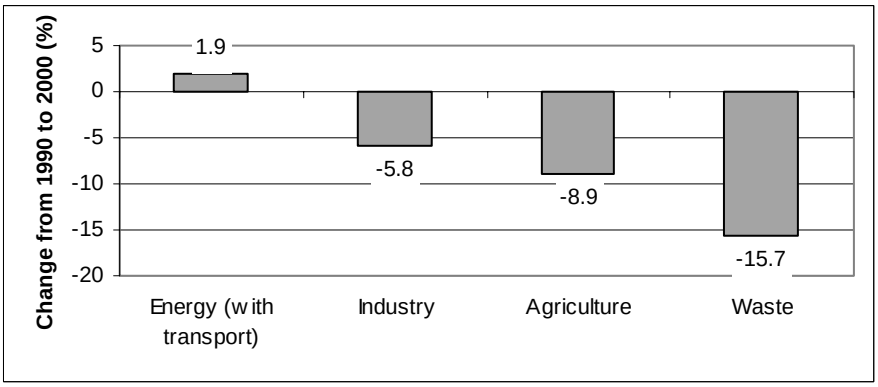


Figure 7. Projected change in GHG emissions by sector from 2000 to 2010, "with measures"

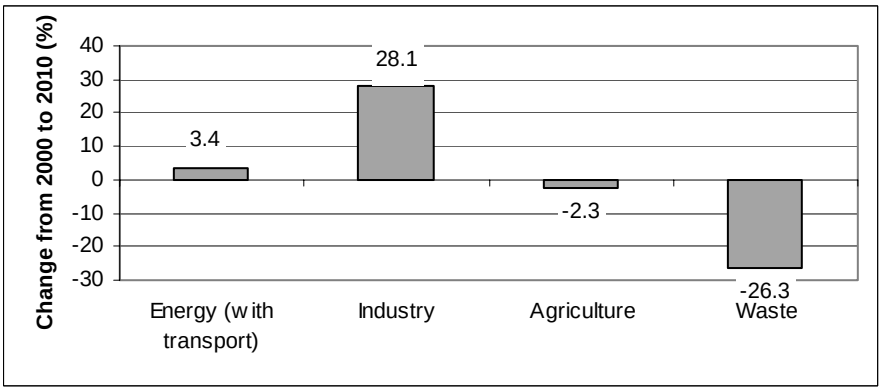
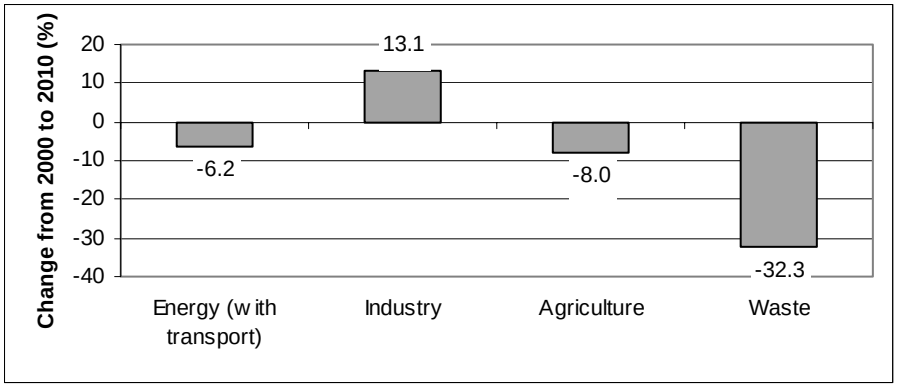


Figure 8. Projected change in GHG emissions by sector from 2000 to 2010, "with additional measures"



VI. PROJECTED REMOVALS OF GREENHOUSE GASES BY SINKS

29. Projections of GHG removals through LUCF were prepared more comprehensively than in the previous national communications. Nevertheless, of the 32 communications reviewed in this report, 11 did not contain a LUCF projection; reasons given were methodological problems or lack of reliable data. For the projections presented, the methodological approach varies from a comprehensive assessment of trends in the sinks (based on forest inventories and the statistics of forest growth and usage) to a simple extrapolation of recent LUCF trends.

30. Table 9 summarizes the LUCF projections of those Parties that presented such a projection. Six Parties (France, Germany, Latvia, Norway, Switzerland, United States) projected an increase in GHG emissions/removals by LUCF in 2000–2010; several other Parties (Belgium, Czech Republic, Estonia, Finland, Greece, Italy, New Zealand, Slovakia, Sweden, United Kingdom) expected that the removals will decrease from 2000 to 2010. Most Parties emphasized that **further methodological progress is needed for the assessment of GHG removals through LUCF. Such progress may lead to considerable changes in the LUCF projections.**

Table 9. LUCF projections by Party (the "with measures" projection)

	GHG total without LUCF (Tg CO_2 equivalent)		GHG removals through LUCF (Tg CO_2 equivalent)			Change in LUCF (%)[a]	
Party	**1990**	**2000**	**1990**	**2000**	**2010**	**1990 to 2000**	**2000 to 2010**
AUS	427.3	507.3	85.9	38.0	38.8	–55.8	2.1
BEL	144.5	157.9	–2.1	–2.3	–2.0	9.5	–13.0
CHE	53.2	52.7	–3.2	–1.8	–4.5	–43.8	150.0
CZE	192.0	147.7	–2.1	–4.0	–3.4	90.5	–15.0
DEU	1 222.8	991.4	–33.7	–16.8	–33.0	–50.1	96.4
EST	43.5	19.7	–6.3	–8.4	–7.2	33.3	–14.3
FIN	77.1	74.0	–23.8	–12.0	–6.5[b]	–49.6	–45.8
FRA	549.3	537.0	–48.7	–55.5	–57.1	14.0	2.9
GBR	742.5	649.1	19.4	15.0	10.3	–22.7	–31.3
GRC	104.9	130.0	1.6	4.2	2.0	162.5	–52.4
HRV	32.0	28.9	–6.5	–6.5	–6.5	0.0	0.0
ITA	520.6	546.9	–23.5	–16.4	–11.3[c]	–30.2	–31.1
LVA	31.1	10.7	–10.8	–4.2	–9.6	–61.1	128.6
NOR	52.0	55.3	–9.6	–18.7	–19.0[d]	94.8	1.6
NZL	73.2	77.0	–21.7	–23.9	–10.0	10.1	–58.2
SVK	72.9	49.2	–2.3	–2.6	–1.8	13.0	–30.8
SWE	70.6	69.4	–20.3	–27.3	–24.3	34.5	–11.0
USA	6 130.7	7 001.2	–1 097.7	–902.5	–1 144.0	–17.8	26.8

Note: For an explanation of country codes, please refer to the annex.

[a] The change in LUCF is calculated as [(2000 – 1990) / 1990] × 100 or [(2010 – 2000) / 2000] × 100.

[b] An average of the projected range for 2010 is taken here.

[c] The number is from the "trend" scenario". It may not be fully compatible with the "with measures" scenario.

[d] The expected average as given in the NC3 (page 43) is used.

VII. SENSITIVITY OF PROJECTIONS

31. The UNFCCC guidelines suggest that the sensitivity of the projections to underlying assumptions be discussed qualitatively and, where possible, quantitatively. Accordingly, some Parties conducted a quantitative sensitivity analysis, within which the impact of key parameters on the projections of GHG emissions was studied.

32. The most common areas of sensitivity analysis were economic growth and technology development, but energy (and/or oil) prices were also frequently considered (see table 10). Sensitivity analyses also considered such factors as implementation of policies and measures for GHG mitigation[11] (Australia), use of renewable energy sources (Austria), size of electricity imports (Austria, Finland), cattle numbers in agriculture (Austria), amount of deposited waste (Austria), use of different modelling approaches (Belgium), gas prices (Canada), parameters for LUCF evaluation (United Kingdom), CO_2 tax[12] (New Zealand), approach to modelling of energy-related CO_2 emissions (United Kingdom), approach to modelling of non-CO_2 emissions (United Kingdom), rate of growth in consumer spending (Sweden), degree of compliance with the ACEA agreement[13] (Sweden), economic growth in energy-intensive industries (Finland) and weather (United States).

[11] The aggregated impact of policies and measures is usually evaluated by comparing the "without measures", "with measures" and "with additional measures" scenarios. Australia conducted a more elaborate analysis to evaluate the impact of partial implementation of policies and measures.

[12] For many Parties, a CO_2 or energy tax is part of the "with measures" or "with additional measures" scenarios. Only a few Parties analysed the impact of a CO_2 or energy tax within a sensitivity analysis.

[13] An agreement to decrease CO_2 emissions from cars signed in 1998 between the European Community and the European Automobile Manufacturers Association (ACEA).

Table 10. Most common sensitivity analyses conducted by Parties

Parameters analysed	Parties
Economic growth	CAN, CZE, GBR, NZL, RUS, USA
Technology development, energy use efficiency, energy or carbon intensity of the gross domestic product[a] (GDP)	CAN, NZL, RUS, USA
Oil prices and/or energy prices[b]	CAN, GBR, USA

Note 1: Some Parties (e.g NZL, RUS), analysed the impact of such parameters without mentioning sensitivity analysis in their national communications.

Note 2: For an explanation of country codes, please refer to the annex.

[a] These three parameters are given together because they all reflect, in general, the expected degree of technological progress.

[b] These two factors are closely linked and are usually analysed together.

33. Because of the wide range of these analyses, it was difficult to generalize their results. Nevertheless, the assumptions appear to have a major impact on modelling results, which implies a related uncertainty in GHG projections. For example, the United Kingdom evaluated the overall uncertainty of its annual GHG emissions in 2010 as about 10 per cent. The estimated contributions of individual components to the total uncertainty are shown in table 11.

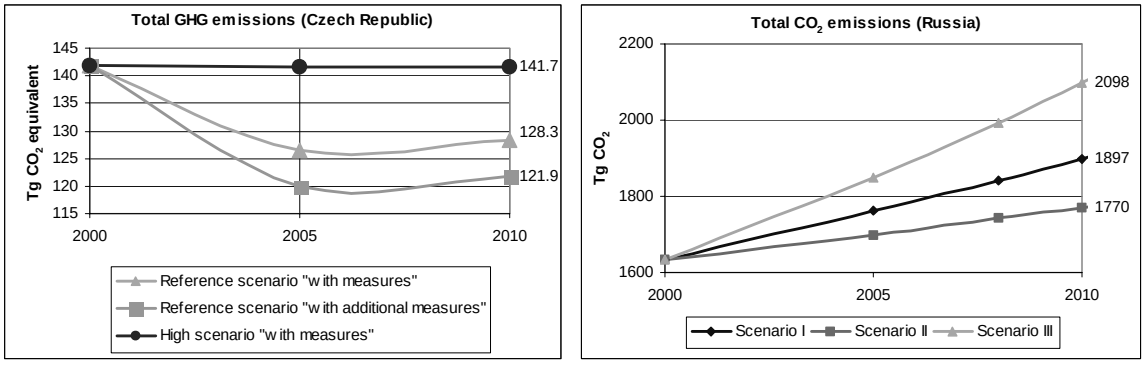
Table 11. Results of the sensitivity analysis conducted by the United Kingdom

Parameter	Sensitivity of the GHG total in 2010 (%)
Combination of GDP and fuel price	4
Approach to economic modelling for energy-related CO_2	9
Assumptions driving land use change emissions projection	2
Non-CO_2 greenhouse gas range	1
Combination (overall uncertainty)	10

34. The uncertainty associated with future economic development is particularly high in EIT Parties. For example, the projections prepared by the Czech Republic indicated that the impact of economic growth might be greater than the impact of additional GHG mitigation measures. In the Russian Federation, three scenarios differing in the GDP growth rate and efficiency of energy use lead to considerably different emission levels (see figure 9).

35. Such results confirmed the relevance of sensitivity analysis and suggested that monitoring of GHG emissions (to identify the actual development path within the projected range) as well as availability of margins and additional options (to permit the adoption of timely measures, should the unfavourable path be realized) are important for successful achievement of GHG reduction targets.

Figure 9. Impact of scenario assumptions on GHG emissions for the Czech Republic and the Russian Federation



VIII. PROJECTIONS OF EMISSIONS FROM INTERNATIONAL BUNKER FUELS

36. Only a few Parties have projected the GHG emissions from international bunker fuels. These projections indicate that the emissions from bunker fuels are expected to increase from 2000 to 2010. The increase in comparison with the 1990 level appears to be considerable. Table 12 presents the available projections by Party.

Table 12. Projected GHG emissions from international bunker fuels

	Tg CO_2 equivalent			Change relative to 1990 (%)[a]	
Party	**1990**	**2000**	**2010**	**2000**	**2010**
AUS	6.40	10.20	22.21	59.4	247.0
BEL	18.30	21.10	28.30	15.3	54.6
CZE	na	505.43	584.05	na	na
FIN	3.20	3.15	3.40	–1.6	6.3
JPN	30.53	na	29.89	na	–2.1
NZL	2.41	2.65	3.25	10.0	34.9
SWE	3.99	6.54	8.60	63.9	115.5
USA	115.00	110.00	128.00	–4.3	11.3

Note 1: na means "not available in the national communication".

Note 2: For an explanation of country codes, please refer to the annex.

[a] The change is calculated as $[(2000 – 1990) / 1990] \times 100$ or $[(2010 – 1990) / 1990] \times 100$.

Annex

List of Parties considered in this report and their ISO three-letter country codes

Party	Country code	Party	Country code
Australia	AUS	Latvia	LVA
Austria	AUT	Liechtenstein	LIE
Belgium	BEL	Lithuania	LTU
Bulgaria	BGR	Monaco	MCO
Canada	CAN	Netherlands	NLD
Croatia	HRV	New Zealand	NZL
Czech Republic	CZE	Norway	NOR
European Community	EC [a]	Poland	POL
Estonia	EST	Russian Federation	RUS
Finland	FIN	Slovakia	SVK
France	FRA	Slovenia	SVN
Germany	DEU	Spain	ESP
Greece	GRC	Sweden	SWE
Hungary	HUN	Switzerland	CHE
Italy	ITA	United Kingdom	GBR
Japan	JPN	United States	USA

[a] This is not an ISO symbol.

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