

Second ECCP Progress Report
Can we meet our Kyoto targets?

April 2003

Executive Summary

In the last two years, the European Climate Change Programme has analysed extensively the most environmentally beneficial and cost-effective additional policies and measures enabling the EU to meet its –8% target under the Kyoto Protocol, equivalent to 336Mt CO₂eq. The programme was not carried out in isolation, but rather built links with on-going activities at EU level. It also dovetails with the Sixth Environmental Action Programme and the EU Strategy for Sustainable Development. In the field of renewable energy and energy demand, there are evident synergies with the European Strategy for the Security of Energy Supply.

This report is a follow-up of the first ECCP report, published in June 2001, that was followed by a Commission Communication in October 2001, laying down the concrete policy proposals the Commission intends to bring forward.

This report gives an overview of the work within the different working groups of the European Climate Change Programme that were operational in 2002, in particular '*JI and CDM & the link with emissions trading*', '*Agriculture*', '*Sinks in agricultural soils*', '*Forest related sinks*' and '*Fluorinated gases*'. It also gives an overview of the follow-up work in terms of implementation of measures that were identified in the first phase of the ECCP.

By bringing together the information and data of the different working groups and implementation activities, the report gives an indication on the EU's ability to meet its Kyoto targets of the first commitment period 2008-2012. In this respect, it should be emphasised that the emission reduction potential for the various ECCP measures are (ex-ante) estimates. Detailed information related to the calculation, the underlying assumptions and the source of the data are given in the specific sections. The actual emission trends in the EU and the Member States are addressed in the Commission's annual greenhouse gas monitoring report.

Results relating to the follow-up of measures identified in the first phase of ECCP

The monitoring mechanism and its review, as well as the EU's emissions trading scheme and the link with the Kyoto flexible mechanisms (JI and CDM) are key elements of the EU's climate change strategy. On these issues, ***the planned work is proceeding on schedule***.

The implementation of measures relating to the ***supply of energy is well on track***. In total, current proposed or implemented measures (RES-E Directive and proposals on transport bio-fuels and Combined Heat and Power) have an emission reduction potential of approximately 150Mt CO₂eq. Some aspects of RES-H are covered by other proposals (CHP, Energy performance of buildings). Additional RES-H initiatives could enable to exploit better the large potential identified in this sector and help removing specific barriers hampering increased market introduction. These could also complete the "third pillar" of the implementation of the renewable strategy -next to RES-E and the bio-fuels proposals- in order to reach the 12% target as put forward in the 1997 White Paper on renewable energy.

The first phase of the ECCP has ***a strong focus on energy demand*** measures in the household, tertiary and industry sector, which was also mirrored in several concrete measures within the action plan established by the ECCP Communication of October 2001. In this sector, considerable CO₂ savings are usually combined with good cost-efficiency due to lower energy costs. With regards to implementation of measures, the interplay of various measures (awareness campaign, labelling of equipment, setting minimum standards, defining best practices, promoting energy services,...) is in many cases decisive in improving energy efficiency in the field. The potential in the first commitment period in the field of energy demand is estimated at 214-259Mt CO₂eq.

In 2002, considerable progress has been achieved in the preparation of key measures (e.g. Directive on the establishment of a framework for the eco-design of energy-using products, Directive on energy services, campaign for take-off & public awareness campaign, public

procurement). It is expected that concrete proposals will be brought forward in the near term. The Motor Challenge Programme has already been launched in February 2003.

Except for the strategy on the reduction of CO₂ emissions of passenger cars, the **implementation of measures in the transport sector proves difficult and shows slow progress** in a number of key areas (e.g. initiative on infrastructure use and charging, a concept for enhanced environmentally friendly vehicles). This is of particular importance in view of the projected further increase of emissions (18% increase in 2000 and 28% increase in 2010 with respect to 1990). With regards to the promotion to shift the balance between modes of transport, the Commission has proposed several measures concerning the revitalising of railways, the quality of port services and a support Program for intermodal freight transport, which may play a major role in curbing emissions in the longer term, i.a. through promoting intermodality. The Commission is also working on actions on urban transport and investigating the promotion of alternative fuels, including their impact on greenhouse gas emissions.

The **strategy on the reduction of CO₂ emissions of passenger cars is now to a large extent implemented**. The monitoring of the voluntary CO₂ commitments is demonstrating positive results. In this respect, it must be noted that all associations have committed themselves to review in 2003 (ACEA and JAMA) or 2004 (KAMA) the potential for additional CO₂ reductions, "with a view to moving further towards the Community objective of 120 g CO₂/km by 2012".

The projected growth in **fluorinated gases, including mobile air conditioning systems, warrants specific action**. Preparations on a regulatory framework on fluorinated gases have continued in the second phase of the ECCP. The Commission will finalise its legislative proposal, in the form of a Regulation on fluorinated gases, with adoption envisaged in the third quarter of 2003. In addition, better control on non-CO₂ emissions in industrial sectors under the IPPC Directive is promoted through periodical update of BREFs.

Methane emissions in landfills make up the large majority of GHG emissions from **waste** (4% of total 1990 emissions). In 1999, they have already been reduced by 22% with respect to 1990 thanks to national measures. The **implementation of the Landfill Directive** means that further reductions in methane emissions can be expected, estimated at 41Mt CO₂eq.

Results relating to new working groups active in the second phase

In 2002, three ECCP working groups were operational dealing with new subjects, i.e. 'agriculture', 'sinks in agricultural soils' and 'forest related sinks'.

The agricultural sector is responsible for 10% of all greenhouse gas emissions. Greenhouse gas emissions have declined with 6.4% in the period 1990-2000, compared to 3.5% overall. It can be expected that the implementation of Agenda 2000 Reform will strengthen this trend. The ECCP working group identified –for the first commitment period- an additional potential reduction of 2.9% of agricultural emissions, totalling 12Mt CO₂eq, to a large extent through the reduction of N₂O emissions from the soil. The recent CAP Reform proposals of 22 January 2003 (COM(2003)23 final) include certain measures and incentives that have, if adopted, implicitly or potentially a mitigating effect on GHG emissions, such as through the introduction of cross compliance requirements with environmental legislation (e.g. the nitrates Directive) and the transfer of funds from the market support pillar of the CAP to the rural development pillar, where Member States may use it to support agri-environmental measures.

Following the Marakech accords, the ECCP established two working groups related to **carbon sequestration in agricultural soils and forests**, in order to assess the EU's potential in this field, as well as its environmental and socio-economic implications. The working groups have identified and assessed a considerable number of climate friendly farming and forestry

activities and practices, which, in many cases, have positive (environmental) co-benefits (e.g. soil protection and bio-diversity). The total technical potential for the first commitment period identified by the working groups is about 60-70 Mt CO₂eq for agricultural soils and approximately 33 Mt CO₂eq for forests. Both working groups have stressed certain limitations (e.g. need for adequate monitoring & verification, geographical differentiation, lack of cost data) and uncertainties (more research needed to investigate long term effects). Like for the reduction of emissions in the agricultural sector, the CAP Reform proposals include certain measures and incentives, that, if adopted by the Member States, have implicitly a positive effect on carbon sequestration, such as definition of good agricultural conditions for the soil linked to direct payments, non-rotational set-aside, and increased funds for rural development, which gives Member States increased possibilities to support agri-environment measures.

Increased demand for **renewable raw resources for energy and material substitution** opens up new opportunities for the EU's agricultural and forestry sector. It is estimated that the total **technical** potential of energy substitution by bio-energy from agriculture, forests and other residues could be 200-600Mt CO₂eq/year (EU-15), representing 60-180% of the total EU-15 reduction required under the first commitment period. Wood products are a physical pool of carbon (currently not accounted for under the Kyoto Protocol) and can act as a substitute for more energy-intensive materials. The production, processing and supply of renewable raw resources should receive more attention in order to meet the expected growth in demand, while taking into account other environmental effects. The CAP Reform proposals include a specific support scheme for the promotion of energy crops, which is envisaged to be reviewed in 2006.

Overall Conclusions

The policies and measures included in this report **have a total emission reduction potential of 578-696 Mt CO₂eq** (excluding the voluntary commitments of the car manufacturers), about twice the EU-15's emission reduction required under the first commitment period of the Kyoto Protocol. In addition, **potentially 93-103 Mt CO₂eq could be sequestered** through the enhancement of sink activities in the agricultural and forestry sector.

In order to have a better overview of the status of implementation, the policies and measures of this report were categorised in terms of their stage of implementation. The **legislative measures currently in force or already proposed** by the Commission represent a potential 276-316 Mt CO₂eq, including key measures such as the RES-E Directive, Directive on the energy performance of buildings, the Landfill Directive, proposals for a Directive on bio-fuels and CHP. However, it must be noted that the 'ex ante' ECCP evaluation of the potential of a certain measure does not necessarily coincide with the actual realisation in the field, as not all of the detailed provisions of the proposals or adopted measures have been taken into account in this pre-evaluation. Another reason is that the estimated potential is based on reaching certain (indicative) targets, which will need to be proven in practice (eg. CHP and biofuels proposals). For the implemented measures, it will be of utmost importance to **closely monitor their implementation and effectiveness, and to review if appropriate**. In addition, the review of the voluntary commitments of the car manufacturers will take place in 2003.

A number of other key measures are in **an advanced stage of preparation** and have an additional potential of 83-116 Mt CO₂eq, comprising proposals to link JI/CDM with the emissions trading scheme, on energy services, public procurement, on minimum energy efficiency standards for end-use equipment, on fluorinated gases and the campaign for take-off & public awareness campaign.

Other measures are still at the preparatory stage and the Commission's examination of the measures is still on going, comprising :

- An analysis of the ongoing Council legislation process and implementation of the CAP reform (including climate change related measures in the rural development plans by

Member States) in view of the further elaboration of the relationship between agricultural policy instruments and climate change benefits ,

- The integration of climate change in the structural funds
- Further measures related to RES-H
- Follow up on the inventory of public aid for energy
- E2MAS : integration energy efficiency in EMAS
- Directive on fiscal measures for passenger cars
- Introduction of a concept of Environmentally Enhanced Vehicles
- Initiative on CO₂ emissions of light commercial vehicles
- Mobile air conditioners

The results of the European Climate Change Programme confirm the projections of the monitoring report for the year 2000, indicating that the EU would not achieve the Kyoto target *with the measures currently in place*, but could exceed the target with *additional policies and measures*. Preliminary data for the year 2001 indicate that for the second consecutive year, the greenhouse gas emissions in the EU are on the rise. This is a strong signal for a continued and strengthened implementation policy, that is accompanied with a strong monitoring process of the effectiveness of the measures that have already been adopted and appropriate review .

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PART I : ESSENTIAL ELEMENTS AND CONCLUSIONS OF THE ECCP

1 The European Climate Change Programme

In the last 2 years, the European Climate Change Program has been an ambitious force for change, initiated and led by the European Commission. Its mission has been to drive forward EU efforts to meet the targets set by the Kyoto protocol. The programme has sought to engage the full range of stakeholders in the process of developing a strategy. It has also promoted the issue of horizontal integration of environmental policy across the Directorates General of the Commission.

The ECCP is based on the May 1999 Communication “Preparing for implementation of the Kyoto Protocol¹ and follows up proposals made by the Environment Council in June 1998 and October 1999. The Council urged the Commission to put forward a list of co-ordinated policies and measures and to prepare appropriate policy proposals.

This second ECCP report is a follow-up of the first ECCP report², including both the progress in terms of the implementation of the first phase of the ECCP, as well the new activities initiated in the second phase. The structure of the report can be summarised as follows.

Chapter 1 gives an overview of the essential principles of the set-up of the European Climate Change Program and indicates how the ECCP has been operating as a driving force for the development of climate related policies and measures in the last 2 years.

Chapter 2 puts the ECCP in a broader international Kyoto context and summarises the current EU progress in terms of meeting the Kyoto targets.

Chapter 3 summarises **the sectoral and main findings** that can be drawn from the ECCP activities, as described in chapter 4 and 5, and includes a standardised overview of all policies and measures, their CO₂ potential and the status of implementation. It also identifies a number of **new challenges** that lie ahead, taking a somewhat broader and **long-term perspective** (post first commitment period).

Chapter 4 gives an overview of the activities and results of the five working groups of the European Climate Change Programme that were operational in 2002.

Chapter 5 includes a comprehensive overview of the progress on the implementation of measures identified in the first phase of the ECCP across the different sectors. Policies and measures which are not strictly part or the result of the ECCP are also included, for instance where they were decided upon prior to its formation.

¹ COM(1999) 230

² <http://www.europa.eu.int/comm/environment/climat/eccp.htm>

1.1 ECCP : scope and organisation

The European Climate Change Programme (ECCP) was established in June 2000 to help **identify the most environmentally and cost-effective EU measures enabling the EU to meet its target under the Kyoto Protocol**, namely an 8% reduction in greenhouse gas emissions from 1990 levels by 2008-2012. This corresponds, in absolute terms, to a reduction of **336Mt CO₂eq in 2010 with respect to 1990**. The reality of an **internationally agreed and legally binding environmental target** and **the EU's leading role** in advancing the Protocol's entry into force through EU ratification in May 2002 has helped considerably to establish the ECCP as an ambitious tool for implementation, complementing the individual efforts of the Member States.

The programme has sought to engage the full range of stakeholders in the process of developing both a strategy and the tools to cut greenhouse gas (GHG) emissions. The ECCP has therefore been set-up as a **multi-stakeholder consultative process**, in which relevant players, such as the Commission, national experts, industry and the NGO community have worked together. Stakeholder consultation is viewed to be essential for the success of the European Climate Change Programme, firstly because it gathered the **required expertise** and secondly by helping **building consensus**, which greatly facilitates the implementation of potential measures.

During the last 20 months, 11 different working groups were established and have operated under the co-ordination of an ECCP Steering Committee:

- Flexible mechanisms: emissions trading
- Flexible mechanisms: JI/CDM
- Energy supply
- Energy demand
- Energy efficiency in end-use equipment and industrial processes
- Transport
- Industry (subgroups on fluorinated gases, renewable raw materials, voluntary agreements)
- Research
- Agriculture
- Sinks in agricultural soils
- Forest-related sinks

The Programme has involved in total more than 200 stakeholders. In some areas it was necessary to split a working group into different sub-groups where there was a large range of subjects being dealt with. The working group structure reflects a **cross-sectoral approach**, whereby each sector is asked to contribute to the set emission reduction objective, while the precise intensity of this effort is being identified, based on **cost-effectiveness** calculations. A common feature of the different working groups was therefore not only the identification of the reduction potential of various measures, but also a criterion "below 20€/t CO₂eq" and "below 50€/t CO₂eq." as a benchmark to evaluate the cost-effectiveness of each potential measure. It should not be regarded as a strict cut-off point but, taking into account the uncertainties related to the specific implementation, gives a general indication of the cost-effectiveness of a certain measure, while other considerations (for instance benefits related to security of supply, related to other environmental issues or in the longer term,) need to be taken into account as well. Other common criteria for the cross-sectoral assessment and comparison of measures were the time frame for implementation and the impact on other policy areas.

The role of the Commission in the framework of the ECCP follows a complementary dual approach. On the one hand, the Commission is responsible through the ECCP Steering Committee for the general co-ordination of the Programme. On the other hand, the

Commission is active as a facilitator in the different working groups. In addition, the Commission is a primary “client”: through its right of initiative it has a major role of converting and translating the ECCP results into an EU action plan for specific measures to tackle climate change.

1.2 The first phase of the ECCP (2000–2001)

1.2.1 Summary and Conclusions - Phase 1

The June 2001 ECCP Report³ summarised the outcomes and conclusions of the first phase of the ECCP, covering the period 2000-2001. The first ECCP Report included reports from the working groups on: Emissions trading, Energy Supply, Energy Consumption, Energy efficiency in end-use equipment and industrial processes, Transport, Industry, Research and Agriculture. The report from the final working group on Agriculture was not finalised at the time and is therefore summarised in this current Report.

The first ECCP report identified **42 cost-effective emission reduction options** (<20€/t CO₂eq) totalling a technical potential of 664–765Mt CO₂eq. In contrast, estimates by the European Environment Agency (EEA) of the emission reductions necessary to reach the EU –8% Kyoto target amount to 336Mt CO₂eq. This means that the technical potential of the cost-effective options identified by the first phase of the ECCP is twice the size of the required emissions reduction.

However, the realisation of the technical potential depends on a number of factors, such as the accuracy of data and the need for a more comprehensive assessment of the proposed measures, the timeframe within which measures are implemented and public acceptance. In order to give a better indication of the short-term potential of cost-effective measures at EU level, the ECCP report makes a distinction between those that are (1) ‘at an advanced stage of preparation’, (2) those ‘in the pipeline’ and (3) those for which ‘more work is needed’.

The final report of the first phase of the ECCP formed the basis for the October 2001⁴ **Communication** from the Commission on “the implementation of the first phase of the European Climate Change Programme”, converting the ECCP results into **a clear political commitment from the Commission**. It highlighted a package of twelve priority measures⁵ and an **action plan for implementation** of these measures, to be brought forward by the Commission in 2002 and 2003. They are grouped in four sections: crosscutting, energy, transport and industry. Throughout the second phase of the ECCP, progress on the development of these measures was monitored and more details can be found in chapter 2.3.1.

1.2.2 Recommendations for Phase 2

In the October 2001 Communication, the Commission committed itself to continuing to assess the environmental and economic impact of further specific measures in a **second phase of the ECCP**. A number of specific actions, identified under the first phase of the ECCP,

³ European Climate Change Programme – Long Report, Commission, June 2001 - http://europa.eu.int/comm/environment/climat/eccp_longreport_0106.pdf

⁴ COM (2001) 580 final

⁵ Cross-cutting: Effective implementation of the IPPC Directive, linking JI and CDM to the EC Emissions Trading scheme, reviewing the Monitoring Mechanism;

Energy: a Directive on Eco-design requirements for end-use equipment, an Energy Services Directive, a CHP Directive, an energy-efficient public procurement initiative, a Public Awareness Campaign/Campaign for Take Off on energy efficiency;

Transport: a Proposal for shifting the balance between modes of transport, a proposal for improvements in infrastructure use and charging, a Biofuels Directive; and,

Industry: a regulatory framework on fluorinated gases.

needed further study in terms of emission reduction potential and cost-effectiveness. Specifically mentioned are:

- an initiative on the promotion of heat production from renewable energy (RES-H)
- E2MAS energy audit and management scheme
- The Motor Challenge Programme
- An environmental agreement with the car industry on Light Commercial Vehicles
- A framework for fiscal measures for passenger cars - as set out in the Community strategy aiming at an emission target of 120g CO₂/km.

In addition, more detailed consideration of the Kyoto Protocol's flexible mechanisms was needed, focusing on how to link Joint Implementation (JI) and the Clean Development Mechanism (CDM) to the future EU Emissions Trading scheme.

Finally, the Marrakech accords have established the basic rules and modalities for accounting sink activities within the Kyoto Protocol. This provided an opportunity to consider new activities in this area within the ECCP. Work was undertaken to assess the potential and implications for using carbon sinks in both agricultural soils and in forests.

1.2.3 Reactions of the European Parliament and the Council

In its resolution⁶ on the Commission Communication, the European Parliament supported the ECCP as a major driving force for developing climate change policies. The resolution also stressed the great environmental and industrial policy significance of the ECCP. The large majority of the proposed measures were supported (e.g. Directives on emissions trading, CHP, minimum energy efficiency requirements for end use products, energy demand management, the public awareness campaign and campaign for take-off, etc.) and the Parliament called on the Commission to come forward with concrete proposals as soon as possible (where this had not already been done). It also called for additional measures in order to enable the EU to meet its Kyoto target, for instance in the agricultural sector and the transport sector.

The Environment Council, in its conclusions⁷, also welcomed the progress made during the first phase of the ECCP and the measures proposed in the ECCP Communication. The Council confirmed that, to complement domestic initiatives, further EU policies and measures should be brought forward as soon as possible, and expressed specific comments on the various proposed measures. They specifically felt that increased consideration should be given to measures reducing methane and nitrous oxide (N₂O) emissions from various sources.

The Council and Parliament's opinions on the first phase of the ECCP confirm the broad consensus among the EU's institutions that climate change is a priority environmental issue, both domestically and internationally.

1.3 Activities in the second phase (2002)

1.3.1 Working group activities in 2002

In 2002, in total five working groups were operational. Two of them had an important input into concrete policy proposals being prepared by the Commission:

- (1) the linking of JI/CDM to the proposed EU emissions trading scheme
- (2) legislation relating to fluorinated gases

⁶ EP Report A5-0237/2002 - adopted on 25 September 2002

⁷ Environment Council Conclusions 15273/01 – 13 December 2001

The other three groups, 'Agriculture', 'Sinks in agricultural soils' and 'Forest-related sinks', followed their mandates to identify concrete policy measures in their respective area and to estimate their environmental and economic implications. The last 2 Working Groups related to sinks were established following the Marrakech Accords, that enabled a more in-depth analysis of their potential in the EU.

Chapter 4 of this report focuses on the activities and results of the working groups that were active in 2002. The final report and conclusions of these working groups were delivered in December 2002/January 2003, except for the Agriculture Working Group, which had already started its activities in 2001 and delivered its report early 2002. In order to limit its size, this report only gives a summary of the full activities of these groups.

More technical background information and a complete overview of the activities of the working groups (including mandates, members, meeting documents, full reports and conclusions) can be found on the ECCP website⁸.

1.3.2 The Changing Role of the ECCP: from catalyst to the motor of change

In the first phase, the ECCP acted predominantly as a initiator, catalyst and discussion forum to prepare a strategy to meet the EU's and Member States' Kyoto objectives. With the October 2001 Communication, laying down the Commission's 2002-2003 action plan, greater focus on the concrete adoption and implementation of measures was required. This process at EU level is in line with developments in the Member States, where concrete actions plans (see also section 2.2 on the monitoring report), are taking shape and more progress is being made than a few years ago. This change from development to implementation of policies and measures is also brought about by the fact that the commitment period is getting closer. As a considerable time span is unavoidable between preparation of a specific proposal and actual emission reductions occurring (covering adoption by the institutions, transposition and implementation), it is of primary importance that measures are indeed brought forward at institutional level as soon as possible. Otherwise, this will reduce the potential reductions realised in the first commitment period, i.e. the effectiveness of the actions taken. Furthermore, it could also impact on the cost-effectiveness of climate policies, because, in many cases, sufficient time for planning and implementation is an important cost factor.

As a result, the second phase of the ECCP had as its first aim monitoring the implementation of the agreed measures. Therefore a significant part of this report is devoted to presenting the progress of the twelve measures from the first phase of the ECCP. A second aim of the ECCP second phase was to continue work on those measures that needed further assessment with regard to their cost and environmental effectiveness. This required issue-specific stakeholder meetings (e.g. on fluorinated gases, energy services, a framework for the eco-design of energy-using products, the campaign for take-off and public awareness campaign) as well as further information and data collection, in particular on the energy supply and demand measures (e.g. RES-H, E2MAS, energy efficiency of end-use equipment) and on CO₂ emissions of light commercial vehicles

Chapter 5 gives a comprehensive overview of progress on climate change activities from the first phase of the ECCP across the different Directorates General. However, policies and measures which are not strictly part of or the result of the ECCP are also included, for instance where they were decided upon prior to its formation. Typical examples are, for instance, the voluntary commitments of the three associations of car manufacturers (paragraph 5.5.1.1), or the Directive on the promotion of renewable electricity (paragraph 5.3.1). These measures continue to be cornerstones of the EU's climate policy. Furthermore, the work on these topics is continuing, through monitoring and review requirements.

⁸ <http://www.europa.eu.int/comm/environment/climat/eccp.htm>

2 Context of the ECCP

2.1 The ratification of the Kyoto Protocol in the EU and world-wide

The European Union

The EU and its Member States ratified the Kyoto Protocol on 31 May 2002⁹, fulfilling and reaffirming their commitment to pursue multilateral solutions to issues of global concern. By the beginning of 2003, all the candidate countries had also completed their ratification processes.

World-wide

The first threshold for the Kyoto Protocol's entry into force has been attained. 55 countries are required to ratify it, and, at the time of writing this report, 102 Parties – representing more than $\frac{1}{3}$ of the global population - have already done so.

The challenge of achieving the second threshold for the Kyoto Protocol's entry into force, which requires the ratification of countries responsible for 55% of industrialised countries' emissions in 1990, is now much closer to a successful outcome, as the countries that have so far ratified represent 43.9% of these emissions.

If Russia ratifies soon, the Kyoto Protocol would enter into force, thus allowing the next meeting of the Conference of the Parties of the United Nations Framework Convention on Climate Change, to be held in Milan, Italy, in December 2003, to be also the first Meeting of the Parties of the Kyoto Protocol. This would give a renewed impetus to the fight against climate change and will send to the world community the clear signal of the importance that developed countries attach to this common challenge.

2.2 Monitoring progress: are we on target?

A comprehensive analysis of the EU greenhouse gas emission trends can be found in the latest monitoring report.¹⁰

Actual progress of the EC

The EU as a whole met its CO₂ stabilisation target in 2000 under the UNFCCC. Emissions for that year are in line with the Kyoto target path for 2008-12. Overall greenhouse gas emissions in 2000 decreased by 3.5% compared to 1990, while in 1999 they had been 3.8% below 1990 levels, according to the most recent estimates. CO₂ emissions were 0.5% below 1990 levels, while CH₄ and N₂O emissions decreased by 16% and 20% respectively. In the EU, greenhouse gas emissions per capita decreased by 6% from 11.5 tonnes in 1990 to 10.8 tonnes in 2000.

EU emissions of CO₂ and other greenhouse gases rose between 1999 and 2000, the most recent period for which EU-wide data are available. CO₂ accounts for around 80% of the EU's total greenhouse gas emissions. One of the main reasons for the overall emissions rise from 1999 to 2000 was a 2.4% increase in CO₂ emissions from electricity and heat production, due in part to an expansion of power generation from fossil fuels, especially coal, in the UK, the EU's second largest emitter. Another reason was continued growth in greenhouse gas emissions in Greece, Spain, Ireland, Italy and Belgium.

⁹ Council Decision 2002/358/EC - concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfillment of commitments thereunder

¹⁰ Monitoring report under Council Decision 93/389/EC, COM (2002) 702 final

The year 2000 figures indicate that more than half of the European Union countries are still heading towards overshooting their agreed share of the EU's greenhouse gas emissions target by a wide margin if no further measures are taken. This is the case for Austria, Belgium, Denmark, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

Spain is furthest away from keeping to its share of the EU target: its emissions in 2000 were 33.7% higher than a decade earlier, more than double the 15% increase it is allowed between 1990 and 2008-2012.

At the other end of the scale Germany, the largest EU emitter, has achieved the greatest emissions cut among the big Member States, recording a 19.1% decrease over the decade. This is not far off the 21% reduction from 1990 levels that Germany is required to show by 2008-2012.

Projected progress of the EU based on Member States' projections

The 'business-as-usual' scenario (with existing measures, but excluding sinks and flexible mechanisms) suggests that in 2010 EC emissions will have decreased by only 4.7% leaving a gap of 3.3% to the Kyoto target. The projected decrease is due to reductions of CO₂ (-2%), CH₄ (-38%) and N₂O (-23%), that more than compensate for increases in the fluorinated gases (+72%) and include emission reductions beyond their respective 'burden-sharing' target (over-delivery) by some Member States.

All Member States except three have identified additional policies and measures to achieve their respective 'burden-sharing' targets. In a model scenario that incorporates such additional measures, seven Member States would exceed their 'burden-sharing' targets by 2010, some of them to a considerable extent. At EC level this surpassing of their targets by a number of Member States would result in emission reductions of -12% below 1990 levels, thereby surpassing the Kyoto target by 4%. It must be emphasised that projections are subject to considerable uncertainties in relation to the methodologies used and the real effect of policies and measures. Uncertainty is also related to the extent of actual implementation, as it takes considerable time before emission reductions materialise. Therefore caution is needed in the interpretation of results.

The Council Decision on ratification of the Kyoto Protocol was adopted in May 2002. As it included the burden sharing agreement, Member States now have a legal obligation to take the necessary measures to comply with the targets. Therefore, although they will profit from measures being taken at European level, those Member States currently projected not to meet their targets will also have to take additional measures to ensure that they achieve their targets.

Candidate Countries

The report also includes for the first time information on the candidate countries' emissions, which are, due to the economic transition, all on track to meet their reduction targets. Candidate Countries are not part of the joint fulfillment of the EU target (the "bubble") nor of the burden sharing agreement laid down under Council Decision 2002/358/EC. Instead, they are subject to individual -8% targets, except Hungary and Poland, which both have a reduction commitment of -6%.

3 Conclusions and Outlook

This chapter summarises the sectoral and main findings that can be drawn from the ECCP activities, as described in chapter 4 and 5, and includes a standardised overview of all policies and measures, their CO₂ potential and the status of implementation. It also identifies a number of new challenges that lie ahead, taking a somewhat broader and long-term perspective (post first commitment period).

3.1 Sectoral conclusions of the ECCP

3.1.1 Introduction

In order to have a better overview, the policies and measures of this report are categorised in terms of their stage of implementation. Four categories can be distinguished :

1. *“In force”*: These measures are adopted by the EU institutions, the main task for the Commission is to monitor the implementation and review if appropriate (as sometimes laid down through specific legislative requirements). Important upcoming reviews are also indicated in the table
2. *“In implementation”*: These measures have been proposed by the Commission and are currently under discussion in the relevant Institutions
3. *“Advanced stage of preparation”*: the preparatory policy work is to a large extent completed and a concrete proposal is envisaged in the Commission’s work plan
4. *“In preparation”*: the Commission’s examination of the measure are still on-going

By bringing together the information and data of the different working groups and implementation activities, the report gives an indication on the EU’s ability to meet its Kyoto targets of the first commitment period 2008-2012. In this respect, it should be emphasised that the emission reduction potential for the various ECCP measures are (ex-ante) estimates. Estimates related to items of the first phase of the ECCP, have been taken over from the first ECCP report, and updated where required. Detailed information related to the calculation, the underlying assumptions and the source of the data are given in chapter 4 and 5.

3.1.2 Cross-cutting issues

The monitoring mechanism and its review, as well as the EU’s emissions trading scheme and the link with the Kyoto flexible mechanisms (JI and CDM), are key elements of the EU’s climate change strategy. On these issues, the planned work is proceeding on schedule.

Policies and measures ‘Cross-cutting’	Emission reduction potential (Mt CO₂eq) By 2010 – EU15	Stage of implementation /timetable
1. EU emissions trading scheme	N/a ¹¹	In implementation
2. Revision of the monitoring mechanism	N/a	In implementation
3. Link JI/CDM to emissions trading :	N/a	Advanced stage of preparation Commission proposal envisaged first half of 2003

¹¹ N/a: not applicable

3.1.3 Energy Supply

The implementation of measures relating to the supply of energy is well on track. In general these measures are focussed primarily on promoting and taking away specific barriers for climate friendly energy generation. In total, current proposed or implemented measures have a emission reduction potential of approximately 150Mt CO₂eq.

Policies and measures 'Energy supply'	Emission reduction potential (Mt CO₂eq) By 2010 – EU15	Stage of implementation/ timetable
4. Directive RES-E	100-125	In force Review in 2005
5. Directives on the promotion of transport bio-fuels (RES-T)	35-40	In implementation
6. Directive on promotion of CHP	65	In implementation
7. Further measures RES-H	36-48	In preparation
8. Inventory public aid for energy – follow-up	N/k ¹²	Inventory completed Follow-up : In preparation
9. Liberalisation electricity and gas	(pm : 80 –120) ¹³	
TOTAL	250- 285	

The dynamic effects of electricity liberalisation on greenhouse gas emissions will depend largely on the specific situations and reaction of market players in the newly competitive market place. For a more precise estimate of these effects and the potential CO₂ reductions, it is necessary to further investigate these changes on the basis of detailed study, taking into account the perceived developments in the Member States.

Some aspects of RES-H are covered by other initiatives (CHP proposal, energy performance of buildings). Additional RES-H initiatives could enable to exploit better the potential identified in this sector and complete the third pillar of the renewable strategy, in order to reach the 12% target as put forward in the 1997 White Paper on renewable energy.

In view of the major role of (different sources of) biomass within the renewable strategy, the production, processing and supply of biomass to the various applications (supply side measures) should receive more attention in order to anticipate the expected growth in demand, as well as the environmental implications of increased utilisation of biomass for renewable energy. These considerations related to the supply of biomass are being dealt with in the specific sections related to agriculture and forestry.

Long term research directed towards new renewable technologies as well international co-operation within the “Coalition of the Willing” established at the Johannesburg summit are key elements for a sustained growth of the renewable sector, first in the perspective of sustainable development and access to energy for the poor, second, in a perspective of future commitment periods (both for the EU and third countries), and thirdly to strengthen the EU’s leading role in the field of renewable technology.

3.1.4 Energy demand

The first phase of the ECCP had a strong focus on energy demand measures in the household, tertiary and industry sector, which was also mirrored in several concrete measures within the action plan established by the ECCP Communication of October 2001. Considerable emission

¹² not known – no final conclusion on potential

¹³ estimation of WG 2 in the first phase of the ECCP

reduction potential through energy efficiency have been identified throughout the economic system, in many cases combined with good cost-efficiency due to the cost savings realised through improved energy efficiency. The results of the WG 3 on energy demand and the JSWG on equipment and industrial processes indicated a total technical potential of 430Mt CO₂eq., based on a product based approach.

In relation to the potential reductions for specific policy measures given in the table below, it should be noted that the interplay of various measures (raising awareness, giving information, e.g. through labelling of equipment, setting minimum standards, defining best practices, promoting energy services,...) is in many cases decisive in improving energy efficiency in the field. In this respect, the role of national and regional authorities is key to develop a comprehensive strategy. Overall, taking into account the above remarks and assumptions, the potential in the first commitment period in the field of energy demand is estimated at 214-259Mt CO₂eq.

In 2002, considerable progress has been achieved in the preparation on key measures identified in the first phase of the ECCP (e.g. Directive on the establishment of a framework for the eco-design of energy-using products, Directive on energy services, campaign for take-off and public awareness campaign, public procurement, etc.) and it is expected that concrete proposals for such key measures will be brought forward in the near term. In this context, it is also worth noting that the proposed revised common rules for the internal electricity market give a larger profile to environmental protection, in particular through provisions that give final customers information on how the electricity is produced, this enabling them to chose sustainable energy supplies.

The Motor Challenge Programme and E2MAS are measures that are focussing on voluntary action in the field of industrial energy efficiency. While both being in an early stage of preparation after the first phase of the ECCP, the first subject has been officially launched in February 2003 and the second has advanced but needs more preparatory work.

Policies and measures 'Energy demand'	Emission reduction potential (Mt CO₂eq) By 2010 – EU15	Stage of implementation/ timetable
10. Directive energy performance of buildings	35 – 45	In force Monitoring and review
11. IPPC: horizontal BREF on energy efficiency	N/k	In preparation Work programme 2003
12. E2MAS	N/k	In preparation Commission proposal envisaged early 2004
13. Energy labelling Directive Existing labels New 2002 (el. ovens & AC) Envisaged revisions (refrigerators/freezers/dish- washers) Planned new (hot water heaters)	(pm : 20 ¹⁴) 1 10 23	In force Monitoring and review Advanced stage of preparation In preparation
14. Voluntary agreements	30-35	In implementation
15. Framework Directive on Minimum energy efficiency requirements	2010 : dependent on implementation of daughter directives	Advanced stage of preparation Commission is analysing integration with eco-efficiency

¹⁴ the emission reduction of existing labels was included in the baseline for 2010 as developed by WG3

	<u>total technical potential:</u> 180	requirements
16. Directive on Energy services	40-55	Advanced stage of preparation Commission proposal envisaged in first half of 2003
17. CTO-PAC energy efficiency	N/k	Advanced stage of preparation
18. Motor Challenge Programme	30	In implementation
19. Public procurement	25-40	Handbook : advanced stage of preparation Directive : In preparation
OVERALL	214-259	

3.1.5 Transport

The strategy on the reduction of CO₂ emissions of passenger cars started in 1995 and is now to a large extent implemented. The monitoring of the voluntary CO₂ commitments is demonstrating positive results. In this respect, it must be noted that all associations have committed themselves to review in 2003 (ACEA and JAMA) or 2004 (KAMA) the potential for additional CO₂ reductions, *"with a view to moving further towards the Community objective of 120g CO₂/km by 2012"*.

With regards to environmentally enhanced vehicles, the Commission has been developing a technical concept. In order to enable progress on this issue the Commission has asked Member States to state their position on whether the EEV concept should include a greenhouse gas based target (next to targets for conventional pollutants).

On the other issues, the implementation of measures in the transport sector proves difficult and shows slow progress. This is of particular concern in view of the projected further increase of emissions (18% increase in 2000 and 28% increase in 2010 with respect to 1990). Transport CO₂ emissions per capita in the new accession countries are three times lower than in the EU-15 and are expected to grow alongside economic development. A specific problem is related to the increased use of mobile air conditioning systems in passenger cars, leading to increased CO₂ emissions as well as HFC emissions.

The limitation of greenhouse gas emissions in the transport sector will require the development of new strategies and strengthened policies and measures in the future. This is necessary to preserve the overall reductions that are achieved in view of meeting the target of the first commitment, and even more prominently, in view of future commitment periods.

In this context, the upcoming Council conclusions 'Towards the 2003 Spring European Council: Review of the implementation of the EU Sustainable Development Strategy and putting into practice the commitments made at the World Summit on Sustainable Development' indicated *'the reduction of emissions (in particular CO₂ and particles) from the transport sector, with a view to breaking the link between the growth of emissions from freight and passenger transport and economic growth'* as a priority for immediate action in order to ensure sustainable transport, as laid down in the Gothenburg objectives.

Policies and measures 'Transport'	Emission reduction potential (Mt CO₂eq) By 2010 – EU15	Stage of implementation/ timetable
20. Community strategy on CO ₂	Total 107-115	VC: monitoring; review in 2003

from passenger cars (including voluntary commitment – VC - of car associations)	Of which VC: 75-80	<u>Labelling</u> : in force <u>Communication on fiscal measures</u> : in implementation <u>Directive on fiscal measures</u> : in preparation
21. Environmentally enhanced vehicles	N/k	In preparation Technical preparation has advanced.
22. Voluntary commitment on CO ₂ light commercial vehicles	5-10	<u>Directive on measurement procedure</u> in implementation <u>VC</u> : preparatory work on technical measures and options for policy development
23. Framework Directive Infrastructure use and charging	40-60	Postponed ¹⁵
24. Shifting the balance of transport modes	N/k	Package of measures in implementation or preparation
25. Fuel taxation	N/k	In implementation Focus on EU harmonisation of taxation, not on CO ₂ reduction
26. Mobile air conditioning systems: HFCs		In preparation (see below)
27. Mobile air conditioning systems: CO ₂	N/k	In preparation
TOTAL (excluding VC)	77 - 105	
TOTAL (including VC)	152 – 185	

3.1.6 Industry & non CO₂ gases

The projected growth in fluorinated gases warrants specific action. Preparations on a regulatory framework on fluorinated gases have continued in the second phase of the ECCP. The Commission will finalise its legislative proposal, in the form of a Regulation on fluorinated gases, with adoption envisaged in the third quarter of 2003. In addition, better control on non-CO₂ emissions in industrial sectors, under the IPPC Directive, will be promoted through a periodic update of the BREFs and through the monitoring of Member States' implementation of the Directive.

Policies and measures 'Industry'	Emission reduction potential (Mt CO₂eq) By 2010 – EU15	Stage of implementation/ timetable
28. Regulatory framework for fluorinated gases	18-21	Advanced stage of preparation Proposal envisaged second half 2003
29. IPPC & non-CO ₂ gases	N/k	In force Review through periodical update of BREFs

¹⁵ In the light of the conclusions of the Brussels European Summit of March 2003, it has been decided to give priority to the preparation of a proposal to modify the Eurovignette system which was requested for June 2003

3.1.7 Waste

In 1990, about 4% of the EU's GHG emissions originated from waste (166Mt CO₂eq). Methane emissions in landfills make up the large majority of GHG emissions from waste (137Mt CO₂eq in 1990). In 1999, emissions had already been reduced by 22% with respect to 1990 thanks to national measures. The implementation of the Landfill Directive means that further reductions in methane emissions can be expected, estimated at 41Mt CO₂eq in 2010. This would mean that methane emissions from landfills would be halved with respect to 1990, making a considerable contribution to overall reductions.

Policies and measures 'Energy demand'	Emission reduction potential (Mt CO ₂ eq) By 2010 – EU15	Stage of implementation/ timetable
30. Landfill Directive	41	In force

3.1.8 Agriculture and forestry

Reduction of greenhouse gas emissions

In the European Union, the main sources of emissions of greenhouse gases (GHG) from agriculture are nitrous oxide (N₂O) emissions from agricultural soils, N₂O and CO₂ emissions from cultivated organic soils, methane (CH₄) emissions from enteric fermentation and CH₄ and N₂O emissions from manure management. Approximately 10% of all EU GHG emissions in 1990 can be attributed to the agricultural sector. Under a 'business as usual' scenario, agricultural emissions are projected to decrease by 4.6% by 2010 and the latest data from 2000 already indicate a decrease of 6.4%.

The working group concentrated on identifying the large number of farming practices that enable emissions reductions, and analysing their environmental and socio-economic consequences. The ECCP working group identified - for the first commitment period - an additional reduction potential of 2.9% of agricultural emissions, totalling 12Mt CO₂eq, to a large extent possible through reducing N₂O emissions from the soil.

WG measures in 'Agriculture'	Emission reduction potential (Mt CO ₂ eq) By 2010 – EU15	Implementation
31. N ₂ O from soils	10	e.g. improved implementation of the nitrates Directive
32. CH ₄ from enteric fermentation	0.3	Livestock numbers predicted to decline with measures introduced by the CAP reform proposals
33. Anaerobic digestion (CH ₄ and N ₂ O)	1.7	Possibility for support through agri-environment scheme; Livestock numbers predicted to decline with measures introduced by the CAP reform proposals
TOTAL	12	

The working group did not aim to investigate additional policy measures within the Common Agricultural Policy, on which a Commission proposal is currently discussed at Council level that already includes policy measures for a further integration of environmental objectives into the CAP. The CAP Reform proposals of 22 January 2003 (COM(2003)23 final) include specific measures and incentives towards a less intensive and more sustainable agriculture, introducing concrete measures that can lead to a mitigating effect on GHG emissions, if

adopted and implemented by the Member States. Incentives for extensification and ensuring cross-compliance with environmental legislation (e.g. the nitrates directive) are expected to reduce nitrogen fertiliser use and thereby reduce N₂O emissions. Methane production from enteric fermentation is projected to decline with reduced livestock numbers, as well as CH₄ and N₂O emissions from manure. More funds are proposed to be made available for rural development, which would give Member States increased possibilities to support agri-environmental measures.

Carbon sequestration in agricultural soils and forests

In 2002, the potential environmental and socio-economic implications of carbon sequestration in the EU were investigated by two ECCP working groups (“agricultural soils” and “forest-related sinks”). The working groups have identified a considerable number of climate friendly farming and forestry activities and practices, which, in many cases, have positive (environmental) co-benefits (e.g. soil protection and biodiversity). Socio-economic impacts can be both positive and negative. The working groups stressed the need to implement such practices within a wider context of **sustainable agriculture and forestry**, aiming to create win-win-win situations in terms of environment, rural development and economic activity.

The total technical potential for the first commitment period identified by the working groups is about 60-70Mt CO₂eq for agricultural soils and approximately 33Mt CO₂eq for forests (afforestation, reforestation and forest management, taking into account the cap for forest management, as defined in the Marrakech accords). A number of **caveats** should be put here in relation to this potential, in particular relating to non-permanence, saturation of the carbon pools, cost-effectiveness and the need for adequate monitoring and verification and for taking into account the geographical differentiation across the EU. This leads to the conclusion that further research, including economic modelling, should be a priority. In terms of the role of sinks, it was emphasised that enhancing sinks can contribute to the achievement of the EU’s Kyoto targets, but in the longer term should be regarded as a temporary supplement to emission reductions.

WG measures ‘sinks’	Emission reduction potential (Mt CO ₂ eq) By 2010 – EU15 ¹⁶	Implementation
WG Forest-related sinks		
34. Afforestation and reforestation: - Afforestation programmes - Natural forest expansion	14 (long term 124)	Possibility for support through forestry scheme
35. Forest management (various measures)	19 (cap)	
TOTAL	33	
WG Sinks in Agricultural soils		
36. Promote organic input	20	Possibility for support through agri-environment scheme
37. Permanent revegetation of set-aside (increased soil carbon)	15	CAP includes set aside provisions
38. Biofuel production with perennial crops	15 (increased soil carbon only) ¹⁷	Possibility for support through carbon credits for energy crops of CAP Reform proposals, but limited to 1.5Mha ¹⁸

¹⁶ The estimates are based on analysis of the technical potential, and not on the implementation of policy measures

¹⁷ the potential in terms of substitution of CO₂ emissions of substituting fossil fuels is much larger

39. Promote organic farming	14	Possibility for support through agri-environment scheme
40. Promote permanently shallow water table on peatland	15	Possibility for support through agri-environment scheme
41. Zero and/or conservation tillage	<9	Possibility for support through agri-environment scheme
TOTAL	60-70	

The working groups did not investigate in detail the impact of specific policy measures, although the working group on forest-related sinks did pinpoint a number of interesting possibilities and guidelines for concrete action in an EU context. In terms of implementation, the role of Member States is regarded as of primary importance through the inclusion of measures in **national Rural Development Programmes and National Forest Plans**. National Rural Development plans can be financially supported by the EU under the (existing) **Agri-Environment Scheme** and the **Forestry Scheme**.

The CAP Reform proposals of 22 January 2003 (COM (2003)23 final) include a transfer of funds from the first pillar of the CAP (market support) to the second pillar (rural development by means of modulation). This measure, if adopted, will provide Member States increased possibilities for agri-environment measures. The proposal also includes specific measures and incentives directed towards less intensive and more sustainable agriculture. The proposals would introduce concrete measures with an implicit positive effect on carbon sequestration or have the potential for this. A major innovation is the creation of a sanctioning mechanism by linking direct payments to farmers with compulsory cross-compliance with environmental legislation and with requirements to maintain land in good agricultural condition. Direct payments could be partially or entirely reduced in case of non-respect of statutory management requirements including obligations arising from about 40 legislative acts applying directly at the farm level (which is a minimum list plus others at the request of the Member States). Specific measures relevant to requirements for good agricultural conditions, such as measures aimed at soil protection, the conservation and enhancement of soil organic matter and soil structure are listed in Annex IV to the Proposal. Further relevant requirements are linked to the protection of permanent pasture, the prohibition of conversion to arable land and to obligatory non-rotational (“environmental”) set aside.

Potential for production of biomass for energy and material substitution

The working groups ‘agriculture’ and ‘forest-related sinks’ considered the potential for the production of biomass for energy and material substitution. First, there is a potential in terms of the availability of land to be used for the production of annual energy crops or for conversion to short rotation tree plantations. In addition, the EU forest area is gradually expanding at a rate of about 0.3% per year, while it is estimated that 30% of the current annual increment of growing stocks remains in the forest.

This situation in the EU’s agricultural and forestry sector opens up important new **opportunities for energy and material substitution**, which will be extended significantly when the accession countries join the EU. The Working group on agriculture estimated that the total **technical** potential of energy substitution by **bio-energy** from agriculture, forests and other residues could be 200-600Mt CO₂eq/year (EU-15), representing 60-180% of the total EU reduction required under the first commitment period (336Mt CO₂eq), and much larger than the identified sinks potential. It is also indicated that an important proportion of the technical potential might be feasible at low cost. The increased supply of biomass is also indispensable in terms of the EU’s renewable strategy. In this context, it should be noted that, following earlier proposals concerning bio-fuels, the CAP proposals of 22 January 2003¹⁹

¹⁸ it is estimated that if the 1.5 Mha would be entirely used for perennial energy crops, the carbon sequestration would be 3.4 Mt CO₂eq.

¹⁹ COM(2003)23 final

introduced a specific supply side measure towards the promotion of energy crops by including a specific support scheme of 45€/ha, limited to 1.5 million ha.

The working group 'forest-related sinks' also considered, in general terms, the relationship between carbon sequestration in forests, and the use of forest resources for material substitution and for energy substitution. Although the subject requires in-depth investigations, the following observations can be made:

- Preserving and enhancing the amount of carbon in the forests through sustainable forest management is a pre-condition for enhancing material and energy substitution in a long term perspective;
- Wood products are a physical pool of carbon (currently not accounted for under the Kyoto Protocol) and can act as a substitute for more energy-intensive materials;
- A carbon-conscious hierarchy for the use of wood and the residues and by-products of its processing should be respected, whilst ensuring a level playing field for all economic operators and allowing the market to operate without distortions.

Outlook

As stated above, the CAP reform proposals have introduced a number of instruments that, are expected to have positive climate change co-benefits, if adopted. The proposals include increased funds for rural development. However, Member States have the possibility to support a broad range of different objectives and instruments in their rural development plans. The mid-term evaluation of the rural development plans in 2004 will provide important information to analyse Member States' rural development plans in terms of climate change.:

- In general, the relationship between agricultural policy instruments and climate change policies needs to be further elaborated. Further steps ahead to support climate change aspects in the agricultural sector would be : introduce measures to enhance the monitoring of greenhouse gas emissions in agriculture and forestry, and of soil organic carbon and carbon sequestration, including the improvement of soil databases;
- the link between specific rules of the Common Agricultural Policy (such as: cross-compliance, set-aside, good agricultural conditions of soils, the support scheme for energy crops, the agri-environment scheme and forestry scheme of the RDR) and their impacts on emissions and carbon sequestration should be elaborated;
- Elaborating the potential of biomass (through energy and material substitution) for CO₂ reduction in a life cycle perspective, its contribution to the achievement of renewable energy targets and its possible ancillary environmental effects, for instance in the perspective of the 2006 review of the energy crops support scheme, as envisaged in the CAP Reform proposals.

In addition, measures for carbon sequestration need to be viewed in the light of their contribution to a European Strategy on soil protection which is being developed and the EU forestry strategy which will be reviewed.

3.2 Overall conclusions of the ECCP

In the last two years, the European Climate Change Programme has analysed extensively the most environmentally and cost-effective additional policies and measures enabling the EU to meet its -8% target under the Kyoto Protocol. This report gives an overview of the work within the different working groups of the European Climate Change Programme. In order to create a comprehensive picture of climate-related policies and measures in the Commission, it has also reported on the follow-up work in terms of implementation, as well on integration work that is not strictly part of the ECCP, but relevant from a climate change perspective.

The policies and measures described in this report have *a total emission reduction potential of 578-696 Mt CO₂eq* (excluding the voluntary commitments of the car manufacturers), about

twice the EU's emission reduction required under the first commitment period of the Kyoto Protocol. In addition, *potentially 93-103Mt CO₂eq* could be sequestered through *the enhancement of sink activities*.

In order to have a better overview of the status of implementation, the policies and measures of this report were categorised in terms of their stage of implementation.

The measures *currently in force or already proposed* by the Commission represent a potential 276-316 Mt CO₂eq, including key measures such as the RES-E Directive, the Directive on the Energy Performance of Buildings, the Landfill Directive, proposals for a Directive on bio-fuels and CHP. However, it must be noted that the 'ex ante' ECCP evaluation of the potential of a certain measure does not necessarily coincide with the actual realisation in the field, as not all of the detailed provisions of the proposals or adopted measures have been taken into account in this pre-evaluation. Another reason is that the estimated potential is based on reaching certain (indicative) targets, which will need to be proven in practice (e.g. CHP and biofuels proposals). For the implemented measures, it will be of utmost importance to *monitor closely their effectiveness and to review them if appropriate*. In addition, the review of the voluntary agreements of the car manufacturers will take place in 2003.

A number of other key measures are in an *advanced stage of preparation* and have an additional potential of *83-116 Mt CO₂eq.*, comprising proposals to link JI/CDM with the emissions trading scheme, on energy services, public procurement, on minimum energy efficiency standards for end-use equipment, on fluorinated gases and the campaign for take-off and public awareness campaign.

Other measures are still *at the preparatory stage* and the Commission's examination of the measures is still on going, comprising :

- An analysis of the ongoing Council legislation process and implementation of the CAP reform (including climate change related measures in the rural development plans by Member States) in view of the further elaboration of the relationship between agricultural policy instruments and climate change benefits ,
- the integration of climate change in the structural funds
- Further measures related to RES-H
- Follow up on the inventory of public aid for energy
- E2MAS : integration energy efficiency in EMAS
- Directive on fiscal measures for passenger cars
- Introduction of a concept of Environmentally Enhanced Vehicles
- Initiative on CO₂ emissions of light commercial vehicles
- Mobile air conditioners

The results of the European Climate Change Programme confirm the projections of the monitoring report for the year 2000, indicating that the EU would not achieve the Kyoto target *with the measures currently in place*, but could exceed the target with *additional policies and measures*. Preliminary data for the year 2001 indicate that for the second consecutive year, the greenhouse gas emissions in the EU are on the rise. This is a strong signal for a continued and strengthened implementation policy, that is accompanied with a strong monitoring process of the effectiveness of the measures that have already been adopted and appropriate review .

3.3 New challenges

This section identifies a number of recent developments in climate related policy areas, that are linked to international developments, such as the Johannesburg Summit, or activities that are being initiated after the adoption of the 6th Environmental Action Plan. This section is

therefore directed towards future challenges, taking a broader and more long-term perspective (post first commitment period) and aims to strengthen the links with other related initiatives and programmes with the purpose of producing policies that are coherent, mutually compatible and reinforcing.

3.3.1 *Renewables and the Johannesburg Renewable Energy Coalition*

The World Summit on Sustainable Development Plan of Implementation stated the need to “...with a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply”. Whilst “recognising the role of national and voluntary regional targets as well as initiatives, where they exist” these conclusions (adopted on 4 September 2002) stopped short of setting targets and timetables for renewable energy. Therefore, the European Community and its Member States - being strong advocates of renewable energies and having experienced significant benefits from the setting of targets and timetables, initiated the Johannesburg Renewable Energy Coalition.

The Members of the Coalition are committed to implementing and even going beyond the WSSD plan of implementation, and to co-operating closely on the basis of ambitious and time-bound targets. Targets and timetables are used to help countries to implement policies to guide investments and develop markets for renewable energy technologies with the aim of substantially increasing the global share of renewable energy sources²⁰.

Immediately following its launch, the Commission, in close co-operation with the Troika, engaged in démarches aimed at widening the Coalition. In this context, a side event was organised in the margins of the UNFCCC COP8 meeting in New Delhi. As of January 2003, 77 countries have confirmed membership of the Coalition and more are expected to do so in the near future. More than 20 countries have expressed a positive attitude towards joining.

The Commission has also engaged in efforts to deepen the Coalition, i.e. to develop a strategy, a roadmap and an action plan. In November 2002, informal discussions took place in Sao Paulo and at the GSFE conference in Graz. The main suggestions were that the Coalition should: adopt a bottom-up approach (consistent with its voluntary nature), develop its work through international and regional conferences and meetings, and pay special attention to innovative public-private partnership arrangements that could promote the development of renewable energy technologies, the transfer of technologies towards developing countries and access to investment funding. It was also suggested that the Coalition should develop its objectives in parallel with the CSD process. The 2004 World Renewable Energy Conference, announced by Germany during the WSSD, is to serve as a major milestone.

Having considered and further developed these suggestions, the Commission co-hosted a second High-Level Coalition side event in the margins of the February 2003 UNEP Governing Council in Nairobi. During this meeting, the Commission promoted the bottom-up approach, explained the link between the Coalition and the EU Energy Initiative, and announced preliminary details of the 1st International Coalition Conference, which will be hosted by Ms Wallström in Brussels. This conference will serve as a stepping stone towards the 2004 Conference in Germany. During the same side event, Germany provided preliminary details their upcoming conference, whilst Denmark also announced its intention to organise a Coalition Conference in the autumn of 2003.

The Commission’s International Coalition Conference will focus on the regional potential of renewable energy (untapped resources) and, most importantly, on developing enhanced public and/or private mechanisms and instruments to increase access to viable and affordable

²⁰ The Coalition initiative is additional to the EU Energy Initiative.

renewable energy investments. Possible improvements to RES development could be obtained through increased synergies between programmes and instruments related to: the security of energy supply, sustainable development, innovative industries and SMEs, private sector development in developing countries, the Kyoto Protocol's flexible mechanisms, etc.

Suggestions made during this high-level meeting will be followed up by an informal renewable energy finance expert group, focusing on enhanced international investment and financing solutions.

The Commission services for Energy, Environment, Aid and Development are co-ordinating the following-up on the Renewable Energy Coalition. A Communication on the Coalition follow-up is being prepared and is expected to be brought forward during the first half of 2003.

3.3.2 *Transport emissions: a continuing concern*

3.3.2.1 Road transport

Already today, emissions from transport are the second largest single source of greenhouse gas emissions in the EC accounting for about 21 % of total greenhouse gas emissions in 2000. Furthermore, emissions from transport have risen rapidly: between 1990 and 2000 CO₂ emissions increased by 18 % or 128 Mt CO₂eq. in the EU. The main reason for the strong growth of CO₂ emissions from transport is the increase in road transport volumes and - associated with this - rising road fuel consumption. This occurs in almost all Member States, but in particular in the cohesion states Ireland, Spain, Portugal and Greece²¹.

The growth in road transport volumes is expected to continue in the future. Even if the policy approach presented in the Commission's 2001 White Paper on the Common Transport Policy²² were implemented, including the achievement of the targets in the Community strategy for CO₂ from passenger cars, the overall transport emissions of CO₂ would rise by 26% in 2010 compared to 1998 – and 50% of this growth would be due to road transport (air passenger transport being responsible for the main part of the other half).

- These figures clearly demonstrate that for *placing the Community in a credible position to advocate an international agreement on more stringent reduction targets for the second commitment period provided for by the Kyoto Protocol* – one of the priority objectives set out in the Sixth Environment Action Programme (6th EAP)²³ - further policy measures are needed to curb the long-term trend of growing GHG emissions from transport.

3.3.2.2 Bunker fuels

While emissions from domestic aviation and shipping are included in Parties' inventories of greenhouse gas emissions under the UNFCCC, bunker fuel **emissions from international aviation and shipping are not yet allocated to Parties** to the UNFCCC, but are instead reported separately by each Party. As a result, bunker fuel emissions are increasing rapidly without Parties being responsible for this under their Kyoto Protocol commitments. Overall, approximately 3.5% of global, human-induced greenhouse gas effects come from the aviation sector, while some 2% comes from the shipping sector.

Action is required of Annex I Parties under the UNFCCC and the Kyoto Protocol.

²¹ COM (2002) 702 final

²² COM (2001) 370

²³ COM(2001)31

The most important issue is ensuring that progress is made at an international level in agreeing a method of allocation and this concern takes precedence over preferences for any other allocation option. It is important that the EU provides clear leadership and exerts pressure at the international level to ensure that progress is made.

With regard to reducing bunker fuel emissions, there are a number of ‘control’ options. The Commission would prefer any measures used to mitigate greenhouse gas emissions from aviation and shipping bunkers to provide a coherent and effective, global approach. Ideally, action should be encouraged and taken at international level through ICAO (International Civil Aviation Organisation) and the IMO (International Maritime Organisation). However, achieving progress at global level has proven to be difficult.

In the interests of a consistent tax system across the different modes of transport, commercial aircraft fuel should be taxed as any other fuel. In March 2003, the ECOFIN Council reached political agreement on a proposal concerning energy taxation, which will allow Member States to tax aviation fuel for domestic flights and, on a reciprocal basis, fuel used for flights between Member States. The question of competition with third countries needs to be taken into account and any distortion of competition with socio-economic implications to the detriment of EU interests has to be avoided. Therefore, the legal barriers to taxation of aviation fuel contained in some bilateral Air Service Agreements (ASAs) between individual Member States and third countries must be addressed in order to avoid that third country carriers operating on intra-EU flights enjoy privileges over Community carriers in cases where Member States decide to make use of the increased room for manoeuvre. Consequently, in future negotiations on air transport relations between third countries and the Community the possibility to make progress in this regard must be safeguarded wherever achievable.

As an alternative, to using taxation as an effective measure to mitigate emissions, in the 2001 White Paper on the Common Transport Policy²⁴, the Commission proposed “*as part of the programme to create the single sky, to introduce differential en route air navigation charges to take account of the environmental impact of aircraft*”. This confirmed the position taken in the 1999 Communication on Air Transport and the Environment - Towards meeting the Challenges of Sustainable Development²⁵, where the Commission pointed out that as an alternative to the preferred option of kerosene taxation, “*...the inclusion of environmental charges into the system of en route charges seems to be a promising technique*”. In their Decision on the Sixth Environment Action Programme (6th EAP)²⁶, the European Parliament and Council identified the need for “*specific actions to reduce greenhouse gas emissions from aviation if no such action is agreed within the International Civil Aviation Organisation by 2002*”.

With respect to marine bunkers, the IMO is currently considering possible measures to reduce greenhouse gas emissions. The Community agreed in the 6th EAP that priority should be given to taking specific actions in this area if the IMO does not bring forward proposals by the end of 2003. In this case, and as any EU control options affecting the construction or design of vessels would probably have to be restricted to vessels flagged in the EU, the focus in future is likely to be on using market-based instruments and/or operational measures to reduce emissions, rather than regulatory standards on ship design. In order to develop its thinking in this respect, the Commission has just launched a new study to investigate the feasibility of market-based mechanisms to promote low-emission shipping in the EU.

²⁴ COM(2001)370

²⁵ COM(1999)640

²⁶ Decision 1600/2002/EC – adopted by the Parliament and the Council on 22 July 2002

3.3.3 *The integration of Climate Change in EU structural funds*

The 6th Environmental Action Program emphasised the need to further integrate the need to integrate environmental objectives in other policy areas and mentions specifically the review the subsidies applied under the Cohesion and Structural funds. In the framework of DG Environment's preparations of an environmental strategy for the Structural Funds post-2006, climate change has been proposed as one of the key priorities for integration in the structural and Cohesion Funds. The attention is focussed on the ten new accession countries and the current cohesion countries (Portugal, Ireland, Greece and Spain), although the principles of integration of climate change in regional funding can be applied throughout.

As indicated in Chapter 2, the ten candidate countries are well on track to meet their Kyoto target²⁷. In fact, total greenhouse gas emissions for these ten candidate countries, included in the monitoring report, declined by 32% between 1990 and 1999. The distance-to-target indicator for the whole region was -30.2 index points (1999). This situation is due to rapid economic decline and restructuring in the first half of the nineties. In most countries, this was followed by a stabilisation or slight increase/decrease of greenhouse gas emissions (depending on the specific situation of the country) in the second half of the decade. In view of their envisaged accession in 2004, these economies are expected to undergo a rapid transformation and development process. Economic and social welfare growth are also expected to be accompanied by important increases in transport and electricity demand, for instance in the household and services sectors. Economic development will be strengthened by substantial EU support through the Structural and Cohesion Funds. How far long term growth will be coupled with increases in greenhouse gas emissions will therefore, to a large extent, be influenced by long term infrastructure investment decisions taken in the coming years. For these countries, the integration of climate change policies in the Structural Funds should be seen **in a long term post-Kyoto perspective**.

The situation in the current cohesion countries (Portugal, Ireland, Greece and Spain) is completely different: they are well above their Kyoto target paths under the burden sharing agreement. For these countries, the distance-to-target indicators range between +8.7 index points (for Greece) to 26.2 index points (for Spain) and substantial additional efforts will be required. Against this background, it seems appropriate to dedicate, in the short term, specific attention to climate change aspects in the shaping of the Cohesion Fund.

DG ENV is currently investigating possible elements of a strategy to integrate climate change better in the Structural and Cohesion funds, such as:

- *horizontal integration of the climate change dimension* :
Ensuring that climate change is integrated in the SFs/CFs in all sectors of economic development (transport, agriculture, energy,...) as well as being considered as a cross-cutting priority; Introduce climate change impact as a selection criteria for individual projects, in monitoring arrangements. This is of particular importance in many sectors like transport, energy, agriculture. In the **transport** sector where road transport infrastructure investments will reinforce expected demand growth. Public transport should get high priority.
- *Funding 'filling the implementation gap'* :
Climate change benefits of certain environmental infrastructure should be properly taken into account, for instance in waste management and air quality:
 - The implementation of the landfill directive has important climate change benefits, due to the reduction and/or utilisation of CH₄ emissions in landfills

²⁷ For a complete overview see the Report from the Commission under Council Decision 93/389/EEC for a monitoring mechanism of Community greenhouse gas emissions, COM(2002)702 final, 9 December 2002

- Environmental investments to improve air quality can have positive climate change impacts
- Directive on Integrated Pollution Prevention and Control (IPPC)

DG ENV is also considering possible main subject areas, including: transport infrastructure and energy, promotion of the production, processing and use of biomass, upgrading of district heating networks, capacity building (emissions trading, GHG monitoring, Joint Implementation, climate change policies and measures), and risk assessment of climate change impacts and adaptation measures.

3.3.4 *Environmental Technology Action Plan*

In March 2002, the Commission issued a Communication on "Environmental Technology for Sustainable Development"²⁸, which demonstrated that environmental technology could contribute to sustainable development by boosting our economies and protecting our environment. The Commission therefore proposed to the Barcelona European Council that it should develop with stakeholders an action plan to overcome the market and institutional barriers that stop the potential for environmental technology innovation from being realised. The Barcelona European Council approved this proposal in March 2002, confirming the political importance of environmental technology. The forthcoming Communication "Developing an action plan for environmental technology" is presenting the first findings of this analysis, as well as the process for consultation of stakeholders. The Commission intends to put forward an action plan on environmental technology by the end of 2003. In developing the action plan, the Commission has decided to focus on four environmental issues: climate change, soil protection, sustainable production and consumption, and water. These issues are all linked to the priority areas identified in the 6th Environmental Action Programme. They are also covered by the Sixth Framework Programme for Research and are relevant to the decisions made at the World Summit on Sustainable Development.

With respect to climate change, an analysis of the ECCP was undertaken from a technology perspective. It analysed the ways in which the ECCP identifies barriers to technology and how the proposed ECCP measures overcome these technical, regulatory, economic and social barriers. This analysis serves two purposes. Firstly, it can help identify how the ECCP framework could be replicated in other areas where policy development is less advanced. Secondly, a number of broad areas were identified as being key elements for future work, i.e. the setting of long term targets, public private partnerships, steering investment decisions towards environmentally-friendly technologies, the assessment of future RTD needs and the potential of future break-through technologies such as hydrogen and fuel cells, photovoltaics, and CO₂ storage. The relevance and research needs of these technologies need to be evaluated in the light of the fight against climate change and the future commitment periods.

Over the coming year it will be necessary to deepen the analysis of these issues. To this end, the Commission will discuss with stakeholders their views and invites interested parties to take a pro-active role in this process in order to stimulate the debate. The Commission intends to follow up this process with a Communication by the end of the year, setting out a concrete action plan.

3.3.5 *CO₂ storage*

Increasing attention both within the EU and at the international level is being given to strategies for extracting energy from fossil fuels without releasing CO₂ into the atmosphere. A number of options for CO₂ sequestration are under discussion such as underground and

²⁸ COM (2002) 122 final

mineral storage, both on-shore and off-shore; the deep ocean and the disposal of CO₂ at power stations through biological systems. However, fuel decarbonisation with CO₂ sequestration is a relatively new strategy and substantial research and development work remains to be done as regards a number of issues such as technology, safety, environmental impacts and costs.

Under the Sixth RTD Framework Programme, CO₂ sequestration technologies could be an important research topic in the European CO₂ Thematic Network. Parallel work is also underway in the Commission to examine the likely range of costs of different CO₂ sequestration technologies and systems. The EC is also considering collaborative efforts at the international level in developing carbon sequestration technologies.

Given the increasing importance of CO₂ sequestration as a possible option in future EU climate change policy it would be appropriate to increase our efforts to examine the fundamental scientific, economic, environmental, and technological dimensions of this issue.

Part II : Overview of Working Group activities and implementation of Policies and Measures

4 The Working Groups

4.1 Working Group 'JI and CDM and the link with Emissions Trading'

4.1.1 Background

The sub-working group of WG1 on the Kyoto Flexible Mechanisms reported in its Final Report of the first phase of the ECCP on discussions related to the implementation of Joint Implementation (JI under Article 6 of the Kyoto Protocol) and the Clean Development Mechanism (CDM under Article 12 of the Kyoto Protocol) by the Community and its Member States. This sub-working group met only twice, but participating stakeholders made a number of useful recommendations and conclusions.

The Commission adopted its proposal for a Directive on emissions trading within the EU (COM(2001)581 final) before rules and modalities for JI/CDM implementation were adopted at international level. This is the main reason why the Emissions Trading proposal did not foresee the inclusion of credits from the Kyoto project-based mechanisms. However, the Commission announced its intention to address the linkages between emissions trading and project-based mechanisms through a separate instrument, once the rules and modalities for JI/CDM implementation were adopted. These rules and modalities were agreed upon at COP7, in November 2001.

This separate instrument is intended to be tabled in the first half of 2003 for it to come into force in 2005. In this context, it was decided to create a specific Working Group on JI and the CDM in order to discuss further JI/CDM implementation, as well as the necessary modalities for linking these instruments to the EU emissions trading scheme. The list of WG members, background documents and presentations, as well as the full WG conclusions can be found on the Commission's website²⁹.

4.1.2 Summary of the Working Group Conclusions

The conclusions reached by the working group include the following points:

JI and the CDM will contribute to global sustainable development through early mitigation action in third countries, in particular in developing countries. The early implementation of the project-related mechanisms represents a major opportunity to build confidence in the Kyoto system by signalling the EU's intention to participate fully in the Kyoto mechanisms. JI and CDM projects should achieve additional emission reductions cost-effectively and result in real, measurable and long-term benefits related to the mitigation of climate change. In addition, the development of appropriately designed JI and CDM projects may also have a positive impact on national and Community research and development activities, giving additional incentives to technological innovation and dissemination.

JI and the CDM should be facilitated by the EC to complement abatement action at home, bearing in mind that domestic action should still constitute a significant element of the abatement effort to be made to meet Parties' targets under the Kyoto Protocol.

JI and the CDM should primarily be driven by the private sector. One way of facilitating the private sector's engagement in JI and the CDM is to recognise JI and CDM credits towards fulfilment of domestic obligations. Therefore, linking JI and the CDM to the forthcoming

²⁹ http://www.europa.eu.int/comm/environment/climat/flexiblemechanisms_secondphase.htm

Community emissions trading scheme would stimulate the development of JI/CDM projects. This would increase the diversity of compliance options for companies and should lead to a reduction of overall costs, while improving the liquidity of the market.

However, the Group recognised that public money could promote the early participation of the private sector in JI and the CDM by reducing risks and promoting markets for JI/CDM units/credits. The possible establishment of a financial mechanism at Community level should be analysed further and could promote JI/CDM development. However, it must be decided whether such an initiative should focus on JI/CDM or be more broadly based on “sustainable development” objectives to take account of developing country policy priorities.

Thus, the early adoption of legislation regarding the recognition of project credits should be pursued as a matter of particular priority so as to allow its implementation as from the commencement date of the EU emissions trading scheme. Linking is practicable as from the date credits are issued in accordance with JI and CDM provisions on crediting periods as laid down in the Marrakech Accords. Though credits from JI projects in practice are not expected to become available before 2008, a signal towards demand for JI project related credits would promote confidence in the Kyoto system.

Linking JI and the CDM to the Community emissions trading scheme should be consistent with the Kyoto Protocol and the Marrakech Accords, and the objectives of the Community emissions trading scheme, while safeguarding environmental integrity. It should be remembered that the overall total quantity of allowances allocated to operators participating in the Community emissions trading scheme will have an impact on the demand for credits. Use of JI and CDM credits in the Community emissions trading scheme should be transparent in order to identify which operator surrenders which credit.

The EU should support the work of the CDM Executive Board and the JI Supervisory Committee as they will play a crucial role in the development of JI and the CDM. Early action on JI and the CDM will also require awareness raising of environmental and other potential risks and benefits as well as capacity building and enhancement in both host and investor countries in order to enable private sector engagement and reduce costs and uncertainties.

Finally, the potential for emission reductions that fall outside the scope of the Community emissions trading scheme should not be neglected. The practicalities related to the integration of domestic project-based activities into the Community emissions trading scheme should be analysed further.

4.2 Working Group Agriculture

4.2.1 Introduction

Within the context of the ECCP, the Agriculture Working Group was created in December 2000 and completed its final report in April 2002.

In the European Union, the main sources of emissions of greenhouse gases (GHG) from agriculture are nitrous oxide (N₂O) emissions from agricultural soils, N₂O and CO₂ emissions from cultivated organic soils, methane (CH₄) emissions from enteric fermentation and CH₄ and N₂O emissions from manure management. Methane emissions from agriculture were 41% of all CH₄ emissions, while N₂O emissions from agriculture reached 51% of all N₂O emissions in 1990. Including CO₂ emissions, 11% of all EU GHG emissions in 1990 can be attributed to the agricultural sector.

Accordingly, the WG Agriculture has analysed the mitigation potential, the socio-economic implications and environmental side effects of measures related to: a) the reduction of N₂O emissions from agricultural soils, b) CH₄ emissions from enteric fermentation and c) CH₄ as

well as N₂O emissions from manure management. Furthermore, the agricultural production of biofuels as renewable raw materials for the energy and industrial sector was included in the analysis. The mitigation potential related to the cultivation of organic soils and carbon sinks in agricultural soils were dealt with in the separate WG on Sinks Related to Agricultural Soils.

The analysis of relevant GHG emissions from the agricultural sector and its reduction potential was based on a review of literature and data, existing studies and on the expert knowledge of the members of the WG Agriculture.

A total of 60 potential measures were evaluated with regard to costs, their effects on farm income and labour, the GHG emission reduction potential, environmental side effects and technical feasibility. Proposals were ranked by evaluating them against each of these criteria. As a result, four measures were selected as important for GHG emission reductions.

4.2.2 Reduction potential of measures in agriculture

4.2.2.1 Nitrous oxide emissions from soil

Nitrogen fertilisation of crops significantly contributes to the emission of GHG, especially through the emission of N₂O from soils. Reduction options for N₂O are generally based on the reduction of nitrogen inputs to soils through enhanced efficiency of fertiliser use and a better integration and accounting of nitrogen in manure applied to soil. A number of measures at farm level can be activated to tighten the nitrogen flow of the farm and thereby lead to reduced losses of reactive nitrogen into the air and water. To achieve improvements in this area, it is important to increase knowledge about greenhouse gasses, especially N₂O, among farmers and extension services.

There is a close link between N₂O emissions from agricultural soils and nitrate losses resulting in groundwater pollution. Measures aimed at reducing nitrate content in water also result in declining N₂O emissions. This potential could be fulfilled by properly implementing the nitrates directive, water legislation and rural development policy measures. Hence, strict implementation of existing legislation is needed (the nitrates directive is one of the pieces of Community legislation which has given rise to a number of infringement procedures).

4.2.2.2 Methane emissions from enteric fermentation

Measures aimed at reducing emissions through enteric fermentation are still dependent on more research and are probably not suitable for the first commitment period. There is a limited potential to reduce CH₄ emissions from cattle by changing or improving the composition of their diet. For milk production, the animal lifetime efficiency may be potentially increased, but this is dependent on further research. The highest potential lies in a reduction of livestock numbers, which is, however, dependent on consumer demand for meat and dairy products.

4.2.2.3 Methane and nitrous oxide emissions from manure management

Methane and N₂O emissions from manure may potentially be reduced by making use of anaerobic digestion (AD) as an alternative energy source. In addition to climate change mitigation, the use of AD for manure has the advantages of destroying pathogens and preventing bad odours. Although substantive technical progress has been made in the AD of industrial waste and sewage sludge, agricultural applications have lagged behind. Nonetheless, the development and introduction of technical solutions for small-scale farms in the form of simple, low cost AD units needs to be encouraged. Less innovation is needed for the introduction of more centralised or larger plants. In order to reduce effectively GHG

emissions a number of technical and policy developments are required, e.g. relating to the certainty of a market for energy from AD and promotion and support for distribution.

The total GHG savings from AD could be 17Mt CO₂eq. Hence, AD provides considerable reduction potential and a source of income for farmers as well, but the cost-effective potential may only reach 10% of the technical potential. Development will only be possible with incentives, which may increasingly be provided by the EU and the Member States.

In order to support the introduction of small-scale farm AD plants, there is a continued need for a better evaluation of data on cost-effectiveness, targeted information and guidance on start-up and operational aspects, system choice, labour impact, legislation and technology suppliers as well as on the capital outlay and investment allowances. More innovation is needed to increase efficiency, simplify energy conversion to electricity and fuels and reduce production costs.

For centralised AD plants the cost-effectiveness differs according to the country and region, depending on the intensity of farming. Generally, the current complex legislation on co-digestion and sales of end products needs to be simplified and end products should receive a quality certification. Further potential instruments would be a tax on waste (if not recycled) and an increased support for "green" energy, such as feed-in laws for CH₄ gas and electricity and removal of taxes (other than VAT) on biofuels and automobiles using biofuels.

4.2.2.4 Bio-energy for carbon substitution

Using biomass for energy could lead to significant reductions in emissions from the energy and transport sectors. The use of biomass may also have an additional effect for carbon sequestration. The total technical potential for bio-energy from forests, agriculture and other residues could be 200-600 Mt CO₂eq/year.

All measures would involve a strong role for energy crops, which could be produced on set-aside land, although this could have negative consequences for the nitrogen balance, biodiversity and conservation interests on set-aside land. The experiences since 1992, however, have shown that the supply of set-aside land for non-food production has not yet led to lasting increases in the cultivation of renewable raw materials. Policy measures to stimulate demand and therefore increase the use of renewable energy in the energy sector should therefore be used. A major proportion of the technical potential might be feasible at low cost in the first commitment period.

4.2.3 Greenhouse gas mitigation potential

Estimating the GHG reduction potential in the agricultural sector is still difficult due to uncertainties about the effectiveness of individual measures. Nevertheless, the potential does exist for a further significant agricultural contribution to GHG mitigation. On the basis of political changes already implemented, baseline emissions are predicted to decline in the first commitment period by around 19 MtCO₂eq, corresponding to a 4.6% reduction of all agricultural emissions and 5.7% of the EU-reduction objective. Taking into account the additional measures discussed in the Working Group, the reduction potential may reach an additional 2.9% of agricultural emissions (9.3% of the EU reduction objective). The reduction potential of energy substitution by biofuels, the carbon sequestration potential of agricultural soils and future changes in livestock numbers are not included in this calculation.

Latest data show that GHG emissions from agriculture already decreased by 6.4% between 1990 and 2000, which is beyond the initial predictions of 4.6% described above. Reductions were achieved particularly in the field of CH₄ emissions from enteric fermentation and N₂O emissions from manure management and from agricultural soils. At the same time,

CH₄ emissions from manure management have stabilised. These positive developments are achievements from the political changes already implemented by Agenda 2000, resulting in the introduction of a set-aside scheme in arable production and a reduction of livestock numbers. It is expected that after the year 2000, the Agenda 2000 Reform will have an additional positive impact on agricultural emissions.

Table 1: Greenhouse gas reduction potential in agriculture

	Mt CO₂eq	Reduction in EU Agriculture	Share of total EU-emissions in 1990	Share of total EU-Reduction objective
N ₂ O from soils	10	2.4 %	0.24%	3.0%
CH ₄ from enteric fermentation	0.3	0.1 %	0.0%	0.1%
Anaerobic digestion (CH ₄ and N ₂ O)	1.7	0.4 %	0.04%	0.5%
Bio-energy production, replacement of fossil fuel (Total reduction potential, the cost-effective potential is significantly lower.)	200-600	53-144 %	5-14%	60-181%

4.2.4 Climate change aspects in the mid-term Review of the CAP

The CAP reform proposals of 22 January 2003 (COM(2003)23 final) constitute an important step towards a greater contribution of agriculture to GHG mitigation. Incentives for less intensive and more sustainable agriculture are proposed, introducing specific measures with a positive effect on GHG emissions. Incentives for extensification and ensuring compliance with environmental legislation are expected to reduce nitrogen fertiliser use and thereby reduce N₂O emissions. Methane production from enteric fermentation is projected to decline with reduced livestock numbers, as are CH₄ and N₂O emission from manure. In addition, increased soil carbon sequestration is likely to result from less intensive arable production, and in particular from increased organic farming and from the fact that set-aside land is planned to be taken out of arable production (“environmental set-aside”). Carbon credits for biofuel production support the replacement of fossil fuels. The proposed larger budget for rural development, if adopted, would provide Member States with an increased margin to support agri-environmental measures.

4.3 Working Group ‘Forest-related Sinks’

4.3.1 Introduction: background and working group activities

From the beginning, the European Climate Change Programme intended to establish a working-group on forest-related carbon sequestration (sinks) once the rules and procedures for the accounting of carbon credits and debits from different forest types and their management became clear.

At COP7 in November 2001, the definitions, rules and modalities for sinks were agreed, including the activities under Art. 3.3 of the Kyoto Protocol (afforestation, reforestation and deforestation) as well as (optionally) those under Art. 3.4, such as forest management. Sink credits gained by activities under Art. 3.3 are unlimited, while debits can be off-set up to a certain amount by forest management activities under Art. 3.4. At the same time, credits for

Parties under Art. 3.4 are subject to individual quotas for forest management (including Joint Implementation), totalling a maximum of 5.17Mt C (approx. 19Mt CO₂eq) per year.

With these rules and procedures being agreed, the ECCP Working Group on Forest-Related Sinks was set up to identify and assess forestry measures that can enhance forest-related carbon sequestration in the EU-15. At the same time, GFA consultants of Hamburg carried out a study about detailed technical aspects of forest-related sinks. The Group met four times between May 2002 and January 2003. To ensure a science-based approach, links with other activities and adequate assessment of the proposals, both open discussion and transparency were key principles of the working group's activities. In the last meeting, the group suggested that it would be worthwhile keeping this working group going as a forum for stakeholder consultation in relation to the Commission's future co-ordination efforts in this field.

The working group members identified a number of promising "*candidate technical measures*" (forestry practices) and assessed their carbon sequestration potential, together with other environmental and socio-economic effects. In addition, the group also considered a series of policy guidelines and recommendations, and identified a number of EU policy instruments that can be used to promote the candidate technical measures. An in-depth assessment of the role and potential of EU forests in terms of material and energy substitution was not part of the mandate of the group. However, in view of the implications of the enhancement of sinks for these down-stream activities, the working group did consider their relationship.

The full report, as well as the various contributions of stakeholders, are available on the ECCP website³⁰.

4.3.2 *Limitations and uncertainties*

The working group indicated that its results are subject to a number of limitations and uncertainties, such as:

- Geographical differentiation across the EU is important for practical implementation; the proposed CTMs are considered valuable instruments, but should not be seen as generally applicable solutions, nor is the set of proposed candidate technical measures to be regarded as exhaustive.
- The IPCC Good Practice Guidance on LULUCF is still under development and could therefore not be fully taken into account.
- Longer term issues, such as permanence of sinks and saturation of carbon pools.
- Implications of monitoring and reporting requirements.
- Cost-effectiveness could not be analysed in a systematic way.
- More knowledge is required concerning certain specific carbon pools, such as forest soil carbon.

In order to reduce uncertainties and improve quantitative results, it is regarded as of utmost importance to continue research in these fields and to study economic implications more in detail, for instance through the application of economic modelling tools.

4.3.3 *Afforestation, reforestation and deforestation*

Between 1990 and 2000, **afforestation and reforestation** activities have extended the total EU forest area of 113Mha by **340,000ha/yr.** or 3%, resulting from nearly equal surfaces of planted forests (in many cases through support from the "2080/92" afforestation scheme and

³⁰ <http://www.europa.eu.int/comm/environment/climat/forestrelatedsinks.htm>

the rural development regulation 1257/99) and natural forest expansion. The Group estimates that, if this process continues at the same rate during the present decade, it may result in a sequestration potential of approximately **3.84Mt C/yr. (14Mt CO₂ eq/yr)** during the first commitment period. In case of a sustained afforestation trend and taking into account an extended EU of 25 Member States, a technical sequestration potential of 34Mt C/yr (125Mt CO₂ eq) may be reached in the long term.

The following AR activities were considered:

Afforestation programmes. The AFFOREST Project, Spain, Poland, Ireland and the UK gave detailed information about the expected GHG benefits from forest extension by plantations on former agricultural or derelict land. The group advised that Community support for this activity under Regulation 1257/99 should be continued and optimised in the framework of the future CAP.

Natural expansion of forests on formerly cultivated or grazed land is an important ongoing process in the EU that results from agricultural and socio-economic trends and policies. The importance of the environmental benefits of this process and the necessity to manage it need to be recognised. The new set aside rules of the CAP Reform are expected to have a significant impact on this process. Active management of forest extension through natural regeneration could be envisaged through the rural development regulation.

Short rotation tree plantations on former agricultural land. Although there is a short-term potential for carbon sequestration, the GHG benefit of this activity was found to be most important for increasing the production of biomass for energy substitution, in line with EU energy policy. The necessity of careful consideration of the environmental impacts was recognised. In this respect, there is a clear need to define best practice and develop guidelines. The CAP reform proposals introduce a specific support scheme for energy crops that could be reviewed later on for further improvements.

Deforestation is not a large scale problem in the EU. Small areas are affected, usually linked to urban and infrastructure development. On the other hand, because the entire carbon stock is lost in a very short time frame, the carbon losses per unit area are large. Several countries (Austria, Belgium, Finland, Sweden, Denmark and France) are expected to report small debits due to deforestation. As most of these countries are not experiencing large scale afforestation, it would be possible to compensate for the debits through forest management activities.

4.3.4 Forest management

Forest management measures have an important potential for application as they can cover a much larger area than AR activities, implying that small GHG benefits per unit area may yield large impacts. For the first commitment period the accountable amount **is capped at 5.17Mt C (19Mt CO₂eq)**. Very rough IPCC estimates of the quantitative impact of forest management measures indicate a potential for an average gain of 20% in yearly carbon uptake by adapting management, but there is a need for more accurate EU figures. The socio-economic impacts of adapting forest management are expected to be more important than in the case of ARD measures and might therefore require more directed policy support.

The following forest management activities were proposed:

Establishment of forest reserve areas. Research by CarboEurope has indicated that absence of forest management enhances carbon sequestration, even in old growth forests, but this measure can only be applied on a limited scale due to its restriction to areas that are specially designated according to nature and biodiversity protection requirements.

Restoration of forest wetlands. As drainage tends to increase mineralisation of soil organic matter, restoration of forest wetlands may produce important GHG benefits, while at the same time enhancing biodiversity. For these measures, one should also consider the impact on the emissions of other greenhouse gases, namely CH₄ and N₂O. The socio-economic implications of such measures can be important and may require compensation of economic operators.

Continuous cover forest management can potentially increase carbon sequestration in growing stock by a factor 1.2 to 1.6 in the long term. It is well established in the public forest estate but its application is limited to certain forest types and local situations.

Prevention of forest fires is seen as a specific measure for the Mediterranean region. Through specific *silvicultural management*, it is possible to lower the risk of fires, while increasing the use of biomass for energy substitution, raising the marketable timber output and enhancing bio-diversity. Another option considered by the group encompasses improved fire prevention through investments in infrastructure, fire prevention and control equipment and improved supervision and access.

Improved management of fast growing plantations in southern Europe can contribute to carbon sequestration if the necessary trade-offs between forest functions are taken into account and fire risk analysis is considered.

For the first commitment period 2008-2012, the combined accountable potential for the EU from ARD measures (3.84Mt C/yr or 14Mt CO₂ eq/yr) and Forest management (capped at 5.17 Mt C/yr or 19Mt CO₂eq/yr) would thus be approximately 9Mt C/yr or 33Mt CO₂eq /yr, which is roughly 10 % of the corresponding EU emission reduction target of ca. 336 Mt CO₂ eq /yr.

4.3.5 Policy guidance

The working group gave some more general policy recommendations:

- To improve accuracy of the quantitative estimates of the GHG benefits and to reduce the uncertainties, more research will be needed.
- More investigation will also be needed on the economic aspects of climate-related measures in forestry, whereby economic modelling may play an important role.
- The Good Practice Guidance on LULUCF activities that is expected to be published by IPCC later this year will have to be taken into account in future policy developments.
- EU forest sinks can contribute to the realisation of emission reduction targets, but they are only to be regarded as a temporary supplement for effective reductions of GHG emissions in the long term.
- Measures to enhance carbon sequestration need to be based on principles of sustainable forest management and the multifunctional role of forests.
- National forest policies will be the first policy tool for deciding how the measures are applied.
- Effective measures should aim for win-win situations that benefit rural development, the environment and economic activity.
- Existing Community instruments for incentives in the forestry sector should be screened for possible optimisations related to climate change objectives.

The working group also considered, in general terms, the relationship between carbon sequestration in forests, and the use of forest resources for material substitution and for energy substitution. Although the subject requires in-depth investigations, the following observations can be made:

- Preserving and enhancing the amount of carbon in forests through sustainable forest management is a pre-condition for enhancing material and energy substitution.

- Wood products are a physical pool of carbon (currently not accounted for under the Kyoto Protocol) and can act as a substitute for more energy-intensive materials.
- A carbon-conscious hierarchy for the use of wood and the residues and by-products of its processing should be respected, while ensuring a level playing field for all economic operators and allowing the market to operate without distortions.

4.4 Working Group ‘Sinks in Agricultural Soils’

4.4.1 Introduction

Measures to enhance carbon sequestration in agricultural soils are potential tools for mitigating global warming as well as for enhancing soil protection. There is evidence that, under current agricultural practices, many European soils are losing organic carbon and constitute thus sources of atmospheric CO₂, rather than sinks. This may be the case for arable cropping systems, which have tended towards greater specialisation and monoculture, and for farmed organic soils, such as peatlands. Farming practices have an important impact on soil organic matter content. Thus, there is a potential for carbon sequestration as well as for a reduction of greenhouse gas emissions from soils.

Carbon sequestration in agricultural soils is accountable under Article 3.4 of the Kyoto Protocol, which covers additional human-induced activities related to changes in greenhouse gas emissions and removals by sinks in agricultural soils and the land-use change and forestry categories. The Bonn Agreement formulated at COP6bis in July 2001 clarifies the implementation of Article 3.4 as follows: “In the context of agriculture, eligible activities comprise "cropland management", "grazing land management" and "revegetation" provided that these activities have occurred since 1990, and are human-induced”. The Marrakech Accords, agreed at COP7 in November 2001, set legally binding guidelines for reporting and accounting for agricultural carbon sinks. Thus, carbon sequestration in agricultural soils is potentially a suitable mechanism to ensure compliance with the EU’s obligation to cut down its greenhouse gas emissions.

4.4.2 Objectives of the Working Group

The ECCP Working Group on Sinks related to Agricultural Soils (“WG Soils”) had the general objective of estimating the carbon sequestration potential of agricultural land in the EU. To this aim, technical measures for carbon sequestration in agricultural soils were analysed with respect to their sequestration potential as well as their environmental and their socio-economic impact. The work of the WG Soils provides the technical background analysis that should enable the Commission to propose, if appropriate, policy instruments aiming at carbon sequestration in agricultural soils to the Council and the European Parliament. Furthermore, as organic carbon is an important issue in connection with soil functions such as fertility, stability, structure and water storage capacity, the group made the link between carbon sequestration and the broader aspects of soil protection.

4.4.3 Overall potential for greenhouse gas mitigation

According to the estimates provided by the experts, there is a realistic potential to sequester up to 60-70Mt CO₂yr⁻¹ in agricultural soils of EU-15 during the first commitment period, which is equivalent to 1.5-1.7% of the EU’s anthropogenic CO₂ emissions. This amount of 60-70 Mt CO₂eq. y⁻¹ would make up 19-21% of the total reduction of 336MtCO₂eq.yr⁻¹ to which the EU-15 is committed during that period.

4.4.4 Specific measures

Soil carbon sequestration is the uptake of atmospheric carbon and its storage in the soil. This report analyses measures aiming at an increase of soil carbon as well as at a reduction of its

loss. Increasing the soil carbon content in agricultural soils can be achieved by increasing the carbon input, decreasing the output or a combination of the two. Possible changes in emissions of N₂O and CH₄, which are both powerful greenhouse gases, are important when determining the overall mitigation effect of a given activity.

Carbon sequestration measures considered by the IPCC in the Special Report on Land Use, Land Use Change and Forestry (LULUCF), which are analysed here, include cropland management to provide higher carbon inputs to the soil, irrigation water management, conservation tillage, erosion-control practices, grazing management, protected grassland/set-aside, grassland productivity improvements, and fire management in grasslands. As this report is concerned with agricultural soils, further aspects, such as forest management and revegetation (except on set-aside land) are not considered further here. The report concentrates upon cropland and grassland management, though organic soils, such as peatlands, are also considered where they are used for agriculture. Management changes within a single land-use (e.g. reduced tillage on cropland), as well as transitions between land uses (e.g. cropland to grassland conversion) are considered.

Carbon sequestration can occur either through a reduction in soil disturbance (since more carbon is lost as CO₂ from tilled soils than soils that are less disturbed) or through increasing the carbon input to the soil. It is important to maintain existing carbon stocks and slow carbon loss through improved management practices.

Table Most promising carbon sequestration measures

	Technical measure	Sequestration Potential per unit area	Potential in EU-15 during first commitment period ³¹	Environmental side effects	Impact on farm income
		t CO ₂ /ha/yr	Mt CO ₂ /yr		
1	Promote organic input on arable land (crop residues, cover crops, farm yard manure, compost, sewage sludge)	1-3	20	Chemical fertiliser can be partly replaced, leading to reduced N ₂ O emission and reduced nitrate leaching. Accounting of additional nitrogen input is required to avoid nitrogen overdose and nitrate losses. Erosion control and reduced nitrate leaching under cover crops. Danger of contamination by heavy metals and other pollutants, as well as biosafety issues, are controlled under Community and national legislation. Reduced pathogen risk from composted material.	Positive long-term tendency due to better soil fertility. Easy implementation, but potentially higher costs due to transport and purchase of organic material and compost production. On-farm composting can provide an additional source of income. Capital and operational costs incurred by setting up a composting facility at farm level may be offset by (1) a fee for taking organic waste (2) income from selling compost (3) savings in fertiliser, water consumption, disease suppression.
2	Permanent revegetation of arable set-aside land (e.g. afforestation) or extension of arable production by introduction of perennial components	2-7	15	Benefits for wildlife, biodiversity and landscape.	Regionally specific, positive only if linked to compensation payment for nature protection.
3	Biofuel production with short-rotation coppice plantations and perennial grasses	2-7	15	The benefit from substitution of fossil fuels by bio-energy is much greater than the effect from carbon sequestration.	Regionally specific, potentially positive if linked to subsidies or emerging markets
4	Promote organic farming	>0-2	14	Benefits for wildlife, biodiversity, landscape, but unclear whether there is a risk of higher N ₂ O emission from incorporation of legume residues. More research is needed here.	Potentially positive due to higher prices for organic products, and support under national RDPs for conversion to organic farming, and to some extent, organic production. Market share is growing. However, lower yields per ha, compared to conventional farming.

³¹ For the estimation of the sequestration potential in the EU 15, the sequestration potential per unit area was taken into account as well as the area suitable for each measure and other limiting factors (see section 5.5). Finally, from an overall potential the potential in the during the first commitment period was estimated considering economic factors.

5	Promote permanently shallow water table in farmed peat land	5-15	15	Benefits for wildlife, biodiversity, landscape, water retention, reduced N ₂ O emissions.	Regionally specific, positive only if linked to compensation payment for nature protection. Some peat lands form the most productive agricultural areas in England.
6	Zero tillage/ conservation tillage	>0-3	<9	In some regions a suitable instrument for erosion control and soil conservation. Soil structure improves under most conditions, but increased bulk density may lead to reduced rootability and infiltration in some cases. Zero and reduced tillage can lead to higher N ₂ O emission and more pesticide use, especially under wet soil conditions. Very small carbon sink in reduced tillage systems.	Site and region specific, possible increased production risks for farmer. Positive only if linked to good erosion control and better soil fertility. Lower labour requirements and operating costs (e.g. lower fuel consumption) have led to an adoption of conservation tillage in a number of large farms. Capital costs involved in investment in equipment for conversion from conventional tillage.

Please note that the figures for the sequestration potential can in general not be combined together.

Measures with a positive carbon sequestration include (see Table for most promising measures):

- Zero tillage systems, which represent an extreme form of cropland management in which any form of mechanical soil disturbance is continuously abandoned, except for shallow opening of the soil for seeding, like continuous mulch-seed or direct-drill. In reduced tillage systems soil disturbance is kept at a minimum or is reduced as compared to conventional plough systems. This measure includes a wide range of different practices depending on various climate and soil conditions. The sequestration rate as well as the potential environmental and socio-economic impacts can thus only be estimated qualitatively, in comparison to zero tillage
- A better use of animal manure, crop residues, sewage sludge or compost, by applying the available material on cropland instead of on grassland or elsewhere as it is common practice. This measure requires some transport of manure from regions of intensive animal production to suitable croplands. The widespread production of compostable waste limits the distance between production and application sites of compost in most cases as well as the transportation costs.
- Improved rotations with higher carbon inputs to the soil
- Switching from conventional arable agriculture to other land uses with higher carbon inputs or reduced disturbance:
 - Bio-energy crop production with perennial herbaceous and woody species only. Considered here is only the carbon sequestration effect, which is much smaller than the beneficial effect resulting from fossil fuel replacement. In annual bio-energy plants (e.g. rape for biodiesel, sugarbeet for bioethanol) carbon sequestration in the soil is not enhanced;

- Set-aside land;
- Conversion of arable land to grassland. This option includes the possibility of expanding field margins, on which grass should be grown, and possibly shrubs or trees;
- Conversion of arable land to woodland (afforestation);
- Allowing natural regeneration to occur;
- Extensification, implying extending the crop rotations and including more intercrops and grasses in order to increase the carbon input to the soil;
- Organic farming.

Measures considered with a smaller or no potential include:

- Cultivation of perennial crops
- Increased fertilisation
- Increased irrigation
- Changes in livestock management to increase productivity.

Increased yields in the past have not produced higher input of carbon in the soil. In contrast, increases in yields were mainly achieved via changes in the harvest index. So, while grain yields increased, the amount of crop residue was even reduced.

4.4.5 Limitations for the application of sequestration measures

4.4.5.1 Regional differences in carbon sequestration

The carbon sequestration values in the Table were derived for average European arable soils. Generally an analysis of the overall carbon sequestration potential of particular measures as well as their potential environmental and socio-economic impacts is limited by strong regional differences, which are due to regional variation in soil types and climate. Whilst some soils (e.g. clay soils) accumulate carbon relatively quickly, others (e.g. sandy soils) may accumulate practically no carbon even after 100 years of high carbon inputs. Similarly, soils in colder climates, where decomposition is slowed by low temperature, may accumulate carbon more rapidly than soils in warmer climates where decomposition is faster. Furthermore, the potential for sequestration is higher in soils with low organic carbon content and decreases in soils with higher organic carbon content.

In the same way do environmental side effects of soil carbon sequestration measures depend on the soil type. The actions that could be foreseen in some kinds of soils, for example the use of sewage sludge, can give varying results according to the type of soil (i.e. mainly due to the texture, permeability, level of the groundwater table, etc.). Reduced tillage may lead to problems of weed control under wet conditions, implying high herbicide applications and potential groundwater pollution, while this problem may be less severe in dryer regions. In most cases, reduced tillage and no-tillage will improve the soil structure, but it may also lead to soil compaction under certain soil conditions, rendering this measure not suitable in some regions.

It is thus not possible to give an overall evaluation for a single action or treatment without taking into account the climate and soil. Generally, management practices also vary from place to place, with the most important for carbon sequestration being soil management / tillage and the use of organic manure and sewage sludge. On a European scale, insufficient information is available on regional variation in management practices.

4.4.5.2 Sink saturation

Whilst the figures given in the Table are approximate for a short period (e.g. a 5 year Kyoto Commitment Period), changes in carbon sequestration need to be considered also over a longer time horizon. Soil carbon sequestration is non-linear. Long-term experiments show that increases in soil carbon are often greatest soon after a land use/land management change is implemented. As the soil reaches a new equilibrium, the rate of change decreases, so that after between 20 and 100 years a new equilibrium is reached and no further change takes place. This phenomenon is sometimes referred to as sink saturation. Whilst soil carbon levels may not reach a new equilibrium until 100 years after a land-use / land-management change, the carbon sequestration potential may already be minimal after 20 years; 20 years is the value used by the IPCC for national greenhouse gas inventories. Soil carbon sequestration does not, therefore, have limitless potential to offset CO₂ emissions; the yearly benefits will continue for about 20 years, but in a digressive way.

4.4.5.3 Non-permanence

Soil carbon sequestered in arable soils may be non-permanent. By reverting to old agricultural management or land-use practice, soil carbon is lost more rapidly than it accumulated. For soil carbon sequestration to occur, the land-use / land-management change must also be permanent. Whilst agricultural soils that are tilled every few years may contain more carbon than the same soils cultivated every year, much of the benefit of reduced tillage is lost by ploughing, when compared to a permanent management change. For practical purposes, therefore, in order to implement a meaningful carbon sequestration policy on agricultural land, management changes must be permanent.

4.4.5.4 Cost-effectiveness

If a sequestration measure is associated with a cost higher than conventional agricultural practice, and this cost is assumed to be constant throughout the period of application of the this measure, the issues of sink saturation and non-permanence have significant implications for the cost-efficiency of carbon sequestration. In the early phase of adoption, when the sequestration rate is high, the cost-efficiency is also high. With lowered sequestration rates in later stages, the cost-efficiency drops, making carbon sequestration continuously more expensive. Finally, if a new equilibrium is reached and no further sequestration takes place, costs would still apply. Reverting to previous practices would release the carbon sequestered during the accumulation process.

This scenario of subsidised carbon sequestration, while adequate for measures making use of increased organic input, is not necessarily realistic in any case. It can be observed in North and South America, where conservation tillage has been adopted on a large scale (around 16% of the agricultural area in the US and 32% in Argentina), without being financially supported for climate change mitigation purposes. The main reasons for the adoption of conservation tillage lie in reduced expenditure of time, fuel and investment into heavy tractors. However, the conversion from conventional tillage to conservation tillage implies new machinery, and thus an initial investment into conversion may in some cases have led to a more cost-efficient production method.

4.4.5.5 Availability of land and adoption of measures

When calculating totals, the area where it is feasible to carry out a specific measure should be taken into account. For example, application of farmyard manure is restricted by the amount of manure produced and environmental restrictions (such as ground water pollution), and conversion of arable land to grassland is restricted to the area of land not needed for arable production. Finding these data, which are not fully available, would be an important step forward in assessing regional differences in the efficacy of carbon dioxide abatement options in European agriculture.

Other factors limiting the implementation of soil carbon sequestration measures are the availability of suitable land / soils and the availability of limited resources (such as the amount of sewage sludge, animal manure or cereal straw available). An estimate of the

potential attainable by the end of the first Kyoto commitment period (2012) is provided in Table 1, though more work needs to be done in estimating social and economic limitations to the implementation of these measures.

4.4.6 Monitoring and verification of carbon sequestration

Accurate monitoring and verification of carbon stocks and changes in soil carbon is essential if any measure is to be successfully implemented - otherwise we cannot account for the success (or failure) of different measures with a sufficient level of certainty.

For the verification of activities under Article 3.4 of the Kyoto protocol, estimates of carbon fluxes and/or changes in carbon stocks are required that are independent of those used in the national report of a Party to the Protocol. This means that for a given human-induced activity, there must be at least two independent methods for assessing the size of an emission by a source or removal by a sink. Whether or not Article 3.4 is verifiable depends critically on what the parties to the Protocol decide is acceptable in terms of verifiability. This report assumes an intermediate stringency in which national reporting will be based on either standardised values for carbon sequestration or regional factors for carbon sequestration derived from benchmark sites. Verification then means monitoring through additional independent measurements in conjunction with modelling, ground-based and airborne observations. However, in order to provide a reliable estimate of soil carbon and nitrogen stocks under different land use and management, the existing soil maps need further refinement.

A monitoring of soil conditions, including organic matter content, is advised to be supported by future EU legislation in the framework of the EU Soil Strategy. The Commission recognised in its Communication “Towards a Thematic Strategy for Soil Protection“ (COM (2002) 179 final) the need to address a soil protection policy and the need to develop a more complete information basis, monitoring and indicators to establish the prevailing soil conditions, and to evaluate the impact of diverse policies and practices. The proposal provides for a soil monitoring legislation, making use of existing information systems, databases and know-how, in so far as possible.

4.4.7 Impact of Carbon Sequestration Measures on Farm Income and Environmental Side Effects

Although it is very difficult to assess the impact of carbon sequestration measures on farm profitability and/or costs, it is possible to describe these effects qualitatively. Many carbon sequestration measures have positive as well as negative effects on farm profitability. For most measures, it is impossible to define whether the overall impact on farm profitability would be positive or negative. Variation is expected between different farms, as well as for the industry as a whole in different Member States, for instance, due to different agri-environmental support schemes. For a few, a positive net benefit is expected, and these measures may be economically viable once they are introduced. However, initial costs of conversion and/or lack of information may be limiting factors for an adoption of new techniques.

For some measures it is possible to provide a rough estimate of potential net benefits. Within rural development policy (agri-environmental scheme), a measure for no tillage in combination with a mulch-seed system exists e.g. in Germany, where between 25 and 60€/ha is paid for this measure. Within the ECCP, 20€ for the reduction of 1t CO_{2eq} is used as an indicative benchmark for cost-effectiveness. Taking this figure and an absorption potential of 1.1t CO₂/ha, a payment of up to 22€/ha could be considered cost effective in terms of carbon sequestration. The economic benefits from CO₂ sequestration, , could finance additional agri-environmental measures. This may be worth even more if soil quality /function benefits are taken into account.

It must, however, be taken into account that the removal of CO₂ from the atmosphere by sinks is non-permanent. Thus, future costs may need to be taken into account to maintain elevated carbon stocks in the soil even if no further sequestration may occur. In comparison, investments into emission reductions rather than removals by sinks have a climate mitigation effect for several hundred of years, which is the residence time of CO₂ in the atmosphere.

4.4.8 Synergies between Climate Change Mitigation and Soil Protection

In addition to contributing to climate change mitigation, soil organic carbon plays a crucial role in soil protection. In its recent Communication “Towards a Thematic Strategy for Soil Protection”, the European Commission recognises that the decline in organic matter is among the major threats to soil that endanger its functions, together with erosion, local and diffuse contamination, sealing, compaction, a decline in biodiversity and salinisation. Organic matter plays a central role in maintaining key soil functions and is an essential determinant of erosion resistance and soil fertility. It assures the binding and buffering capacity of soil, thus contributing to control the diffusion of pollution from soil to water.

4.4.9 Policy instruments supporting carbon sequestration

Within the first pillar of the Common Agricultural Policy, the Agenda 2000 reform introduced environmental protection requirements, whereby Member States should take the environmental measures they consider to be appropriate in view of the situation of the agricultural land used or the production concerned. These measures may include support in return for agri-environmental commitments, general mandatory environmental requirements or specific environmental requirements constituting conditions for direct payments. Member States should decide on penalties for non-respect of environmental requirements, which may include a reduction or the cancellation of the market support.

The CAP already provides opportunities for measures aimed at carbon sequestration and soil protection. A number of agri-environmental measures offer opportunities for the build-up of soil carbon, the enhancement of soil biodiversity, the reduction of erosion, diffuse contamination and soil compaction. These measures include support to organic farming, conservation tillage, the protection and maintenance of terraces, safer pesticide use, integrated crop management, management of low-intensity pasture systems and lowering the stocking density and the use of certified compost. These measures can be developed further to enhance beneficial practices.

The CAP reform proposal (COM (2003) 23 final) constitutes an important step towards a greater contribution of agriculture to GHG mitigation. It provides for incentives for extensification and ensuring compliance with environmental legislation, which are expected to reduce nitrogen fertiliser use and thereby reduce N₂O emissions. An aid of 45€/ha as a support for energy crops is proposed. In addition to that, increased soil carbon sequestration is likely to result from less intensive arable production, and in particular from increased organic farming, and from the fact that set-aside land is planned to be taken out of arable production. Set-aside will be non-rotational; however, member states will be able to allow rotational set-aside where this was necessary for environmental reasons. If non-rotational set-aside land will be ploughed rarely or not at all, carbon sequestration is expected to increase compared to the conditions on rotational set-aside.

The proposal provides for a transfer of funds from the first (market) pillar to the second (rural development) pillar of the CAP by means of modulation. The proposed additional funding for Rural Development Plans could lead to benefits for carbon sequestration, if Member States will invest it, in increased soil protection measures. Generally, more funds available for agri-environmental measures should stimulate an increased adoption of environmentally friendly production techniques.

The proposal includes that direct payments to farmers will be conditional to cross-compliance relevant to requirements to maintain land in good agricultural condition, among other aspects.

Targeted measures aimed at soil protection, the conservation and enhancement of soil organic matter and soil structure, which are included in these requirements, are listed in Annex IV to the Proposal. Furthermore a new chapter entitled 'Meeting Standards' includes the possibility for Member States to offer temporary and digressive support to help their farmers to adapt to the introduction of demanding standards based on Community legislation concerning the environment, public, animal and plant health, animal welfare and occupational safety. Additionally, a farm advisory system is proposed to be mandatory as a part of cross-compliance requirements. Farm audits will involve structured and regular stocktaking and accounting of material flows and processes at enterprise level defined as relevant for a certain target issue (environment, food safety, and animal welfare). Support for farm audits will be available under rural development. As a result, farmers' awareness about potentially superfluous and environmentally negative input in agricultural production should be increased.

4.4.10 Conclusion

Some of the technical measures identified in this report appear to be suitable tools for the European agricultural sector to help combat global warming. These measures are to some extent already used in different Member States and are eligible for inclusion in national Rural Development Programmes, where they can be financially supported under the Agri-Environment Scheme. The CAP Reform proposal provides fore increased opportunities to support environmentally friendly agricultural production,

The overall estimate of the carbon sequestration potential is limited by strong regional differences in (1) the sequestration potential of a measure, (2) the environmental impact of the measures, and (3) the socio-economic impact of the measures. This regional variation prevents a uniform strategy for carbon sequestration across the whole EU and makes a decentralised strategy, which takes into account the national, regional and even site-specific variation in socio-economic and environmental factors, more promising.

Generally, it has to be stressed that soil carbon plays an important role for the vital functions of soil and contributes to the long-term maintenance of soil fertility and function. Measures for carbon sequestration have therefore to be viewed not alone from the perspective of climate change mitigation, but also from the viewpoint of their contribution to a European policy of soil protection.

Carbon sequestration in soils is likely to have only a limited potential for greenhouse gas mitigation in isolation. It needs to be part of a broader strategy of measures for greenhouse gas mitigation and would provide added value to efforts to improve the sustainability of soils and agriculture through increased organic carbon levels in soils. The greatest potential of the measures discussed is likely to come from the substitution of fossil fuels with bio-energy crops, which has the double benefit of offsetting carbon emissions and additional carbon sequestration in soils.

4.5 Fluorinated gases

4.5.1 Background: Results of the first phase of the ECCP

The objective of the Working Group on fluorinated gases under the ECCP was to develop the basis for a framework of an EU-policy to reduce emissions of the fluorinated greenhouse gases covered by the Kyoto Protocol (HFCs, PFCs and SF₆) in a cost-effective way. The first report of June 2001 concluded that fluorinated gases contributed about 2% (65 Mt CO₂eq) of overall EC greenhouse gas emissions in 1995. Views on the likely future evolution of these emissions levels varied but were in the range of 2-4% of total emissions by 2010 (98 Mt CO₂eq), with a particular increase expected in HFC emissions. It was agreed that this potential growth warrants specific action from regulators and industry to limit emissions of fluorinated gases. Consequently the group recommended that a regulatory framework in a

“Community Directive on Fluorinated Gases” should be established. The key objectives of such a Directive would be:

- Improved monitoring and verification of emissions of fluorinated gases.
- Improved containment of fluorinated gases.
- Marketing and use restrictions in certain applications

4.5.2 Follow-up in the Council and the European Parliament

With the Communication on the implementation of the first phase of the ECCP the Commission endorsed the recommendations of the working group without any change. The Environment Council at its meeting of 12 December 2001 supported the Commission’s proposal for legislative action and confirmed its objectives. The Council stated that the legislation should address stationary and mobile sources. Marketing and use restrictions should be considered in those cases where viable alternatives existed and improvement of containment was not feasible.

In its resolution of 25 September 2002 on the Commission Communication the European Parliament welcomed the Commission's intention to submit a proposal for a framework directive on fluorinated gases. It considered the expected reductions in emissions of fluorinated gases and improved monitoring as a cost-effective and environmentally efficient measure. The European Parliament considered it important that all areas of application are covered by the proposal.

4.5.3 Mandate and activities of the Working Group in the second phase

In this second phase of the ECCP the mandate of the working group has changed. It is now a forum for stakeholder consultation on the preparatory work for the envisaged Community legislation.

In the reporting period the group discussed the draft reports of the two regulatory impact studies for the future legislation. The first of these deals with the expected costs of introducing measures to contain emissions in the various Member States. The results of the draft final report confirm that containment can be regarded as a cost-effective approach in the refrigeration and air-conditioning sector. Costs in the Member States vary according to the structure of the refrigeration sector and measures already taken. In those cases where control systems are already in place incremental costs will be low while they are considerably above average where there are delays in the implementation of earlier legislation. The emission reduction achievable by 2012 due to additional containment efforts is estimated by the consultant in the range of 12-15 million tonnes CO₂ equivalent for an average cost of €18.32 per tonne CO₂ equivalent.

The second study examines the cost and impact on businesses of potential marketing and use restrictions of certain applications of fluorinated gases. A total of nine sectors have been investigated. According to the preliminary findings in the draft final report such restrictions could contribute to an emission reduction equivalent of around 6 Mt CO₂eq in 2010 for an average cost of <€1 per tonne CO₂eq. This reduction would correspond to about 6% of the estimated total emissions of fluorinated gases in 2010. Both regulatory impact studies were finalised in January 2003.

4.5.4 Mobile air conditioning

In the last few years, mobile air conditioners are increasingly fitted as standard feature in most cars. Air conditioner-related emissions comprise both CO₂ from operating air conditioning compressors and leakage of HFCs themselves. Greenhouse gas emissions due to mobile air conditioning are significant and growing fast in the European Union. In a

consultation paper³², the European Commission estimated that these emissions will be between 31 and 53 Mt CO₂ eq in 2010 and between 54 and 90 Mt CO₂ eq in 2020 without technological improvement or additional policies. About one third of these emissions are due to higher fuel consumption and consequent CO₂ emissions and two thirds due to the emissions of the refrigerant, HFC-134a. This would be equivalent to 16 and 28 grams of CO₂ equivalent per kilometre in 2010 depending on the assumptions. These data do not include the possibility for technical improvements, such as a move to HFC with lower global warming potential (HFC 152-A) or a future move to 42V battery systems. The Wuppertal Institute's³³ report gave a similar, albeit slightly lower estimate of 13.7g/km CO₂eq in 2010.

While the sub-group on Fluorinated Gases was working, the Commission was also studying in detail the impact of air conditioning systems on the emissions of greenhouse gases from vehicles. This is in response to the Council's request of 10 October 2000 to the Commission to "*study and prepare measures in reduction of all greenhouse gas emissions from air conditioning in vehicles*". The ECCP sub-group Fluorinated gases had considered the options for reducing HFC emissions from mobile air conditioning systems to some extent during the first phase, while WG 4 (Transport) had deliberated the impact of mobile air conditioners on fuel consumption and subsequent CO₂ emissions. This preliminary work was developed further by two Commission studies: one focussing on measuring the actual leakage of HFCs from mobile air conditioners in the EU and one focussing on how to include the additional fuel consumption and consequent CO₂ emissions to the test cycle, with a view to informing the consumer of this increase. The reports from these two studies have just been completed.

Since vehicle manufacturing is a global business, the Commission considers it important to consult the stakeholders on the options to reduce greenhouse gases. It organised an international conference on the Options to Reduce Greenhouse Gas Emissions due to Mobile Air Conditioning on 10 and 11 February 2003³⁴. The purpose of the conference was to collect comprehensive information on the state of play and to identify policy relevant options on how to reduce greenhouse gas emissions due to mobile air conditioners used in passenger cars. The purpose was also make recommendations to regulators and vehicle manufacturers in the EU and elsewhere on what action needs to be taken.

In the conference it was evident that there are different views among the industry of the possible advantages and disadvantages between containing the current emissions of HFC-134a and to phasing out to HFC-152a or CO₂ (or hydrocarbons) as the refrigerant. Understanding that action is needed, several industrial representatives asked the Commission to take initiative in order to provide industry with a long-term planning perspective. Also many regulators in EU Member States are waiting for the Commission's proposal for the regulation on fluorinated gases. Given the international context of the problem, the choice of refrigerant of mobile air conditioners is an important issue for developing countries. NGOs stated that a phase-out of HFC-134a as the refrigerant is the only sustainable solution for mobile air conditioners and that this phase-out should start in 2008.

On increased energy consumption (responsible for 30 to 40% of the greenhouse emissions from mobile air conditioning in the EU) and the consequent increased CO₂ emissions the overall conclusion was that it is in everybody's interest to make the mobile air conditioners more energy efficient and that corresponding initiatives should be developed. The Commission's plans to develop a standard test procedure, to inform the consumer by adding adequate information to the label of CO₂ emissions (Directive 1999/94/EC), and to develop policies which guide manufacturers towards more efficient systems were generally supported but not discussed in detail.

³² http://europa.eu.int/comm/environment/air/mac2003/pdf/consultation_paper.pdf

³³ http://www.wupperinst.org/Publikationen/Presse/2003/01_2003.html

³⁴ see <http://europa.eu.int/comm/environment/air/mac2003/>

After the receipt of the responses to the consultation paper made for the Conference (11 March) the Commission will decide on its regulatory approach during the second quarter of 2003 and make the appropriate legislative proposals.

4.5.5 Next steps

Following the finalisation of the studies and the conference on mobile air-conditioning, the Commission will finalise its legislative proposal, in the form of a Regulation on fluorinated gases, with adoption envisaged in the third quarter of 2003. In addition, the Commission will consider including the operation of mobile air conditioning systems during the type approval tests for measuring pollutant and CO₂ emissions. This would enable to make a proposal aimed at informing consumers about the impact of vehicle air conditioning systems on greenhouse gas emissions.

5 Policies and measures

5.1 Revision of the Monitoring mechanism

On 5 February 2003, the Commission approved a proposal for a new Council Decision concerning the mechanism for monitoring greenhouse gas emissions in the Community and evaluating progress towards meeting the Community's commitment under the Kyoto Protocol. The proposal to amend the existing EU Decision 99/296/EC on the monitoring of greenhouse gas emissions in the EU:

- replaces Council Decision 93/389/EEC for a monitoring mechanism of Community CO₂ and other greenhouse gas emissions, as amended by Decision 99/296/EC.
- reflects the reporting obligations and guidelines for the implementation of the UN Framework Convention on Climate Change (“UNFCCC”) and the Kyoto Protocol, as set out in the political agreement and legal decisions taken at the sixth (part two) and the seventh Conferences of the Parties (“COP7”) in Bonn and Marrakech;
- provides for further harmonisation of emission forecasts at Member State and Community-level, in the light of experience with the current reporting practices;
- addresses reporting and implementation requirements relating to the ratification of the Kyoto Protocol and the ‘burden-sharing’ between the Community and its Member States under Council Decision 2002/358/EC;

The widening the scope of the current Decision includes the insertion of new monitoring and reporting requirements that cover areas such as the flexible mechanisms, including registries set out under the Kyoto Protocol. In addition, it is proposed to make a distinction between annual and periodic reporting obligations and to shift the annual reporting cycle on Climate Change programmes and projections to biannual reporting. Provisions on projections of greenhouse gas emissions are strengthened since experience with the current provisions has shown that there is a need for more comprehensive and detailed data in this area. However, in order to limit the reporting tasks of Member States, only the provision of data of interest to the Community is requested.

The proposal also provides for some of the details of the reporting and monitoring tasks to be laid down in implementing provisions, to be adopted by comitology, taking account of the rather technical nature of the Decision.

Member States are required to report to the Commission by 15 January 2005 on ‘demonstrable progress’ in order for the Commission to fulfil its reporting obligation to the UNFCCC by 1 January 2006. Linked to this, provisions are included for a review to be undertaken to assess the progress made and, if necessary, to propose suitable measures in order to ensure achievement of the EC target.

Overall, this proposal will help the Community and the Member States to comply with their international commitments in the area of climate change and improve the completeness and transparency of EC greenhouse gas inventory data and of EU climate change policies.

5.2 Proposal on Emissions Trading

Following the positive response to the Green Paper on greenhouse gas emissions trading within the European Union³⁵ and the contribution made by the ECCP working group on the

³⁵ COM (2000)87

Kyoto Protocol's market-based mechanisms, the Commission made a proposal for an EU-wide greenhouse gas emissions trading system on 23 October 2001³⁶.

The aim of this proposal is to ensure that greenhouse gas emissions are reduced where it is most economically efficient to do so. An EU-wide emissions trading scheme will reduce the costs to the economy of cutting greenhouse gas emissions by about 35% by allowing the trading of allowances, so that operators who would incur high costs to achieve additional emissions reductions can instead buy allowances from operators who can meet their obligations at lower cost.

The European Parliament gave strong support to this proposal in its first reading, which was completed on 10 October 2002, and the Commission took account of a number of these amendments in its amended proposal of 27 November 2002³⁷.

The Council reached unanimous agreement on the amended proposal at its meeting of 9 December 2002. This agreement confirms the EU's continued political leadership in the area of climate change and the EU emissions trading scheme. The scheme will be the biggest scheme world-wide so far, potentially covering up to 30 countries in the period up to 2012, with participation of the EEA countries and in view of the forthcoming EU enlargement. The greenhouse gas emissions expected to be covered by the scheme are estimated to account for about 46% of the EU 15's total CO₂ emissions in 2010, and about 4,000 to 5,000 installations across the existing EU Member States will be affected.

The Directive is currently awaiting its second reading in the European Parliament and agreement between the EU institutions. It is hoped that it will be adopted by Council before the end of 2003.

5.3 Energy Supply

5.3.1 Directive on the promotion of electricity from renewable energy

The RES-E Directive 2001/77/EC is one of the key elements of the implementation of the 1997 White paper for a Community Strategy and Action Plan on renewable sources of energy, aimed at doubling (from 6% in 1995 to 12% in 2010) the contribution by renewable sources of energy to the European Union's gross inland energy consumption.

The aim is to promote an increase in the contribution of renewable energy sources to electricity production in the EU electricity market. An indicative target of a 22% share of RES electricity in 2010 (compared with 13.9% in 1997) has been agreed. The Directive contains a number of provisions, including obligations on Member States to adopt indicative targets, general conditions for MS support schemes, reporting on progress to the Commission, establishment of a system of guarantee of origin and rules to ensure (priority) grid access. The implementation of the Directive is expected to have an estimated emission reduction potential of 100-125Mt CO₂eq if the targets are achieved.

The RES-E Directive is currently being transposed into national law by Member States, who have until the end of October 2003 to do so. National indicative targets for the amount of electricity to be produced from renewable sources by 2010 have recently been agreed, both with existing member states and also the ten candidate countries who will join the EU in 2004.

In order to monitor closely the implementation and impact, the Directive also includes specific reporting obligations, both for the Member States and for the Commission. In

³⁶ COM (2001)581

³⁷ COM (2002)680

particular, the Commission will report by the end of October 2004 on the progress achieved towards the indicative targets. Before October 2005, the Commission will report on the application and effectiveness of national support schemes. This report will, if appropriate, be accompanied by a proposal for a Community framework for such support schemes.

5.3.2 Proposals for the promotion of biofuels in the transport sector

On 7th November 2001, the Commission adopted a package of measures relating to road transportation fuels³⁸ :

- a Communication on alternative fuels for road transportation and on a set of measures to promote the use of biofuels
- a Directive on the promotion of the use of biofuels for transport
- a Directive on the possibility of applying a reduced rate of excise duty on certain mineral oils containing biofuels and on biofuels

The proposed directives lay down targets (raising biofuels from a 2% proportion of all gasoline and diesel sold for transport purposes in 2005 to 5.75% in 2010) for the market penetration of biofuels in each Member State and enable the possibility of reductions in excise duties on biofuels.

The main barrier to wider use of biofuels in transport and the development of the biofuels industry is the current cost to the end-user of biofuels and their consequent lack of competitiveness against fossil fuels. The directive requires Member States to find ways of stimulating demand for and therefore attracting investment in the biofuels industry. This should in turn lead to an expansion in supply and a reduction in production costs through economies of scale and technical innovation.

If the target of increasing the share of biofuels used in transport to 5.75% by 2010 is reached then this suggests an overall annual saving by 2010 of around 17.5 Mtoe. Based on an approximate (life cycle) CO₂ saving of 2t CO₂/1000 litres of fuel, this corresponds to an annual CO₂ saving of 35-40 Mt CO₂eq, although the cost is relatively high at approximately €100/tonne saved.

The Council has adopted a Common Position following the European Parliament's first reading. The proposal will receive its second parliamentary reading early 2003.

5.3.3 Proposal for a Directive on Combined Heat and Power (CHP)

The overriding objective of this proposal is to create a framework which can support and facilitate the installation and proper functioning of electrical cogeneration plants, where a useful heat demand exists or is foreseen. This overall objective translates into two specific aims.

In the short term, a cogeneration Directive should serve as an instrument for consolidating existing and, where feasible, promote new high-efficiency cogeneration installations in the internal energy market. In order to create a level playing field, regulatory certainty and in some cases financial support are vital for cogeneration. This applies to the current transitional phase of the liberalisation process, where the internal energy market is not fully completed and where the internalisation of external costs is not reflected in energy prices.

In the medium to long-term, a cogeneration Directive should serve as a means to create the necessary framework that will ensure that high-efficiency cogeneration, alongside other environmentally friendly supply options, constitutes a key element when decisions on

³⁸ COM (2001) 547 final

investment in new production capacity are made. By creating a supportive framework, such cogeneration can contribute to the establishment of more diversified and energy-efficient supply systems in the Community.

The proposal covers the following main elements, which remove barriers for the successful expansion of CHP:

- Guarantee of origin of electricity produced from cogeneration (as a result of the “disclosure” requirements of Directives concerning common rules for the internal markets in electricity and natural gas);
- provisions obliging Member States to analyse the national potential for high-efficiency cogeneration and barriers to its realisation;
- provisions for national support schemes and evaluating the experiences gained from the application and coexistence of different support mechanisms for cogeneration used by Member States;
- provisions laying down the principles for the interaction between cogeneration producers and the electricity grid and also to facilitate grid access for cogeneration units using renewable energy sources and micro-cogeneration plants below 1 MW;
- provisions requiring Member States to evaluate current administrative procedures, with a view to reducing the administrative barriers to the development of cogeneration.

New high efficiency and well designed cogeneration installations planned on the basis of a relatively stable heat demand and operated for a reasonable amount of hours over the year are generally considered to be a cost-effective energy solution. Nevertheless, determining the costs-effectiveness of this proposal must necessarily be subject to many uncertainties and assumptions. In this context, a key issue is to define the reference case with which the cost-effectiveness of cogeneration is compared.

In the context of the European Climate Change Programme, reference was made to an estimated savings potential from a cogeneration Directive of 65Mt CO₂eq, at a cost below €50/t CO₂eq. This estimate corresponds to the 18% target share of CHP in electricity generation by 2010. However, it should be underlined that actual reductions are subject to uncertainties because the proposed Directive will leave the choice of implementation strategy and specific support mechanisms used up to the Member States. It should also be noted that these cost estimates are based on the assumption that the cogeneration used is gas, using combined cycle gas turbines with electrical efficiencies of 55%. In other words, this is the assumption that generates the most conservative estimates as to the cost-effectiveness of cogeneration. If other references were used, cogeneration would be more cost-effective.

The proposal was adopted by the Commission in July 2002 and is in co-decision process with the European Parliament and the Council. The first reading of the Parliament is expected to take place in the first quarter of 2003.

5.3.4 Initiative on the promotion of heat from renewable energy sources

Background and key data

The 1997 White paper for a Community Strategy and Action Plan on RES³⁹ proposed that the EU should aim to double (from 6% in 1995 to 12% in 2010) the proportion of energy

³⁹ COM (1997) 599 final

produced from renewable sources. So far, much of the effort to meet this renewables target has focussed on the promotion, including target setting, of renewable electricity (RES-E), as well as biofuels for the transport sector, (RES-T) (see above). Such measures have, until now, not been proposed for heating applications. However, bearing in mind that about 50% of primary energy use in Europe is dedicated to supplying heat for buildings and industrial applications, the White Paper indicated that the share of renewables in heating applications should also be substantially increased to meet the overall target.] The envisaged growth in heating applications is mainly to be realised through biomass (including biofuels and biogas derived from biomass and biodegradable waste), but there is also some potential for growth in solar thermal energy. Recent analysis regarding the expected trend in the share of renewables, taking into account the set targets for bio-fuels and RES-E, suggest that an additional 15-20 mtoe biomass for heating will be required to achieve the overall renewable target. This estimate is equivalent to a saving of approximately 36 to 48 MtCO₂eq⁴⁰.

Working Group 2 on Energy Supply recommended in the first phase of the ECCP that the Commission should consider launching an EU initiative to promote RES-H. The 2001 ECCP Communication indicated that the possibilities for a RES-H initiative would need to be elaborated further. This should be seen in the context that, within the Community strategy and action plan, a considerable number of legislative and other initiatives are being implemented that can apply to certain heating applications based on RES⁴¹.

New Studies and research in relation to RES-H

A consultancy study⁴² for the Commission focussed on looking at to what extent existing Directives, including those on RES-E, the Energy Performance of Buildings and CHP, adequately cover the promotion of RES-H. In general, the study concluded that this is partly the case. In addition, the actual incentive given in these specific directives is to a large extent dependent on how they are implemented by the Member States, for instance:

- In the energy performance of buildings directive: the extent to which integrated methodology and minimum standards promote the use of RES-H in buildings is to be defined by Member States' transposition.
- In the CHP proposal: the extent to which Member States' support schemes specifically promote the use of CHP based on renewable energy.

It was also mentioned that a proposal for an Energy Services Directive could also promote the supply of renewable (district) heat as a service product.

However, many other RES-H issues, such as target setting, rules for support schemes, monitoring and reporting, harmonisation of (environmental and other) standards for installations, and certification are not covered by existing Directives/proposals. Specific applications related to small-scale biomass, large-scale applications of biomass boilers in industry and waste heat from biomass power plants are not covered by any of the measures that are currently envisaged.

The study also indicated the large potential of RES-H in the new accession countries, both in terms of the supply side (availability of biomass and possibilities for diversification of the

⁴⁰ lower figure based on replacement of average fuel mix for space heating; higher value based on assumption that mainly oil, coal and electricity heating will be replaced by renewable applications

⁴¹ Communication on the implementation of the Community Strategy and Action Plan on Renewable energy sources (1998-2000), COM (2001) 69 final

⁴² Heat from Renewable Energy Sources, VHK consultants -

http://europa.eu.int/comm/environment/climat/renewable_energy_srcs_heat.pdf

rural economy) as well as the demand side (upgrading and conversion of wide-spread, but inefficient and polluting, district heating networks)⁴³.

The study recommended that a more comprehensive initiative on the promotion of RES-H could be pursued through a specific Communication or a Directive. A number of stakeholders commented on the report⁴⁴. Most respondents were supportive of an EU initiative to promote RES-H. The wood industry expressed concern that promotion of RES-H would reduce the availability of wood.

On the supply side, the ALTENER project ENER-IURE⁴⁵ recommended various measures to enhance the availability of agricultural and forestry biomass resources, as well as the need for increasing the harmonisation of technical, environmental and quality standards. A typical example is the proposed support scheme for energy crops, as part of the Commission proposals in the framework of the reform of the Common Agricultural Policy. In particular, the requirement to provide for a contract with the processing industry will support better tuning with demand and strengthen the supply chain. The proposal envisages a review of this support scheme by the end of 2006, which would provide an opportunity to develop such instruments further, also taking into account the context of the identified potential in the new accession countries and an assessment of possible negative environmental impacts.

In January 2003, the ALTENER BIOHEAT project 'Promoting biomass heating in large buildings and blocks'⁴⁶ was finalised. The report concludes that modern pellet and woodchip boilers provide heat at a level of comfort, efficiency and economics that make it a viable alternative to fossil fuels throughout Europe. The market penetration of RES-H is at very different levels in different Member States for various reasons, including the availability of renewable resources, government support (or lack of) or incentives, knowledge and experience of good practice and perceptions of biomass heating/other RES-H. The study indicated also the main elements needed for successful development of the bioheat market:

- remove the lack of information on state-of-the art technologies
- promote (demonstration) projects and disseminate best practice
- the development of an EU pellet market
- financial incentives to compensate for higher risk and transaction costs
- a harmonised set of emission standards for the installations
- standards on fuels and boiler quality
- training of professionals
- the creation of energy service companies

The study indicates an EU initiative would be necessary to underpin national policies. It gives four different options: (1) increased efforts within the Intelligent Energy for Europe Programme, (2) a Communication on a Community strategy for RES-H, (3) issuing a Directive on RES-H and (4) the integration of RES-H in the RES-E Directive.

Outlook : further steps on RES-H

The Commission plans to issue a Communication regarding the promotion of renewable energy sources in the EU and internationally in the near future. Success stories from regions of the Community show that practical leadership by local and regional authorities plays an important role in achieving a higher use of RES in this sector. The Commission does share the

⁴³ District heating is supplied to 22 million. people in the EU-15, or 6% of its population. A European Union, enlarged to 26 countries, would bring these figures up to 56 million., or 12% of the enlarged Union. (source: <http://www.euroheat.org>)

⁴⁴ Comments were received from the German Ministry of Environment, Inforse Europe, CEI-Bois, Flemish Department of Natural resources and Energy, and the Austrian Energy Agency

⁴⁵ ALTENER contract no. 4.1030/C/00-025/2000

⁴⁶ ALTENER contract no. 4.1030/Z/00-163/2000

concern about the low rate of growth in biomass and solar heating. In examining how to respond, measures at EU level need to tackle specifically those barriers that have an EU dimension, both at the demand and the supply side. In this respect, the following measures will be considered:

- Certification of biomass heating equipment on the basis of a harmonised set of emission standards, could help creating an internal EU market for such equipment, create economies of scale for producers, while preventing negative environmental impact on air quality
- Certification of biomass can facilitate trading between Member States and import from non-EU countries. Certification can cover both the certification of fuel characteristics and certification of origin and sustainability of biomass. The certification of biomass can be a valuable tool for support schemes.
- The envisaged Commission proposal on energy services provides opportunities to boost market development in this sector
- Member States are encouraged to take a pro-active approach to promote renewables within the implementation of the Directive on energy performance of buildings and a future directive on combined heat and power. On the basis of the progress in terms of implementation and adequacy of the existing legislative frameworks, the Commission will consider additional measures in future revisions of these instruments.
- Aim for a better integration of renewable energy policies in the structural and cohesion funds. In this respect, the conversion of existing district heating networks on accession countries offers a large potential.
- Further evaluate the implications of the EU's renewable energy targets for agriculture and forestry policy, also in the perspective of the review of the energy crops support scheme.

5.3.5 Inventory of Public Aid Granted to Different Energy Sources

The Green Paper “Towards a European strategy for the security of energy supply”⁴⁷ drew attention to the fact that it was unclear how much public aid was being provided to support the different sources of energy used in Europe. The Paper underlined the need to draw an inventory of all state aid to the European energy sector. In addition, the RES-E Directive requires the Commission to present a report indicating whether there is any discrimination between the support provided for different energy sources.

As a result, the Commission has published an “Inventory of public aid granted to different energy sources”⁴⁸, which includes details of both direct and indirect aid provided to the main energy sectors (coal, oil, nuclear, gas and renewables) by the EU and its member states and regions, as well as international public funding. The report shows that there are still difficulties in a number of areas in quantifying the exact level of aid provided to different sectors, but it does succeed in giving more transparency to the different sources of funding which are or were provided for the energy industry.

The report will be used as a basis for further in depth analyses, which will aim to identify, evaluate and control public aid. It will assist in ensuring that any public aid granted in future is consistent with the political priorities of the European Union, such as the promotion of renewable energy to help tackle climate change.

The report finds that large amounts of state aid (€6,3 billion in 2001) are still supporting coal production in Germany, Spain, France and the UK, but that this subsidising of the industry is being phased out in most of these countries. Oil receives much less support than coal,

⁴⁷ European Commission, December 2000

⁴⁸ European Commission, December 2002 -

http://europa.eu.int/comm/dgs/energy_transport/home/aids/doc/energy_inventory_en.pdf

although the oil industry does (like the coal industry) benefit from VAT reductions and exemptions from excise duty in some Member States.

Many different types of direct and indirect funding are now being used by the different Member States and the EC to support the renewable energy sector, such as direct price support schemes, capital investment, tax incentives for consumers and investment in research and development. For renewables, the level of support from both member states and EU-level funds, such as the European Regional Development Fund, the Common Agricultural Policy (CAP), the Sixth Framework Programme and Intelligent Energy for Europe, is increasing over the next few years.

While large sums in state aid were directed to the nuclear industry in the past, most of the aid and research investment now available is focussed on the management of radioactive waste and nuclear safety. However, although the amount spent on nuclear R&D has fallen significantly, €1.23 billion will still be spent on nuclear R&D under the 6th Framework Programme and \$942m was spent by the Member States on this in 1998. This is a significant proportion of some Member States' total R&D spending on energy. Finally, the natural gas industry has benefited from large-scale investment in transport/distribution infrastructure, including state subsidies, EU structural funding and EIB (European Investment Bank) loans. Member states have also used tax exemptions to encourage the growth in the gas industry.

5.3.6 Directives on the full liberalisation of the electricity and gas markets

Increased competition between different energy sources will favour flexible, less capital intensive and smaller scale production methods. This is expected to induce a shift from coal-based to gas-based power generation. In combination with the higher efficiency of gas fired power plants, this would lead to lower CO₂ emissions. In this respect, during the first phase of the ECCP, Working Group 2 estimated a potential for CO₂ reduction of approximately 80-120 Mt CO₂eq.

The ultimate effects of electricity liberalisation on greenhouse gas emissions will depend largely on the specific situation and reaction of market players in the newly competitive market place. Whilst bringing the benefits for consumers and the economy as a whole, liberalisation may also have an adverse impact on the innovation and investment rate in the sector, which may offset or postpone the expected shift. In addition, reduced prices for electricity and gas can spur energy demand and lead to increasing consumption. On the other hand, liberalisation creates opportunities for energy service companies to compete on the basis of bringing down customers' overall energy cost.

For a more precise estimate of the effects and the potential CO₂ reductions, it is necessary to further investigate these issues on the basis of detailed study, taking into account the perceived developments in the Member States.

5.4 Energy Demand

5.4.1 Introduction

The first phase of the ECCP had a strong focus on energy demand measures, which was also mirrored in several concrete measures within the action plan established by the ECCP Communication of October 2001. Considerable emission reduction potential through energy efficiency had been identified in the household, tertiary and industry sector; in many cases combined with good cost-efficiency due to the cost savings realised through improved energy efficiency. On the basis of the results of WG 3 on energy demand and the JSWG on

equipment and industrial processes, Annex I gives an overview of the emissions and emission reduction potential based on a “product and equipment” approach, totalling a technical potential of 430Mt CO₂eq.

In relation to the policy measures, it should be noted that the interplay of various measures (raising awareness, giving information, e.g. through labelling of equipment, setting minimum standards, defining best practices, promoting energy services,...) is in many cases decisive in improving energy efficiency in the field. Ideally, these measures work together towards the same scope: more energy efficient equipment and buildings, as well as a more energy-conscious behaviour of the user in buying and using these tools. In this respect, the role of national and regional authorities is key to develop a comprehensive strategy.

5.4.2 Directive on the Energy Performance of Buildings

The proposal was adopted by the Energy Council on 25 November 2002 and allows a transposition period of three years. Therefore the measures in the directive must come into force by 4 January 2006, although many Member States and Candidate Countries have already begun to prepare for national legislation.

The basic objective underlying this Directive is to promote the cost-effective improvement of the energy performance of new buildings, as well as larger existing buildings when they undergo major renovations. The proposal covers four main elements, including:

- an integrated methodology for calculating energy performance;
- the application of minimum standards based on this methodology;
- the certification of the energy performance of buildings when they are constructed, rented out or sold; and,
- the regular inspection of boilers and air conditioning systems.

The importance of the Directive in terms of energy and CO₂ savings is emphasised by the fact that 40,7 % of the energy consumption in the EU is used in the residential and tertiary sector. Space heating is by far the largest energy end-use of households in Member States (57%), followed by water heating (25%). For the tertiary sector, the importance of space heating and water heating is somewhat lower (52% and 9% respectively). If satisfactorily and fully implemented, the proposed Directive is expected to be able to reduce CO₂ emissions by around 220 Mt in total at a cost of less than €20/tonne of CO₂, of which 150Mt CO₂eq would be reduced at no or negative cost (i.e. a cost saving). The emission reduction potential by 2010 is estimated at 35-45Mtonnes/year.

5.4.3 Integrated Pollution Prevention and Control and energy efficiency

The IPPC Directive takes an integrated approach to pollution prevention and control in large industrial and agricultural (pig and poultry) installations. Operators and authorities should determine the measures that yield the best results for the environment as a whole.

In order to obtain IPPC permits, operators must demonstrate that their installations are using BAT (best available techniques) to control pollution, including in many cases emissions of greenhouse gases. The first phase of the ECCP made a clear recommendation to make better use of the directive in the context of climate change by using the permitting process to encourage those operators affected by IPPC to reduce their greenhouse gas emissions. Although the ECCP did not estimate explicitly the environmental effectiveness and costs, a

study performed for DG Environment on 'Energy Management and Optimisation in Industry' has indicated considerable cost-effective savings of up to 60-70Mt CO₂eq/year⁴⁹ for all manufacturing installations covered by IPPC, not including implementation of CHP⁵⁰.

The Commission is working to ensure that all Member States have transposed the Directive correctly and implement it fully. In the information exchange that the Commission organises between Member States, new accession countries, the industries covered by IPPC and NGO's on best available techniques, the Commission emphasises that both energy efficiency and emissions of non-CO₂ greenhouse gases (see chapter 4.6) need to be adequately addressed.

Work on developing the 'horizontal' BREF (best available techniques reference document) on energy efficiency techniques is to start in 2003. This will provide further information on generic, rather than industry-specific, techniques, which can be used to make production more efficient by reducing the demand for electricity and heat. The BREF will give Member State authorities guidance on best available techniques to improve energy efficiency..

The industries covered by the Commission proposal for a Directive on Emissions Trading (most of those requiring IPPC permits) will not be required to reduce their CO₂ emissions in order to receive an IPPC permit (although those not covered by the EC scheme may be required to demonstrate that they are using BAT in order obtain an IPPC permit). This is because this would impinge on the principles behind the emissions trading scheme of allowing participants to reduce emissions in the most cost-effective way. Nonetheless, processes giving rise to lower CO₂ emissions described in certain "vertical" (industry-specific) BREFs will be useful in providing guidance for companies wishing to reduce their CO₂ emissions so they can sell emission allowances and/or make the running of their business more cost effective. It is not possible to quantify reliably either the cost or emissions reduction potential of the BREF documents as these documents do not establish any mandatory standards. It has also been decided that policy makers, as well as the public, need better information about the amount of pollution that different installations are responsible for. Therefore, the Directive provides for the setting up of a European Pollutant Emission Register (EPER).

Also relevant to reducing energy demand through IPPC is the IMPEL (Implementation and Enforcement of Environmental Law) network's project on '*Energy Efficiency in Environmental Permits*'. The final report of December 2002 concludes that the practical implementation of the basic obligation to use energy efficiently is "very problematic". The main reasons identified in the project were lack of an explicit definition of energy efficiency, environmental authorities' lack of experience in regulating energy efficiency and limited technical guidance, for example in the BREF's. This shows that there is a need for Member States to increase their efforts to ensure that IPPC installations are operated in an energy efficient manner.

5.4.4 E2MAS: integration in EMAS

Energy-EMAS (E2MAS) will be a voluntary energy efficiency management scheme for companies and other organisations based on the EU Eco-Management and Audit Scheme (EMAS). Energy-EMAS will encourage best practice in energy efficiency and also address greenhouse gas emission targets.

Companies are often not fully aware of all the possibilities for improving energy efficiency or, even if they are aware of it, they do not gain much public visibility for their achievements. Energy efficiency improvements need more than just technological innovations, as important

⁴⁹ Based on study: energy management and optimisation in industry

⁵⁰ <http://europa.eu.int/comm/environment/ippc/index.htm> (under "IPPC related documents")

as they are. Comprehensive solutions should also include continuous and systematic evaluation of performance, the setting of targets and planning of relevant measures, employee involvement, a suitable procurement policy and communication with stakeholders. The Energy-EMAS guideline will target these areas and focus in particular on small and medium-sized enterprises by offering them a quality framework to improve continuously their energy efficiency. Specific issues include lighting and office equipment, heating and cooling systems, power generation, insulation and transport. The scheme would give companies additional public visibility by being able to use an Energy-EMAS logo and by including company names in a register at the EMAS website of the European Commission and/or national EMAS websites.

Reductions will heavily depend on the uptake of Energy-EMAS by the economic operators. If significant parts of economic sectors were to implement it, the reductions could be considerable, i.e. several percentage points in overall efficiency gains.

EMAS is already implemented in circa 4000 organisations and sites all over Europe, of which over 40% are small and medium-sized enterprises, representing over 2% of European industry in terms of people employed. The Commission promotes EMAS through conferences, awareness-raising campaigns, information material, a helpdesk and a user-friendly website. Once the EMAS-Energy guideline is adopted, suitable EMAS events and other means will be used to promote the guideline along with EMAS.

The first draft guidelines for E2MAS were presented to Member States and stakeholders in May 2002 at the EMAS Article 14 Committee. Further discussions then took place at the next Committee meeting in October 2002 with a view to including a greenhouse gas emission target for organisations in the guidelines. Technical work will be carried out in 2003/4 and adoption of the final version is planned for 2004.

5.4.5 Energy labelling: mandatory energy labels

Framework directive 92/75/EC on the energy labelling of household equipment prescribes that a comitology procedure should be used to adopt Commission Directives for the compulsory energy labelling of eight specific product groups. A label showing the energy performance of the model must be displayed on each appliance on sale, therefore encouraging the consumer to buy more energy efficient products. By 1999, Commission Directives for the energy labelling of refrigerators, freezers, washing machines, tumble dryers, dishwashers and lamps had been issued.

Annex I, based on the results of the ECCP JSWG on 'Energy efficiency and end-use equipment and industrial processes', shows that for white goods there will be a CO₂ reduction of 25MtCO₂ in the 2010 baseline with respect of 1990⁵¹, despite the increased demand for e.g. dishwashers and tumble dryers. Already, consumers are buying more efficient appliances as was shown by manufacturers in their input into the ECCP⁵². Industry analysis shows that this is mainly as a consequence of energy labelling and the related measures by Member States⁵³. Partitioning one third of the saving to restrictive measures at the lower end of the market (minimum standards, voluntary agreements), the CO₂ savings from Commission Directives issued before 1999 amount to 17MtCO₂. Taking out the negative effect of an increased market

⁵¹ Baseline means that no additional measures are introduced.

⁵² CECED Report on Energy Consumption of Domestic Appliances in European Households, CECED, 2001.

⁵³ CECED lecture by prof. Stamminger at Energy Plus workshop, HomeTech, Berlin, 2001.

Manufacturers showed that for refrigerators/freezers roughly two thirds of the savings were a consequence of energy labelling and rebate/promotion measures by Member States (which would not have been possible without the methodological framework and reference values of the label) and one third was due to the Minimum Standard

penetration of dishwashers and tumble driers, the contribution of existing energy labels is estimated at 20Mt CO₂eq.

To increase demand for energy efficient appliances, two further energy labelling directives have been adopted in 2002: Commission Directive 2002/31/EC on air conditioners, adopted in March 2002, and 2002/40/EC on electric ovens, adopted in May 2002. These directives will introduce compulsory energy labelling for domestic electric ovens and air conditioners. The efficiency of the air conditioners and ovens will be shown using a scale from A (very efficient) to G (inefficient). Member States were required to have implemented both directives by 1 January 2003. It is difficult to estimate the emission reductions which will result directly from the implementation of these directives, but, as the demand for air conditioners is increasing, reductions could be expected to be in the region of 1Mt CO₂/year at no or negative cost, once existing appliances have been replaced by more efficient ones.

In addition, based on the results of the ECCP JSWG, the revision of existing labelling directives (especially on refrigerators/freezers) has an additional potential of 10Mt CO₂eq. Preparations are on-going related to the introduction of a new labelling directive on water heaters, which has a potential of 15Mt CO₂eq.⁵⁴

5.4.6 Voluntary Agreements

Several recent EU strategic policy documents, such as the Green Paper on Security of Supply, the Communication on the ECCP, the Green Paper on Integrated Product Policy, and the Communication on environmental agreements, refer to voluntary agreements as a possible instrument.

Effectively, voluntary actions in the field of energy efficiency and CO₂-reduction exist since the mid-1990s. The overview below gives a selection of current voluntary actions:

- Voluntary Agreements (industry-wide (>70% coverage of EU) + quantitative targets):
 - Standby TV and VCR (EICTA, 1997); new targets are under consideration by the industry for colour televisions, including on-mode consumption
 - Washing machines (CECED, 1997); new targets are under consideration
 - Refrigerators, freezers and their combinations (CECED) A new self-commitment by the industry is considering the phasing out of the least efficient models
 - Detergents (incl. Energy saving consumer behaviour washing machines, AISE 1998)
 - Standby Audio (EICTA, 2000)
 - Dishwashers (CECED, 2000-2001)
- Codes of Conduct (for individual companies + quantitative targets):
 - Digital TV Services (2000)
 - External Power Supplies (2000)
- Voluntary Programmes (for individual companies + “best practice”)
 - GreenLight (non-residential lighting)
- Voluntary Energy Labelling:
 - EU Energy Star (for office equipment)
 - EU Environmental Product Declarations (ISO/TR 14025, Environmental Labels and Declarations – Type III environmental declarations)
- Eco-label: the granting of the Eco-label is subject to demanding energy efficiency levels

A rough estimate is that all the voluntary agreements and actions before 1999 contributed around 10Mt CO₂eq of emission reductions. Voluntary actions set up after that date could

⁵⁴ these figures are based on the results of the ECCP JSWG in Annex I, and using the two-third /one third rule for attribution of the potential to labelling and minimum standards respectively

contribute up to 20-25Mt CO₂eq of emission reductions, on condition that there is sufficient participation and the ambition level is kept in line with the technical possibilities.

5.4.7 Directive on the establishment of a framework for the eco-design of energy-using products

The Commission is currently preparing a Directive on the establishment of a framework for the eco-design of energy-using products, which would create the possibility to set, through subsequent implementing measures, minimum energy efficiency requirements for energy-using products. . The aim in relation to energy efficiency is to ensure a level of energy consumption/efficiency which is close to the minimum life-cycle cost for the end-user of the equipment.

If widely implemented (i.e. depending on the number of implementing measures eventually adopted), the Directive will tap into a total technical potential of 180Mt CO₂ reductions. The Commission plans to come forward with its proposal in 2003. Substantial savings are likely to be seen after the replacement of existing installed equipment, from about 2008.

5.4.8 Proposal for a Directive on Energy Services

The liberalisation of the electricity and gas market has improved the efficiency of energy production and distribution (on the supply side), and has led to increased competition based on the kWh price. However, competition in the supply of electricity only addresses half of the market for least-cost energy services. The other half is demand-side energy efficiency. Therefore, the market is not complete before full economic and environmental efficiency has been achieved through including the efficient use of energy on the demand side.

Since the first in-depth discussions of the ECCP WG3 and its initial announcement in the Communication regarding the implementation of the first phase of the ECCP, the Commission has further prepared and elaborated the proposal. Two SAVE-financed study were carried out and a major stakeholders meeting was held on 8 May 2002. Several bilateral discussions have also been carried out, as well as workshops and conferences on the subject. . A number of position papers on the proposals were received, analysed and taken into account.

As indicated above, this proposal is designed to remove barriers that prevent the satisfactory functioning of the market for goods and services related to the efficient end-use of energy. Member States will be encouraged to develop their own schemes to promote energy efficiency on the end-use side, with the involvement of energy suppliers and other actors, including installers of equipment. Possible instruments to do so include:

- the establishment of legal frameworks by Member States for measures such as performance contracting, third-party financing and other market-based financial initiatives;
- supportive frameworks for measuring, implementing and monitoring energy efficiency improvement targets established by Member States based on indicative (reference) values and adapted to national markets and to the internal market; including public sector obligations, and
- the establishment of energy efficiency funds for financing programmes for energy efficiency, carried out by or in close co-operation with utilities.

The Directive proposal will thus establish savings targets in terms of annual reductions in energy intensity of final demand. In addition, minimum levels of investment in energy

efficiency in the public sector, mainly through business-driven activities, is being considered. These investments augment the energy efficiency activities currently financed by public authorities. Regulations by Member States to allow cost recovery for investments in energy efficiency made by energy suppliers should be made possible, and where applicable, a innovative tariff structures will be encouraged. Member States will be provided with standardised definitions and evaluation methods for benchmarking energy efficiency and for monitoring and certification of energy savings and cost-effectiveness of the activities implemented.

If satisfactorily implemented, this Directive is expected to be able to reduce CO₂ emissions by some 40 to 55 Mt/year by 2010. Most of these reductions will be achieved using very cost-effective investments, i.e. involving no or negative overall costs, and the remaining initiatives will cost less than €20/t CO₂eq. The measures will have short payback periods and will therefore lead to cost savings for energy consumers. As there is profit to be made in providing these services, the directive will also benefit utilities, installers and other actors participating in this market.

The Commission intends to bring forward a proposal in the first half of 2003.

5.4.9 CTO-PAC on energy efficiency

The basic objective underlying this Campaign for take-off and public awareness campaign is to increase awareness among different groups of stakeholders of the fact that energy efficiency is the most immediate and cost-effective tool available to meet the EU Kyoto commitment. In this respect, the initiative is a supporting measure, aiming to facilitate the satisfactory implementation of legislative and non-legislative measures in the field of energy efficiency. The target groups for the campaign are the domestic and commercial sectors, including for small and medium-sized enterprises, as well as the public sector. Especially municipalities and local and regional authorities will be included in actions, as they are best placed to have an impact on the public at large.

Through information, indicative targets for efficiency, partnerships, databases, achievement awards, promotion of best practices and similar promotional measures, this supporting measure will add value to many on-going EU and Member State measures in the field not only of energy efficiency but also renewables. The inclusion of renewables is planned to coincide with the on-going campaign for take-off for renewables. The latter is scheduled to be completed at the end of 2003.

Two stakeholder meetings have been held in order to determine the terms of reference of the campaign as well as to discuss general policy considerations. The framework devised by ECCP WG3 has been used. Terms of reference have now been written and will be published as soon as funding is made available. Publication of the terms of reference should take place soon thereafter. Financing will be through the SAVE Programme in the Intelligent Energy-Europe Programme, expected to be approved by the European Parliament and Council in May 2003. The budget is expected to be €4-5 million for the period 2003 –2006. A committee will be formed to follow the Campaign, based partly on the stakeholder group established to develop the terms of reference.

5.4.10 Motor Challenge Programme

Electric motor driven systems used in industry and buildings account for up to 30% of all electricity consumed in the European Union. Technologies, techniques and skills exist on the market, which if adopted on a large scale, would result in major electricity savings and thus in reduced CO₂ emissions. Recent examples from the field have shown that between 30% and 50% of electricity used for pumps, compressor, fans, conveyors, lifts, etc. could be saved by

investing in energy-efficient motor systems. Such investments are usually profitable for the end-users, with a pay back time of less than three years. Only a proportion of the potential energy efficiency improvement can be achieved through policy actions (e.g. minimum efficiency requirements) on individual motor system equipment (e.g. motors, pumps, compressors, etc.), most of the savings are linked to the system design, operation and maintenance. In the first phase of the ECCP, an emission reduction potential of 30Mt CO₂eq was considered achievable in this sector.

The Motor Challenge Programme is a European Commission voluntary programme, open to all industrial companies, through which they are aided in improving the energy efficiency of their motor driven systems.

The Motor Challenge Programme objectives are:

- to show end-users the large energy efficiency potential available in motor systems, to help end-users to select the most appropriate and cost-effective ways of improving efficiency, and to indicate to end-users ways of getting technical assistance and financial aid (mainly through third party financing) for the energy efficiency actions;
- to make end-users aware of 'life cycle cost' when they are choosing industrial equipment, and in energy efficiency management tools (procurement, energy analysis and monitoring, etc.);
- to enlarge the market for energy efficient motor equipment, thus reducing its price and increasing the market acceptance of new technologies and techniques;
- to develop an energy service industry which could provide technical assistance and finance for energy efficiency projects in industry.

Participating companies commit to an Action Plan to identify and implement energy efficiency measures. The Partner company determines which production sites, and which types of systems, are covered by the commitment. Challenge Partners will receive aid, advice and technical assistance from the Commission and from participating National Energy Agencies (for the list of participating National Energy Agencies, look at the Motor Challenge Programme website: <http://energyefficiency.jrc.cec.eu.int/motorchallenge/index.htm>).

The Motor Challenge Programme Design Phase has been completed by a large consortium comprising stakeholders (all the motor system component manufacturer associations), energy experts (from the majority of Member States) and end-users. The Pilot Phase has also been completed in two companies in thirteen Member States. The results of the Pilot Phase are encouraging. The Motor Challenge Programme official launch was held in February 2003 in Brussels. About ten companies have already committed to the Motor Challenge Programme. It is expected that during 2003 a considerable number of companies will join the Programme, which is scheduled to last for a period of five years. The programme aims to gather enough test cases and information so that the energy savings achieved within Motor Challenge can be disseminated to, and replicated by, other companies and thus become a benchmark for best practice in energy management in this area.

5.4.11 Energy Efficient Public Procurement

Public procurement of energy-using equipment, including transport equipment, is a powerful tool for focusing large amounts of purchasing power on environmentally-friendly technology. Local, regional and national governments should use this purchasing power, thereby establishing leadership and creating best practice examples at the same time.

The EU public procurement Directives allow for the possibility of directing public procurement towards requiring high standards of energy efficiency. Following the 'Commission interpretative communication on the Community law applicable to public

procurement for integrating environmental considerations into public procurement'⁵⁵, the first phase of the ECCP envisaged the development of specific guidance on energy efficiency within a handbook on green public procurement, in order to exploit better its emission reduction potential. In addition, it announced that the need for additional legislative initiatives in the area of energy efficient public procurement would be considered.

The Practical Handbook on green public procurement is currently in preparation and a first draft should be available for public consultation by June 2003. In addition, the Commission is currently assessing the possibility of developing a legislative proposal. A possible Directive proposal on energy-efficient public purchasing would aim to direct the very large demand from the public sector for energy and energy-using equipment toward renewable energy sources and energy-efficient equipment, including transport equipment. A major SAVE-financed study ('PROUST': Public Procurement of Energy Saving Technologies in Europe) is nearing completion and will provide important input into the preparation of a possible proposal in the second half of 2003. Applying cost-effective criteria and minimised life-cycle costing, while adhering to current public procurement rules allowing environmental considerations to be addressed, this directive will result in an increased share of environmentally-friendly public procurement. Discussions are proceeding on using the Managenergy network of municipalities to pilot the initiative.

If satisfactorily implemented, a Directive is estimated to have an emission reduction potential of 25-45Mt CO₂eq, most of which comprises investments that cost less than 20€/tonne CO₂eq.

5.5 Transport

5.5.1 Community strategy on CO₂ and passenger cars

5.5.1.1 Introduction

The Commission is in the process of implementing the Community's strategy to reduce CO₂ emissions from passenger cars and improve fuel economy⁵⁶. It aims to achieve an average CO₂ emission figure for new passenger cars of 120g CO₂/km by 2005 (2010 at the latest). The starting point for the monitoring of the strategy is 1995. It is based on three main pillars:

1. Commitments made by the automobile industry on fuel economy improvements, aimed at achieving an average specific CO₂ emission figure for new passenger cars of 140g CO₂/km by 2008/9⁵⁷.
2. Fuel-economy labelling of cars⁵⁸, which aims to ensure that information relating to the fuel economy and CO₂ emissions of new passenger cars offered for sale or lease in the Community is made available to consumers in order to enable them to make an informed choice.
3. The promotion of the fuel efficiency of cars using fiscal measures.

5.5.1.2 The Monitoring of the Voluntary commitments with ACEA, JAMA and KAMA (reporting year 2001)

⁵⁵ COM (2001) 274 final

⁵⁶ Council conclusions of 25.6.1996

⁵⁷ In addition the associations will evaluate in 2003/4 the potential for additional fuel-efficiency improvements with the view to moving further towards the objective of 120 gCO₂/km by 2012

⁵⁸ Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO₂ emissions in respect of the marketing of new passenger cars

The third annual report on the effectiveness of the Community strategy to reduce CO₂ emissions from passenger cars⁵⁹ indicated that considering all measures, including those taken at national level, the average CO₂ emissions from passenger cars decreased in the period 1995 to 2001 from 186g CO₂/km to 167-170g CO₂/km⁶⁰ (-10%).

In order to meet the final target of 140g CO₂/km additional efforts are necessary as the average annual reduction rate of all three associations needs to be increased. On average the reduction rate must be around 2%, or about 4g CO₂/km per year. Over the reporting period 1995 to 2001, ACEA has achieved on average about 1,9% per year, JAMA 1.5% per year and KAMA 0.9% per year⁶¹. However, it was anticipated from the beginning that the average reduction rates would be higher in the later years.

5.5.1.3 Fiscal measures for passenger cars

The European Council and the European Parliament have adopted a target of reducing CO₂ emissions from new passenger cars to 120g/km by 2005, or by 2010 at the latest, in order to stabilize the total CO₂ emissions from road transport at a level of 3% above the emissions in 1995⁶². This target goes beyond the target of 140g CO₂/km provided for in the commitments of the car industry leaving a "gap" of 20g CO₂/km to cover. The car industry's commitment is to be achieved mainly through technical developments, and market changes linked to these developments. This leaves scope for further market changes to be brought about by the other instruments - in particular fiscal ones⁶³ - which are part of the Community strategy. The 20g CO₂/km "gap", mentioned above, which is equivalent to approximately 30 Mt CO₂, must be closed with the help of these other instruments and the Council has invited the Commission, on several occasions, to consider fiscal framework measures.

The Commission has, based on a study carried out by COWI⁶⁴, recently presented its position on fiscal measures in a Commission Communication⁶⁵, which is focusing on registration (RT) and annual circulation taxes (ACT). In the Commission's opinion, vehicle taxation needs to establish a more direct relationship between tax levels and the CO₂ performance of each new passenger car. Vehicle tax differentiation has been identified as an important parameter for improving the overall fuel-efficiency of new passenger cars. Existing vehicle taxes should be replaced by taxes fully based on CO₂ emissions or, alternatively, a CO₂-sensitive element should be added to existing RT and ACT. Add-on elements would also allow other national environmental objectives to be taken into account, e.g. the early introduction of EURO IV standards.

The Communication is spurring the discussion in the Council and the European Parliament regarding policies and options for future action in the field of passenger car taxation. In the

⁵⁹ COM (2002) 693 final

⁶⁰ the range takes into account all known potential uncertainties

⁶¹ All percentage figures based on the data as corrected by the associations. The final figures will be slightly lower

⁶² Communication from the Commission to the Council and the European Parliament: A Community Strategy to reduce CO₂ emissions from passenger cars and improve fuel economy, COM(95)689final.

⁶³ The COWI study showed that, under the given restrictive boundary conditions and by using fiscal measures in the most appropriate manner (i.e. applying CO₂ diversified vehicle taxes), it is not possible to attain the EU target of 120g CO₂/km for new cars by 2008-2010. Although it is possible to reduce the average CO₂ emissions of new passenger cars in the EU by about 5% (the reductions range between 3.3% and 8.5% according to the Member State concerned). An additional 5.5% average reduction would be necessary to achieve the target of 120 g CO₂/km by additional measures, e. g. fiscal measures going beyond the scenarios and conditions of the COWI study.

⁶⁴ COWI (2001): "Fiscal measures to reduce CO₂ emissions from new passenger cars." Final report of study contract ENV.D.3/ETU/2000/0027.

See http://europa.eu.int/comm/environment/co2/co2_home.htm

⁶⁵ COM(2002)431 final

light of the results of the consultation process, the Commission is preparing proposals for Community legislation – to be put forward in 2004 - on the restructuring and approximation of the ACT and RT tax bases, in order to make these taxes more CO₂ efficient and more consistent with the internal market.

5.5.1.4 Overall assessment

The implementation of the commitments by the car industry shows good progress. The “Joint Reports” show that ACEA and JAMA so far made significant progress, while KAMA has to increase its efforts significantly. In order to meet the final target of 140g CO₂/km, all three associations have to maintain or increase their efforts. The specific CO₂/km value achieved in the calendar year 2001 is in the range of about 167 to 170g CO₂/km, compared to 186g CO₂/km in 1995, the reference year for the strategy. It is quite unlikely that the target set out in the Community Strategy will be met as early as 2005. However, it remains realistic that the objective will be met by 2010 if the necessary measures are taken and all efforts are made. It seems clear that, to achieve the overall target, the implementation of all three pillars of the strategy will be necessary.

The recently published Commission Communication on passenger car taxation presents options for taxation schemes that can support the Community Strategy to reduce CO₂ emissions. In addition the results of the 2003⁶⁶ review of the potential for additional CO₂ reductions by the manufacturers' associations will be of great importance with a view to moving further towards the Community's objective of 120g CO₂/km by 2012.

5.5.2 Other transport measures

5.5.2.1 Infrastructure use and Charging

The Commission has been preparing a Communication relating to the use of economic instruments which will aim to ensure that users of the transport system pay according to true costs, including external costs, that their travel causes to society and therefore encouraging a modal shift back towards more sustainable forms of transport.

By encouraging travellers to use more environmentally-friendly transport, efficient charging would reduce congestion, accidents and environmental nuisances (pollution, noise, etc.), including CO₂ emissions. It could also raise additional revenue that could be used to finance improvement in public transport infrastructure. If widely implemented in all modes of transport and regions, charging could reduce road traffic by 5-15%. This would be translated into similar reductions in CO₂ emissions.

5.5.2.2 Fuel Taxation

At the moment there are three proposals to amend, modify and supplement the existing Community legislation on excise duties of mineral oil products under discussion in the Council:

1. Proposal for an amendment of the Directive on mineral oil excise duties to allow reduced rates or exemption of mineral oil excise duty for biofuels or the biofuel content of mixed fuels as compensation of higher production costs (COM(2001)547).
2. Proposal on Taxation of Energy Products (initial Commission proposal: COM(1997)30 final). On 20 March 2003, The ECOFIN Council agreed a political agreement on this proposal.
3. Proposal for a Council Directive amending Directive 92/81/EEC and Directive 92/82/EEC to introduce special tax arrangements for diesel fuel used for commercial

⁶⁶ 2003 for ACEA and JAMA, 2004 for KAMA

purposes and to align the excise duties on petrol and diesel fuel (COM/2002/0410 final).

5.5.2.3 Environmentally enhanced vehicles

The Commission has continued its work on introducing the concept of Enhanced Environmentally-friendly Vehicles (EEV) into the relevant type approval legislation for light duty vehicles (passenger cars and light commercial vehicles), so as to give an option to Member States to promote new vehicles that are performing beyond current or future (EURO IV) standards, while being compatible with the internal market. A concept already exists for heavy duty vehicles. A recently completed study proposes emission targets for conventional exhaust emissions, as well as a number of options for relative target values for relevant greenhouse gases. Early 2003, the Commission invited Member States to state their position. Based on these replies once they are available, the Commission services aim to be in a position to put forward an appropriate proposal.

5.5.2.4 Shifting balance between modes of transport

Modal shift from road and air to railways and waterways transport is promoted as a contribution to curbing the growth of greenhouse gas emissions from the transport sector. Several measures proposed in the White Paper on a common transport policy (COM (2001)370) have already been launched.

Revitalisation of railways

The Commission, on 23 January 2002, with a Communication Towards an integrated European railway area (COM (2002)18), has proposed five measures aiming at improving the market share of railways by better integration of the railways networks in Europe:

- Improving rail safety by a clear procedure for granting the safety certificates, which every railway company must obtain before it can run trains on the European network.
- Bolstering the fundamental principles of interoperability with a proposal on amending two existing directives 96/48 and 2001/16.
- Setting up an effective steering body, the European Railway Agency.
- Extending and speeding up opening of the rail freight market.
- Joining the Intergovernmental Organisation for International Carriage by Rail (OTIF).

Quality of port services

The Commission has proposed a Directive (COM(2002)101) on market access to port services in the seaports of the Member States open to general commercial traffic with a minimal annual volume of activity of 1.5 million tonnes of freight or 200.000 passengers. The measures are designed to ensure transparency in procedures for the selection of service providers will help to improve the quality of port services, reduce their cost and develop intermodal transport, which will in turn encourage use of maritime transport. The Council, in its meeting on 17 June 2002, adopted a common position.

Promotion of intermodal freight transport

The Commission, on 4 February 2002, has proposed a support programme for intermodal freight transport “Marco Polo”(COM(2002)54). The “Marco Polo” programme will provide Community funding to new international transport solutions, which offer a viable alternative to road freight transport. It should help shift the expected increase of international road freight of 12 billion tonne-kilometres per year, from congested roads to rail, short sea shipping and inland waterway transport by improving services and logistics of these environmentally more friendly modes. The Transport Council on 5 December 2002 reached a political agreement on

the MARCO POLO programme, which provides for a budget of 75 million euros for the period 2003-2006.

5.5.2.5 Commercial vehicles

After having forwarded to Council and European Parliament a proposal on the incorporation of light commercial vehicles into Directive 80/1268/EEC on the measurement of fuel consumption and CO₂ emissions, the Commission has initiated the work on measures to reduce the CO₂ emissions from this vehicle category. The final report of an assessment study has been submitted in February 2003 and will be discussed with national experts and stakeholders within the coming months. The study focuses on technical options to reduce emissions in a cost efficient manner. Based on the results of the study and the subsequent expert discussions the Commission service is aiming to put forward proposals for appropriate measures in the course of this year.

5.6 Industry : non CO₂ gases

5.6.1 IPPC & non-CO₂ greenhouse gases

Since the Communication on the first phase of the ECCP was published in October 2001, progress has been made in implementing the Integrated Pollution Prevention and Control (IPPC) Directive. To support the implementation, fifteen BREFs (best available techniques reference documents) have been produced and a further ten are currently being developed by expert working groups. Many of these BREFs cover techniques for reducing greenhouse gas emissions, including the planned horizontal BREF on energy efficiency (see section 4.3.3).

The BREFs will be particularly important in setting out BAT for the reduction of non-CO₂ greenhouse gases as, these gases will probably not fall within the scope of the EU emissions trading scheme before 2008. A number of the BREFs cover processes which emit greenhouse gases. For example, the following BREFs consider BAT to reduce these emissions:

- Large volume organic chemicals BREF – techniques to reduce N₂O emissions from adipic acid production;
- Non-ferrous metals BREF – techniques to reduce PFC emissions from aluminium production;
- Intensive livestock farming BREF – techniques to reduce N₂O and methane emissions from pig and poultry farming; and
- Refineries BREF – techniques to prevent fugitive methane emissions.

In some of these and other BREFs further research is needed into identifying BAT for reducing emissions of non-CO₂ greenhouse gases. Following this, more detailed coverage of these BAT will be included in the BREFs when they are revised. The revisions of the already finalised BREFs will begin in 2003.

In addition to this, the BREF on the production of ammonia, acids and fertilisers is currently being developed. This is expected to be finalised by the beginning of 2004 and to cover BAT to reduce N₂O emissions in nitric acid production. The working group for this BREF is currently looking at progress made by some European companies in reducing these emissions from nitric acid production through trials of abatement techniques.

Unfortunately, in many of the IPPC sectors where BAT to reduce non-CO₂ greenhouse gas emissions are being promoted, reliable data is not currently available on the potential emission reductions if the BAT are implemented. However, Member States are now required to maintain inventories of emissions data (including greenhouse gas emissions) from IPPC facilities and to report this to the Commission. The reported data will then be available in the European Pollutant Emission Register (EPER). Member States must submit their first report in June 2003 to cover emissions in 2001 (alternatively 2000 or 2002). This reporting should

make it easier in future to identify the processes and sectors where there is the most potential for further emission reductions from using BAT.

5.7 Waste

5.7.1 Introduction

In 2001, the study “*Waste management options and climate change*” assessed climate change impacts in terms of net fluxes of GHG emissions from various combinations of options used for the management of municipal solid waste (MSW). The executive summary and final report can be found at :

http://www.europa.eu.int/comm/environment/waste/studies/climate_change.htm

5.7.2 The Landfill Directive

In 1990 the waste sector accounted for 4% of EU greenhouse gas emissions, therefore making a significant contribution to the climate change problem. Methane emissions from the breakdown of biodegradable waste in landfills (which makes up the majority of greenhouse gas emissions from waste) have already been reduced by 22% from 137Mt CO₂eq in 1990 to 106Mt CO₂eq in 1999 thanks to domestic measures, already taken by member states and regions. However, further reductions can be achieved through the Landfill Directive.

The implementation of the Landfill Directive means that all new landfill sites must now have gas recovery facilities and such facilities will also need to be installed in all existing landfill sites by 2009. In addition, the amount of biodegradable municipal waste going to landfill must be reduced by 50% with respect to 1995 levels by 2009 and by 2016 it must be reduced by 65% from 1995 levels. This means that further reductions in methane emissions can be expected. It is estimated that the Landfill Directive and national initiatives will reduce the emissions to approximately 65MtCO₂eq by 2010 and to 28MtCO₂eq by 2020 (-109Mt CO₂eq, i.e. an 80% reduction with respect to 1990 levels).

5.7.3 The impact of recycling

The national strategies, prepared as a result of the Landfill Directive, will encourage the reduction, reuse, recycling, composting, mechanical biological treatment (MBT) and anaerobic digestion of waste. The aim of the strategies is to divert biodegradable waste away from landfill sites. In addition, many Member States/regions have considered how to reduce the landfilling of non-biodegradable waste e.g. through setting up/expanding and promoting doorstep collection services for recyclable waste. The End of Life Vehicles (ELV), Waste Electrical and Electronic Equipment (WEEE) and Packaging Directives will all also contribute to increasing the amount of material recovered and recycled and, as a result, will reduce greenhouse gas emissions. Recycling of waste has significant benefits with respect to primary production from virgin material extraction in terms of energy and GHG savings. Further measures to promote recycling of waste will be debated and planned in the Thematic Strategy on recycling of waste. This will begin in 2003 with a first Communication from the Commission and will address the benefits of increased recycling in terms of the further reduction of GHG emissions.

The table below gives an overview of the GHG emission benefits, based on a life cycle approach:

Produced material	CO ₂ savings (t CO ₂ eq/tonne of material produced)
Glass	0.26
Paper	0.9

Ferrous metals	1.5
PET	1.8
textiles	3.2
aluminium	9.1

Also, the RES-E Directive will encourage the diversion of biodegradable waste away from landfill. In order for the EU to reach its indicative target of 22% of electricity coming from renewable sources by 2010, Member States will want to increase the use of biodegradable waste for energy recovery, provided that the waste management hierarchy is not undermined.

The Commission is currently considering further measures to encourage the use of sewage sludge and biodegradable wastes as organic soil fertilisers, rather than landfilling or incinerating these wastes. This would consequently reduce the greenhouse gas emissions from landfill sites and incineration. The organic waste would also lead to an increase in the organic matter in the soil, increasing its fertility while promoting its role as a carbon sink. Such measures may be taken forward by amending the Sewage Sludge Directive and bringing forward an initiative to encourage the biological treatment of biodegradable waste. Such measures are expected to be proposed in 2003 and 2004 respectively.

In addition to end-of-pipe waste management processes, the prevention of waste generation and optimal use of resources can largely contribute to reducing GHG emissions as well as other environmental impacts. The thematic strategy on the Sustainable Use of Resources and the Integrated Product Policy will be important instruments for increasing the efficient use of resources and implementing waste prevention objectives.

5.8 Research: the Sixth Framework Programme

The Sixth Framework Programme⁶⁷ will run from 2002-2006 with a budget of €17.5 billion. A number of thematic strategies have sustainable development as a direct or indirect objective (e.g. global change, energy and transport) Much of the research carried out under the Sixth Framework Programme will have both environmental benefits and will promote innovation, therefore improving the cost-effectiveness of production processes and creating new market and employment opportunities.

Research will continue to contribute to our understanding of the climate change phenomena, prediction of future CO₂ concentration, assessment of impacts, adaptation techniques and mitigation measures. The carbon cycle and the mechanisms of natural sequestration (forests) will be explored further. Research on the storage of CO₂ from fossil fuels is a promising area, with decreasing costs of capture, both before and after combustion.

In the surface transport sphere, technologies for propulsion systems based on alternative and renewable fuels, in particular near-zero emission engines (including hybrid and fuel cell systems) are on the priority list for research and development, together with the development of non-polluting forms of transport in the urban environment. In the area of breakthrough technologies for energy production, hydrogen production, transport, storage, safety, and end-use coupled with enhancing the competitiveness, performance and reliability of fuel cells have the dominant place. In aeronautics, there are efforts to improve engine and airframe technologies and concepts that could lead to more 'environmentally-friendly' aircraft.

In the area of renewables, the degree of maturity of the various technologies varies considerably, from wind energy which is currently viable commercially, to more long term options such as photovoltaic, wave or ocean energy. Research is concentrated on a) developing cost-effective integrated approaches from sustainable biomass procurement to

⁶⁷ http://europa.eu.int/comm/research/fp6/index_en.html

efficient fuel production and use, b) reducing costs and improving efficiency and reliability of photovoltaics, and c) reducing costs and improving efficiency and reliability with industry taking an increasingly leading role in co-ordinating pan-European projects on wind, geothermal, ocean and solar energy.

In the industry sector, there is specific to life cycle analyses of products and processes. Information and Communication Technologies are also a source of considerable research: research on "e-Business" and resulting resource productivity gains; work organisation and innovations in workplace design for cutting work-related travel and making more efficient use of office facilities; and corporate governance.

ANNEX I:
**Basic data for the estimation of the total CO₂ emission reduction potential
in the residential, tertiary and industrial sector (product-based approach)**

Fuel-Related CO ₂ emissions 1990 (in MtCO ₂)				
Sector/function group	Residential	Tertiary	Industry	Total
Total	762	456	1031	2249
<i>of which</i>				
Spaceheating/cooling, of which	481	304	75	860
Fossil, of which	371	226	56	653
Transmission losses	190	116	29	334
-windows	75	46	11	132
-walls	55	34	8	97
-floors	30	18	5	53
-roofs	30	18	5	53
Ventilation losses	70	43	11	123
Heating system losses	111	68	17	195
Electric, of which	90	78	19	187
Heating (incl. heatpump)	73	33	8	114
Cooling (airconditioners)	2	32	8	42
CH pump	15	13	3	31
District heating	20	?	?	20
Hot water, of which	103	35	?	138
Fossil	67	24		91
Electric	36	11		47
Whitegoods & Cooking, of which	109	26		135
Fossil (mainly hobs)	9			
Electric, of which	100	26		126
Refrigeration/freezers	62	14		76
Washing machines	20			20
Dishwashers	7			7
Laundry driers	4			4
Electric ovens	7	12		19
Lighting (electr.)	40	65	16	121
Electronics, of which	16	14	4	34
Consumer el. (TV, audio, IRD, etc.)	15			
Stand-by	7			
On'	7			
IT/ office equipment	1			
Industrial Motors, of which			268	268
Variable speed drives (VSDs)			147	147
Pumps			67	67
Compressors			47	47
Fans			42	42
System opt.				
Other(electric)	13	12	108	133
Ind. process heat			560	560
Autogeneration	neg	neg	?	
Total (check)	762	456	1031	2249
<i>of which (by energy source)</i>				
Fossil	447	259	616	706
Electricity	295	206	415	501
Heat	20	?	?	20

Source: Composed by VHK 2002 on basis of European Climate Change Programme(ECCP) working group reports & docs JSWG and WG3 ('provisional analysis'), European Commission, 2001.

Residential sector: Comparison 1990-2010 baseline (BaU) by product/function

RESIDENTIAL SECTOR Sector/function group

Fuel-Related CO₂ emissions (in MtCO₂)

Sector/function group	Reference 1990	Baseline 2010	Reference 1990 minus Baseline 2010	Total
Total	762	797	-35	-5%
<i>of which</i>				
Spaceheating/cooling, of which	481	466	15	3%
Fossil, of which	371	350	21	6%
Transmission losses	190	186	4	2%
-windows	75	70	5	7%
-walls	55	55	0	0%
-floors	30	30	0	0%
-roofs	30	30	0	0%
Ventilation losses	70	73	-3	-4%
Heating system losses	111	91	20	18%
Electric, of which	90	88	2	2%
Heating (incl. heatpump)	73	68	5	7%
Cooling (airconditioners)	2	3	-1	-50%
CH pump	15	17	-2	-13%
District heating	20	28	-8	-40%
Hot water, of which	103	115	-12	-12%
Fossil	67	84	-17	-25%
Electric	36	31	5	14%
Whitegoods & Cooking, of which	109	84	25	23%
Fossil (mainly hobs)	9	9	0	0%
Electric, of which	100	75	25	25%
Refrigeration/freezers	62	43	19	31%
Washing machines	20	11	9	45%
Dishwashers	7	8	-1	-14%
Laundry driers	4	6	-2	-50%
Electric ovens	7	7	0	0%
Lighting (electr.)	40	50	-10	-25%
Electronics, of which	16	64	-48	-300%
Consumer el. (TV, audio, IRD, etc.)	15	35	-20	-133%
Stand-by	7	12	-5	-71%
On'	7	23	-16	-229%
IT/ office equipment	1	29	-28	-2800%
Other(electric)	18	18	0	0%
Autogeneration	0	0	0	
Total (check)	767	797	-30	-4%
<i>of which (by energy source)</i>				
Fossil	447	443	4	1%
Electricity	300	326	-26	-9%
Heat	20	28	-8	-40%

Source: Composed by VHK 2002 on basis of European Climate Change Programme (ECCP) working group reports & docs JSWG and WG3 ('provisional analysis'), European Commission, 2001.

Note: Conversion Electricity 1990: 1 TWh el. = 0.5 MtCO₂; 2010 1 TWh el. = 0.45 MtCO₂

RESIDENTIAL SECTOR
Sector/function group

Fuel-Related CO2 emissions (in MtCO2)

	Baseline 2010	ECCP 2010	Baseline 2010 minus ECCP 2010	Total
Total	797	618	179	22%
<i>of which</i>				
Spaceheating/cooling, of which	466	376	90	19%
Fossil, of which	350	264	86	25%
Transmission losses	186	153	33	18%
-windows	70	47	23	33%
-walls	55	50	5	9%
-floors	30	27	3	10%
-roofs	30	27	3	10%
Ventilation losses	73	71	2	3%
Heating system losses	91	40	51	56%
Electric, of which	88	72	16	18%
Heating (incl. heatpump)	68	56	12	18%
Cooling (airconditioners)	3	3	0	0%
CH pump	17	13	4	24%
District heating	28	40	-12	-43%
Hot water, of which	115	92	23	20%
Fossil	84	63	21	25%
Electric	31	29	2	6%
Whitegoods & Cooking, of which	84	70	14	17%
Fossil (mainly hobs)	9	7	2	22%
Electric, of which	75	63	12	16%
Refrigeration/freezers	43	36	7	16%
Washing machines	11	8	3	27%
Dishwashers	8	7	1	13%
Laundry driers	6	5	1	17%
Electric ovens	7	7	0	0%
Lighting (electr.)	50	38	12	24%
Electronics, of which	64	34	30	47%
Consumer el. (TV, audio, IRD, etc.)	35	20	15	43%
Stand-by	12	2	10	83%
On'	23	18	5	22%
IT/ office equipment	29	14	15	52%
Other(electric)	18	18	0	0%
Autogeneration	0	-10	10	
Total (check)	797	618	179	22%
<i>of which (by energy source)</i>				
Fossil	443	334	109	25%
Electricity	326	244	82	25%
Heat	28	40	-12	-43%

Source: Composed by VHK 2002 on basis of European Climate Change Programme (ECCP) working group reports & docs JSWG and WG3 ('provisional analysis'), European Commission, 2001.

Note: Conversion Electricity 1990: 1 TWh el. = 0.5 MtCO2; 2010 1 TWh el. = 0.45 MtCO2

	CO2 Emissions 1990	CO2 Emissions 1995	CO2 Emissions 2010BaU	CO2 Emissions policy scenario	CO2 Emissions Savings 1990/2010 policy scenario	CO2 Emissions Savings 2010BaU/ 2010 policy scenario
Residential equipment: - Electricity - Other fuels for heating and hot water ⁶⁸	307,30 438	309,10	325,10 434	255,06 327	52,2 111	70,40 107
Industrial equipment: - Electricity in motor systems ⁶⁹	278,30	284,1	305,78	239,50	38,80	66,28
Tertiary equipment: - Electricity - Other fuels for heating and hot water ⁷⁰	213,88	243,0	297,86	257,36	-43,48	40,50
Source : final report ECCP JSWG on energy efficiency in end-use equipment and industrial Processes						

**Total savings potential residential, tertiary and industrial sector:
2010 baseline vs. 2010 policy scenario:**

Saving potential baseline 2010 vs. 2010 policy scenario

	JSWG	Annex
Electricity Residential	70.4	82
Fossil fuel space/water heating Residential	107	109
Electricity Tertiary	40.5	40.5
Fossil fuel space/water heating Tertiary	65	65
Electricity Industry	66.3	66.3
Fossil fuel space heating Industry	14	14
Fossil fuel process heat Industry	60	60
total	423.2	436.8

⁶⁸ The ECCP WG 3 has analysed in details the consumption and policy actions related to buildings and in particular to the heating of buildings. The most important equipment for heating and water heating are boilers. A revision of the efficiency requirements (Directive 92/42) and a new labelling scheme for boilers could results in CO2 saving of about 35 Mt

⁶⁹ Electricity for other end-uses and other fuels are included in the process part

⁷⁰ There is a large degree of uncertainty about these figures and the potential savings WG 3 will provide some figures