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TO THE COUNCIL, THE EUROPEAN PARLIAMENT,
THE ECONOMIC AND SOCIAL COMMITTEE
AND THE COMMITTEE OF THE REGIONS

# Climate Change - The EU Approach for Kyoto

## 1. Introduction

On 3 March 1997 the EU Environment Council adopted a negotiating position on climate change that, *inter alia*, established a quantified emission reduction objective for inclusion in the Community's protocol proposal to the UN Framework Convention on Climate Change (UNFCCC). This proposal sets a 15% reduction of emissions for three greenhouse gases carbon dioxide ($CO_2$ ), methane, ($CH_4$), and nitrous oxide ($N_2O$ ) by 2010, individually or jointly, compared to 1990 for all industrialised countries that are parties to the Convention. At the 19/20 June Environment Council, Ministers also agreed to include in the EU's negotiating proposal an intermediate reduction objective of at least 7.5% for 2005. The EU position covers an average reduction for a basket of three greenhouse gases. At this stage no decision has been taken on specific targets for the three gases.

The EU position in the negotiations has been widely debated both inside the EU and at the international level, particularly among other industrialized countries. Reactions have varied widely from positive recognition of an ambitious policy to over sceptical questioning of the technical, economic or political feasibility of the targets and in some cases outright opposition.

This Communication seeks to place the EU negotiating position in an overall context and is designed to show both that it is technically feasible and that within a sound policy framework it is economically manageable to arrive at a reduction of greenhouse gas emissions of 15% by the year 2010 despite the underlying upward trend. The targets were agreed because of their environmental necessity and on the basis of studies showing that the targets are technically and economically feasible using in the main currently available technologies and practices. These targets are based on the assumption that other industrialised countries will make comparable commitments. It is also recognized that implementing the targets will be politically challenging.

The EU negotiation position covers a basket of three greenhouse gases. By far the most important of these is $CO_2$ , responsible for approximately 80 % of the impact when the gases are weighted according to their so-called "global warming potential". $CO_2$ emissions are also the most difficult to reduce since, unlike other emissions arising from fossil fuel use such as $NO_x$ and $SO_2$, there are as yet no end of pipe solutions for $CO_2$. Business-as-usual scenarios for $CH_4$ and $N_2O$ indicate a likely reduction of emissions and the possibility even for a significant reduction. This implies that a cost-effective reduction of the overall emission of the three gases might include a higher reduction of $CH_4$ and $N_2O$ emissions than 15 % and a lower reduction than 15 % for $CO_2$. However, because of the high relative weight of $CO_2$ it will still be necessary to achieve a reduction of $CO_2$ above 10% in order to meet a 15 % overall target.

For these reasons the focus of this Communication is on $CO_2$ emission reductions. The special circumstances concerning the other two gases are dealt with in chapter 6.

A Commission Staff Working Paper prepared in parallel with this Communication sets out a fuller technical and economic justification underlying the EU negotiation position and explains in greater detail where the necessary reductions in greenhouse gas emission

are expected to take place, the likely economic impact of the measures and the possible instruments to implement the policies. This paper also outlines a number of EU proposals already on the table which, when adopted, will facilitate limitations and reductions in greenhouse gas emissions.

This Communication examines the 2010 EU negotiating position which has been the focus of international debate and is also more important in a long-term climate strategy. It is essential to bear in mind that the core of any strategy to protect the global climate aims at a significant switch from the long-term trend for greenhouse gases to increase globally to a significant decrease. This requires action now with the benefits spread over a longer time frame.

## 2. Why is action necessary now?

The First Conference of the Parties to the Framework Convention on Climate Change, held in Berlin in April 1995, decided to initiate negotiations on the necessary commitments for industrialized countries to limit and reduce greenhouse gas emissions in the years after 2000. The EU was always a strong supporter of the Berlin Mandate. The Second Assessment Report from the Inter-governmental Panel on Climate Change ( IPCC), published early 1996, has confirmed the view, already held by the EU, that it is urgent to initiate the necessary changes in production and consumption patterns that will allow the long-term reduction of global greenhouse gas emissions necessary to meet the long term objective of the Climate Convention. The EU has recognised that failure to do so could have potentially damaging effects in the long-term since society needs to have a realistic timeframe for change to take place in an open and transparent way.

Whereas the negotiations on the Climate Convention in the early nineties were based on the precautionary principle (action may be needed even in the absence of the final proof of the damage), the Second Assessment Report goes a step further by acknowledging that the "balance of scientific evidence suggests that there is a discernible anthropogenic influence on the global climate". The global problems associated with climate change could have a substantial negative impact on global agricultural production and productivity, reduce biological diversity, lead to land loss and population displacement and increase a number of vector-borne diseases. The damages are likely to be proportionately more significant for the developing countries.

It is important to underline that the scientific evidence of climate change (including research reported in, or initiated after the second IPCC Second Assessment Report) indicates that unacceptable social, economic and ecological impacts could occur in the coming decades. This calls for a precautionary approach. Moreover, much of the expected negative impact of climate change is likely to occur in countries that have only marginally contributed to causing the problem and without the financial resources to compensate for any possible damage. If industrialised countries do not act now to mitigate climate change future generations will not only be confronted with the cost of climate change impacts but the economic costs associated with limiting emissions could be much greater since there will be less time to make the adjustment.

A particular reason to initiate early action on $CO_2$ emission reductions is the long lead time necessary before policy decisions show their full impact on the emissions. Many "traditional" environmental problems offer relatively fast end-of-pipeline solutions or modifications of existing technology: reducing $SO_2$ emissions, eliminating lead from gasoline or phasing out of CFC's. This is not the case for $CO_2$

Since $CO_2$ emissions are inherently linked to use of fossil fuels (coal, oil, gas) and since no economical removal technology exists as yet, the only way to reduce $CO_2$ emissions is through modification of structures, processes, equipment and behaviour which directly or indirectly use fossil fuels. Because of the very long lifetime of investments in the transport and energy sector and because of the relatively long lifetime of many energy consuming goods (cars, refrigerators, etc.) a $CO_2$ emission strategy will need a much longer horizon for implementation than for most other environmental problems.

As chapter 7 explains, early action by industrialised countries is also a prerequisite for limiting the growth in greenhouse gas emissions from developing countries. The latter is a development that is expected to be increasingly important in coming years.

## 3. Possibilities to reduce $CO_2$ emissions.

All $CO_2$ emission reduction possibilities have a cost impact and the more society is prepared to pay, the greater the range of reduction possibilities. In this Communication, among the actions to reduce greenhouse gas emissions either through investments incorporating existing efficient technologies or the application of new technical approaches and practices, only those that can be expected to be politically acceptable are considered. In this context such reduction possibilities must not be excessively costly and should not have unacceptable social and distributional effects. These emission reduction possibilities have been the subject of numerous studies in recent years and how to realise this potential has been an essential part of the preparations within the EU for the negotiations of a climate protocol.

For the analysis of the reduction possibilities in the various sectors of the EU economy the pre-Kyoto scenario in Table I is used as a reference. It assumes an 8% increase in total $CO_2$ emissions by 2010 compared to 1990 provided no additional new measures are taken.

Table I - Sectoral Distribution of $CO_2$ emissions in EU - Mtonnes

| Sector/year | 1990 | 2010 | % inc/dec |
|---|---|---|---|
| Transport | 743 | 1032 | + 39% |
| Industry | 626 | 532 | - 15% |
| Energy Industry | 141 | 158 | + 12% |
| Domestic/Tertiary | 654 | 680 | + 4% |
| Electricity/Heat Production | 1036 | 1057 | + 2% |
| **Total emissions** | **3200** | **3459** | **+ 8%** |

Source: Pre-Kyoto scenario based on Eurostat data (Excludes international marine bunkers but includes international air transport )

Table I shows that it will be important to address the transport sector where the inherent tendency to continuous strong growth will pose a challenge for the achievement of any emission reduction target. Table I shows a 39 % increase in $CO_2$ emissions from transport between 1990 and 2010, much of which will come from road and air transport. In this context, it should be noted that because energy prices to end-users in the transport sector are generally higher than elsewhere in the economy, targeted action aimed at removing existing market failures and inefficiencies in transport is required to significantly cut emissions at low costs.

The Council has already adopted a $CO_2$ emisson target which corresponds to an improvement in the average fuel economy of new cars in the market in the order of 30% by 2005, over today's average. Future fuel use is not fully taken into account at the moment of vehicle purchase. However, vehicle fuel economy can be improved at low cost with available technology. To this end, the Commission is currently discussing with the automobile industry the possibility of an effective and transparent environmental agreement in which the industry would commit itself to reducing the $CO_2$ emissions from cars. Other elements of the strategy are fiscal measures and fuel economy labelling to influence the vehicle market.

The uncompleted internal market in rail and the existing barriers to intermodal transport are other examples of transport inefficiencies whose removal would also imply low cost energy savings. The Commission has already proposed several measures to address these issues. For example, the liberalisation and revitalisation of the Community's railways is expected to bring down transport costs and enhance service quality in rail, thereby attracting traffic that currently goes by road. Similarly, the implementation of the action programme proposed by the Commission in its Communications on the Citizens' Network about Improving Public Transport and on Freight Intermodality should lead to a greater use being made of alternatives to road and air transport.

Finally, measures to improve transport pricing proposed by the Commission should enhance transport efficiency, both within and across modes.

Although it is clear that these policy approaches require significant adjustments in the transport system, their implementation would hold out the prospect of major environmental, transport and economic benefits. The Commission is establishing a report on a strategy for the reduction in the growth of $CO_2$ emissions from transport that will be adopted in the near future.

The industrial sector is characterized by very different energy intensity ratios and $CO_2$ emissions from one sub-sector to another. In general, the most energy intensive sectors, particularly those exposed to international competition, already pay close attention to energy efficiency for sound economic reasons, notably lower final energy prices ~~of~~ faced by international competitors. For other industrial sectors a number of market barriers together with the low world energy prices which have applied for more than 10 years have pushed the issue down the list of priorities. Even though direct industrial $CO_2$ emissions are becoming relatively less important in overall emissions there is evidence from several Member States that these can still be further reduced in most sectors. The Dutch experience of an approximately 2% annual increase in energy efficiency since

1990, achieved in the framework of negotiated agreements is particularly convincing in this context.

The role of the electricity sector in meeting the challenge of climate change is a key one. This is recognized by both the electricity supply industry, Member States' authorities and the Commission. The Commission's services have completed an in-depth review with Eurelectric and other stakeholders on electricity's contribution in achieving both sustainable development and greenhouse gas reductions. Developing energy services is recognised as fundamental to these objectives and this linked to improved supply technology, greater fuel switching and increased use of non-fossil fuels will lead to substantial reductions in emission levels.

Taken together reduction potential from the electricity sector reflects improved end-use efficiency thus reducing overall demand, and greater production efficiencies.

On the end-use side there are numerous ways to improve efficiencies, both in the industrial and in the domestic and tertiary sectors. Refrigerators, computers, TV's, washing machines, light bulbs are only a few examples where use of existing technology will allow the same level of service with much less energy consumption. Electric motors used extensively in industry can similarly be improved. The EU has already developed mandatory energy efficiency labeling scheme for the principal "white goods" and mandatory standards for refrigerators/freezers to improve efficiency. The Commission is now negotiating standards on a more extensive product range with the relevant industrial sectors.

Likewise on the supply side the overall thermal efficiency of exisiting fossil fuel power plants in the EU was around 38% in 1994 compared with new power plants that typically offer efficiencies of around or even above 50%. There is, therefore, some scope for reducing $CO_2$ emission through an accelerated closing of low efficiency old plants. Additional reductions will result from switching from coal to natural gas as planned in several Member States. Combined heat and power production could further add to the reduction possibilities. It is estimated that increasing co-generation's share of EU electricity production from the present level of 9 % to 18% in 2010 could save up to 150 Mtonnes of $CO_2$ .

The Commission's believes that doubling the share of renewables in the EU energy consumption from the present 6% of overall energy consumption to 12% in 2010 while being a challenge to the electricity industry is a realistic target. Windpower and increased use of biomass in electricity generation are the most competitive uses of renewables. Without at least half of the increase in renewables taking place in the electricity sector the 12% is not likely to be met. The experience from Denmark where installed wind power capacity is coming close to 1000MW and accounts for around 5 % of electricity consumption is a convincing example that the Commission's objective is not unrealistic. A recent Commission Green Paper has underlined that the realisation of this potential will require strong measures such as access of renewables to grid systems, obligations for renewable energies, increased payments for renewables and financial engineering in favour of renewables. A forthcoming White paper will set out the Commission's policy

direction for the future development of renewables, together with a comprehensive and detailed action plan. Publication is planned by the end of this year.

Most of the possibilities for reduction in emissions contained in the Commission Staff Working Paper have, at least in a qualitative way, been accepted for a number of years. It is equally true that in certain areas technological development has increased the potential or brought down the cost of a number of technical solutions to a more acceptable cost range.

It is however disappointing that the use of most available climate friendly technology has been modest. Low energy prices and expectations of this continuing is an important factor in explaining this. The fact that up-front investment is more important than long term overall cost for both industry and private consumers is another part of the explanation. The result is that despite the cost of different measures varying considerably there already exists a large amount of "no-cost" or "low-cost" possibilities to reduce greenhouse gas emissions.

*Conclusion:*

In conclusion, what part of this greenhouse gas emission technical reduction potential can be tapped depends on what levels of economic, social or political cost are deemed acceptable. Work carried out so far shows that it is possible to identify technical reduction possibilities for reducing $CO_2$ emissions of 800 Mtonnes. This would be sufficient to achieve a 15% reduction of $CO_2$ emissions by 2010 compared to 1990 instead of the 8% increase in this gas foreseen in the business-as-usual scenario in Table I. When implemented with the right mix of cost- effective policies, this technically feasible reduction potential can become both economically manageable and political acceptable.

Table II gives estimates of the potential $CO_2$ emission reductions possibilities for the main sectors in the EU. It is estimated that there are $CO_2$ emission reduction possibilities of around 300 Mtonnes in the power sector, 180 Mtonnes in transport, 200 Mtonnes from the end user sectors and 100 Mtonnes from renewables. The Commission underlines that these reductions in $CO_2$ emissions will be a challenge for the political decision makers. The quantities reflect the implementation of a series of policies and measures similar to the ones suggested in the following chapter. For each sub-sector, the reduction that is achievable depends on the detailed formulation of the measures.

The Commission Staff Working Paper sets out in more detail the measures that will have to be taken to achieve these $CO_2$ emission reduction possibilities.

Table II - Estimates of possible potential $CO_2$ emission reductions (Mtonnes $CO_2$) per sector in EU

| Sector | Emission Reduction Possibilities |
|---|---|
| Transport | |
| of which | 180 |
| - passenger car | 100 |
| - intermodal shift | 50 |
| - other measures | 30 |
| Industry | 100 |
| Energy Industry | 20 |
| Domestic/Tertiary | 100 |
| Renewables/Heat | 100 |
| Power generation | 300 |
| of which | |
| - fossil fuel switching | 50 |
| - cogeneration/ thermal efficiency | 150 |
| - renewables/electricity | 100 |
| TOTAL | 800 |

## 4. Elements for a Climate Change Strategy

A successful climate strategy needs to be comprehensive, cost-effective, technically and politically feasible and avoid negative social or regional side effects from the policy necessary to implement it. This Communication does not aim at prescribing such as strategy in detail but, attempts to outline the possible elements for a successful strategy. The development of a full strategy will only be possible when the result of Kyoto is known.

Any EU strategy while being effective in meeting the interim targets also needs to initiate a process of technological and behavioral changes that curbs the growing greenhouse gas emissions and sets them on a sustainable paths which will meet the requirement for continued reductions at and beyond 2010. That implies the need to address both the emission intensity of economic activities as well as the growth in demand for goods and services which trigger the increase in greenhouse gas emissions.

The choice of the right strategy with the right mixture of instruments is not only important from the technical or economic point of view, it is the core of the political challenge of making progress to protect the global climate. In the development of this strategy it will be necessary to ensure that the action is taken in the right way, - both to ensure a cost-effective strategy and to avoid negative social, equity or regional side effects from policy implementation.

The Commission is therefore convinced that a comprehensive strategy that brings all these elements together is a top priority. The Commission has already tabled a number of proposals including:

- the Communication - Energy Dimension of Climate Change[1] and the Council Conclusions on it in which the Council invites the Commission to come forward with an action programme in the energy sector to address climate change in the energy sector in the context of common and co-ordinated policy measures

- the extension of SAVE II to the year 2000 with a budget of 45 Mecu and a proposal for an ALTENER II programme

- a proposal for Rational Planning Techniques in the supply and demand cycle

- a Communication setting out a strategy for reducing $CO_2$ emissions from cars

- proposals, in the context of the Common transport policy, for the revitalisation and liberalisation of the railway sector and for European Rail Freight Freeways, in order to encourage the shift of freight from road to rail

- a proposal for a Council Directive to restructure the Community framework for the taxation of energy products (COM(97)30)

- a proposal for Fifth Framework Programme for RTD covering the period 1998 to 2002 for which an overall amount of 16.3 bn Ecu is proposed.

The Commission, however, is convinced that proposals on the table and in the pipeline are not sufficient to meet the targets proposed by the EU and depending on the outcome in Kyoto will make additional proposals that will reduce significantly $CO_2$ , some of which are already listed in the working programme, to complete the strategy that will allow the EU to meet its post-Kyoto commitments. Additional proposals could be:

- a proposal aimed at significantly increasing the share of renewable energies in the EU's energy consumption by 2010 along the lines spelled out in the Commission's recent Green Paper

- a proposal to increase significantly by 2010 the share of cogeneration - the production of electricity and heat - in the EU's electricity production

- a series of actions regarding standardization, harmonisation and liability to promote intermodal freight transport

- revision of the Trans-Europe Network guidelines to integrate strategic environmental considerations

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[1] Com (97) 196 final of 14.5.97

- proposals to significantly improve the overall thermal efficiency of power plants; increased penetration of co-generation would be a particular effective way to improve thermal efficiency.

In addition potential exists for developing a comprehensive approach to promote sustainable consumption patterns with a positive impact on climate policy goals. To facilitate such reorientation of consumer behaviour and choice, it is necessary to promote consumer awareness and to provide them with appropriate education, reliable information and advice.

A comprehensive strategy calls for the use of a broad range of **policy instruments.** Traditional regulatory measures will play a role in some cases (examples of regulation are, banning the use of HFC's for self chilling cans, higher efficiency standards for certain electrical equipment). However, in many areas more flexibility for economic sectors offers obvious advantages.

*Economic incentives* - positive as well as negative - are one way to secure a high level of flexibility and can often achieve an objective more rapidly and at a fraction of the cost of regulation.

In this context it is important to be aware that the use of *fiscal incentives* does not imply higher taxes overall. In areas already subject to taxation, incentives can be created through differentiation (as was done to promote lead-free gasoline). Switching the tax burden from labour to energy and carbon intensive production is a revenue-neutral possibility likely to reduce barriers and to increase the acceptance by the consumer of cost-effective technologies.

Some of the key challenges will be to identify and to implement policy measures that allow the exploitation of energy efficiency improvements in the existing stock of buildings and equipment.The social discount rate employed is the one used in public policy decisions. Private discount rates can of course be higher. For this reason measures are needed to bridge the gap between the social rate of return and the private rate of return used by business and commerce when they take their investment decisions.

There are also other *market based options* such as changes in the current structure of subsidies. The present trend for phasing out subsidies on energy products such as coal should be continued and accelerated where this brings benefits for emission reduction. At the same time using short-term and temporary subsidies to encourage renewables or clean technologies is an additional option available.

*Negotiated agreements* between public authorities and specific industrialized sectors. These offer, in principle, maximum flexibility for industry to act in a cost-effective way. The Commission has recently issued a Communication outlining the conditions under which Negotiated Agreements would be useful instruments.

*Technical options* used to achieve the EU emission reduction objectives up to 2010 are mainly based on existing technologies. The role of new technological research and development is limited for this time horizon. Additional efforts are needed to diminish the

cost of existing advanced technologies given that at present they are not always competitive.

Furthermore, *socio-economic research* is necessary, in order to understand better the barriers to the application of available technologies to realise emission reduction possibilities and organisational aspects of the integration of new technologies. The impacts of economic instruments both at the micro and sectoral levels and the condition for behavioural change (including consumption patterns) also need to be researched.

In relation to RTD, it is very important to underline the need for continued focused research that will assess the socio-economic and ecological impacts of climate change (especially at the regional level) and will develop the necessary technical solutions to reduce greenhouse gases beyond 2010 and to cope with possible adverse impacts. Such research efforts could also be an advantage for EU competitiveness and lead to improved opportunities for EU exporters of such technologies.

Above, many possibilities for reducing emissions in the EU have been identified. However, the implementation of measures to capture this potential and to reduce emissions, particularly above the normal rate of equipment replacement, is unlikely to take place in the absence of strong action. No one instrument will be sufficient for achieving the Community's emission target. It will require a combination of actions.

Any policy or strategy must, therefore ensure the broadest possible co-operation and acceptance of all stakeholders: governments, industry, trade unions and the public at large. Several sectors of society and several regions of Europe will have to cope with significant changes if an overall 15% reduction of greenhouse gas emissions in the EU is to be achieved over the next 13 years. Options that have a favourable benefit on employment and economic growth should be pursued.

While liberalization is generally conducive to higher efficiency it is less supportive of investments that pay off in the long-term rather than in the short-term. The globalization of capital markets have been followed by expectations from investors of rapid profits from invested capital. The profitability of the more cost-effective measures to reduce CO2 emissions, however, often need longer periods to pay back the investment. This is a problem that will have to be addressed politically as part of the implementation of any future strategy. Investors need the certainty of a firm commitment to reductions to persuade them to invest in cost-effective efficient measures.

Policies to break the growth trend in emissions will have to attack the problem from two sides. They will have to reduce the emission intensity of relevant economic activities, and they will have to curb growth in demand for goods and services triggering the emission of greenhouse gases. In consequence, the environmental success of any strategy will depend on these policies' ability to stimulate the necessary technological and behavioral changes. Their political, economic and social success will depend on their economic and distributional implications. To this end, a least-cost strategy, based on a multi-gas, cross-sectoral and multi-country approach, not yet developed in detail, should be pursued.

## 5. Economic Implications

Even a comprehensive strategy based on a least-cost approach is not costless but comes at a price. Production processes and products will have to be adjusted to become less polluting or fuel and energy consuming, new technologies will have to be developed, and the dissemination of existing cleaner technologies will have to be accelerated, the replacement of old and pollution intensive production facilities by more modern and environmentally friendly capital stock will have to be accelerated and consumption patterns and habits will have to be changed. All this entails costs: resource costs for developing and implementing new technologies, adjustment and distributional costs for adjusting to an altered framework for supply and demand and for different demand and supply dynamics and other welfare costs resulting from an interference in production and consumption decisions to limit greenhouse gas emissions. This will make the implementation of such a policy a challenging process.

However, most of the above cost components will at least partially be compensated for by cost savings: investing in a more fuel and energy intensive production process or product will lead to fuel and energy savings[2], reducing excessive use of fertilizers in agriculture will reduce input costs. Moreover, a reduction in the demand for polluting products and services frees financial resources for alternative uses. The wider emission-reducing technology is spread the more likely will it be that economies of scale come into play and substantially reduce mitigation and resource costs, potentially putting in place a virtuous circle. Most efforts will also have secondary benefits: reducing the use of fertilizers in agriculture will also be beneficial for the quality of groundwater; reducing demand for traffic services will also improve ambient air quality; reducing noise, congestion and accidents, or reducing fuel consumption will contribute to less acidification. It should be noted that the total environmental benefits that can result from avoided ecological damage of adverse climate impacts (with associated social and economic benefits) are difficult to calculate accurately. It is essential, however, that they are taken into consideration in the overall assessment.

*The costs:*

Estimating the net costs of a strategy to combat greenhouse gas emissions would require detailed and reliable information on mitigation costs, preferably at the individual enterprise level, for the whole economy, and across all relevant greenhouse gases. Moreover, the degree and effects of adjusting production and consumption patterns in line with the planned policy objectives would have to be quantified as would welfare costs resulting from interferences into production and consumption patterns. The same holds

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[2] Indeed, replacing an old coal-fired power plant by a plant based on combined cycle gas turbine production is normally a win-win situation for both the environment and the power generator, investing in a car with improved fuel efficiency comes at zero lifetime costs for the car-owner in Europe as long as the investment costs of the efficiency-improving technology are not too high.

for offsetting cost savings and side effects. Finally, the different cost components, including offsetting cost reductions and resource savings do not necessarily match over sectors, regions or in time. Typically, policy measures require substantial investment in mitigation technologies or changed demand patterns before resource cost savings, side benefits and the core benefits can be enjoyed. Also sectors and firms providing mitigation technologies or benefiting from changed consumption behaviour are not identical with those who have to invest in cleaner production.

This information is not yet available on a sufficiently detailed and broad scale. Nevertheless, there exist numerous efforts to quantify the overall costs connected to a policy aiming at a reduction in greenhouse gas emissions. These estimates are using bottom-up and top-down approaches, often based on partial information, simplified assumptions, and often reflecting only parts of the economy and economic effects. Notwithstanding these shortcomings, they give a first rough impression of the issues at stake, quantified in money terms.

For a 15% reduction in $CO_2$ emissions compared to 1990 estimates of the direct compliance costs related to energy supply/demand mitigation actions [3] range from around 15bn Ecu to about 35 bn Ecu annually by 2010. This corresponds to roughly 0.2 and 0.4 % of GDP in the year 2010. This estimate is based on $CO_2$ alone since adding methane and nitrous oxide is not expected to alter this drastically[4]. A cost-effective multi-gas strategy could even be somewhat less costly. The lower cost figure assumes that a part of the reduction can be achieved through zero or low net cost measures, i.e. resource costs related to the introduction of more efficient mitigation technologies are expected to be (almost) totally paid off through fuel and energy savings over the life cycle. The lower cost estimates are also based on the assumption that the political decision-making process manages to pursue the cost-effective solutions for reducing $CO_2$ emissions, i.e. to pursue those policies which allow the reduction target to be met at least costs. This requires that $CO_2$ is reduced by those quantities and in those countries and sectors where it can be done more cheaply.

Figure 1 depicts the annual direct compliance costs (in 2010) as a function of the emission reduction compared to 1990. A reduction of 15% compared to 1990, when effected in a least cost way, might cost between 15 bn and 30 bn Ecu, depending on the model. POLES estimates suggest costs of 30 bn Ecu (35 bn Ecu if the emissions are not based on the least-costs). Costs are high also because POLES assumes a 15% increase in $CO_2$ emissions compared to the 8% increase in emissions in the pre-Kyoto scenario. The results of PRIMES are only available for reductions of up to 12% in emissions. If these results are extrapolated to a 15% reduction in emissions a similar range of costs is obtained compared to other models .

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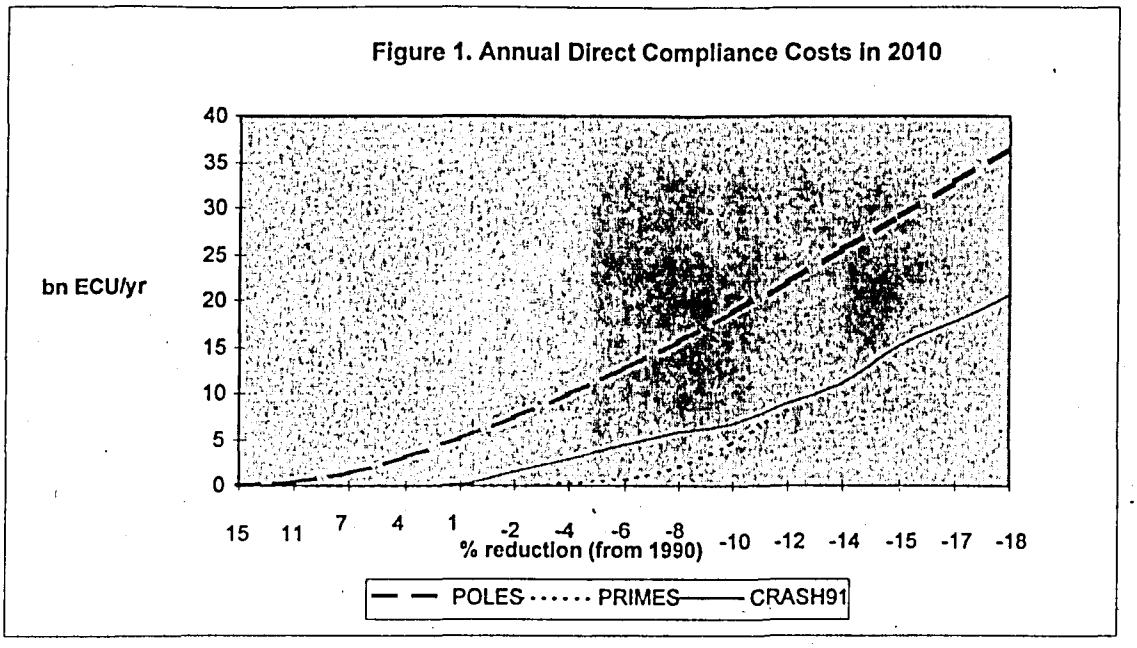
3 The Commission Staff Working Paper provides more details on this and the following.

4 The Commission Staff Working Paper provides more detail on this.




The estimates are assuming discount rates of 8%[5] and are based on existing technologies. New technologies and the exploitation of substantial economies of scale once there are prospects for fast growing markets for these technologies may reduce mitigation costs. Moreover, work under IPPC has recently confirmed that the possibility to apply Joint Implementation could significantly (up to 50%) reduce the overall cost figure. The Community has actively supported Joint Implementation in the protocol negotiations and there is evidence that a number of industrialized countries such as the Associated Countries, can offer relatively cheap $CO_2$ reduction potential.

Similarly, emission trading in principle offers scope for overall cost reduction. It is, however, important to make sure that an eventual emission trading system will be set up in such a way that it ensures that the overall reduction objectives are met.

The assessment of the macro-economic impact shows wider ranges. While the direct static effects, as a result of higher resource cost, are negative, the overall impact, when considering the traditional multiplier effects are much more difficult to predict and depend to a large extent on the policy package chosen. The Commission Staff Working Paper reports on different studies that have tried to assess overall costs. Not all studies have taken the 15 % reduction by 2010 as their basis. Estimates in available studies range from a positive impact on GDP of close to 1 % to a negative impact of up to 1.5 %. That implies that the absolute GDP level might be 1.5% lower with than without climate policy. These observations are in line with a recent report from World Resources Institute (WRI) and with the IPPC second assessment report. Positive impacts can occur if the

5 Poles and Primes results are based on a 8% discount rate and CRASH91 uses 5% to 8% ( depending on the country). These are discount rates that are usually applied for public policy decision making . Similar discount rate levels are used in AUTO-oil and the acidification strategy and recommended by international organisations such as the OECD. Private discount rates might of course be higher.

revenues or carbon/energy taxation (or the revenues from selling tradable permits) are used in a effective ways, such as reducing labour costs for employers or giving investment tax credits.

It is important to note that in spite of the uncertainty none of the cost figures are disturbingly high compared to the overall GDP, or compared to the expected 50 % growth in GDP between 1990 and 2010.

The underlying assumption for the EU policy on climate change is that other industrialized countries undertake comparable commitments to cut greenhouse gas emissions. With unilateral action in the EU alone, the changes in industrial structure and costs would be much larger. Energy-intensive industries would relocate to outside the EU. Moreover, energy consumption in the EU might fall but rise elsewhere (since global energy prices would fall). As a result carbon dioxide emissions in the rest of the world would increase (carbon leakage) which would partially undo the efforts of the EU to reduce global emissions.

*The benefits*:

The benefits of any climate strategy are difficult to quantify in monetary terms. This is especially so because of the global and inter-generational nature of the climate change issue. Further complications arise because of the difficulties of attaching money values to categories such as ecological preservation and human health impacts.

The benefits, both primary and secondary, of emission reduction are often less obvious and the cost estimates mentioned above neglect the positive economic primary and secondary benefits from reduced damage due to less air pollution. Estimates of the primary (climate) benefits depend on the assumptions made on discount rates, climate sensitivity, the reference point for the emissions and the weight attached to damage in developing countries. Accounting for all these factors suggests that the global benefits of a 15% reduction in $CO_2$ emissions in the EU would be between 0.3bn and 101 bn Ecu /yr.

These estimated benefits are for the world as a whole and only part of them will benefit the EU. The large range of estimates for the benefits mainly depends on the value attached to damage occuring in the distant future. If this value is very high (the discount rate is zero) damage in the future is worth as much as damage now. If the value is low (e.g. a discount rate of 10 %) the value of 100 Mecu of damages in 50 years ahead would be worth less than 1 MEcu now. The choice is basically political .

The above estimate does not yet reflect the avoided damage costs (secondary benefits) due to the reduction in other pollutants. The strategy would not only reduce greenhouse gases but would also reduce sulphur dioxide, nitrogen oxides sulphur and particulate emissions compared to current legislation by 15% to 25% if not more. The associated benefits (on mainly human health, agriculture and infrastructure damages) can be estimated to be at least 11bn to 32 bn Ecu. In addition, the reduction in $CO_2$ emissions

would also cut the annual compliance costs from the Commission's proposed acidification strategy by at least 4 bn Ecu each year.

The total (primary and secondary) benefits related to the reduction in greenhouse gases are difficult to express and quantify in monetary terms. Available estimates suggest that these might range from 15 to 137 bn Ecu per year. This estimate taken together with the direct compliance costs, would imply that the proposed emission reduction could on balance bring net benefits if one attaches a high value to damage in the far future.

Improving overall the allocation of resources, e.g. through a better restructuring of tax systems will tend to have, positive overall effects on employment. $CO_2$ emission reductions are often linked to the more labour intensive solutions, i.e. imported fuels could be replaced by domestically-produced mitigation technologies. Although this is difficult to quantify in general terms, it has to be an important element in the detailed elaboration of a climate change strategy after Kyoto.

Finally, it is necessary to emphasise the strong case for collective action, first and foremost by the industrialised countries. Unilateral action would imply that the EU would carry the full costs of the policy alone. At the same time other countries would benefit without having contributed to the solution. Coordinated action ensures that environmental costs and benefits for the EU would be better balanced. Joint action with other industrialized countries is therefore essential to overcome the imbalance that would be created by unilateral action and is the only way that the parties can arrive at an effective climate policy.

*Conclusion*

Although the overall costs might look to be relatively manageable at the aggregate level, costs could be substantially higher at the disaggregated level, e.g. for specific sectors and could have a significant impact on their international competitiveness if other industrialised countries do not take on comparable commitments. The extent to which the costs are politically and socially acceptable depends on the willingness of society to invest in a European policy that addresses global warming. This will crucially depend on the commitments of other industrialized countries described in chapter 7. Joint action is a condition for a proper balance of costs and benefits for all countries concerned.

Mitigation costs differ between economies, regions, sectors and firms, and also between greenhouse gases. These differences and the numerous leverage points and policy measures for reducing greenhouse gas emissions make the choice of the policy mix and the geographical coverage of a comprehensive climate policy a crucial issue. Policy makers should struggle for implementing a policy mix which achieves the aimed-at emission reduction at least cost. This holds both domestically and internationally. The more instruments and measures are available and the broader the geographical coverage the cheaper and the more politically acceptable a cost-effective strategy will turn out to be. Moreover, common and co-ordinated policies and measures could open a new and less costly vector of cost-effective policies, inter alia because it would make policies globally more environmental efficient, e.g. through limiting the risk of carbon leakage.

## 6. Other Greenhouse Gases

**Methane** is the second most important greenhouse gas in the EU basket. In 1990 agriculture accounted for 45 %, waste 32 % and energy 23 % of EU methane emissions. Calculations, referred to in the Commission's Communication on methane ( COM (96) 557), indicate that in 2010 compared to 1990 a reduction of methane emissions of up to 13% to 15% is feasible with current policies. A reduction of 40% over the same period is estimated to be the maximum technically feasible assuming that significant policy changes are made.

The costs of this extra 25% reduction of $CH_4$ ( from around 15% to around 40% ), equivalent to around 100 Mtonnes of $CO_2$, can be estimated at around 20 to 30 Ecu/tonne of $CO_2$ equivalent reduced which gives an annual cost of around 2bn Ecu to 3bn Ecu. However, this additional 25% methane reduction may allow $CO_2$ to be reduced by 12% instead of 15%. It should be noted that this additional 25% reduction assumes a 60% reduction of methane emissions in the waste sector and reductions of 34% in agriculture and energy . As far as agriculture is concerned, further analysis is required to ensure that only such measures are pursued that are technically feasible, politically acceptable and consistent with other policy objectives. It is therefore uncertain, how much of the reduction potential of methane above 15 % will actually take place.

Policy measures aiming at improved treatment of waste, methane recovery in new and existing landfills, best available recovery techniques in coal mines, minimising emissions in the production on-shore and off-shore of oil and natural gas and minimum leakage standards and more frequent control of gas pipelines need to be pursued. For agriculture, a better storage and treatment of animal manure is a promising option and there is a need for analysing how the Common Agriculture Policy (CAP) and Rural Development policies can assist such a development, for example, in the form of incentives or investment aid for covered manure storage combined with biogas utilisation, notably at larger intensive animal production units. Research into the possibilities for improved feeding of animals should also be encouraged in the Community's agricultural research programme.

Emissions of **Nitrous oxide**, $N_2O$, in 1990 amounted to 0.9 Mtonnes, equivalent to around 300 Mtonnes of $CO_2$ Reductions in $N_2O$ emissions from industry, in particular the nylon producing sector, which accounts for a third of total $N_2O$ emissions can lead to a reduction of 30% in $N_2O$ emissions in the year 2010. $N_2O$ emissions from energy use (power stations) are expected to remain stable up to 2010 since most new power plants are likely to be gas fired and the lower $N_2O$ emissions will more than offset growth in electricity production. $N_2O$ emissions from agriculture are estimated to fall due to reduced fertilizer use and this trend should be further assisted by enhancing the agricultural component of the CAP in the context of Agenda 2000 . The reductions in these sectors will more than offset increases from transport due to catalytic converters. Consequently, estimated reductions in $N_2O$ could be between 70 to 95 Mtonnes of $CO_2$ ( equivalent ).

The reduction of $N_2O$ ( 0.285 Mtonnes) could cost around 120 Ecu/ton of $N_2O$ or 0.36 Ecu/ton of $CO_2$ equivalent , in total 0.03 bn Ecu. As regards policy instruments, steps can be taken to ensure that as regards emissions from industry agreements cover all producers. In agriculture, increased support should be given to environmentally friendly farming practices, such as best practice in fertilizer use. In the energy sector intensified research to reduce $N_20$ emissions from fluidised bed combustion of fossil fuels needs to be pursued and improved catalytic technology is required in the transport sector.

## 7. All industrialized countries must be committed to comparable action

Implementing reductions in greenhouse gas emissions that will imply significant changes in production and consumption pattern, is not possible for individual countries or groups of countries such as the European Community. Many industries operate in an environment with increasing global competition where relatively small cost margins are important. More and more economic sectors compete for capital in a global market where short term profit is important. And several important industrial sectors in Europe have faced or are facing overcapacity that make changes difficult to achieve.

Experience with the implementation of the Climate Convention since Rio makes it evident that only in a global regime of shared responsibility and comparable commitment will it be possible to change the trend in emissions which is necessary. This is why the EU proposal is a negotiation position and not a unilateral commitment. It is based on the assumption that other industrialized countries must and can act in the same way and it is linked to the proposal to identify common and co-ordinated policies and measures to achieve the targets. It has been argued that agreed common and co-ordinated policies and measures will reduce the flexibility for parties to the protocol in implementing their commitments. The EU position is based on the belief that in some cases : global co-ordination of policies and measures makes it easier to pursue cost-effective solutions and it reduces the political resistance to take action that will easily be seen as applying to only some parties to the protocol.

It is important to underline that the potential for $CO_2$ emission reductions identified in the EU for achieving the proposed EU target by 2010 are available to other industrialized countries as well. Significant improvement in fuel efficiency in cars and electricity consumption in appliances can be achieved throughout the world. Higher performance of fossil fueled power plants or accelerating the use of renewables can also be achieved as well as improved energy efficiency in industry.

It is also clear that many of these measures can also apply in developing countries. There is reason to believe that even without legal commitment by developing countries, a significant carry-over effect is likely to be observed. Fuel efficiency of cars is basically decided by international producers based in Europe, US and Japan and cars exported to or produced in countries outside these countries will not continue with higher specific fuel consumption. The same will hold true in several other areas.

## 8. Developing Countries

The Climate Convention, as well as the Berlin Mandate, recognise that industrialised countries must take the lead in reducing greenhouse gas emissions. Industrialised countries emission accounted for 75 % of global emissions in the base year 1990 and on a per capita basis $CO_2$ emissions in industrialised countries are on average 10 times as high as in developing countries.

It is also generally true that the ongoing and expected development in developing countries is likely to lead in future to much higher emissions from these countries, although on a per capita basis most developing countries will remain well below emission levels in industrialised countries.

The answer to the challenge is three fold. The first answer is a reinforcement of the obligation on industrialised countries to act now. Only through political and technological leadership will it be possible to create a situation that will bring developing countries closer into the global process.

The second answer. Both greenhouse gas emissions and the economic capability to limit or reduce greenhouse gas emissions vary enormously among developing countries. It is important, therefore,that the more developed among the developing countries gradually assume bigger responsibilities when their level of development justifies it. There is no room for free riders on this issue. This reflects the fact that both greenhouse gas emissions and the economic capability to limit or reduce greenhouse gas emissions vary enormously among developing countries.

Finally, if the industrialised countries apply and develop technologies that have low greenhouse gas emissions in order to meet their emission reduction commitments many of these are also likely to be applied in the developing countries in reducing their emissions. The Commission recognises that to facilitate this technology transfer the Community will need to focus and to expand its technical and financial cooperation with the developing countries.

## 9. Conclusions

In conclusion the Commission underlines:

- that the potential future damage and cost resulting from anthropogenic climate change makes it imperative to urgently reduce greenhouse gas emissions

- that industrialised countries must continue to take the lead

- that the emission reduction targets are technically feasible and economically manageable in the EU only if all industrialised countries make comparable reduction efforts

- that many of the measures identified within this Communication for a cost-effective strategy, are equally applicable to other industrialised countries

- that the choice of the right mixture of instruments is essential for a cost-effective climate strategy.

- that given the political challenge and the need for action, the involvement of all parts of society will be needed.

- that the Commission will develop a more detailed Climate Change strategy after the emission reduction commitments have been agreed in Kyoto

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