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**The Kyoto Protocol: Current State and Implication
for EU-25 Member States.
A Focus on Agriculture and Forestry.**

*Please note the addendum to this report is available on the MEACAP website,
to reflect on more recent developments*

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1 Introduction¹

In the last few decades, international and global environmental issues have become an important concern of the international community. Among the variety of environmental challenges, climate change is often considered one of the most serious threats to the sustainability of the world socio-economic system. The first major political response to this problem was the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, which induced a process that led to the adoption of the Kyoto Protocol in 1997. This climate treaty established for the first time binding emission targets for industrialised countries and was welcomed as a landmark in international climate policy.

However, in March 2001, the US President, George W. Bush, announced that the US would not comply with the Kyoto Protocol in its present form. The remaining Annex B countries decided to continue the Kyoto process and reached a compromise on the climate treaty at the resumed 6th Conference of the Parties to the UNFCCC (COP-6bis) in Bonn, July 2001 and a subsequent deal signed at COP-7, the Marrakech Accords. By July 2004, the Kyoto Protocol had not yet achieved sufficient signatories to come into force. This situation is strongly linked to the US decision as it has changed the incentives of other countries to participate in the climate agreement, by modifying the costs and rendering the Kyoto Protocol's minimum participation rule increasingly binding: A precondition for the protocol to become enforced is that at least 55 Parties to the Convention, representing at the same time at least 55% of 1990 carbon dioxide emissions of Annex I Parties², must have ratified the treaty.

After the US withdrawal from the Kyoto Protocol in March 2001, the EU took the leadership in international climate-change control, negotiations supporting initiatives to continue the Kyoto process and to strengthen climate-change activities in general. In particular, with the adoption of the EU emissions trading scheme (EU ETS) in October 2003, the EU has laid the foundation for its strategy to reduce greenhouse gas (GHG) emissions and to meet the Kyoto Protocol targets. At the same time, the EU ETS framework was complemented by a host of additional initiatives, some of them still pending³.

The EU thus supports the international process on climate change control by focussing primarily on domestic/internal climate activities. However, while the EU and several other countries have reacted to the US decision by reinforcing their commitment to continue the Kyoto process, at the same time a number of other countries have decided to fall in line with the US position. In particular Russia, whose ratification is

¹ This paper presents and analyzes the situation in June 2004 that is prior to Russia's ratification of the Kyoto Protocol in November 2004 which puts the Treaty into force. The political and economic consequences of Russia's decision are examined in a specific Addendum to this paper. It has been decided to keep the two documents separate in order to show the evolution of the negotiation process and to highlight the sudden changes in the political situation.

² The Annex I countries are the industrialised countries that, as parties to the UNFCCC, have pledged to reduce their greenhouse gas emissions by the year 2000 to 1990 levels as per Article 4.2 of the Kyoto Protocol are listed in Annex I. Annex I Parties consist of countries belonging to the OECD, the Economies-in-Transition and Turkey.

³ These initiatives include the linking of Joint Implementation (JI) and the Clean Development Mechanisms (CDM) to the EU emissions trading framework, the so-called Linking Directive, the revision of the EC Monitoring Mechanism of Community CO₂ and other greenhouse gas emissions, the Regulation on fluorinated greenhouse gases and the Registry Regulation. The sectors not

indispensable to bring the Kyoto Protocol into force, has only very recently taken its final decision with regard to the ratification.

The core objectives of this paper are threefold:

Firstly we want to describe the present state of implementation of the Kyoto Protocol shedding some light on its complex bargaining processes and trying to understand what its future development could be.

Secondly we want to analyse the implications of the Kyoto Protocol, focussing in particular on the costs imposed on the EU economic system, particularly in the light of recent policy events: US withdrawal, Russia's evolving position, and the willingness of the European Union to stick to the Protocol.

Thirdly, we want to introduce the present role of the agricultural sector - with a specific focus on the EU25 - in the context of the Kyoto Protocol. Therefore, the contribution of the agricultural and forestry sector to the accumulation and storage of greenhouse gases will be discussed.

This paper will be subject to updates presented as addenda, to reflect on the developments on the Kyoto Protocol through the life of the MEACAP project.

2 An overview on recent developments in international climate policy

Let us start by providing a deeper insight in the development of the international Kyoto process, focussing thereby in particular on the role played by the European Union. In order to provide a comprehensive analysis, we will first discuss the characteristics and most important features of the Kyoto Protocol itself. Then we will examine the Protocol's state of ratification, highlighting the most important policy developments. Finally, in the light of this situation, we will analyse the costs incurred by the Kyoto Protocol in various policy scenarios.

2.1 The Kyoto Protocol

The Kyoto Protocol on the reduction of GHG emissions signed in Japan in 1997, constitutes one of the most important treaties in the field of environmental policies.

Summarising, the main components of the Kyoto Protocol are as follows:

1. ***Binding commitments for industrialised countries, exemption from reduction for developing countries.*** Covering a basket of six Greenhouse Gases⁴ (GHG), the Kyoto Protocol sets binding emissions reduction targets for industrialised countries and requires that by the year 2005 'demonstrable progress' must be made in achieving those targets.⁵ By 2012 the overall GHG emissions of industrialised countries should decline to an average 5.2 per cent below their 1990 levels. For the first time in history, industrialised countries accepted legally binding targets for emissions of a range of greenhouse gases. In addition, by signing the Protocol, industrialised countries appear to admit to bear the main responsibility for the prevailing concentration of greenhouse gases. Under the Protocol, economies in transition, including Russia and several states from the former Soviet Union, are allowed to catch up with their economic development after experiencing serious economic recession in the early 1990s before they must comply with strict targets. The choice of the base year of 1990 allows these countries to dispose of notably large amounts of emission credits due to their currently lower emission levels compared to 1990. Developing countries, including the large economies of India and China, were exempted from binding reduction targets under the Kyoto Protocol.
2. ***Flexibility Mechanisms.*** The Protocol also establishes a series of 'flexibility' measures, which enable countries to meet their targets by cooperating on emission reductions across country borders and by establishing carbon sinks such as certain forestry and land-use activities to soak up emissions. In

⁴ Carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulphur hexafluoride (SF₆).

⁵ According to the principle of common but differentiated responsibilities which has been set in the UNFCCC, the developing countries, including the large economies of India and China, were exempted from binding reduction targets in the first commitment period. Indeed, the per capita emissions of these countries are much lower than the industrialised countries' emissions and at the moment their priorities are rather centred on the maintenance of development than on environmental issues.

particular, the following three flexibility mechanisms are introduced: international emissions trading (IET, also referred to simply as ‘emissions trading’), joint implementation (JI) of GHG mitigation or sequestration projects between developed countries, and the Clean Development Mechanism (CDM) to set incentives for joint projects in abating GHG emissions between Annex I (developed country) and Non-Annex I (mostly developing country) Parties to the Convention. These mechanisms are meant to assist countries in meeting their emission targets in a flexible, cost-effective way.

3. **55% clause.** In addition, an entry-into-force provision was established: a precondition for the Protocol to enter into force is that at least 55 Parties to the Convention, representing at the same time at least 55 per cent of 1990 carbon dioxide emissions of Annex I Parties, must have ratified the treaty.

4. “Bubbles”. Emission limitations can be jointly managed through a ‘bubble’ or group of countries, which has to achieve the overall target of all its participating countries, with the possibility of distributing the burden within the bubble. The EU15 has formed such a bubble with an overall reduction target of – 8% with respect to 1990 emissions (see Table 1 below for individual Member States targets).

In the Kyoto Protocol, the targets, methods and timetables for global action against climate change were set. However, the precise rules were missing and left for further negotiations. The Kyoto Protocol thus left a lot of questions unresolved, with the common understanding that these challenging issues would require resolution through further negotiations. In particular, the rules for the flexible mechanisms still needed to be negotiated, the accounting for sinks and sources of GHGs from land-use changes and forestry had to be specified and questions regarding compliance issues, the funding mechanisms and capacity building in developing countries needed to be resolved.

The next section will analyse the crucial phases of the negotiation process on the Kyoto Protocol’s details. In particular, we will show that decisions to adhere or not to the Protocol by some key countries, as e.g. the US and Russia, are strongly influencing both the negotiation process and the cost-effectiveness implications of the treaty if it would be put eventually into force.

2.2 The Kyoto Protocol’s state of ratification

The negotiation process continuing from Kyoto (Conference of Parties n° 3 – COP-3) to the last 2003 COP-9 in Milan is very complex. Rich in technicalities, and dominated by contrasts in positions between but also within developing and developed countries, it is not always easy to follow. In attempt to provide a summary of this complicated history the following facts can be highlighted:

1. Recognised role of sinks lowering the total amount of emission reductions required to Annex I Countries. The COP-7 in Marrakech needed to become a success in order to support the Kyoto process after the failure at COP-6 and the withdrawal of the US. Therefore, the key countries that are required to satisfy the 55 per cent clause had a strong negotiation position and succeeded in further weakening their

contributions during the negotiations on the Marrakech Accords by focussing on the potential contribution to emission reductions achieved through sinks. For example, Russia managed to almost double its sinks allowances.

2. The increased participation of Developing Countries. Presently 34 developing countries have ratified the Protocol. Unluckily their commitment does not contribute enough to reach the threshold of 55% imposed on developed countries only. According to the principle of common but differentiated responsibilities which has been set in the UNFCCC, the developing countries were exempted from binding reduction targets in the first commitment period. Indeed, the per capita emissions of these countries are much lower than the industrialised countries' emissions and at the moment their priorities are rather centred on the maintenance of development than on environmental issues. Still, in order to find a successful long-term approach to climate change control, developing countries also need to be included. The ratification by 34 developing countries indicates their willingness to participate, showing that they are already becoming active.
3. The American withdrawal. In March 2001, the US decided not to participate in the Kyoto Protocol in its present form. Nonetheless, the remaining Annex B countries continued the process towards the ratification of the Treaty. However, the US defection has induced a number of serious environmental and economic problems, ranging from the deterioration of the environmental effectiveness of the Protocol to the increase in Russia's bargaining power.
4. The EU willingness to go alone. After the US withdrawal, the EU took the leadership in the Kyoto process. Their early ratification, the repeated announcement of "Kyoto as the only game in town" and the adoption of the internal EU emission trading scheme demonstrate their firm position to move ahead with the Kyoto Protocol.
5. The unclear position of Russia. The US withdrawal, as indicated above, has also changed the incentives for the remaining countries to participate in the climate agreement. In particular Russia's bargaining power has increased as it is now indispensable for enabling the Kyoto Protocol's entry-into-force. Indeed, Russia still continues to send contradictory signals about its climate strategy. Diplomatic efforts are ongoing in order to convince Russia to ratify the Kyoto Protocol (also shown by a recent deal between the EU and Russia to support Russia's accession to the WTO). More positive signals from Russia have been made in September.
6. Summarising 2, 3, 4 and 5 the current state of Kyoto is that a total of 123 countries, 34 of which are developing, ratified the Protocol. The Annex1 countries which have presently ratified, account for 44.2% of the total GHG emissions. The USA and Australia decided to opt out, while the position of the Russian Federation is still uncertain. Should Russia ratify (even without USA and Australia), the total of GHG emissions covered will rise to 61.6% putting the Treaty into force. Another advantage from Russia participation will be to lower the compliance cost, due to the large amount of emission permits injected into the emission trading market (see below).

BOX1

Kyoto Negotiation Process: Backstage.

In March 2001, the US President George W. Bush announced that the US would not comply with the Kyoto Protocol in its present form. Nonetheless, the remaining Annex B countries decided to continue the Kyoto process and reached a compromise on the climate treaty at the resumed 6th Conference of the Parties to the UNFCCC (COP-6*bis*) in Bonn, July 2001⁶. The outcome of the Bonn negotiations and the subsequent deal signed at COP-7, the Marrakech Accords, have been interpreted as a commitment to the approach embodied by the Kyoto Protocol. Indeed, notwithstanding numerous concessions to achieve this compromise, the Marrakech Accords to the Bonn Agreement were received as a milestone in international climate-change control due to the broad consensus on the important role of the Kyoto Protocol in serving as a precedent for multilateral action against climate change. In addition, the Marrakech Accords have politically opened up the path for the ratification of the Kyoto Protocol, thus initiating a crucial phase of climate policy.

Nevertheless, as of July 2004, the Kyoto Protocol has not yet achieved sufficient signatories to come into force. This situation is strongly linked to the US decision as it has rendered a crucial element of the Kyoto Protocol, the 55% clause, increasingly binding. After the US withdrawal, almost all the remaining industrialised countries must ratify the Protocol in order to reach the needed percentage. Due to their large share of 1990 emissions, Russia and Japan play a major role in this context, acquiring considerably greater bargaining power in the negotiations and thus different incentives to participate in climate policy⁷. The US decision has also changed the incentives of the other countries participating as is shown by the policy developments that we will discuss in the sequel to this paper.

After the US decided to defect from the Kyoto Protocol, the EU confirmed its new leadership role in international climate policy. This process has been induced by the events that occurred during the resumed COP-6 in Bonn, where the EU showed for the first time leadership and demonstrated that it is capable of setting the tone in international climate policy. One month after COP-7, in December 2001, the EU had already made some progress by compiling a “Draft Proposal for a Council Decision 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 fulfilment of commitments thereunder” (EC, 2001). The momentum towards ratification that has been induced by this process continued even before the World Summit on Sustainable Development in Johannesburg (September 2002). Indeed, the European Union announced the ratification of the Treaty on May 31st, 2002. As foreseen, since the US withdrawal, the EU has proceeded with Kyoto in order not to lose its positive image in international environmental policy. Furthermore, the EU made clear within the context of the 8th Conference of the Parties in New Delhi, that it considers Kyoto as “the only show in town”,

⁶ The Annex B of the Kyoto Protocol contains a list of countries taking on legally binding commitments along with a listing of their actual commitments as defined in the Kyoto Protocol.

⁷ A further important aspect with respect to Russia (and other Eastern European countries) concerns so-called “hot air”: since Russian economic activity has decreased during the 1990’s, so too did their carbon emissions concerns. Therefore, the emission limits set by the Kyoto Protocol imply excess emission rights which are commonly called “hot air”. Provisions in the Protocol allow the sale of these rights to countries which are searching for low-cost abatement options. Furthermore, they can also be “banked” for later periods.

urging other countries to participate and criticising again in particular the US for their refusal to ratify Kyoto (The Hindu, Oct. 24th, 2002).

In Japan, the decision-making process leading up to the ratification of the Kyoto Protocol met with a number of contradictory signals. In January 2002, The Japan Times reported that Japan was planning to ratify the Kyoto Protocol early in 2002 (The Japan Times, Jan. 21st, 2002)⁸. Despite these early promising signs, ratification was postponed several times due to internal problems, first to March 2002 and then to late Spring 2002. Widely divergent views held by two government ministries over climate change control strategies – in particular over domestic measures to be taken to meet the emission targets – and uncertainties over the plans of other key players, e.g. Canada and Australia, were the main reasons behind Japan's delayed ratification. Furthermore, although Japan did manage to achieve a number of concessions in Marrakech, business groups still were reluctant to support the Kyoto Protocol. They feared that the commitment to the Kyoto emission reduction targets could lead to a competitive disadvantage with respect to the US. However, despite these controversies, the Japanese Cabinet approved the Kyoto Protocol on June 4th, 2002.⁹

An important step forward in the Kyoto process was achieved at the UN World Summit on Sustainable Development (WSSD) held in Johannesburg from August 26th to September 4th, 2002¹⁰, where China announced it would ratify the Kyoto Protocol. Already in January 2002, China had expressed its favourable views on the Kyoto Protocol and surprised the world by calling it a “win-win deal for industrialised and poorer countries alike” and by pushing for the earliest possible enforcement of the Treaty (Planet Ark, Jan. 18th, 2002). This statement showed that China was getting serious not only about domestic environmental protection, but also about international cooperation to control climate change. China confirmed its willingness to participate in the Kyoto framework by approving the treaty on August 30th, 2002. Despite the lack of a reduction target for greenhouse gas emissions¹¹, Beijing's decision to ratify the Kyoto Protocol is generally considered as an important boost to the domestic and international fight against global warming (ABC Online, Sept. 3rd, 2002).

After China, on September 2nd, 2002, Canada's Prime Minister Jean Chrétien announced in Johannesburg that the Canadian Parliament would be asked to ratify the Kyoto Protocol by the end of 2002 (The Globe and Mail, Sept. 2nd, 2002). Notwithstanding some strong criticisms of the Prime Minister's strategy by Canadian provincial governments, Canada ratified the Kyoto Protocol on December 17th, 2002 (Toronto Star, Dec. 17th, 2002).

However, despite these positive signs, several other countries are still uncertain in their position on the Kyoto Protocol. In particular, Australia decided after the US defection to postpone its ratification of the climate treaty. In addition, Russia has also had (and still has) difficulties in deciding on a clear position with regard to the Kyoto Protocol. Given

⁸ Even if the ratification was postponed, on February 1st 2002 the government announced an anti-global warming bill in line with the Kyoto Protocol which would be implemented soon (Kyodo News, Feb. 1st, 2002).

⁹ Due to the strong links with the US economy, Japan is still particularly worried about the US plans on climate change control and there are signs that Japan plans to enhance its cooperation with the US on climate change control. Even before ratifying the Kyoto Protocol, Japan started preliminary talks with the US aimed at discussing how Japan and the US might cooperate to reduce GHG emissions (The Japan Times, Feb. 27th, 2002; Japan Today News, Feb. 27th, 2002). In early April 2002, government officials from Japan and the US agreed on 15 steps to prevent global warming (CO2e.com, April 5th, 2002). Although Japan finally decided to ratify the Kyoto Protocol, its parallel initiatives with the US and its efforts to convince other countries of the advantages and necessity to participate in the Kyoto agreement demonstrate that Japan is still dubious and concerned about the present climate regime. See, for example, Japan Today News, Jan. 19th, 2002 and Japan Today News, Feb. 27th, 2002; Japan Today News, June 4th, 2002.

¹⁰ For an overview on the key outcomes of the Johannesburg Summit see e.g., United Nations (2002).

¹¹ China has said it is open to exploring cooperation opportunities under the Kyoto agreement, in the short run and primarily with respect to financial and technical aid deals. Chinese officials emphasise that the government will voluntarily try to restrict the growth of CO2 emissions, but is strictly opposing binding GHG reduction targets (The Japan Times, Jan. 26th, 2002).

that Russia is indispensable for the Protocol's entry-into-force and that a possible Russian defection would imply a considerable increase in the abatement costs for the EU and Japan, Russia has obtained a greater bargaining power.¹² The increase in its bargaining power has motivated Russia to further exploit its strong negotiating position. As the outcome of COP-7 demonstrated, the need to induce Russia to participate in the agreement translated into various concessions to Russia, e.g. less stringent targets or increased flexibility (e.g. increased sinks allowances)¹³.

The change in Russia's incentive to participate is also proved by the continuous delay in the decision to ratify the Kyoto Protocol. Several contradictory statements have characterised the position of the Russian government on the time and conditions for Russia's ratification of the Kyoto Protocol. On April 22, 2003, the Russian Ministry of Economic Development and Trade concluded that the Kyoto Protocol would yield no economic benefits for Russia, hinting that Moscow has no economic grounds for ratifying the treaty and emphasising thereby the importance of economic incentives for Russia's decision on Kyoto.¹⁴ This was confirmed at the Climate Change Conference, held in Moscow from September 29th to October 3rd, 2003. President Putin's opening address explained that Russia's position had considerably changed during the last year. Putin said that Russia has not made a decision on whether to ratify the Kyoto Protocol and would not do so until it had finished studying the implications that ratification would have for the country, looking also at the benefits that could arise from global warming to a northern country like Russia: "The government is thoroughly considering and studying the entire complex of difficult problems linked with it. A decision will be made only after this work has been completed and it will be made in accordance with the national interest of the Russian Federation." (RFE/RL, Sept. 29th, 2003). The insistence that more research is needed seems to represent a further piece of Russia's strategic bargaining strategy, rather than indicating that it does not intend to ratify the Kyoto Protocol at all¹⁵. Indeed, initial negative signs at COP-9 in Milan by President Putin's chief adviser on economic issues Andrei Illarionov indicating that Russia would not ratify the Kyoto Protocol in its present form were immediately contradicted by the Russian Deputy Minister of Economy, Mukhamed Tsikhanov (see CNN News, Dec. 2nd, 2003). According to Tsikhanov, "there are no decisions about ratification apart from the fact that we are moving towards ratification." This is also because Russia's industry and NGOs both seem to be in favour of ratification¹⁶, as signalled by recent developments. After key Duma committees rejected the Kyoto Protocol, Russia's government and parliament looked to be headed for a collision as a major ministry spoke out in favour of the environmental treaty (Reuters, April 15th, 2004).¹⁷ The debate on Kyoto continues in Russia, as recent official announcements that Kyoto will be ratified in 2004 clearly indicate. Indeed, as the European Union agreed to back Russia's bid to join the World Trade Organization, but

¹² The reason for this uncertainty is closely linked to the US withdrawal: Following the drop-out of the world's largest source of demand for emission permits, the permit market is characterised by a much lower demand for and a much higher supply of permits. Consequently, the permit price decreases and thus countries like Russia face a different situation with respect to the sale of hot air: their revenues and profits become smaller. The loss of revenue for Russia induced by a lower permit price and above all by the reduced quantity of emission permits being exchanged is likely to lower total welfare in Russia and thus to reduce the benefits for Russia from participating in the climate agreement. Therefore, Russia has an incentive either to leave the Kyoto Protocol, or to renegotiate it in order to reduce its obligations and/or the costs of complying with these obligations.

¹³ Indeed, already Buchner, Carraro and Cersosimo (2002) indicated that Russia can exploit its increased bargaining power in two ways: (i) either by obtaining further economic incentives to participate in the Kyoto agreement; (ii) or by reducing the costs of participating in the Kyoto agreement through less stringent targets or increased flexibility (e.g. increased sinks allowances).

¹⁴ Japan Today, 22.4.2004 (<http://www.japantoday.com/e/?content=news&cat=1&id=257445>).

¹⁵ The link between Russian emission credits and the European emission trading system appears to play a key role vis-à-vis Russia's official position.

¹⁶ In particular, Russian industries see the potential benefits arising from joint projects where European countries invest in the introduction of cleaner technologies in Russian plants (see e.g. The International Herald Tribune, Oct. 28th, 2003).

¹⁷ The Ministry of Industry and Energy has prepared a report for President Putin that backs the Kyoto Protocol.

with no formal agreement on the Kyoto Protocol, Valdimir Putin said afterwards that he will speed up the process of ratifying the Kyoto Protocol (PointCarbon, May 21st, 2004).¹⁸

Summarising, notwithstanding the concessions obtained by the different countries, the Kyoto Protocol has not yet entered into force. As of April 15th, 2004, 123 countries have ratified the treaty, accounting for 44,2% of 1990 emissions¹⁹. The US, as indicated above, has adopted a domestic approach, changing thereby the incentives for the remaining countries to participate in the climate agreement²⁰. This situation can be especially seen by Russia whose bargaining power has increased as it is now indispensable for enabling the Kyoto Protocol's entry-into-force. Indeed, Russia still continues to send contradictory signals about its climate strategy, as at the last Conference of the Parties in Milan. Since this meeting, on an international scale few has happened. Diplomatic efforts are ongoing in order to convince Russia to ratify the Kyoto Protocol (also shown by the recent WTO deal), but at the same time the growing interest in the European Emissions Trading Scheme (EU ETS) demonstrates the trend for pursuing regional climate efforts. Indeed, the EU has clearly taken leadership in international climate policy, and preparations for the start of its internal emissions trading system in January 2005 are under way.

Future climate talks will need to tackle an issue which represented a key area of disagreement in New Delhi: the formal engagement by the parties on international climate-change control after the Kyoto Protocol's first commitment period. Post-2012 perspectives need to be discussed and compromises among the diverse countries have to be found. In this context, delegates at COP-10 in Buenos Aires, will have the difficult task of improving the relationship between industrialised and developing countries, which suffered a setback after COP-8. COP-9 has further highlighted the division between developed and developing countries, notwithstanding some progress visible in innovative approaches discussed in the side events. Still, communications between the EU and the developing countries require improvement, acknowledging that the question of equity needs to be tackled not only at the scientific, but also at the political level. Only after such a debate has been started seriously can a common base for negotiations between developed and developing countries on the future process of climate-change control be created. At the same time, given the difficulties of bringing the Kyoto Protocol into force, there are signs of a shift in the focus of the negotiations towards more promising, "real" issues. Indeed, the host of COP-10 (to be held Dec. 6-17 in Buenos Aires), Argentina, proposes discussing the creation of funds and mechanisms for "adapting" to the increasingly accelerated phenomenon of global warming. In particular, the suggestion to discuss the creation of "adaptation mechanisms" came from the Argentine Foreign Ministry's director of environmental affairs, Raúl Estrada Oyuela, who took part in the negotiations that led to the implementation of the Convention on Climate Change in 1994, and to the design of the Kyoto Protocol in 1997.

2.3 An analysis of the costs of the Kyoto Protocol: an EU focus.

¹⁸ Point Carbon, Russia and EU agree on WTO, Russia to speed up Kyoto: reports, May 21st, 2004.

¹⁹ For an update see <http://unfccc.int/resource/kpstats.pdf>

²⁰ Numerous recent studies converge in emphasising that without the US contribution no effective emission control can be achieved (see Buchner, Carraro and Cersosimo, 2002, for a summary of this literature). In particular, the US defection, in addition to a straightforward reduction of emission abatement, induces the following chain of reactions. The drop-out of the largest source of permit demands reduces the demand for GHG emission permits which implies a lower equilibrium price in the permit market. This lower price reduces the costs of complying with the Kyoto Protocol in the remaining Annex B countries, but it also lowers their total emission abatement through leakage effects²⁰. In addition, the incentives to undertake environmentally-friendly R&D and technological innovation are lowered. As consequence: (i) the environmental effectiveness of the Kyoto Protocol is strongly reduced; (ii) the incentives to abate emissions and invest in climate friendly technologies are substantially lowered in all countries, and (iii) the bargaining power of permit suppliers has considerably increased in climate negotiations.

Having made a strong commitment to comply anyway with its “bubble” commitment of an 8% cut with respect to 1990, the key issue for the EU25 seems to be how much this will cost. Whether or not the Kyoto Protocol will come into force appears now a secondary issue for EU countries. However, should it fail to become effective, huge changes in environmental policies cannot be excluded.

The key determinants of the final compliance costs are the reduction targets set at the country level, and the number and identity of the countries that eventually will participate in Kyoto (if it comes into force).

The targets, number and identity of ratifying countries all influence compliances cost and the possibility for flexibility mechanisms to operate.

2.3.1 The EU 25 and Kyoto Targets

Table 1 reports the current situation of Kyoto accomplishments for the EU 25 countries. Some observations are worth making: (a) Targets are differentiated across countries (third column), the tightest emission reductions are imposed to Luxembourg (-28%), Germany, Denmark (both -21%) and the UK (-12.5%). The loosest is that of Greece (+25%). (b) Interestingly, targets are not directly connected to the effective cost of compliance. In fact, considering the distance to target index (DTI, sixth column) indicating how far countries are from their commitment and accordingly how much they are likely to pay to fulfil their Kyoto requirements, it appears that some countries with high reduction requirements are also those that are likely to bear the lower costs (negative DTI). The most important of such cases are Germany and the UK. As is well known, the relatively easy task of Germany is due to the unification process; this induced a widespread rationalisation of the production system with important closures of obsolete, inefficient and high polluting plants in East Germany. The UK on its turn benefited from the process of the restructuring of the energy supply sector due to privatisation and the closure of local mines. On the other side, countries facing an apparently modest reduction commitment may experience high costs (positive DTI). A typical example is Italy which has a required reduction of -6.5% and a DTI of 10.50. This is because, due to its particularly severe taxation system on the energy sector, Italy has already gained a good degree of energy efficiency leading to a relatively low emission intensity with low cost alternatives already having been exploited, additional emission reduction can now be gained only at a relatively high cost. (c) Newcomers (former EU Accessing Countries), except Slovenia, present a negative DTI, while positive DTIs arise mainly for former EU 15 Countries. In general this indicates which countries might be most inclined to exploit some benefits from flexibility mechanisms within the EU25 as a whole.

TABLE 1: EU25 Kyoto Commitments

	2001 Historical GHG Emissions Without LUCF (Mt. CO2 eq.) (*)	Kyoto Target as % Reduction wrt 1990 GHG Emissions	Kyoto Target in Absolute Terms (Mt. CO2 eq.) (**)	2010 GHG Emission Projections With Existing Measures (Mt. CO2 eq.) (**)	Distance to Target in 2001 (%) (***)
Austria	84.145	-13	67.30	86.05	16.80
Belgium	148.836	-7.5	133.70	171.18	10.50
Denmark	68.952	-21	54.70	80.42	11.40
Finland	79.466	0	77.09	89.90	4.70
France	527.151	0	549.34	582.50	0.40
Germany	1067.497	-21	965.90	812.08	-6.80
Greece	127.685	25	131.11	147.21	9.80
Ireland	69.424	13	60.16	74.00	23.90
Italy	541.531	-6.5	486.74	540.10	10.70
Luxembourg	10.789	-28	7.85	na	-28.80
The Netherlands	214.783	-6	203.98	256.00	7.40
Portugal	83.754	27	82.49	95.20	21.60
Spain	377.030	15	240.26	307.40	23.80
Sweden	69.745	4	73.38	70.88	-5.50
United Kingdom	646.086	-12.5	649.69	630.67	-5.20
Cyprus	na	na	na	na	na
Czech Republic	146.718	-8	176.70	128.29	-18.60
Estonia	19.794	-8	40.02	18.86	-51.00
Hungary	73.134	-6	79.40	65.91	-14.40
Latvia	10.413	-8	25.58	12.81	-56.40
Lithuania	24.642	-8	na	na	-56.30
Malta	na	na	na	na	na
Poland	380.606	-6	435.27	394.00	-28.90
Slovakia	49.442	-8	67.10	53.19	-26.20
Slovenia	20.507	-8	18.57	22.15	6.00
TOTAL	4842.130		4626.33	4638.80	

(*) Based on 2001 values, except Lithuania (1998), Slovenia (1996); considering CO₂, CH₄ and N₂O only. Source: Our calculation based on UNFCCC: "Latest List of Greenhouse Gas Inventory Submission".

(**) Considering all six greenhouse gases. Transport and land use change and forestry not available. Source: FCCC-SBI-2003-7-Add.3, Table 4. GHG projections for Annex I Parties.

(***) The distance-to-target indicator (DTI) measures the percentage deviation of actual emissions in 2001 from a (hypothetical) linear path between base-year emissions and the target for 2010. Source: EEA (2003), "Greenhouse Gas Emissions Trends and Projections in Europe 2003 – Summary" Luxembourg: Office for Official Publications of the European Communities.

2.3.2 The role of Flexibility Mechanisms

The main message about a flexibility mechanism, whether it is Joint Implementation, Emissions Trading or the Clean Development Mechanism, is that countries' emission reductions are not confined within national geographical and, most importantly, technological borders, but can be accomplished where they are cheaper within certain rules. Countries in which emission reductions are costly, e.g. because of more environmentally

efficient production systems, are allowed to reduce emissions in less environmentally efficient countries, where this is relatively cheap and account this reduction as theirs. Alternatively, on the same rationale, they can buy “cheap” emission reductions from low abatement cost countries (again these are usually less environmentally efficient countries, but here also technology can play an important role), as long as they are less costly than domestic reduction. In these two ways (the first describing JI and CDM and the second ET) costs are minimised between countries with reciprocal gains for all parties.

The key point to highlight here is that these gains are induced by asymmetries between countries: that is, for flexibility to offer substantial cost savings it is necessary that the countries involved in flexibility projects have significantly different abatement costs. If countries were identical in this respect, no room for flexibility would be allowed.

This stresses the importance in a cost assessment of applying Kyoto to the EU of determining which countries will eventually participate: the highest cost savings opportunities will be offered by the joint participation of countries with different cost structures, that is, basically, developed and developing countries and/or countries with very different technologies and production systems.

Translating this to reality: the two possible extremes are represented by a full ratification of the Protocol by all the countries of the world (highly optimistic) or by a (pessimistic) agreement involving the EU alone. Within this range of possibilities lies the situation considering a protocol without USA and Russian participation.

Table 2 tries to put some figures to quantify Kyoto Protocol implementation costs at the extremes of this range, reporting results from a selected number of studies. All the studies demonstrate the cost reducing opportunities of flexibility mechanisms applied within Annex1 countries (ET and JI) or extended to all possible participatory countries (JI, CDM).

Table 2: Potential Costs of Kyoto Protocol as % of GDP (*)

	Domestic Action (no flexibility)		A1 Permits Trading		Global Permits Trading	
	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>
USA	-0.4	-2.0	-0.2	-0.5	-0.1	-0.2
JPN	-0.3	-0.9	0.0	-0.4	-0.01	-0.1
AUSTRALIA	-1.3	-1.8	-0.1	-0.7	-0.3	-0.3
EU15	-0.18	-0.90	-0.1	-0.4	-0.03	-0.2
CHN	-0.2	-0.2	0.15	-0.1	0.4	-0.6
IND	0.1	0.1	0.15	0.0	0.7	0.2
ROW	0.4	-0.4	0.4	0.15	-0.09	-0.2
Annex1	-0.5	-1.2	0.0	-0.3	0.0	-0.1

(*) Our adaptation following information reported in: Grubb and Vrolijk, 1999; Manne and Richels, 1999; McKibbin et al., 1999; Boeringher and Loeschel, 2002.

A1 = Annex 1 Countries

ROW = Rest of world

In general, costs appear to be quite low as a proportion of GDP. Focussing on the EU, the worst case is represented by domestic action without flexibility (second and third columns, approximating the EU acting alone) when costs amount roughly to -1% of GDP in 2010. If global emission trading is allowed, they are reduced to 0.2% or to 0.03% of GDP (sixth and seventh columns). Of course asymmetries within the EU are not revealed in this table and in some cases costs can vary considerably from this average value. By the same token, the distribution of the cost burden between economic sectors is not apparent either. It is a common view that the most heavily penalised will be the energy and heavy industry sectors.

As can be expected, the role of the USA and the former Soviet Union (FSU) during the first commitment period (2008-2012), appears particularly strategic. This is especially so from an EU perspective. Given the objective difficulty of establishing by the first commitment period both extensive JI projects and a well functioning CDM market with developing countries, the scope for using flexibility mechanisms to reduce costs is confined principally to ET i.e. flexibility among Annex 1 countries.

The US withdrawal has both negative and positive consequences. The negative consequences are obviously perceived from the environmental point of view and are related to the lowered effectiveness of the Protocol, which does not involve one of the largest emitters. There are, however also positive consequences in terms of reduced compliance costs, for the countries that decide to comply with the Protocol. Indeed the US were considered one of the major source of demand of permits in the emission trading market. With the US out of the system, emission permit price is likely to decrease offering to the potential buyers, the EU in particular, "cheap" opportunity for emission reduction. This outcome is supported by different studies, a selection of which is presented in Table 3.

**Table 3. Implications of the U.S. withdrawal from the Kyoto Protocol.
Changes in estimated compliance costs in 2010 for Annex 1 Countries.**

Study	Total compliance costs ¹		
	Kyoto Protocol	KP plus sinks	KP plus other provisions
Hagem and Holtmark (2001)	Almost no cost	-	-
Kemfert (2001)	Almost no cost	-	-
Eyckmans et al. (2001)	Almost no cost	-	CPR + ceilings: + 31%
Den Elzen and Manders (2001)	- 87.5%	- 92.5%	-
Böhringer (2001)	- 96.7%	- 100%	With 60% banking: - 50%
Manne and Richels (2001) ²	-	-	Sinks + banking: small variat.
Den Elzen and de Moor (2001)	- 81.6%	- 89.5%	50% banking: - 72.1%
Böhringer and Löscher (2001)	-	Perfect competition: - 100%; Monopolistic supply: - 72.3%	-
Buchner et al. (2002)	- 66.76%	-	-
Den Elzen and de Moor (2002)	- 81.6%	-	Marrakech: - 92.1%
Löscher and Zhang (2002)	-	Perfect competition: - 100%; Monopolistic supply: - 72.7%	Sinks + cartel: - 37,7% Sinks + Nash: - 66,2%

¹ Percentage changes are computed with respect to the values of permit price and compliance costs in the case in which the US is assumed to comply with the Kyoto Protocol.

² This paper assumes that the US will start complying with its Kyoto emissions constraint in 2020.

As can be seen, US withdrawal is estimated to have a dramatic influence, reducing Annex 1 country costs of the Kyoto Protocol in a range of – 67% to - 100% (second column). Additional cost reductions are attainable by exploiting the potential of sinks (third column). Finally, other flexibility options, such as those provided by the possibility of banking permits, offer different cost reduction opportunities.

A hypothetical Russian withdrawal could have two consequences. The first is political: as things are now, without Russia, the 55% clause could not be fulfilled. Thus the Kyoto Protocol could not come into force and possibly a new international architecture for GHG reductions would have to be built. The second is economic, presenting exactly the opposite implication of the US withdrawal. Supposing the EU decided to

go alone, the absence of a strong seller of permits willing to offer low cost abatement would strongly reduce the cost reduction potential provided by flexibility.

Data presented in Table 2 can provide a “rough” indication on the potential role played by Russia. This can be seen in particular when comparing the difference between the “domestic action” case in which the different groups of countries act alone to meet their Kyoto targets (approximating “Russia out”), and the “Annex 1 permit trading” case in which emission trading is allowed (approximating “Russia in”).

Two important qualifications of results in table 2 are in order:

- 1) all the studies reported assume USA participation.
- 2) They assume that the seller of permits is the FSU Block in which Russia accounts for 63% of total supply (Ukraine 17% and all the remaining FSU countries for 10% (Victor et al., 1998)).

Nonetheless, the assumptions embodied in “Annex 1 permit trading” (Table 2, fourth and fifth columns) are still an approximation of the advantages provided by Russian participation. With the USA in, EU costs for example can be reduced roughly the 50% (from 0.18% to 0.1% of GDP in the “low cost” case or from 0.9% to 0.4% of GDP in the “high costs” case). Now, considering that according to table 3 the defection of USA lowers costs to an additional 67%, the role of Russia without USA can be even bigger.

3 The role of agriculture and forestry in the context of GHG control²¹

In general and in developed countries in particular, agriculture contributes only a small percentage share of GHG emissions. When forests and forestry practices are also considered, the share of the combined sector is smaller because forests are usually acting as ‘negative emitters’ of GHG due to their role of carbon sink for CO₂.

Sources of agricultural GHGs and interactions between them are complex. The sources include not only carbon dioxide (CO₂), as with other sectors, but also nitrous oxide (N₂O) and methane (CH₄).

CO₂, the most significant greenhouse gas (GHG) from most other sectors, is the least important for agriculture. Unlike most energy-based industries, more than 90% of GHG emissions from agriculture consist of nitrous oxide coming from fertilizers, and manure and methane from livestock. Energy-related GHG emissions come from activities such as grain drying, heating farm buildings, and use of off-road machinery such as tractors and other machines. Deforestation is the second largest source of carbon dioxide. When forests are cleared for agriculture or development most of the carbon in the burned or decomposing trees escapes to the atmosphere. There is uncertainty about the global scale of resulting emissions but it is estimated that from 800 million to 2.4 billion tons of carbon are released globally every year as an effect of a

²¹ Adapted from UNEP/UNFCCC (2002).

deforestation alone. However, when new forests are planted the growing trees absorb CO₂, removing it from the atmosphere (see Box 2).

The second most important greenhouse gas after CO₂ is CH₄, produced by cattle, dairy cows, buffalo, goats, sheep, camels, pigs and horses. Most livestock related methane emissions are produced by enteric fermentation of food by bacteria and other microbes in the animals' digestive tracts; Another source is the decomposition of animal manure. At the global level, farm livestock account for 30% of the methane emissions attributable to human activities.

Roughly another 1/5 to 1/4 of global methane emissions arising from human activities is produced by wetlands or paddy rice farming. Accounting for over 90% of all rice production, wetland rice is grown in fields that are flooded or irrigated for much of the growing season. Bacteria and other micro-organisms in the soil of the flooded rice paddy decompose organic matter and produce CH₄ which is released to the atmosphere.

The nitrogen contained in many mineral and organic fertilizers and manures enhances the natural processes of nitrification and denitrification that are carried out by bacteria and other microbes in the soil. These processes convert some nitrogen into nitrous oxide. The amount of N₂O emitted for each unit of nitrogen applied to the soil depends on the type and amount of fertilizer or manure, the timing, soil conditions and climate.

Opportunities for agriculture to reduce GHG emissions are complex and varied, but agricultural GHG emission reductions can be achieved in the following ways:

- soil and water management (e.g., soil conservation techniques, soil nutrient management);
- manure management (e.g., design of efficient manure handling facilities);
- carbon sequestration (e.g., use of crop residues for industrial purposes, and physical products such as straw houses, agro-forestry);
- livestock management (e.g., pasture and grazing and livestock feeding strategies);
- reduced livestock numbers
- improved energy efficiency
- other energy related measures e.g. appropriate production of biofuels

BOX 2

The Role of Carbon Sinks.

Forestry and many other forms of land use have the potential of sequestering atmospheric carbon. For this reason, the provisions of the Kyoto Protocol allow for the possibility of emission reduction credits for some land use, land-use change, and forestry (LULUCF) activities. In particular, Article 3.3 of the Protocol states that biological sources and sinks can be used for meeting the national emission reduction commitments, but limits these sources and sinks to

afforestation, reforestation and deforestation occurring since 1990. In addition, Article 3.4 provides the possibility of taking into account further human-induced activities that cause changes in greenhouse gas emissions and are related to the categories of agricultural soils, and land-use change and forestry.

However, the provisions in the Kyoto Protocol regarding sinks (in general, LULUCF) have been seriously debated as they give rise to a number of scientific and political concerns. For instance, the inclusion of carbon sinks has created confusion as to how anthropogenically induced net changes in forest carbon stocks should be treated; furthermore the role of soils in land-use change and forestry introduces an additional complexity (see e.g. Jonas et al, 1999). The problem is that plants and soils can act as carbon sinks, but there is no scientific certainty about how much carbon is being removed from the atmosphere by particular forms of soil or vegetation management, or whether the removal from the atmosphere is permanent. The use of carbon sinks in meeting emission targets is thus not only controversial but also complex and questions concerning an accurate definition of 'sinks', the consequences of their use and possibilities to measure the impact need to be clarified. Therefore, characterised by numerous uncertainties, the role of the LULUCF has posed a key problem in finding a compromise to pave the way for the Kyoto Protocol's ratification. Questions concerning the types of LULUCF activities that can be accounted for and how much credit countries could get for their forestry and land-use activities and consequently in which dimension these activities could lessen the adverse effects of emission reduction measures have figured largely in the negotiations. The controversial contribution of sinks in helping developed countries to reach their emission reduction targets was largely responsible for the November 2000 failure of the COP-6, an event that was considered crucial in subsequent difficulties in the process to make the Kyoto Protocol enter into force in the near future. As a consequence of the failure at COP-6, the next round of negotiations became very important for the success of the Kyoto Protocol, especially with the defection of the US. For this reason, a number of concessions were made to the key players in order to keep the process alive, and the text of the Protocol was substantially watered down. For example, both Russia and Canada obtained a larger number of credits for their forestry (carbon sinks) in the 'Bonn Agreement' (COP-6*bis*) than had been offered in earlier negotiations. Requirements for 'supplementarity', a previously high priority for the EU, was reduced in significance. At COP-7 in Marrakech, the delegates continued to work on the outstanding technical issues on the basis of the Bonn Agreement, attempting to resolve, among other questions, details on LULUCF. Being aware of the necessity to successfully conclude this conference in order to support the Kyoto process, the key 'Umbrella' countries that were needed to satisfy the 55 per cent clause succeeded in further weakening their contributions. For example, Russia managed to almost double its sinks allowances. In summary, the role of sinks – and especially the LULUCF - have played a major role in the process towards the ratification of the Kyoto Protocol, and still represent a crucial element in the negotiations on climate change control.

3.1. EU 25 Agriculture and Forestry: GHG Emissions.

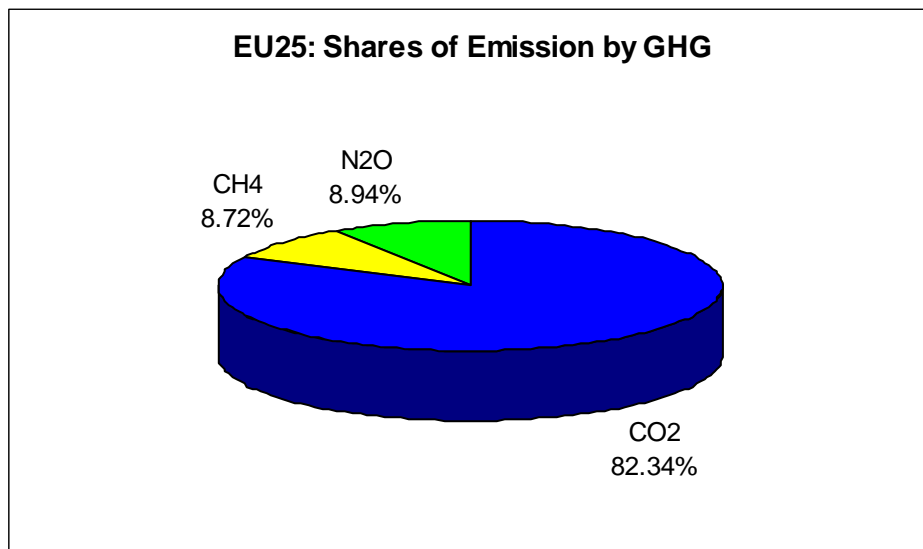
In 2001, GHG emissions from the EU25 were comprised CO₂ (82%), CH₄ (8.7%) and N₂O (8.9%) respectively (Fig. 1). Agriculture's contribution to GHG emissions was relatively limited, accounting only to 9.4% of the total (Tab. 1). The forestry sector, in its turn provided a sink for CO₂ quantifiable as more or less 6% of total GHG emissions from the EU25 economic system and amounting to nearly 60% of GHG emissions from EU25 agriculture. Turning to the individual GH gases: the contribution of agriculture to CO₂

emissions in the EU25 was small, less than 1% of the total, whereas it was substantial for both CH₄ and N₂O amounting to the 47% and 59% of the respective totals (Tab. 1).

CH₄ and N₂O represented the biggest shares of GHG emissions from the agricultural sector, constituting together more than 99% of total agricultural emissions (Fig. 2). The major source of CH₄ emissions was enteric fermentation (74% of total CH₄ emissions), followed by manure management (24%). Fertilisation of agricultural soils and again manure management were the most important sources of agricultural N₂O: the first amounted to 86% and the second to 11% of the total N₂O emitted (Tab. 2).

Carbon sinks were mainly made up of the existing stock of forest and woody biomass accounting for 99% of total CO₂ storage.

Fig. 1



Agriculture = 9.4% of total

Fig. 2

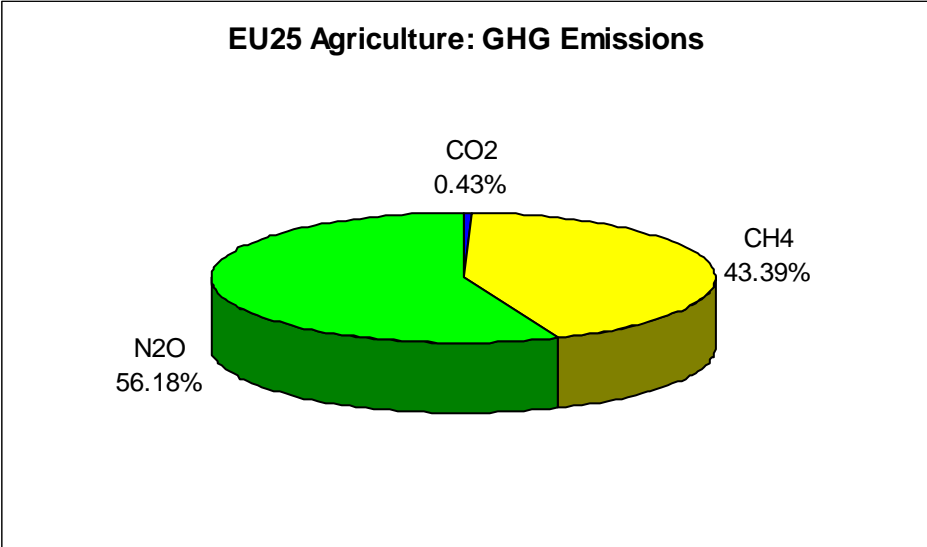


Table 4

EU 25 Emissions in 2001 (*)								
	CO₂		CH₄		N₂O		TOTAL GHG (CO₂ eq.)	
	Sectoral Contribution (Gg.)	Sectoral Contribution (%)	Sectoral Contribution (Gg.)	Sectoral Contribution (%)	Sectoral Contribution (Gg.)	Sectoral Contribution (%)	Sectoral Contribution (Gg.)	Sectoral Contribution (%)
Total Emissions/Removals with LUCF	3700335.40		20220.972		1414.166		4563367.36	
Total Emissions without LUCF	3987116.44	100.0	20108.56	100.0	1395.91	100	4842129.61	100
1. Energy	3805907.17	95.5	5964.014	29.7	376.21	27.0	4047778.08	83.6
2. Industrial Processes	166285.39	4.2	31.69	0.2	155.54	11.1	215167.88	4.4
3. Solvent and Other Product Use	5906.63	0.1	33.00		12.18	0.9	10376.03	0.2
4. Agriculture	1945.79	0.049	9442.40	47.0	828.21	59.3	456981.91	9.4
5. Land Use Change and Forestry	-286781.04	-7.2	112.41	0.56	18.25	1	-278762.25	-5.8
6. Waste	7071.46	0.2	4637.45	23.1	23.77	1.7	111825.71	2.3

(*) Lithuania 1998, Slovenia 1996.

Table 5

EU 25 Emissions in 2001: Focus on Agriculture and Forestry (*)								
	CO2		CH4		N2O		TOTAL GHG (CO2 eq.)	
	Sectoral Contribution (Gg.)	Sectoral Contribution (%)	Sectoral Contribution (Gg.)	Sectoral Contribution (%)	Sectoral Contribution (Gg.)	Sectoral Contribution (%)	Sectoral Contribution (Gg.)	Sectoral Contribution (%)
4. Agriculture	1945.79	100	9442.402	100.0	828.212	100.0	456981.91	100.0
A. Enteric Fermentation	0	0	7045.543	74.6	19.157	2.3	153894.99	33.7
B. Manure Management	0	0	2267.942	24.0	95.187	11.5	77134.88	16.9
C. Rice Cultivation	0	0	111.863	1.2	0	0	2349.12	0.5
D. Agricultural Soils	1945.79	100	6.984	0.1	712.582	86.0	222992.85	48.8
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	0	0	10.070	0.1	1.286	0.2	610.06	0.1
G. Other Agriculture Activities	0	0	0	0	0	0	0	0
5. Land Use Change and Forestry	-286781.04	(**) 92.4	112.415	100	18.25	100	-278762.25	(***) 91.78
A. Forest and Woody Biomass Stock Change	-266380.92	85.9	0	0	0	0	-266380.92	87.71
B. Forest and Grassland Conversion	-35142.40	11.3	25.712	23	0.91	5	-34319.93	11.30
C. Abandonment of Managed Lands	-3017.47	1.0	0	0	0	0	-3017.47	0.99
D. CO2 Emissions and Removals From Soils	23442.01	-7.6	0	0	0	0	23442.01	-7.72
E. Other	-5682.26	1.8	86.703	77	17.34	95	1514.06	-0.50

(*) Lithuania 1998, Slovenia 1996.

(**) 100 = A+B+C+E.

(***) 100 = A+B+C

4 Conclusions

During the last several decades, climate change has evolved as a major topic in international policy discussions. The adoption of the Kyoto Protocol, establishing for the first time in history binding emissions reduction requirements for industrialised countries, represents a milestone in international efforts to control climate change. It is one of the most ambitious texts within the history of environmental agreements since it links environmental, economic and legal components. However a number of issues in the Protocol were not sufficiently elaborated or were left deliberately vague and therefore their subsequent definition posed problems and disputes. A further difficulty consisted in the complexity and technicality of the issues, expressed in the enormous volume of texts that had to be agreed. As a consequence, the negotiations on the rules that were needed to prepare for the Kyoto Protocol's entry into force turned out to be demanding and restrained by the circumstances. In addition, the positions of some of the various groups of states involved in the negotiations changed during the process, due to political interests or further scientific information. In particular, the decision of by far the biggest producer of carbon dioxide emissions, the US, to not ratify the Kyoto Protocol induced a number of consequences for the Kyoto process, increasing above all the bargaining power of the remaining players – including Russia. This was mainly due to the fact that the rules of the Kyoto Protocol for entry into force require 55 parties to the Convention to ratify the protocol, including Annex I parties accounting for 55 per cent of that group's carbon dioxide emissions in 1990.

As things are now, the Protocol can only become operational if Russia ratifies, which is now in prospect.

Assuming ratification by Russia but not the USA, the costs for the EU of implementation appear to be very low (potentially zero), whereas the cost of EU ratification without Russia could amount roughly to 1% of GDP. This figure of course does not take into account asymmetries among European countries and production sectors within a country. The alternative would be to abandon the entire architecture of the Protocol and rethink from scratch the global climate change strategy.

In this picture, the role of agriculture and forestry is not negligible. Agriculture contributes less than 10% to total European GHG emission, nevertheless it is the major emitter of both CH₄ and N₂O (44 % and 56% of total respectively). In addition the forestry sector is presently providing a sink for carbon quantifiable as equivalent to about 6% of what is totally emitted.

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