

The Newsletter of the French Council of Economic Analysis

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EDITORIAL

The US government's decision not to ratify the Kyoto Protocol has fuelled the debate on global warming. The relevance of an early action against greenhouse gas emissions is now, once again, discussed. The CAE report by Roger Guesnerie, with joint contributions from climate specialists and economists, concludes that the international effort against global warming that was decided in Kyoto should be pursued. The report also concludes that the quantity-based regulation instruments defined in Kyoto should be implemented. Roger Guesnerie invites Europe to move ahead in the limitation of greenhouse gas emissions, arguing that Kyoto appears to be a reasonable compromise when one takes into account, using economic analysis, the irreversibility and the non-linearities that surround global warming. He opposes the idea that uncertainty about the effects and costs of climate change is a reason to delay action. Roger Guesnerie argues, however, that the Protocol should be reformed in two ways. In the long-run, the reduction of greenhouse gas emissions should be allocated in a way that is more in accordance with equity principles and should be designed in a way that provides incentives for developing countries to join the global effort against climate change. Trade instruments should be amended in order to address the issue of the competitiveness of countries that implement the Kyoto Protocol. Carrying out Roger Guesnerie's suggestions would require a stronger international cooperation because they tackle two difficult international issues: the implicit historical allocation of emissions to developed countries and the supremacy of trade rules over other international standards.

Mario Dehove

Executive Chairman of the CAE

Kyoto and the Economics of Global Warming

Report by Roger Guesnerie

Ten years after the Rio de Janeiro summit, where developed countries decided to tackle the issue of climate change, five years after the setting of quantitative targets for reducing greenhouse gas emissions in Kyoto, and while Europe and the United States disagree on the implementation of the Kyoto Protocol, Roger Guesnerie sheds light on the economic issues surrounding climate change. The objective of his report is not to deal with short-term negotiations but to fuel a longer term reflexion.

Climate change raises many questions dealing with economic policy. Given the large uncertainties surrounding the impact of global warming, and the low reversibility of the increasing concentration of greenhouse gases, what is the right agenda for action? Is the architecture of the Kyoto Protocol fundamentally flawed, as argued by the US Administration? How to deal with countries that will not participate in the effort for controlling emissions, while enjoying the benefits of the preservation of the climate, a collective good? How to protect the competitiveness of countries that impose environmental constraints on their producers?

In addition, the fight against climate change raises ethical issues regarding the fair allocation of emission rights for greenhouse gases at the international level, and the need to combine a global effort with the economic development of a large part of the planet. Finally, the need for new disciplines and institutions in order to ensure that commitments are respected raises the broader issue of governance at the international level.

Few certainties, but some major risks

The mobilization of climate specialists has resulted in considerable progress in the knowledge of global warming. Scientists remain careful in front of major uncertainties, but most of them now agree that the recent trends in climate changes reveal the beginning of a large phenomenon of global warming. The emission of greenhouse gas has increased dramatically since the industrial revolution. The natural regulation mechanisms of the planet are not able to cope with such emissions: only half of the gases emitted are captured in natural sinks in the continental biosphere (trees growing faster) and in the ocean. The other half accumulates in the atmosphere and contributes to the increase in temperature that has been observed during the last century. The parallel between the growth in greenhouse gas concentration and the increase in temperature is, at least, spectacular (Figures p. 2).

Recent studies suggest that at the end of the century, the average earth temperature will experience an increase of 3 to 6 degrees celsius if no measure is taken. This would result in an increase in the sea level, the disappearance of some emerged land, the desertification of some areas and an increase in climate variability. There are also potential risks of profound modifications of the climate system, even though it does not seem possible to assess their probability at this stage. The physical mechanisms involved are highly non linear and therefore difficult to predict. Changes in the oceanic circulation, with the Gulf Stream that would no longer regulate

the climate of Western Europe are plausible, even if such changes are unlikely in the short run. Cumulative emissions that would get out of control are a potential threat, if frozen areas should warm up and free greenhouses gases presently held in topsoil, or if warmer oceans should absorb less atmospheric carbon or if polar ice caps should melt and reflect less solar rays. However, the range of estimates of temperature and sea level changes is large, and scientists are so far unable to predict with precision local consequences of an average increase of temperature. Predictions of the likelihood as well as of the intensity of extreme events such as hurricanes and tornadoes are also surrounded by large uncertainty.

The poor knowledge of the effects of global warming is one of the main arguments of the U.S. administration to reject the architecture of the discipline to limit greenhouse gas emissions adopted in Kyoto. This argument, however, can hardly justify inaction, given that it is equally possible that the damages of global warming be underestimated as well as overestimated.

What action against global warming?

Even a dramatic reduction in greenhouse gas emissions would only have a limited impact in the short-run. At the end of the century, the average sea level would still increase, and the earth would still become warmer (roughly by 1.4 to 2.6 degrees if one could stabilize the level of CO₂ at twice the present concentration, a scenario that would impose a considerable effort for reducing emissions). What is the point of imposing the costs of limiting emissions to the present generation, for the benefit of (remote) future generations? Why transfer wealth to future generations that are likely to be richer than the present ones, and would that be fair? Isn't there any way to increase the 'global world welfare' in a safer and more efficient way, for example by using the same amount of money for

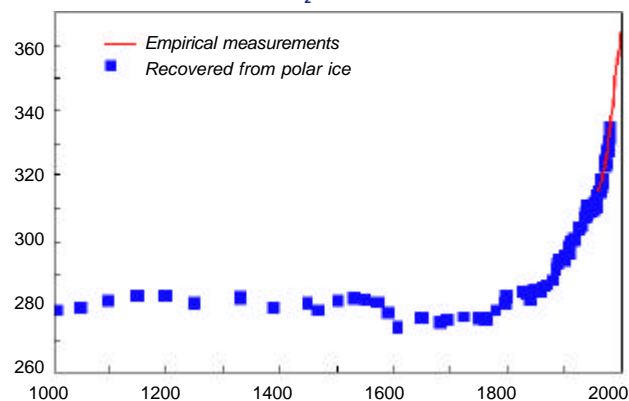
education, water supply or health programs? Is it consistent to act for the benefit of future generations, while we do so little for certain present populations of the planet?

Intertemporal economic analysis recommends to emphasize the emission reduction effort when it is less costly. This is not, however, a motivation to delay action until new technologies appear. It is clear that the solution, in the long-run, can only come from technological progress and that investing in research is crucial. Nevertheless, slowing the accumulation of greenhouse gases leaves more time for technical solutions to emerge. Early commitment to act makes the willingness to fight global warming more credible. It also provides profitable perspectives for investing in research. From this point of view, economic incentives to reduce emissions of greenhouse gases and investment in research of technical solutions are two policy instruments that are complementary rather than alternative, as described by the US Administration.

The costs of an efficient policy against global warming cannot be neglected. Simulations provide diverging estimates, according to models and scenarios, but the costs of implementing the original Kyoto Protocol is often estimated to amount to a few tenths of a percent of the GDP. It is noteworthy, though, that the costs are often expressed as a percentage of GDP rather than in dollars for comparability reasons, but they correspond to a draw on the economy that would not modify the growth rate of the economy if the changes are introduced gradually enough to be expected by agents. The costs of the effort increases with the level of emission reduction. That is, there is set of measures involving relatively low costs that can be implemented in developed countries. Considering the feedback effects on prices and the induced technical change, this first set of measures yields a return that is higher than alternative actions, including investment in research. With the

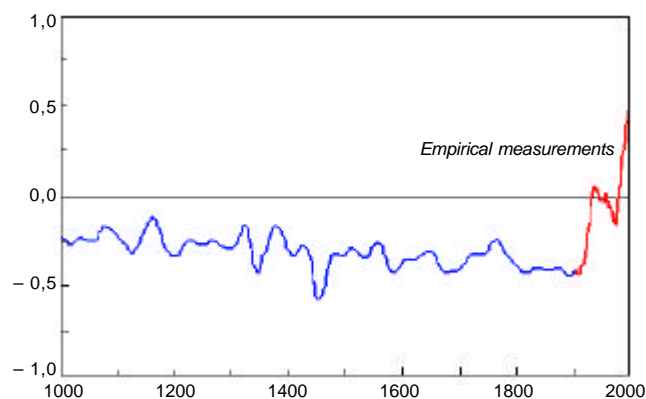
Evolution during the last millennium (Northern hemisphere)

a. Atmospheric CO₂ concentration (ppm)



Sources: Etheridge and *al.*, 1996 and Keeling and Whorf, 1998.

b. Changes in average temperature (in °C)



Source: GIEC, 2001.

additional argument that an early posting of the priority given to the effort against global warming could modify the expectations of both polluters and innovators, the immediate implementation of a collective action against greenhouse gases emissions is well founded.

Overall, the magnitude of the effort initially planned in Kyoto was reasonable. The type of uncertainty and the peculiar time horizon involved in this issue make cost analysis difficult, and the calibration of the optimal effort particularly cumbersome. However, the analyses concluding that Kyoto involves an excessively rapid effort rely on oversimplistic calculations. The damages linked to global warming are not limited to direct effects. The economic calculation must include risk aversion and account properly for the extreme risks, that are both catastrophic and unlikely. In the presence of irreversibility, it is also necessary to account for

option values, and in particular for the fact that there might exist a window of opportunity for action, that will not last. One must also take into account for the calculation, the fact that new information is likely to arrive. Future information (for example concerning the fact that such or such concentration of CO₂ involves larger hazards than expected), could require a fast decrease in emissions, which might be very costly. The opposite information (that the damages were overestimated) could show that the decrease in emissions was excessive, but might eventually prove less damageable and less costly. The option of avoiding some extra costs imposed to the next generation can justify a progressive but immediate decrease in emissions of greenhouse gases. From this point of view, the action decided in Kyoto is not too early and the magnitude of the effort appears to fall in a reasonable range of estimates.

The architecture of the Kyoto Protocol

Kyoto relies on quantitative commitments, i.e. on the volume of emissions of greenhouse gases. The choice of regulating quantities (emission ceilings and permits), compared to price instruments (carbon taxes) is questionable. The two instruments are not equivalent in the presence of uncertainty regarding the cost of damages and the cost of effort, and the inertia in the damages in the medium-run, combined with uncertainty regarding the cost of effort, could lead to favor price instruments. However, a deeper analysis shows that the Kyoto architecture has several advantages:

- Setting quantity targets results in a greater visibility of the objectives. It also avoids the interference of exogenous fluctuations of oil prices on the collective action;
- Taxes are less acceptable for developing and transition countries. Setting quotas at the national level makes it possible to account for particular situations, for the different exposure of countries to the consequences of climate change, as well as for their development needs;
- The possibility of international trade in permits reduces considerably the economic cost of controlling emissions (roughly by a factor of two), by making it possible to reduce emissions where it is less costly. Markets for permits would also make apparent an international price for atmospheric carbon, that agents can include in their optimization process. Opposition to such markets for pollution rights on moral grounds is not founded.

Kyoto could nevertheless be improved by setting a ceiling price (guaranteed provision of permits when the market price exceeds this ceiling) and a floor price on the market of emission permits. Such an innovation would contribute to stabilize the expectations of the various agents, and could make the agreement more acceptable.

After a critical examination of the architecture of the Kyoto

Protocol, this report argues in favor of the revitalization of the Protocol, with some improvements, rather than of its rejection. The various alternative proposals do not appear superior.

How to allocate emission rights?

A crucial issue is the initial allocation of emission rights. An allocation faithfully based on past emissions ('grandfathering' in the language of the negotiators) raises issues on international equity: the present pollution is mainly due to a few developed countries that would benefit from large pollution rights, while future development of other countries would be constrained by low emission rights.

Nevertheless, a quick and drastic change in the present sharing of emissions would be economically inefficient, and would endanger the adherence of the largest polluters to a global agreement (from this point of view, the effort imposed by Kyoto on the United States, in view of the trend of future emissions, could be seen as 'excessive', even though this country is the main polluter). At the national level, accounting for the present level of emission in the allocation of permits also corresponds to an 'implicit past contract' between the society and producers.

Soft transitions that can be anticipated far in advance by economic agents could limit the macroeconomic adjustment costs. The combination of an efficient and fair policy pleads for a slow modification of the existing implicit property rights. Nevertheless, within a given country, transfer of property rights to firms should remain temporary and transitory. At the international level, the long-term evolution of national quotas is more problematic. A utopist point of view could lead to base the allocation of emission rights on a more egalitarian reference, for example an allocation of emission rights on the basis of the population of each country. But even the scenarios that combine a decrease in global emissions and a convergence

towards a single level of emission per capita worldwide over seventy years impose considerable levels of effort not only within the United States but also within other countries where industry and transportation should experience significant growth.

An urgent problem must be solved, the integration of developing countries in the Kyoto framework. The solution adopted in the Protocol is the Clean Development Mechanisms (i.e. emission credit for developed countries when they invest in a project that reduces developing countries' emissions). This solution presents some political advantages, but it is economically flawed, being too complex and a potential source of distortions.

The challenge of the integration of developing countries in the Kyoto framework is formidable. A failure to integrate these countries would mean the failure of the whole Kyoto construction. A success would ensure a sustainable agreement. The proposals of Roger Guesnerie's report, in regard to these aspects are based on two observations. First, it is quite shocking to ask countries with small CO₂ emissions to pay to limit the climate change caused by other countries. Second a significant reduction of emissions is compatible with generous quota rights for developing countries. These countries would therefore adopt less polluting technologies, generating limited costs in these countries, and would act as net suppliers of carbon emission permits on the market. This would result in significant transfers from developed countries, while limiting the adjustment costs for the latter countries. That is, a 'win-win' agreement between developed and developing countries is possible.

To make such an agreement work will nevertheless be difficult. One of the central messages of the report is that it is necessary to present economically attractive solutions to developing countries in order to make Kyoto sustainable and to be able to go beyond the

Protocol. In the short-run, these solutions must be generous enough to make developing countries join the Kyoto framework. This can require allocating non constraining ceilings, or emission quotas higher than the actual emissions for developing countries. However, it is also important to set clear rules for the medium run, so that these incentives become an engine for adopting environmentally friendly strategies in developing countries.

The issue of international governance

Global warming raises a more general issue of international governance. Each country's best interest is not to participate in an agreement if the other countries participate (each country counting on the others to bear the costs of the effort while enjoying the benefits of a public good, the world climate). In addition, providing generous incentives for some countries (e.g. Russia) to participate by allocating permits that exceed their emissions and that they could sell on the market could result in an opportunist behavior. Finally, reducing greenhouse gas emissions involves some costs for polluting industries (carbon taxes or purchase of emission rights), that could create distortions of competition if some countries are not subject to the same discipline.

The Kyoto architecture, with quantity objectives at the international level does not imply that the national policies implemented to reach the emission targets be based on the same architecture. A domestic price system that could make it possible to reduce emissions can be implemented through a set of taxes that would not handicap domestic products compared to the imported ones. Carbon taxes could be deductible for the share of production that is exported. Implementing such a tax system would nevertheless be complex, especially for the gases other than the CO₂, for which it is hard to tax the emissions 'upstream', e.g. through a tax on fossil fuel. A

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tax system that would track the emissions and be applied on the final goods would require tracking physical flows, for example involving a system of carbon base accounting.

It appears necessary to consider the effects of a change in international trade rules in order to find a better articulation between market access and climate protection. If it is not possible for a country to discriminate between imports coming from a country that does not comply with an international discipline on a common good (like the climate), the non participating country that does not bear the effort costs will enjoy a extra competitiveness, and a larger market share. This could result in a higher overall emission level at the earth level. That is, the presence of common goods provides some arguments for some linkage between trade and environmental negotiations. A change in the World Trade Organization rules would not easy

to negotiate, and is unlikely to be accepted by all members. It could perhaps be useful to consider globalizing the negotiations on trade and the negotiations on global common goods. Economic analysis suggests that expanding the scope of the negotiation could increase the space of mutually beneficial agreements.

Finally, Kyoto must be supplemented by an ambitious effort of technological cooperation at the community level. An ambitious policy of research and development for new technologies as well as for carbon sinks is the only solution to face the challenges in the long run. In this area, it is necessary that the European Union become intellectually more autonomous in terms not only of technology but also in terms of intellectual analysis of the climate policy.

The report is discussed by Paul Champsaur and Alain Lipietz. **Paul Champsaur** shares Roger Guesnerie's point of view on the costs of limiting emissions and the fact that action against climate change should not be delayed. He believes that the Kyoto discipline within the European Union could be implemented using price instruments, and that a debate on taxing energy as an intermediate consumption should take place at the European level.

Alain Lipietz also shares several points of view expressed by Roger Guesnerie, but challenges the idea of 'grandfathering' in the allocation of emission rights. At the international level, he advocates for setting an overall level of emission quota at the quantity of greenhouse gases that can be recycled by the earth ecosystem, and for allocating emission rights on a per capita basis.

This report includes several complements that focus on key issues.

Philippe Jean-Baptiste, **Philippe Ciaï**, **Jean-Claude Duplessy** and **Jean Jouzel** (Institut Pierre-Simon Laplace) explain what is known and what is still uncertain regarding the physical aspects of climate change.

Philippe Ambrosi and **Jean-Charles Hourcade** (Centre national de la recherche scientifique), discuss the costs of the damages resulting from climate change.

Patrick Criqui (Université de Grenoble), **Marc Vielle** (Commissariat à l'énergie atomique) and **Laurent Viguier** (Université de Genève) describe the results of several scenarios on global warming, based on several models, and assess the costs of policies that would reduce greenhouse gas emissions.

Franck Lecocq (The World Bank) and **Jean-Charles Hourcade** explain how uncertainty, irreversibility and long term discounting can be taken into account in the economics of global warming.

Cédric Philibert (International Energy Agency) sheds a light on the choice between policy instruments based on prices (taxes) and quantities (permits) and suggests how the Kyoto architecture could be improved.

Christine Cros (Secrétariat général du Comité interministériel pour les questions de coopération économique européenne) and **Sylviane Gastaldo** (Ministère de l'Écologie et du Développement durable) describe the various market based experiments for regulating emissions and discuss the prospects of tradable permits in the case of global warming.

Jean-Louis Bal, **François Moisan** and **Alain Morcheoine** (Agence de l'environnement et de la maîtrise de l'énergie) present a state of the art on the technological solutions for reducing emissions, and substitutes for fossil fuel.

This set of complements to the main report by **Roger Guesnerie** provides information on several difficult questions raised by climate change.