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The role of Europe in climate negotiations (1992-2010)

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Chapter 1: The role of Europe in climate negotiations (1992-2010)

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Introduction

Europe has long been one of the two major historical emitters of greenhouse gases with the United States, but the latter was recently overtaken by China as the first largest emitter. Europe's contribution is now declining as emerging countries' economies (in particular India and China) are rapidly growing.

Even though Europe is probably not the most vulnerable region of the world to climate change impacts, it has performed a key role in the emergence and establishment of a global climate regime.¹ Yet, Europe is a complex actor in the international arenas of negotiations as it encompasses a supranational power, the EU with its own institutions, and member states. What is more, the number of member states has increased during the period, with the successive enlargements to 15 new members between 1995 and 2007. Although the EU resists conventional classification, it is conventional to consider it as an international actor with the ability to define and shape international policies (Smouts and al, 2003).

Climate negotiations have been initiated at the Earth Summit in Rio de Janeiro in 1992 with the adoption of the United Nations Framework Convention on Climate Change (UNFCCC). This convention proceeds through annual diplomatic meetings called Conference of the Parties (COP). The most famous achievement of the UNFCCC is the Kyoto Protocol, the disposition of which ends in 2012. The last two COPs, which were supposed to define the future of the Kyoto protocol and therefore of a potential climate regime after 2012, showed a paradigm shift in the climate negotiations (Bodansky and Tale, 2011).

First, the Kyoto Protocol reflected a top-down approach of climate negotiations, that is to say it started from a common global objective and derived it into domestic commitments. On the contrary the Copenhagen Accord used a bottom-up approach through nationally-determined pledges (Bodansky, 2010). Furthermore, the Cancun Agreements represent an attempt to exit the climate-centric drift of climate negotiations by bringing up development issues. Indeed, even though the UNFCCC accord at Rio in 1992 had put climate policies in the perspective of sustainable development, this paradigm became to a certain extent a rhetoric stance as the cap-and-trade approach framed the negotiation game before and after Kyoto. In this regard, the problem was less the Kyoto framework *per se* than its interpretation as essentially a burden sharing problem to be solved in isolation with overall development objectives or other world governance issues (Hourcade and Shukla, 2007).

¹ International regimes are agreements amongst the international community to collectively address common problems, such as Climate change. Krasner has defined regimes as "sets of implicit or explicit principles, norms, rules and decision making procedures around which actors actors' expectations converge in a given area of international relations", from Krasner S., 1982, "Structural Causes and Regime Consequences: Regime as intervening Variables", International Organization, Vol36, n2, p186



This paper addresses the evolution of climate negotiations, through the lens of the role of Europe (the EU and member states) in the establishment of intergovernmental governance on climate change. The climate regime has been articulated around the UNFCCC and the Kyoto Protocol and has been developed in three phases (Bodansky, 2010). After the establishment of the UNFCCC convention (phase 1) and the elaboration of the Kyoto Protocol in the nineties (phase 2), the current phase of climate negotiations addresses the post-2012 period after the Kyoto Protocol commitments period ends (phase 3). This paper is thus organized as follows. Section 1 analyzes the foundations of the European Climate policy and its role in establishing a global climate regime under the umbrella of the UNFCCC. Section 2 analyzes the inertias and routines of the European policy which have paved the way for institutional path dependencies² (Pearson 1994, 2000, 2004), and contributed to disconnect the climate affair from development challenges before and after Kyoto. Section 3 addresses the post-Kyoto period and the weakening role of Europe in climate negotiations.

1. Europe has a leading role in the establishment of an international climate regime (1988-1997)

A primary axis of negotiation between Europe and the US (1988-1992)

Three years after climate models forecasted for the first time a global temperature increase due to anthropogenic greenhouse gases (GHGs) emissions, the G7 launched in 1988 the International Panel of Climate Change (IPCC) on one side, and on the other the negotiations for a climate Convention. The first important step of these negotiations was the adoption of the United Nations Framework on Climate Change (UNFCCC) during the Rio de Janeiro conference in 1992. Europe and the US were the important actors in framing the issue and setting an international coordination. In the meantime, the European Commission also emerged as the coordinator of the European environmental policy, dealing with strong national interests. In this section we first identify the driving forces and circumstances which pushed the climate change issue into the public agenda in US and Europe; then we explain the process which led to the adoption of the UNFCCC.

² The concept of path dependency was initially developed by economics to explain technology adoption processes and industry evolution. It was applied more recently in work in comparative politics and sociology. Path dependencies encompass a broad range of mechanisms set up in the past which restrict as time goes on the options of change. They also highlight the role of cognitive and formal institutions in structural changes. Yet Pierson (1994) shows that ultimately Reagan and Thatcher partially succeeded in dismantling the welfare state because of specific lock in and the importance of veto groups. Using B. Arthur's on increasing returns and D. North's works, Pierson (2000, 2004) shows that the path dependency relies on four main characteristics: unpredictability ("early events have a large effect and are partly random, many outcomes may be possible"), Inflexibility ("The farther into the process we are, the harder it becomes to shift from one path to another"), Nonergodicity "Accidental events early in a sequence do not cancel out", Potential Path inefficiency ("In the long-run, the outcome that becomes locked in may generate lower pay-offs than a forgone alternative would have").



A “foreseen political issue” (Cobb and Elder, 1975)

Climatologists first addressed the issue of climate change under the umbrella of the United Nations at the end of the seventies. In 1979, the World Meteorological Organization, the UN Environment Programme and the International Council of Scientific Unions hold the first Climate Conference in Geneva. This was primarily attended by scientists and drawn little political attention. The Villard Conference, organized by the World Meteorological Organization, the United Environment Programme (UNEP) and the International Council of Scientific Unions (ICSU) in 1985 expressed a consensus about the potential negative impacts of climate change. Until the mid-eighties, climate change was a confidential issue limited to the research community.

It is thus surprising that the United States, under the Bush presidency, took so seriously such a distant and uncertain issue. Their responsiveness can however be explained by the close relationship between climate change and energy security. In 1989, before the World Energy Conference which took place in Montreal, James Schlesinger, former U.S. Secretary of Defense and Energy, declared that the reluctance of the American public to accept the disciplines necessary to reduce oil dependence made the United States the “best ally of the Arabs³.” He added that given the political instability in the Middle-East, his country would be condemned to maintain military control over this region throughout the 21st century. Climate change could thus be used to convince the American people to accept the discipline they had refused so far.

The situation was not so different in Europe and Japan: the discipline which had been imposed after the two oil shocks of 1973 and 1979 had loosen through a period of low oil prices. Indeed, the two oil chocks in the seventies had revealed the vulnerability of oil-importing economies to fossil fuel prices. In reaction, France launched a large nuclear program while Germany or Denmark supported the development of renewable energies. But the spectacular decreasing of oil prices in the eighties partially undermined again the necessity to pursue a transition towards a low energy economy.

Despite this “chaotic” policy process, energy security has gradually become a priority of the public agenda of Western countries. The Toronto Conference in 1988 led to the establishment of the International climate group of expert (IPCC) structured in three groups as follows. The first working group assesses available scientific evidence on climate change, the second analyzes its environmental and socioeconomic impacts, and the third is to formulate response strategies. A few months after the second Climate conference in 1990 held in Geneva, the United Nations General Assembly called for a Framework Convention on Climate Change, which would be adopted in Rio in 1992.

³ Schlesinger J., Energy and Geopolitics in the 21st Century, World Energy Conference 14th Congress, Montreal, 1989



A leading role of Europe in the setting of the Convention

Some of the European leaders saw in the climate issue an opportunity to affirm the European leadership on a case which put the US in the defendant position, as the biggest GHG emitter. It would then be possible to introduce developing countries in a triangular game, in which Europe would take the initiative of emissions reduction policies. Vogler et al (2007) note that “the negotiating histories of recent conventions indicate that the EU has seized the opportunity provided by US abandonment of its previous undisputed role as a leader in international environmental policy”. This position is also in line with the continuous legal and constitutional effort that has given life to a « European preference for the environment » (Fitoussi, Laurent and Le Cacheux, 2010). Box 1 gives precisions about the environmental competencies of the EU.

Box 1: Environmental competencies of the EU

The European Union (former European Economic Community) is a supranational power in which Member States have kept part of their sovereignty. A series of treaties (Rome, Maastricht, and Lisbon) define its competences which have been expanded over the last thirty years. Indeed, until the European Single Act in 1986, the treaty of Rome did not define environmental competences for the EC1. The treaty of Maastricht went a step further with an amendment stating that “environmental protection requirements must be integrated into the definition and implementation of other Community policies” and added the precautionary principle (JO CE C224, 1992). This opened the way to a broader treatment of Climate change both as an energy and an environmental issue. Once competency has been established there is a question of whether it is exclusive (to the Community) or shared (with the Member States). For environmental issues, competencies are shared. The significance for concluding international agreements is that the agreements on issues of shared competence are ‘mixed’ and both the Member States and the Community has to sign and ratify the agreement. These mixed agreements are symbolic of the complex intertwining of member state governments and supranationality that characterizes the EU.

The European Parliament adopted a resolution in 1986 to recognize the need for a European policy on climate change (Official Journal of the EC, 1986), after the Villach Conference⁴. Before the organisation of the second climate conference in 1990, the EU reacted very quickly and competed with the US to get the leadership of the negotiations. In June 1990, the European Council meeting in Berlin called for early

⁴ The Villach conference stood in Austria in 1985. The discussions focused on the role of carbon dioxide and of other greenhouse gases in Climate variations and associated Impacts. The conference gave some recommendations and insisted on the need for further investigations on the issue.



adoption of targets and strategies for limiting emissions of greenhouse gases (Bulletin of the EC, 1990, p19); it was followed by a declaration at a joint Council of Energy and Environment Ministers in 1990 stating that CO₂ emissions should be stabilized in the European Community as a whole by the year 2000 at 1990 levels. This decision had the greatest impact on the development of the European climate policy (Grubb, 1995).

Since then, the Commission affirmed its role in the definition of a European Climate policy. The experience of acid rain legislation in the mid-eighties which imposed stringent reductions in sulphur dioxide emissions to EU countries⁵ gave the Commission the confidence that it could legislate on a major environmental issue (Haigh, 1996). Interactions between the Commission, the different directorate services (DG) and the "green states" such as Denmark, Germany and United Kingdom⁶, rising gradually as important actor since their appearance in the 70s, led to a policy draft in 1990 putting forward four major elements of climate policy: (i) a regulatory approach, (ii) fiscal measures, (iii) burden sharing among member states and (iv) the scope for complementary action at the national level (Haigh, 1996). This package was strongly articulated around energy concerns in line with the first framing of the issue mentioned above. It set the basis of a climate policy community involving a stable range of actors (Jordan, 1990) and has contributed to shape the European climate policy.

The policy package set up by the Commission two years later pushed hard to implement its stabilisation target. It comprised: (i) a framework directive on energy efficiency within the SAVE programme, (ii) the setting of the ALTENER⁷ programme with measures to promote renewable energy, (iii) a directive on a combined carbon and energy tax and (iv) a decision concerning a monitoring mechanism for CO₂ emissions. As some experts noticed, the package was ambitious and a means of pressure from the Commission to take the lead in the negotiations towards member states and the US.

The third proposal was the most emblematic. The idea of a tax⁸ was put forward by the head of the DG XI (Environment direction) Carlos Ripa di Meana. It would tax the energy content of activities for 50% and their carbon emissions for 50%.

⁵ The legislation imposed to large combustion plants a 58% reduction of sulphur dioxide emissions by the year 2003 compared with 1980 levels.

⁶ The Climate Action Network was formed in 1989 and gathered Environmental NGO's interested in the problem of climate change. It performed a sizeable influence in the negotiations around the Kyoto Protocol (see Gulbrandsen Lars H., Steinar, 2004)

⁷ The ALTENER program promoted renewable energies in Europe. ALTENER I ended in 1997, ALTENER II in 1999

⁸ Initially, only carbon emissions were to be taxed. Intense discussions between DG XI (Environment), DG XVII (Energy) and the Commission led to a mix tax project, as GG XVII was concerned to protect the European industry of coal and brown coal (Ikwue and Skea, 1994, 1995)



At the pre-Rio conference on sustainable development in April 1992, the tax was promoted as an innovation in fiscal policy. But the willingness to reach a compromise had made the tax project too complex⁹. Also, the tax project was weakened in what would seem, on the light of today's policies challenges, an unusual alliance between energy-intensive industries and NGOs, calling for a clear environmental objective and thus defending a system of quotas. France, which supported a carbon tax instead of a carbon/energy tax in order to protect its nuclear program, withdrew its support from the Commission's proposal three weeks before the Rio conference. Eventually France, the least European developed countries (Portugal, Spain, and Greece) and UK formed a coalition against the tax. Lacking a common clear proposal, European countries could not assert themselves towards the US. Nevertheless, Europe was a leader in term of emissions reduction and a "forerunner" in terms of internal action.

As for the US, they had been confronted to the "Global Climate Coalition" lobby which gathered oil companies, coal-producing states and industries, and mobilized public opinion against the idea of an international carbon tax (see for instance levy and Kolk, 2002, and section 2). Also, the Gulf War had solved their energy security issue for a while, and the need to reduce oil importations was not imperative anymore (Hourcade, 2002; Giddens, 2010).

Eventually the US and the UK found a trade-off formulation in Rio: a non-binding call for an attempt to return in 2000 to the 1990 emissions levels.

The convention was signed by more than 150 states and the EC at the Rio Conference in June 1992. The UNFCCC set up a number of new institutions and provided financial assistance and technology transfer for developing countries. The convention established the precautionary principle as a "guiding principle in the international response to climate change" (Haigh, 1996). The parties were asked to take precautionary measures to "anticipate, prevent or minimize the causes of climate change and mitigate its adverse effect". A Conference of Parties (COP), subsidiary bodies on science and implementation, reporting and review procedure were also set up.

The convention relies on three main challenges:

- An environmental challenge: the article 1 of the Convention claims the necessity of a long term goal of stabilizing greenhouse gas concentration "at a level that would prevent dangerous anthropogenic interference with the climate system". Using a top-down approach (Bodansky, 2010), in article 4.2 Annex I countries (OECD and transition countries such as former soviet republics) committed to stabilize their GHG emissions in 2000 at the 1990 level. In a more bottom-up approach, they also committed to adopt national policies and measures on

⁹ In particular, a clause included the implementation of measures by other member states of the OECD in order to maintain the competitiveness of European industrial activities. There was also a possibility to reduce the amount of the tax for high energy intensive industries confronted to strong international competition (COM (92), 226 final, june 2th, 1992)



climate change mitigation and to communicate them periodically to the UNFCCC (article 4.1).

- A political challenge: the EC finally signed the Convention after a compromise was found to leave the decision of a tax to the council of finance Ministers. The Convention emphasized the possibility of national taxes which might amount to something equivalent to EC proposal. Nevertheless, despite the non-binding character of article 4.2, the EC's position in terms of reduction commitment had strengthened it.
- A development challenge: the Convention recognizes the carbon debt of developed countries through equity-based differentiation of required efforts among industrialized and developing nations (article 2) and the adoption of near term non binding quantitative emissions goals for industrialized countries. But no mechanisms were set up to tackle the climate change challenges for developing countries (countries not referred to by the annexes at the Convention). The UNFCCC however recognized their high vulnerability to both climate change and response measures (i.e. emissions reduction policies).

Article 2 gave rise to numerous misunderstandings. Although this statement was inequitable because it did not account for pre-existing inequalities, it was meant to remain a diplomatic declaration. However it set the intellectual framework for the whole process, and is the first type of path dependency which Europe was unable to overcome in the following negotiations.

From Rio to Kyoto (1992-1997): the emergence of political path dependencies

After the Rio Conference in 1992, the second step of climate negotiations was the Kyoto Protocol in 1997 which set binding emissions for developed countries. Despite significant progress in the recognition of the issue, these two steps paved the way for misunderstandings between developed and developing countries. Political path dependencies derived from internal divisions in Europe on climate policies (e.g. the carbon tax project), in addition to a fierce competition with the US to take the leadership of the negotiations, putting aside developing countries.

The Berlin COP (1995) and the price/quantity controversy

The UNFCCC became effective in 1994. Each year a conference of the Parties was planned to pursue the negotiations. In March 1995, under the pressure of Southern countries (except OPEC countries), the first COP in Berlin stated the necessity for further commitment from developed countries. But during this COP an irreversible mechanism emerged in the choice of climate policy instruments.

Two main mitigation options were put forward to regulate greenhouse gases emissions: a carbon tax or emissions quotas. The choice between the two instruments should depend, in theory, on the uncertainty on reduction costs and impacts of climate change (Weitzmann, 1974).



Until 1994, most of the American and European economists and negotiators defended a carbon tax, which did not require complicated technocratic dispositions and permitted to control the cost of climate policies. But the tax was clearly put aside as an option as the negotiations went on. Once Europe withdrew the carbon/energy tax project before the Rio Conference, quantity-based instruments were imposed as the solution. An informal coalition between NGOs, firms and diplomats emerged on both sides of the Atlantic to support the quotas option. NGOs considered quotas as a means to enforce meaningful reductions to developed countries, and firms resisted any project of tax. Once Europe withdrew the carbon/energy tax project before the Rio Conference, quantity-based instruments were imposed as the solution.

The Berlin Mandate (1995) represented a turning point in which quantity based mechanisms were definitely adopted. The US delegation was prepared to negotiate with Europe on a carbon tax project, while European diplomats had come to support quantity based mechanism, as they thought the US would never accept a tax. However, the Clinton administration was hoping international negotiations would put pressure on its own country to finally adopt a carbon tax. This optical illusion (Hourcade, 2002) buried all kind of tax project for a while, and led to a mandate for the adoption of quantified targets in the Kyoto Conference. This mandate locked all Parties into an inextricable "burden-sharing" pathway, in which a maximum level of global emissions would have to be found and shared between Parties.

The Kyoto Protocol (1997) and the success of the top-down approach

The Kyoto Protocol went a step further than the Rio conference. Signed by 172 countries, binding reduction emissions were adopted by 38 countries of the Annex I. They committed to a global reduction of their emissions by 5.2% over the 2008-2012 period, in comparison to 1990 levels. The Kyoto Protocol also introduced a comprehensive approach through the Joint Implementation for developed countries. JI was an opportunity for Annex I countries to lessen their burden in terms of emissions abatement through a variety of market oriented institutions and rules including international emissions trading, broad coverage of emissions sources and sinks, and some temporal flexibility in complying with emissions commitments.

During the Kyoto negotiations, three groups of countries with their own interests emerged: the Umbrella group countries (the US, Canada, New Zealand, Australia, Norway, Russia, Japan), the G77 plus China (developing countries), and Europe. Two principal issues fed controversies among the three groups during the negotiations.

- First, Europe and the Umbrella group argued over the setting of domestic policies vs. flexibility mechanisms such as a cap-and-trade.¹⁰ On one side, the US supported unconstrained exchanges of emissions permits in order to limit the costs of a carbon constraint by equalizing marginal abatement costs among

¹⁰ Cap and trade is an environmental policy tool with a mandatory cap on emissions and emissions permits. There are also sources of flexibility such as the possibility to trade the permits.



countries. Emission permits were also supposed to strengthen the competitiveness of firms through innovation and minimize abatement costs. On the other side, Europe endorsed a concrete ceiling limiting flexibly mechanisms in order to ensure minimum domestic efforts.

- Second, the US Congress (resolution Byrd Hagel) had considered that the US would adopt quantitative constraints provided that developing countries committed to follow the same track. The Joint Implementation¹¹ mechanism was thus supposed to integrate Southern countries to the global effort. But developing countries were sceptical about JI considering that it did not provide guarantee in terms of development options. It could represent a windfall opportunity for developed countries to minimize the efforts of emissions reduction outside without promoting development and growth. A last minute solution, the CDM (Clean Development Mechanism, article 12) was found. This mechanism was supposed to enable Annex I countries to benefit from the potential of cheap emission in developing countries while promoting additional development. Basically, the CDM incorporated the ideas of joint Implementation, but reversed the order of priorities: CDM projects should contribute to development objectives of host countries, helping to contribute to the objectives of the Climate Convention, and only then, help investor countries in meeting their emission reduction commitments.

During the first phase of climate negotiations a European Climate policy has gradually emerged overwhelming to a certain extent national interests of member states. Throughout the process which led to the Kyoto Protocol, the EU has emerged with the US as a “pusher” in the negotiations over targets and gradually as the coordinator or policy entrepreneur of the negotiations. The EU has always sought a common position between member states, especially when Europe has become a participant of the negotiations on its own, and between developed and developing countries¹².

The Kyoto Protocol was a significant progress as regards to international climate negotiations and became the core of the climate regime. Even though UNFCCC recognized the responsibility of developed countries in past emissions, the Kyoto Framework relied on two main misunderstandings between developed and developing countries. First, developed countries considered that binding emission reduction targets were able to making amends, and that flexible mechanisms could

¹¹ The mechanism known as “joint implementation,” defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one ton of CO₂, which can be counted towards meeting its Kyoto target. Joint implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.

¹² The EU succeeded in persuading the other countries to accept higher targets. It showed instrumental leadership



both offer indulgencies to soften the burden sharing and tackle developing countries' developmental challenges. But the bargain was ultimately unacceptable for the latter, especially for emerging countries, whose economy was growing at a spectacular rate despite the Asian and Mexican financial crises of the late nineties. The next section will analyze to what extent the top down framework was gradually weakened by the rising of Emerging countries. This setting also challenged the recent European leadership in the negotiations.

2. The rising importance of emerging countries and the fragmentation of the climate regime has weakened the European position (1997-2005)

Europe takes the lead of the Kyoto process in a context of increasing bottom-up initiatives

The adoption of the Kyoto protocol was a significant progress as regards to international climate negotiations. Modest but agreed targets and a cap-and-trade system strengthened the framework initiated at the Rio Conference.

However, at the Hague conference in November 2000, the parties spectacularly failed to agree, leaving the ratification of the Kyoto Protocol in doubt after some intense final hours of negotiations. One main reason was the opposition between the EU and the US about the implementation of the Protocol (Grubb and Yamin, 2001)¹³. The US favoured the full use of the flexibility mechanisms agreed at Kyoto in order to soften the burden sharing while Europe regarded them as a supplementary approach to domestic policies.¹⁴ In particular, one main controversial point was the so-called "sinks" which refer to the allowance of carbon credits a country can gain from land use that absorbs carbon dioxide (e.g. forests). The US wanted all managed lands to be included in sinks under the 'catch all' article 3.4 of the Kyoto Protocol. Europe was unwilling to take into account croplands and grasslands in addition to woodlands because quantification was too uncertain. The summit ended in an impasse which revealed the limits of the European hard line in terms of negotiations.¹⁵ Taking into account the limits of the European position at The Hague summit, the Swedish and

¹³ In fact, the last night of the negotiations, the EU and the US failed to find a deal despite the UK Prime Minister's John Prescott's bilateral interactions with the US and the European "troika" lead by the French presidency.

¹⁴ The Protocol states that use of the Kyoto mechanisms should be 'supplemental' to domestic action. The EU proposed that this principle should be embodied in the form of a 'concrete ceiling' on the percentage of a country's obligation that could be met internationally (Grubb and Yamin, 2001).

¹⁵ In particular the French presidency headed by former green Environment minister Dominique Voynet was criticized of being too dogmatic and its position driven by green lobbies



Belgian presidencies adopted a less focused position on national interest and multiplied their efforts to ratify the Kyoto Protocol by involving other parties, in particular members of the Umbrella Group (Canada, Russia) and the G77 which was set aside from the last rounding of the negotiations at The Hague summit.¹⁶

Moreover, the US position withdrawal strengthened the difficulties to ratify the Kyoto Protocol. The Byrd-Hagel motion, adopted at the unanimity by the US Senate in 1997 a few weeks before the Kyoto Protocol, had already undermined the US position in the negotiations. It stated that the US should sign no protocol which would affect negatively their economy without commitment from India and China. It pointed out the rising growth of GHG emissions in developing countries and claimed that they would overcome the US emissions before 2015. Nonetheless, without clear mandate, the Clinton administration continued to contribute to international negotiations. On the contrary, the Bush Jr. administration changed radically the referential of the US climate policy. A few months after the failure of the conference of La Hague, in March 2001, the US announced that they would not ratify the Kyoto Protocol. They argued that scientific evidences of climate change were lacking, that there was no commitment from developing countries, and that mitigation policies could be costly for the US economy. An additional explanation to the US withdrawal comes from the fact that Russia and Ukraine had been attributed excess permits compared to their needs. Because of the economic depression they had been suffering from since the beginning of the 80's, these countries would have "free" carbon permits called "hot air" that they could sell on international markets, and more particularly to the US. This "hot air" thus implied important financial transfers from the US to Russia and was perceived as unacceptable by the American Administration.

From 2001, the trauma of the World Trade Center terrorist attack on September 9 strengthened a shift from a general multilateral approach in international negotiations to unilateral initiatives. The new strategy put the emphasis on voluntary actions, R&D and sectoral agreements. Developing adaptation strategies to climate change were also favoured to mitigation.

This new position put henceforth the pressure on Europe. If the Kyoto Protocol had a chance to be implemented, Europe had to show the way by effective emissions reductions to achieve its -8% objective of emissions reduction between 2008 and 2012 (first period of commitment). Europe positioned itself as a leader in climate policy "based on its willingness to take action at home"¹⁷. It did so through a range of policy and measures and "lead by example" the negotiations (Grubb and Gupta, 2000)¹⁸. The EU ratified the Kyoto Protocol in May 2002¹⁹ and launched a European

¹⁶ Following (Gupta and Grubb, 2000), the EU adopted an instrumental leadership i.e a based on tactics and the understanding of long term issue.

¹⁷ Blair Tony, Speech on the 10th anniversary of the Prince of Wales Business and Environment Programme, 14/09/2004

¹⁸ The practice of leading by example can be enhanced by the active promotion of ideas through international regimes.



Climate change program to fulfil its commitments. The package comprised in particular a project of European cap and Trade which resulted after intense negotiations between the Commission, Member States and lobbies to the world largest emission permit market, the EUETS launched in 2005. In 2007, the EU also adopted the Climate and Energy Package (EC 2008). The package set three main objectives for 2020: 20 % greenhouse gas emission reduction, 20 % energy efficiency improvement and 20 % renewable energy in total European energy consumption. It included a Strategic Energy Review focusing on both external and internal aspects of EU energy policy. A conditional commitment of an extension to a –30% objective in case of a more ambitious agreement was also included. The Commission continued to play a leading role in terms of proposals and coordination in all this process.

A complex European climate governance limits the EU's room for manoeuvre

During the implementation of the Kyoto Protocol, the multi-scale governance of the EU made the European decision making process related to climate policy increasingly uncertain. Despite a key role through all the decision making process, the Commission had to deal with national policy styles and stable community policies to find a consensus.²⁰ Indeed, although the Commission took on the role of think tank, initiator of policy proposals, it had limited room for manoeuvre compared to the council of ministers which voices members States' positions. At various times during the process, member States have shown some reluctance to a top down approach in climate policies fearing to lose sovereignty by a transfer of competence to the EU in terms of emissions reductions. Furthermore, contrary to the issue of the acid rains in the eighties, CO₂ emissions are the product of a wide range of activities. Reducing emissions affects for instance industry, electricity consumption, domestic heating, public and personal transport. Moreover, each country's response to the climate change issue is conditioned by the pre-existing organization of ministries and regulatory offices, economic incentives, and sectoral lobbies representing powerful veto groups.

Before the Kyoto Protocol, national interests fuelled policy communities at the European level to thwart the project of a carbon tax. Firms gathered in powerful associations (EURELECTRIC, EUROPIA) which essentially relayed the reluctance of the French nuclear industry (EDF and Framatome) and the German industry against any kind of constraints. The German government and industries also reached an agreement against any type of greentax which would offset the great restructuring of the German industry after the reunification. The UK, following Margaret Thatcher's stringency in the eighties, hated the idea of a new tax and European least advanced

¹⁹ The ratification involved ten new countries after the enlargement in 2004.

²⁰ International agreements involving the EU reflect the bargaining between member states and between the EU and the other parties – what Jachtenfuchs describes as a 'three- level game' Markus Jachtenfuchs (1996) *International Policy Making as a Learning Process? The European Union and the Greenhouse Effect*. Aldershot: Avebury



countries (Spain, Portugal, and Greece) edged against any attempt to limit their development. More broadly, policy networks which emerged around the climate change issue at the national and European level channelled the development of the European climate policy, ultimately favouring market based instruments and reinforcing another path dependency. Controversies around the concrete ceiling debate before la Hague conference (Gupta and Grubb, 2000, Hourcade and Gherzi, 2002) did not change the way Europe dealt with the content of climate policy designs. Moreover, as competencies about the climate change issue between the EU and member states are shared, the presidency and the Commission negotiated jointly. In la Hague, the Environment Council had not given the negotiators a mandate broad enough to make compromises on the EU's behalf. A second weakness was that individual member states followed their own avenues to the detriment of overall coherence.

Eventually, this complex multi-scale governance led to a consensus around an ambitious global 2K objective, but without background policy packages, especially for helping developing countries finance their transition to a low carbon society. This messianic position finally proved inefficient in the current phase of renegotiation of the Kyoto Protocol.

The increasing gap between the EU and developing countries: The Marrakech conference as a turning point of the negotiation

After the US withdrawal, COP-6 took place at Bonn in July 2001. The 180 countries gathered for that occasion agreed on a political agreement which was translated in legal terms during the Marrakech Conference (COP-7) in November 2001.

At the Marrakech conference, Europe played a key role in the final trade off between the three groups related to the implementation of the Kyoto Protocol. Europe made several concessions to the Umbrella group to make the implementation of the Kyoto Protocol easier. It agreed on a qualitative rather than a quantitative limit on the supplementary issue between domestic policies and flexible mechanisms and Russia, Japan and Canada received generous amount of extra emissions credits. Projects of afforestation or reforestation were made eligible to the CDM for up to 1% of the emissions. Confronted to the reluctance of Japan, Russia and Australia towards a compliance system, its adoption was postponed.

Finally, the Kyoto Protocol became effective in 2005 after being ratified by Russia (it was thus ratified by the necessary 55% of countries representing 60% of World emissions of greenhouse gases). Although it was a success for Europe, the balance of powers in international negotiations had already changed in favor of developing countries. Developing countries succeeded in obtaining new financing funds: an adaptation fund was set up to help the most vulnerable countries and a special fund for climates changes to promote the access to technologies and expertise to developing countries.



The active participation of the BRICS in the negotiations process shifted the primary axis of the negotiation from EU-US to developed-developing countries, especially after the freeze period following the withdrawal of the Bush administration.

Moreover, the European position showed a misunderstanding of the development challenges of developing countries in particular emerging ones. The Protocol partially brought answers to challenges in terms of development that developing countries would be confronted with in the future. In particular, no clear mechanism was set to tackle the huge need for infrastructure (transport, building) in emerging countries by 2050. Indeed, the agreement on emissions reduction targets stated in the Kyoto Protocol put aside the implementation of coordinated domestic policies and measures which were the central point of the European position before Kyoto.

Although OECD and Europe were committed by the UNFCCC to find a mechanism of financial and technical transfer, the content of the CDM (Clean Development Mechanism, see the previous section) was postponed to the next COP. By setting at the core of the framework a cap and trade mechanism, the Kyoto Protocol opened the door to path dependencies in terms of climate policies. Developed countries wrongly thought that developing countries would accept to share the remaining stock of emissions, in line with an objective limiting the impacts of climate change.

In parallel, significant funding for cooperation policies reflected the willingness of the EU to claim its soft power ambition in the framework of the United Nations (Vogler, 2007). In particular, the EU development cooperation policies claimed to tackle in priority climate change challenges in the least developed countries. But they favoured North-South countries relationships due to former colonial relationships and hence neglected to a certain extent emerging countries. One other reason of this discrepancy is that financial and technology transfers are much easier to set up towards these countries in comparison to emerging ones, which are becoming fierce economic competitors.

Furthermore, beyond rhetorical arguments, under the pressure of Northern European countries, EU policies aimed in priority at supporting innovation policies to adapt the European economy to globalization, as stated in the road map of the Summit of Lisbon in 2001.²¹ Development was more regarded as an issue of competitiveness rather than a global issue in terms of North-South relationships i.e technology transfers, life styles catching up between developed and developing countries, poverty alleviation etc.

Finally, specificities of European foreign policies, the increasing diversity and complexity of climate mechanisms (CDM, adaptation funds...) and myopic understanding of emerging countries' rising influence have to some extent limited the setting of comprehensive and innovative transfer policies between them and

²¹ The objective was to set the leading innovative society in the world by 2010



Europe.²² These institutional path dependencies locked the European “directional leadership” (Gupta and Grubb, 2000) in terms of reduction emissions and limited its adaptation to the fragmentation of the climate regime.

3. From Bali to Copenhagen: the marginalization of Europe, confronted to the China-Brazil-India-US axis (2007-2010)

Given that the first phase of the Kyoto Protocol ends in 2012, the negotiations process had to be re-launched in 2008 in order to prepare the post-Kyoto phase. The process had five targets:

- Elaborate a new framework succeeding the Kyoto Protocol and elaborating durable quota exchange system and compensatory mechanisms (CDM for instance).
- Integrate China and the US in the Accord. They were the two biggest emitters and had taken no binding commitment on their emissions.
- Determine a long-term (2050) global emissions target.
- Urge developing countries to adopt binding emissions targets by 2020.
- Institute a durable financing system, sufficient to help developing countries reduce their emissions and adapt to climate change impacts.

The Montreal and Bali conferences (2005-2007)

At COP-11 in Montreal (2005), COP-13 in Bali (2007) and COP-14 in Poznan, the process of international negotiations was thus re-launched (Guerin, 2008).

In Montreal, two negotiation frameworks supposed to work in parallel were instituted: the first one was dedicated to the future commitments of developed countries which had ratified the Kyoto Protocol (thus excluding the US) and was called the “AWG-KP” after the Bali Conference. The second working group, called after the Bali conference the “Ad Hoc Working Group on Long-term Cooperative Action under the Convention” or “AWG-LCA” aimed at coordinating the Parties to set long-term mitigation targets, but was not supposed to lead to any binding commitment.

²² Scientific investigation on the climate issue which has gradually emerged as a sub regime of the climate regime with its own institutions (Jäger et O’Riordan, 1996) has to some extent contributed to the decision making process and the setting of path dependencies in terms of policy options. In particular, economists have early addressed climate change issue research and set a community networks of modelers. The European Commission has developed its own referential in terms of economic approach which largely insists on a market based approach. Alternative perspectives challenging the theoretical framework of a single price and focusing more on domestic policies to address the specific issues of countries have been gradually marginalized. This setting may explain hypnosis effects of European decision makers noticed by some experts (Hourcade 2002).



These two working groups were supposed to work separately²³ and converge in 2009, before the Copenhagen conference, to include the US and developing countries into the negotiations process.

As they had been included in the Bali Action plan against their will, the US underlined the importance of their influence on negotiations for the after-2012 period, more than their determination to participate in the global effort. Besides, the perspective of the US presidential elections a few months later led most developed countries to refuse any quantified target.

Eventually, in the absence of tangible measures or targets, the Bali Action plan defined the guidelines of a new regime, which was articulated around five key issues of equal importance:

- The shared long term vision of a global architecture of cooperation.
- The setting of stronger action to mitigate GHG emissions in developed and developing countries, taking into account each region's constraints. In this framework, the Parties had to formulate structural proposals on the "burden sharing" issue.
- Adaptation to climate change.
- Technology transfers mechanisms.
- Financing for both adaptation and mitigation policies.

Until the Copenhagen Conference, Europe had been the only Party in line with the Bali Action Plan, with the adoption of the Energy/climate package. It contained commitments to reduce GHG emissions by 20% compared to 1990 levels by 2020, and provided for a more stringent target of 30% reduction in case a global agreement would be found in Copenhagen. It also contained reduction targets by 2050 in line with a 2°C rise of global temperature.

The Copenhagen Conference (2009) and the marginalization of Europe

The Copenhagen Conference was supposed to achieve the negotiations which had begun in Rio and to launch a new round of negotiations for the next decade. The conference gave rise to high expectations among civil society. Climate change had become a priority on the international agenda, and was tackled during the previous

²³ The possible fusion of the two working groups was a key point of controversies during the Bali Conference. Some developing countries favoured a single negotiation process to put the pressure on developed countries in terms of reduction emissions. On the contrary, the US feared that the fusion would imply binding commitments. Ultimately, a compromise was reached quite closed to the European proposal. The two working groups would work separately.



G8 and G20 summits and MEF (Major Economies Forum on Energy and Climate).²⁴ This has strengthened the idea that an ambitious agreement would be possible at Copenhagen. The third report of the IPCC published in 2007 (IPCC 2007) had pointed out the high probability of climate change due to human activities, and the media-related Stern Report had raised concerns about the cost of climate change (between 5 and 30% of GDP losses each year by 2050) (Stern 2007).

The outcomes were far below all these expectations. Even though 30 000 people attended the conference, an *a minima* non-binding agreement was reached. Moreover, in the last round of the negotiations, the EU was totally marginalized. Indeed, the schedule of the negotiations was dramatically ambitious. Technical negotiations rapidly got bogged down in the two working groups during the first week. The Danish presidency awkwardly managed the process, setting a draft agreement far before the end of the negotiations and too closely in line of the US position. Confronted to this heavy process and blocked negotiations, some head of States at the end of the second week shorted cut the traditional process of negotiations of the UNFCCC and reached to an agreement the evening before the end of the Conference. Actually, the main negotiators were the US, China, some member states such as France and Germany, and other BRICS such as South Africa.

In comparison to the outlines of the Bali Action plan, the outcomes of the conference were relatively modest:

- As regards the Shared vision, only “deep cuts” in emissions were mentioned in order to limit the increase in global temperature to no more than 2°C (para 2). No date of peaking emissions and global goal emission targets are mentioned.
- As for adaptation, the agreement parallels adaptation to the impacts of climate change and adaptation to response measures (e.g. because of oil revenue losses in OPEC countries). This comparison can be problematic as oil revenue losses will potentially be larger than adaptation needs.
- For developed country mitigation action, a bottom-up process called “pledge-and-control” was set up, and allowed each Annex I Party to define its own target level, base year and accounting rules. Even though these targets are ambitious, they are way below the necessary level to respect the 2° target.
- For the first time, developing countries commit to reduce their emissions, with both domestic efforts and the help of developed countries. A registry was established for listing NAMAs (Nationally Appropriate Mitigation Actions), financed by international support. The controversial point was the monitoring system to put in place as regards to these mitigation actions. China and India rejected all kind all binding system but ultimately agreed on a voluntary monitoring system of

²⁴ MEF includes 17 countries : Australia, Brazil, Canada, China, EU, France, Germany, India, Indonesia, Italia, Japan, South Korea, Mexico, Russia, South Africa, Great Britain and the USA. In 2008, the summit of l’Aquila, admitted the need of limiting the warming below 2°C related to the pre-industrial period (the EU official target).



"measurement, reporting and verification" in accordance with guidelines adopted by the COP (para 5) communicated each year.

- A "fast start" fund of \$30 billion was agreed on for the 2010-2012 period, to finance both adaptation and mitigation measures. Developed countries committed on a financing target of \$100 billion per year by 2020 and on the creation of a "Green Climate Fund" designed to channel a significant share of this financial backing.

The big come-back of a bottom-up approach in climate negotiations brought an unavoidable inconsistency as regards the climate target (see for instance Carraro and Massetti (2010) and Rogelj et al. (2010)). Indeed, the Kyoto "top-down" approach that started from a common global objective (e.g., the 2°C objective) and tried to derive it into consistent commitments for all country parties (the "burden sharing") gave rise to unsolvable disputes over the burden sharing rules and led to a deadlock of negotiations. Breaking this deadlock entailed a paradigm shift and the creation of a "bottom-up" approach, based on "pledge-and-control", at the basis of the Copenhagen Accord. This approach corresponds to the political economy of climate change negotiations realities: mitigating climate change requires ambitious domestic policies with potentially large economic impacts, requiring internal negotiations within each country, the results of which have no reason to be consistent with an accepted global objective.

During the Copenhagen Conference, the EU was marginalized in the crucial last hours of the negotiations. Even though European cohesion was used to being strong around environmental issues, the EU appeared disunited during the Conference. Actually, the strong emissions reduction objectives adopted the year before within the EU, and the financial consequences at stake, might have pushed Member States to participate individually to the negotiations. France, for instance tried vainly to set efficient bi-lateral cooperation with African countries. Indeed, the final agreement was finally concluded "by separating major developing nations from poorer-ones, while skating past European desires for a more comprehensive and binding agreement"²⁵. The European messianic position on mitigation was indeed undermined to a certain point. Comments concerning the European position were harsh against Europe: "the EU went into the conference with a strategy of leading by example (...) but has been widely criticized (...) for not marshalling other nations to follow and for ending up sidelined at the summit."²⁶

Europe ended up arbitrating the negotiations between the US and big emerging countries (China, India, Brazil and South Africa), and put pressure on them to obtain an Accord. To do so, Europe had to sacrifice all of its initial requirements, but managed to introduce for the first time the 2°C objective in the Accord. As for emerging countries, and more particularly China, they have gained a leading role in

²⁵ Kanter James, EU blames others for « great failure » on climate, New York Times, 23/12/2009

²⁶ Kanter James, op. cit.



the negotiations process, to the detriment of Europe and the least developed countries. The new place they have acquired within international organizations is a disruption in the game rules and shows a turning point in climate negotiations.

Cancun (2010): Europe looks for a place in an more fragmented climate regime

The key challenge of the Cancun summit after the disillusion of Copenhagen was to save the process of setting a sound foundation for meaningful, long-term global action. The outcomes went past the expectations.

The text approved in Cancun is far from solving the climate problem but is a basis for effective international action on climate. It repeats the 2 °C target and the need to reduce global emissions as soon as possible. For the first time, rich and developing countries agreed on climate targets within the UN framework, even though the nature of their commitments is different. The agreement confirms the transition from a pure burden sharing vision to a “pledge and control” approach, and defines a system to monitor and verify emissions reduction efforts in developing countries, providing tools to implement policies to support them financially, and to verify that countries fulfill their commitments. By accepting this new system, India, Brazil, China and other developing countries showed their willingness to compromise and give credibility to their domestic efforts on climate.

The agreement also creates a framework for adaptation in developing countries, with the creation of a committee of adjustment, regional centers to facilitate the development of adaptation policy, and a system to assist developing countries in the development of national adaptation plans. It also launches a process of reflection on a mechanism to assist countries affected by natural disasters and climatic shocks. The text also establishes the Green Climate Fund, provides the procedures for its governance and operation, and repeats the goal of providing \$ 100 billion per year to help developing countries reduce emissions and adapt to climate change. Finally, the text sets up a mechanism to fight against deforestation in South countries, and includes commitments to reduce emissions from land use in developed countries.

However, the text has no legal value, and nothing will force countries to meet their commitments, except the desire to preserve their reputation and credibility. In addition, emissions reduction targets come from the Copenhagen pledges, and are largely insufficient to limit global warming to 2 °C, even though this objective is reminded the text. In the absence of a greater involvement of the US, unfortunately it was unthinkable to go further in this area, especially since the loss of Congress by Democrats makes even more unlikely the establishment of a law ambitious climate in the United States in the coming years. As for the Green Fund, it is certainly a first step towards more efficient funding for developing countries, but the source of that money remains uncertain, while states deficits are huge and no progress has been made on innovative financing (tax on international transport and financial transactions).

Finally, the commitments made under the Kyoto Protocol expire in 2012, and it is imperative that decisions on the continuation of the process are made quickly. At the



latest, a solution must be found at the Durban conference in 2011. But Japan - followed later by Russia - has opened the Cancun conference announcing its refusal to take part in this second phase, as the major emitters like China and the US are not involved. And without Japan and Russia, there is almost nothing left for Europe to discuss on the idea of a second Kyoto phase. If Europe refuses, there will be nothing left of Kyoto. The decision on this difficult point was postponed to Durban, despite the insistence of developing countries for rich countries to undertake a second phase as soon as possible.

If Kyoto disappears, the agreement reached in Cancun will be crucial, as it would be the only UN agreement on climate change with targets for emissions reduction and financial flows facilitate both mitigation and adaptation in developing countries.

The Cancun agreement saved the UNFCCC process: countries have clearly said they had accepted a text which did not completely suited their wishes, because they had felt the whole document was well balanced and they had the impression everyone had made concessions. Only Bolivia, completely isolated, persisted in refusing the text which was considered too modest, in spite of the most vulnerable countries' urgings. Europe can also see this agreement as a diplomatic success even if its level of ambition remains below their requirements. As Bodansky (2011) notes "apart from the European Union, which has pledged to boost its emissions reduction target from 20% to 30% as part of a global deal,⁴³ there is little indication that countries feel this way". Most importantly, while they are so often criticized for focusing on their national interest, the major emerging economies have shown their willingness to make concessions and to advance on the climate issue.

Conclusion

This chapter has pointed out the main contribution of Europe to the establishment of an international integrated climate change regime. The international recognition of the climate change issue provided new perspectives for the European diplomacy and re-launched the European institutional dynamics after a decade of deadlock and euroscepticism. The Commission has been the main policy entrepreneur of this process, relying on an opened policy network. This setting definitely contributed to make institutional arrangements easier between member states and EC institutions. Nonetheless, the multilevel European governance complicated the task for Europe to speak as one on the international stage. As long as attention was high and scientific issues were the focus, it was easier to reach consensus, even on weak targets, and Europe benefited from a significant breathing space. But as soon as the debate focused on policies and measures after the Rio summit, national interests expressed their opposition to any type of initiative with short term negative impacts on their economy. Paradoxically, at the same time, Europe became the leader of the



negotiation, in particular after the withdrawal of the US. This setting gradually undermined the European position in negotiations.

In line with the first framing of the climate change issue, a path dependency in terms of climate policy design has emerged favouring energy security options at the expense of development and cooperation options towards developing countries. As policies drew on a cap-and-trade approach, the Kyoto protocol framework provided partial responses to the sustainable development issue. This climate-centric drift of negotiations could not but lead to an impasse in a context of financial crisis and rebalancing of world economic powers. It is indeed impossible today (i) to ask new middle classes in emerging economies to slow their access to decent living conditions if not affluence, (ii) to do as if a priority was given to long term risks without a due attention to the whole set of priorities of the Millenium Assessment (Johannesburg, 2002) including poverty alleviation and the prevention of a dualistic world development (iii) to ask populations from OECD countries, weakened by massive unemployment and worried about the sustainability of their welfare benefits, to pay the entire climate bill including compensating transfers towards the developing world.

The current emergence of multilateral exchanges between developed and developing countries may open new perspectives for the European climate policy. But until now, no clear alternative to a broad market exchange of permits has emerged except, to a certain point, the CDM and adaptation funds. Considering that emerging economies will build the bulk of their infrastructures over the next decades and might be very soon locked in carbon intensive development patterns, there is a narrow window of opportunity for shifting the content of investments in energy, building, transport and end-use equipments. In absence of domestic carbon prices to change the complex set of economic signals, climate finance appears as a good candidate to align development objectives with low carbon bifurcations, if it is inserted in a global view of the climate-development issue. Besides, the Cancun Agreement establishes a Green Climate Fund and future "market-based mechanisms to enhance the cost-effectiveness of, and to promote, mitigation actions" (Cancun Agreement, paragraph 80). In addition to that, reforming the financial system could be necessary to avoid repeated financial crisis and to reorient a significant part of the world savings towards investments that could trigger a long wave of "sustainable growth".

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Chapter 2: Building a few scenarios for innumerable energy and climate futures

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Introduction

The first chapter of this deliverable addressed the evolution of climate negotiations, through the lens of the role of Europe (the EU and member states) in the establishment of intergovernmental governance on climate change. This first step is somehow necessary to build scenarios on future climate policies. Indeed, the responses to the intertwined issues of energy security, environmental safety of large scale alternatives to fossil fuels (nuclear, biofuels) and climate change depend critically upon the articulation between the negotiation of formal regulatory regimes (e.g. Kyoto framework) and the policies conducted at the regional and national levels.

Also, a numerical foresight is necessary to disentangle the many facets of these issues because the energy/environment interface depends, beyond the energy sector, upon a) dynamics in sectors such as transportation, urban infrastructures, agriculture and land-use, energy-intensive industry, b) the global dynamics of the world economy, including industrial competition, trade flows and capital markets, with, at this latter stage, a critical role of the magnitude and sharing of the oil rents.

The purpose of this second chapter is thus to delineate socio-economic scenarios coherent with that of WP1, and which identify current and future challenges related to the analysis of mitigation policies, and, to some extent, to the analysis of impacts, adaptation and vulnerabilities to climate change. These scenarios will then be translated into numerical exercises with the IMACLIM-R model.

1. Objective: eliciting the development-climate Gordian Knot

The shared diagnosis underlying this proposal is that the development of economic scenarios should internalize the objective of better informing policy debates about how various visions of future long term development pathways affects the content, the efficacy and the social costs and benefits of adaptation and mitigation policies.

This paper provides a proposal for the production of scenarios that stems from the following four policy-oriented concerns:

- To clarify **catching – up (or differentiation) dynamics**, not only in terms of per capita GDP growth but also in terms of physical development patterns. These dynamics are not determined by pure economic decisions; they involve political bargaining, households' preferences and are far from the classical ``carbonomics.'' Yet, these patterns are essential in determining and describing economic growth, and more particularly its energy content, as they affect the



need for energy services in sectors such as transport or dwellings. The articulation between consumption styles, technological and localization patterns (C-T-L) is a critical parameter for the energy future with and without climate policies for any region in the world. However, the major uncertainty is about how this articulation will be made by developing countries in the next decades. Even though the economic context will matter in the shaping of development patterns, it will do so together with infrastructure decisions that involve political bargaining, as well with the evolution of households' preferences in various cultural contexts.

- To delineate **the interplay between climate policies and sustainable development**, including energy security and poverty alleviation, in a context of long-term changes such as ageing, migrations, higher capital mobility and evolving world trade organization;
- To investigate **the relative role of energy and non-energy parameters and policies** in the achievement of high or low emission stabilization targets;
- To detect the **long-standing implications of short term development options** both for climate change and for overall development sustainability – this applies primarily to the dynamics of infrastructures and land-use, with a strong concern for technological and structural lock-in.

2. Methodological challenges

Short, medium and long-run: linkages and path dependencies

The disconnection between very long run scenarios and scenarios examining short term policy issues should be reduced as far as possible and this for many strong reasons. First, negotiations will be conducted mostly on medium term objectives, and the “passing points” between today and the end of the century are critical. Second the analysis of costs (or double-dividends) of early action cannot be separated from the impact of these decisions on the carbon content of growth over the medium and long run and of the differentiation and the sequencing of decarbonisation efforts amongst countries and sectors. Third, short and medium term emission trends will determine the pace of global warming and the magnitude of the environmental irreversibility effect.

The main challenge is the question of the path dependencies of development patterns and emissions trends, in particular those created by the building and transportation infrastructures in developing countries, the investments in electrical sector, the orientation of R&D, the dynamics of land uses.

Endogeneization of scenario variables, to avoid the combinatory gap

The **determinants of GHG emissions** can be grouped into three categories:



- The **economic growth engine** (demography, productivity growth and catch-up assumptions, savings, capital flows, fragmentation or integration of the world economy).
- The content of the **development patterns** (consumption patterns, technological styles, land cover and localization of activities, patterns of income distribution).
- The dynamics of the **energy systems** (energy efficiency, technological options on the supply and demand sides, fossil fuel resources) and the final price of fossil based energies.

A common ambition for energy-economy modellers should be to further endogenize the interdependences between these parameters, making for example GDP growth and structural change result from the interplay between the growth engine, the characteristics of development patterns and the energy markets. In particular this implies to consider a comprehensive endogenous growth engine – not only endogenous technical change, but also endogenous structural change and growth – when it is possible to get robust estimations of real mechanisms.

Non optimal baselines

The common practice is to use compact macroeconomic models or multi sector computable general equilibrium models for projecting equilibrated growth pathways (often optimistic for reasons of political correctness) and to represent environment policies in the form of new constraints altering these trends. This constitutes an intellectual obstacle to detect the possible leverage effects between climate policies and development since real sustainability challenges come primarily from:

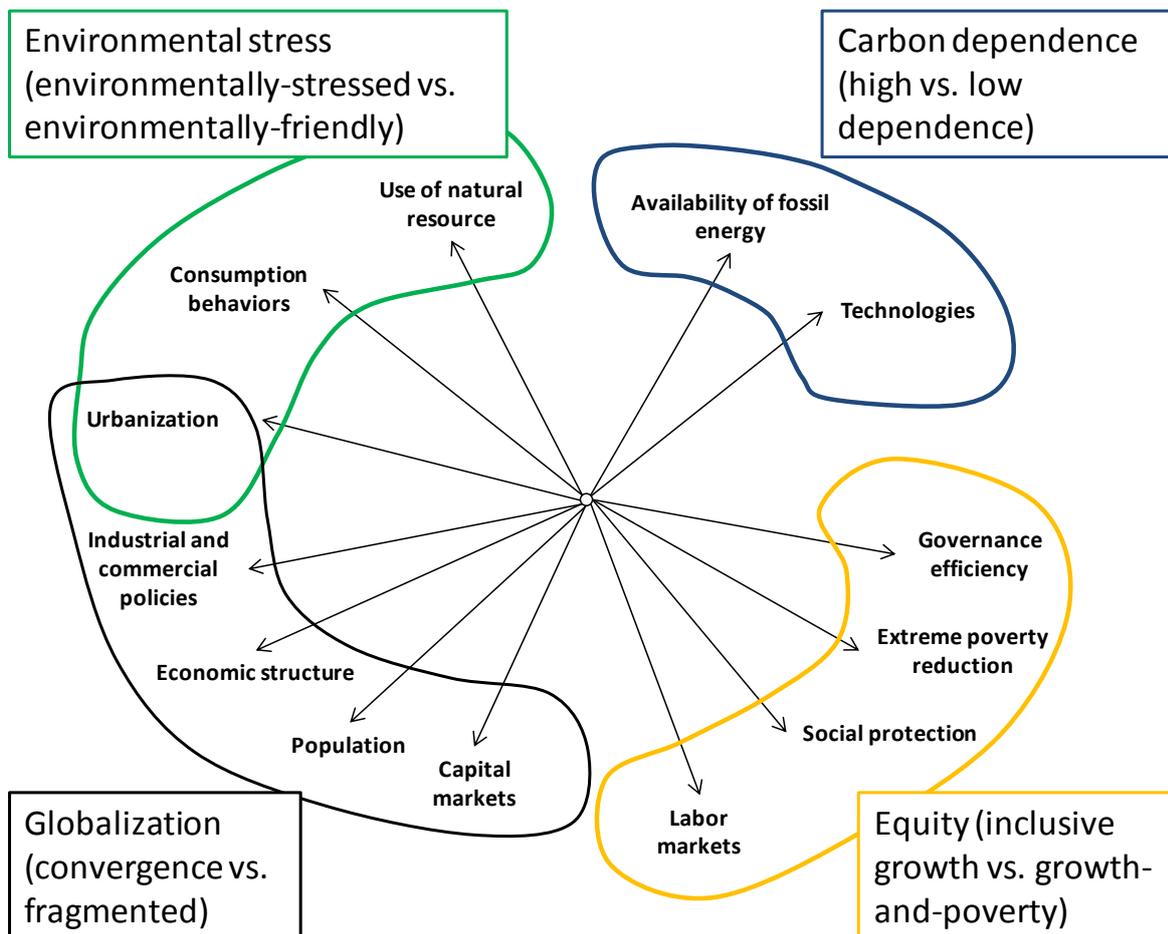
- **imperfections in the economic machinery**, the hallmarks of which are the existence of incomplete and fragmented markets (multiple discount rates, unequal marginal costs across sectors & regions), weak policy regime, poor governance, under protected property rights and dual economy in perpetual reformation;
- **fuzziness of economic signals and non economic information** and delays in perceiving ultimate consequences of current decisions. This inhibits timely actions and triggers higher transition costs to adapt to changes of the economic context (energy shocks, sudden moves in capital flows, over or under estimation of long term demand in rigid sectors);
- **feedbacks from climate change and degradation of local environments** : it is indeed increasingly misleading to project baseline 'at constant natural environment' since the coupled feedbacks from changes in environment and climate will generate stresses on natural resources (e.g. water, ecosystems) and degradation of land and labor productivity.

3. Scenario development

Scenarios aim at informing policy debates about how various visions of future socio-economic conditions affect (i) mitigation efforts required to achieve particular radiative forcing pathways, (ii) adaptation efforts that could be undertaken in response to the climate change associated with those pathways, and (iii) residual impacts. Even though the AUGUR project focuses on the period before 2030, it is important to build narratives that are relevant for IAV (Impacts, Adaptation and Vulnerability) analysis for the medium and long-term coherence.

Narratives development

We propose to build the narratives from a combination of four choices, one for each of the four following dimensions:



- **A “converging” world vs. a “fragmented” world.**

In a converging world, the economic structure of developing countries converges rapidly toward the structure of industrialized countries. For instance, the share of agriculture in their economies decreases in terms of GDP and exports. Also, available technologies are similar in industrialized and developing countries; and urbanization



rates converge around rich-country standards. Developing countries have a demographic transition so that population ageing converge and global population growth rates decrease.

In a more fragmented world, conversely, developing-country economies catch up more slowly, and they remain for an extended period of time based on agriculture, raw-material extraction, and tourism. These countries remain largely rural. In such a world, developing countries are more dependent on rich countries for high-technology goods and can balance their imports only thanks to low-value-added goods and services. Population remain young in developing countries, with high fertility and mortality rates, and global population growth rates are higher than in a homogenous world.

This dimension is mainly about changes in economic structures and not trade and openness, even though a converging world has more international trade than more fragmented ones. Indeed, in a homogenous world industrial and commercial policies seek for export-led growth, while a fragmented world induces a more inward-oriented growth. In such a world globalization of financial markets is limited while in a homogenous world capital markets are integrated.

This dimension is important for IAV (Impacts, Adaptation and Vulnerability) analysis for two main reasons. First, agriculture in developing countries is likely one of the most negatively affected sectors by climate change (Lobell et al., 2008). In a more homogenous world, these countries would be less vulnerable because agriculture becomes less important in their economy. They would also be at reduced risks of food insecurity because of better access to world food markets thanks to alternative non-agricultural exports (Chen and Kates, 1994). Second, the future of urbanization matters because urban and rural areas have different main vulnerabilities (e.g., flood in urban areas vs. droughts in rural areas). Population matters because it has important impacts on food security, flood risks or housing.

This dimension is relevant for MP (Mitigation Policies) analysis because the economic structure of developing countries will determine their energy consumption and production. In a fragmented world, since developing countries remain mainly rural and based on agriculture, their energy consumption is similar to their current one, i.e. much lower than in developed countries. In a converging world, developing countries' energy consumption will depend on the other dimensions, for instance the type of technologies available and the magnitude of urban sprawl. Population growth rates are important for MP analysis because higher population growth rates imply higher energy consumption. Even though it is not very well understood yet, population ageing is important as well, because it might be accompanied by a decline in the number of people per household (a process already observed in industrialized countries). As small households consume more energy per person than large households (Ironmonger *et al.*, 1995), CO₂ emissions might increase with increased aging (MacKellar *et al.*, 1995).



- **An “inclusive development” in which extreme poverty disappears rapidly vs. a “growth and poverty” development with a significant share of people remaining below the poverty line.**

In an inclusive world, poorest communities have a voice in political choices, national governance takes into account poverty reduction as an important policy goal, and policies are successful in reducing the share of people in extreme poverty. Social protection is reinforced so that almost everybody gets access to basic services, such as health services, education, energy and transport, drinking water and sanitation, financial services, secured land tenure, risk management practices. Labor markets are less flexible, with an increase in minimum wage.

In a more “poverty and development” oriented world, a fraction of poor-country population is excluded from these services. Labor markets remain much more flexible in developing countries than in developed countries.

This dimension is partly independent of the previous one, because extreme poverty may either disappear or increase in countries, regardless of their aggregate development and economic growth.

This dimension can also include differences in terms of governance efficiency. In particular, in an inclusive world environmental policies are likely to be more efficient than in a “poverty and growth” world. Conversely, a non inclusive world can include a lack of government regulation that often implies the existence of a huge informal sector (Gerxhani, 2004). Indeed, in such a world, informal market labor is likely to be widely developed (undeclared labor, lack of social benefits, sub-minimum wages, poor working conditions, etc.) (Palmer, 2008). Other phenomena such as “tax evasion” can also be important with large consequences on energy consumption in case of the implementation of a carbon tax for instance.

This dimension has consequences on MP analysis because today 20% of the global population lack access to electricity and 40% of the global population rely on traditional use of biomass for cooking (IEA, 2010). The burning of biomass in inefficient stoves emits black carbon, which plays a large role in global and regional warming (Luoma, 2010). In a “strong governance world” households can climb more easily the “energy ladder” (Reddy, 2000; Reddy and Balachandra, 2006). An “inclusive development” world implies universal electricity access and an expansion of household access to modern fuels. This would increase global energy consumption compared to a “poverty and development” world, but improved stoves and greater conversion efficiency would reduce its GHG content (IEA, 2010).

It is important for IAV analysis to take into account this dimension because poor communities are considered the most vulnerable to climate change (Smit and Wandel, 2006). They are more exposed to environmental conditions (e.g., their access to natural resources like water is not mediated by infrastructure). They have also to cope with multiple stressors (O’Brien et al., 2004) and have less capacity to adapt, because of lower financial capacity, education and health, institutional capacity, or political weight for instance (Yohe and Tol, 2001).



- **An “environment-oriented” world vs. “environmentally-stressed” world.**

In an environment-oriented world, policies, technologies, management practises and lifestyles lead to an efficient use of natural resources and reduce environmental stresses. There is a differentiation in consumption behaviors, each region yearning – or being enforced – to follow a more energy-sober development style.

In an environmentally-stressed world, water-use is inefficient, energy and mobility demands are growing. Potential for adaption technologies (e.g. salinization, trade of agricultural goods, water transport, agriculture fossil-fuel based inputs) is high. Soil depletion and degradation are accelerated and reduce agriculture productivity and increase natural risks (e.g., floods). Biodiversity losses are large. In this world, the use of natural resource is already creating environmental stresses, even without climate change, and climate change impacts affect already vulnerable environments.

This dimension is largely independent of the previous ones, since economic development and poverty reduction may be done – temporarily – with or without efficient use of natural resources.

It matters for IAV analysis because ecosystems ability to cope with climate change depends on the other stresses they have to cope with (Noble et al., 2005), and because additional resource scarcity from climate change can have different consequences depending on how they are managed. For instance, reduced rainfall has larger economic consequences if existing resources are already stretched by inappropriate agriculture production and if ground water is not usable because of pollution or salinization (Arnell, 2004).

This dimension is important for MP analysis because mobility preferences and spatial organization determine the energy content of economic growth through the populations’ need for energy services. Furthermore, consumption preferences will determine investments in new infrastructure in the transportation and residential sectors, and thus the ability of these sectors to react to mitigation policies and reduce emissions. Indeed, the sectors of the economy are characterized by significant inertias in installed capital, infrastructure and behaviours that cannot be changed overnight. In some sectors, productive capacities and infrastructures have lifetimes of several decades (IEA, 2000; Worrell and Biermans, 2005). For instance most industrial installations have lifetimes over 30 years while urban infrastructure, transport infrastructure and some building have lifetime over a century. This inertia constrains the pace of possible decarbonisation of the sectors, and a lock-in of the transportation and residential sectors in carbon-intensive pathways can have very important consequences on mitigation costs. Accordingly, an “environment oriented” world has a larger capacity to mitigate climate change than an “environmentally-stressed” world.

- **A “low carbon dependence” world vs. a “high carbon dependence” world**



In a “low carbon dependence” world, the availability of fossil energy is low. World oil resources are scarce, with an oil production reaching its maximum level before 2020, and gas and coal are expensive to extract. Potential for new technologies is high, and it is easy to orient technical change towards mitigation. Low carbon technologies such as electric cars, biofuels, CCS (Carbon Capture and Sequestration) and renewable energy sources are easy to develop, because of a low inertia in the renewal of equipments and fast technical progress.

In a “high carbon dependence” world, fossil fuels are largely available and fossil energy prices thus remain low for a few decades. The pace and direction of technical change favors carbon intensive technologies and carbon alternative liquid fuels (e.g. Coal-To-Liquids).

This dimension is partly independent from the previous one because it is driven by geological parameters and some technical parameters independent from the agents’ choices (the pace and direction of technical change is partly exogenous and partly endogenous since it depends on learning-by-doing mechanisms and investments in R&D).

It matters for IAV analysis because carbon dependence will determine the potential for developing adaptation-friendly technologies (e.g. use of desalinization and air conditioning).

It is important for MP analysis because mitigation policies will be cheaper if fossil energy prices are high and low carbon technologies are easy to develop. In a world locked in a carbon intensive pathway because fossil energy is cheap, mitigation potential is very thin.

Scenario building

The scenarios will be built from combinations of these four axes, to match as much as possible the CAM model scenarios.

Scenario (1): Consolidation

In this scenario we are in a converging world with growth and poverty. This world is environmentally-stressed and has a high carbon dependency.

In this world the economic structure of developing countries converges rapidly toward the structure of industrialized countries, and capital and labor markets converge as well. There is no increase in the role of the states, labor costs are thus reduced by a low fiscal pressure, which however increases income inequalities. Growth is founded on inequalities, and must be driven by the richest. A large diffusion of the US consumption style is ambioned, and management practises and lifestyles lead to an inefficient use of natural resources, which increases environmental stresses. The access to such a lifestyle might however be limited by the inequalities, and only rich people might have access to energy-intensive lifestyles. This scenario is accompanied by important migration flows. In this world fossil fuels are largely available and the pace and direction of technical change favors carbon intensive technologies and carbon alternative liquid fuels.



Scenario (2): Bipolar (or tripolar)

In this scenario we are in a fragmented world with growth and poverty. This world is environmentally-friendly and has a low carbon dependency.

Globalization is fragmented with different growth regimes in different parts of the world. This world is a mixed world, with relatively rapid technological development in low carbon energy sources in key emitting regions, leading to relatively large mitigative capacity in places where it matters most to global emissions. It is however unclear whether these capacities could be used, and we might subdivide this scenario in two scenarios depending on life-styles choices in key emitting regions (US and China mostly). In other regions development proceeds slowly, inequality remains high, and economies are relatively isolated, leaving these regions highly vulnerable to climate change with limited adaptive capacity.

Scenario (3): Regionalization

Globalization is fragmented with different growth regimes in different parts of the world, since the lack of harmonization in regulation leads to inward-oriented growth patterns enforced by protection policies such as capital control. A high equity concern implies strong redistributive policies in all regions, but no convergence in labor markets regulation or social protection. This fragmented world with inclusive growth implies intermediate levels of economic development, and relatively rapid and diverse technological change. The emphasis is on local solutions to economic, social, and environmental sustainability. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels. In this scenario carbon dependence is ambiguous and we might subdivide it in two scenarios.

Scenario (4): Multipolar governance

In this scenario we are in a converging world with inclusive development. This world is environmentally-friendly and has a low carbon dependency.

This world is convergent, development proceeds at a reasonably high pace, with rapid changes in economic structures toward a service and information economy, and with reductions in material intensity. Inequalities are lessened, technological change is rapid and directed toward environmentally friendly processes, with the introduction of clean and resource-efficient technologies including lower carbon energy sources and high productivity of land. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity.

4. Key parameters for these scenarios in the IMACLIM-R model



Globalization

- **Income distribution:** Gini curves will be added to the model, as well as the level of informal economies prevailing in growth pathways and the number of people living below the poverty threshold. More specifically, in some regions a detailed description of informal energy consumption in the residential sector will be modeled.
- **Labour productivity and catch-up:** labour productivity will stay constant in the informal sectors while it will grow in the formal ones. We will thus need to carefully consider initial productivity gaps and partial vs. full catch-up at the sector level. Then, equations driving this parameter should take into account the sum of cumulated investments in each sector in each region, so that the effective catch-up rate (high or low) would depend on endogenous economic growth (assuming that 'leader economies' will follow mean productivity growth rates between 1.6% and 2% per year). The high and low catch up rates would ultimately be combined with assumptions about the evolution of informal sectors to determine the overall catch up of emerging economies.
- **Saving rates and ageing:** in all regions, the secular evolution of the saving rates is correlated with the pyramid of age and, especially in developing countries, with migration flows and money flows from migrants. Scenarios could benefit from an overlapping generation analysis, in which the evolution of regional saving rates hangs on assumptions about risk aversion, pure time preference and long run interest rates.
- **Capital flows:** the evolution of each region's capital account could be given by WP1 for instance.
- **Capital deepening** trends have to be checked (around central values) to fit with realistic ICOR values.

Equity

- **Fiscal pressure and government spending.** Government spending will be bounded according to three assumptions: (i) the "European pattern" with an increasing upper limit towards the European standards, (ii) the "US pattern" with a decreasing upper limit towards the US standard, and (iii) a "stability pattern" with a constant boundary. Actual spending will then be a function of income and of the respective shares of young and elderly people in each population.
- **Labour markets rigidity:** the wage curve elasticity can be adapted according to the different assumptions on labour markets convergence.
- **Wages indexation on labour productivity growth:** this indexation can be modified according to the different assumptions on social cohesion and equity.



Environmental stress

Assumptions about consumption styles, technology and localisation patterns may be combined into two contrasted visions of development over the 21st century:

(1) ***deepening and generalization of post-war II development patterns*** that basically continue on existing trends with a progressive convergence of all societies towards high levels of material consumption (with due adaptation to local conditions), standardization, economies of scale, 'just in time' stock management;

(0) ***re-switching and tunnelling towards an alternative pattern*** in which some of current trends are altered, for reasons unrelated with climate concerns, to achieve a less material intensive development ('service and information society'). In this hypothesis, developed countries progressively change their development styles whereas developing countries bypass the most material intensive phases of development.

These two visions will be declined for following three sets of assumptions:

- **Consumption styles:** the (1) and (0) patterns incorporate respectively high and low assumptions regarding a) saturation asymptotes for demands of energy consuming services such as housing space or electric devices b) preference for mobility (short and long distance);
- **Technological patterns:** the (1) and (0) patterns are separated by different assumptions about a) the material content coefficients b) the substitutability potential between metals, fossil based feedstocks and bioproducts (bioenergy, biomaterials) c) the infrastructure choices in construction and transportation d) the transport input in production,
- **Localization patterns:** the (1) and (0) patterns will be characterised by high and low levels of households mobility demand (in consistency with assumptions about individual preferences and infrastructure policies) and territorial distribution of populations and activities (strength of the ocean coastal drift). The latter distinction is critical to elaborate consistent land cover scenarios and their implications for the carbon cycle (deforestation).

Carbon dependence

Carbon dependence is not a parameter in itself, but rather the conjunction of several mechanisms: availability of fossil resources, influence of oil-producing countries on prices, ease to shift from a carbon intensive economy an economy that uses few fossil resources.

- **Oil, gas and coal markets:** we describe (i) the amount of oil ultimately recoverable resources; (ii) the extend of Middle-East investment to postpone depletion at the oil field scale; (iii) the inertia in non-conventional oil production development; (iv) the indexation of gas prices on oil prices and (v) the coal price growth sensitivity with respect to coal production growth.



- **Middle-East strategy:** the Middle-East is a “swing producer” (Rehrl and Friedrich, 2006) that benefit from market power and can adjust its production to manipulate the oil price over the short-run.
- **Alternative liquid fuels supply:** we describe the ability of biofuels and CTL (Coal-to-liquids) to penetrate the energy markets.
- **Carbon free options for power generation:** we describe the ability of renewable electricity generators, carbon capture and sequestration (CCS) and nuclear plants to penetrate the electricity-generation capacities.
- **Energy end-uses technologies:** we describe the more or less rapid deployment of new technologies in the transportation and residential sectors (e.g. electric vehicles, very low energy buildings).

5. Policy mixes to achieve GHG stabilization scenarios

For each scenario, climate policies will be computed. The relevant policy mix will be constructed according to the assumptions on development patterns and equity concerns of each scenario. For instance we assume that ambitious climate policies are difficult in scenarios in which the world is fragmented.

The emissions profiles retained for the stabilization scenarios can be adjusted to some exogenous cost-minimizing profiles (in aggregate GDP terms) for each region under a fully idealized when and where flexibility assumption with full participation of all countries to a climate regime beyond 2012.

Not to enter the complex issues involved in the precise definition of such a climate regime and since a fully-fledged emissions trading system amongst all economic agents is unrealistic given the asperities of the real world, stabilization scenarios could, **in a first step:**

- assume the existence of a single world carbon price applied to all gases;
- interpret this price as resulting from a carbon trading system amongst Parties (in the Kyoto sense) to which emissions allowance have been given in such a way that no import or export is economical for none of the regions or countries,
- let governments convert this world price domestically at their convenience (carbon taxes, emissions quotas at the sector level, pricing differentiation in function of income levels etc ...) to account for the specifics of their economies or any social constraints;
- assume that governments take any complementary measures helping to reach the final target at a minimal social cost (efficiency standards, modal choices in transportation, urban infrastructures),
- assume that countries experiencing more significant transitory or permanent GDP losses than others will remain in the system and that international community will

assist them (loans, assistance to dedicated investments) in minimizing these net losses.

The **variants** of stabilization scenarios could basically concentrate on three dimensions:

- Make explicit ***economic signals that may swamp carbon price signals*** as a major component of climate policies – this concerns in particular the prices of land and real estates, wage adjustments, the heterogeneity of capital costs (risk premium included) amongst countries and sectors;
- Capture the impact of ***regulatory uncertainty*** and ***price volatility*** on the efficacy of deployment of climate policies and alternative technologies, in view of examining what combination of policy tools would minimize the perverse effects of these parameters and enhance the incentive to innovate on both the demand and supply side.
- Examine the ***time tables of policies*** (binding emissions targets, carbon markets and/or carbon taxes, other pricing policies, non price measures, compensating transfers) capable to minimize the transition costs towards a stabilized fully-fledged climate regime governed by a single carbon price

The basic assumptions behind these policy variants is that, even though the assumption of a unique world carbon price applied from now on and without complementary policies is a very useful benchmark for policy analysis, it does not correspond to an optimal policy in a 'second best' economy with sharp political constraints. Variant scenarios should thus relax this assumption, accept the ***transitory existence of disparities in levels of carbon pricing*** and examine the following policy issues:

- *Timing of various forms of commitments* and pledges by countries for a fragmented and progressively converging regime;
- Content and timing of policies *on non-CO2 gases and carbon sequestration*;
- Content and timing of *infrastructure policies*;
- *Differentiation of policy signals* across sectors (energy, industry, land transports, aviation and shipping, agriculture);
- Design and timing of policy tools to alleviate transitory tensions generated by the emergence of a carbon price: international transfers to mitigate *the adverse effects on low income populations* and/or to launch early policy signals to reorient investments in infrastructure sectors, sectoral approaches for exposed energy intensive industry.

Example of climate policy regime

Countries could be divided in three groups:



Group I: USA, Japan, Canada, Australia, New Zealand, and “Greater Europe”, consisting of EU-27, Norway, Switzerland, and Iceland, and the Non-EU Eastern European countries including Belarus, Ukraine, Moldova.

Group II: Essentially all developing countries with the exception of several identified non-participants (the third group). Technically, all countries not included in Group I or III. Included are China, India, Brazil, South Africa, OECD members Korea, Mexico, and Turkey, and most other countries in Asia, Latin America, and Africa. This group could be subdivided between emerging and “vulnerable” countries.

Group III: The third group of countries includes fossil energy resource owners that may have little or no incentive to participate in a global climate policy regime. Included are Russia, the (Central) Asian Former Soviet Union countries (Armenia, Azerbaijan, Georgia, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan and Kazakhstan), as well as Middle East OPEC countries Saudi Arabia, Iran, Iraq, Algeria, Libya, Kuwait, Qatar, and UAE.

A target could be a 50% reduction of global emissions (CO₂ equivalent emissions including all Kyoto gases calculated on the basis of 100 year GWPs) in 2050 relative to 1990. In this scenario, Group I and II countries adopt this target, and aim at a 50% reduction of their combined emissions relative to 1990. Regional emissions caps could be distributed as follows:

Group I: 80% emissions reductions relative to 1990 in 2050. Caps in years between the present and 2050 are determined by applying a linear schedule originating at baseline level for 2012.

Group II: Adoption of emissions constraints through 2020 corresponding to Copenhagen pledges. These include a variety of instruments (notably intensity targets for China and India), and many countries in this group made no pledges. Group II countries make reductions necessary to achieve the goal of 50% reduction in combined Group I and II emissions by 2050. This allowable total is allocated across regions/countries in the second group according to 2020 allowable emissions (grandfathering), and a linear schedule between the two points will determine the constraints in intermediate periods.

Group III: Unconstrained emissions throughout the 21st century. This group of countries includes fossil energy resource owners that may have little or no incentive to participate in a global climate policy regime.

Full when and where flexibility of emissions reductions among Group I as of 2012, and among Group I and II countries as of 2020 could be allowed. As a consequence, physical emissions will differ from emissions rights assigned by individual caps.

Conclusion

This second chapter has identified current challenges related to developing socio-economic narratives and scenarios for the analysis of response strategies to climate



change. It offers perspectives to develop scenarios around four axes that can better facilitate communication between the different work packages of the project. Indeed, addressing the issues of climate change and energy security requires taking into account demographic, social, economic, technological, and environmental developments. Our proposal is in line with the current IPCC process of building new integrated scenarios, to facilitate research and assessment that can characterize the range of uncertainty in mitigation efforts required to achieve particular radiative forcing pathways, in adaptation efforts that could be undertaken in response to the climate change associated with those pathways, and in residual impacts. Therefore, to provide a basis for characterizing uncertainty in mitigation and adaptation responses, the IPCC new socio-economic scenarios will be defined along two axes: socio-economic challenges to mitigation, and socio-economic challenges to adaptation.

The analysis of the role of Europe in climate negotiations since the establishment of the UNFCCC, which was made in Chapter 1, helped us delineate the main challenges for Europe in global governance on energy and environmental issues. In particular, the current evolution of the climate regime towards a more bottom up process puts pressure on Europe to find a new balance between the nature of its leadership vis-à-vis other parties and its own complicated governance. Europe stands at the middle of the road, either it will still play a leading role in the negotiations and pursue strong policy commitments or gradually will be a second stage actor of climate policies and the competition for green growth leadership. Further discussion with the other work packages will precise the policy mixes and global climate regime which will be tested in our different scenarios, so that scenarios are computed and analyzed in the next step of the AUGUR project.

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