Phylipsen Climate Change Consulting

European experiences with burden sharing in climate change

Lessons learned for the post-2020 negotiations

Dian Phylipsen and Kornelis Blok

Funded by the MAPS programme

MAPS
Mitigation Action Plans & Scenarios

www.mapsprogramme.org

December 2013

Contact: D.Phylipsen@PhylipsenConsulting.com

Executive summary

Differentiation of mitigation efforts has worked before…

Even before the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, there were discussions about the contributions that groups of countries and individual countries ought to make to the global effort to mitigate human-induced climate change. An important first achievement in this discussion was the Kyoto Protocol to the Climate Convention, in which developed countries agreed to quantified emission limitation or reduction targets for 2010. For the European Union (EU), a joint target was included in the Protocol, which was shared among its member states in a differentiated way, taking into account individual country circumstances.

At the request of the MAPS programme, the current paper aims to provide insights into the lessons that can be learned from the practical experiences in the EU with the sharing of climate change commitments that could be relevant in light of the international post-2020 negotiations.

Using an approach explicitly based on the most important negotiating barriers…

In support of its role of driving the EU climate change agenda as the EU Presidency in 1997, the Dutch government engaged the authors of this paper to support the negotiations process on the EU negotiation position for COP3 in Kyoto.

In consultation with the Dutch negotiating delegation, the so-called Triptych approach to burden sharing was developed. The aim of the approach was to determine the 'reasonable' contribution of each Member State to a joint EU target for emission reductions, taking into account the main differences in national circumstances between the different member states. It was based on the three main barriers in the negotiations for a joint position among member states. These were:

- differences in economic structure, where member states with an energy-intensive structure would argue that they needed more room for emissions than member states with a less energy-intensive sectors;
- differences in energy sector structure and renewable energy (RE) potentials, where member states with a coal-intensive resource base or limited RE potentials would argue a need for more lenient emission targets;
- differences between member states in standard of living, where member states with a comnparatively low standard of living would argue the need to be allowed to grow their emissions as their living standards converged with those of the others.

On the basis of these three negotiating barriers, emissions were divided into three categories reflecting the underlying differences between member states:

- emissions from internationally oriented heavy industry, considered to be the main determinant of differences in emissions due to differences in economic structure;
- emissions from the power sector;
- emissions from the remaining sectors, jointly referred to as the more domestically oriented sectors, considered to cover the emissions mostly influenced by differences in standard of living.

The approach then aims to calculate an overall 'emission allowance' for each of the three categories in a way that takes into account the differences between member states, which then add up to an

overall emission allowance, or emission reduction or limitation target, at the national level. This is done by applying different criteria to each of the emission categories to calculate a 'reasonable' amount of emission allowances for that category. The criteria are applied uniformly to all member states, whereby the national circumstances are taken into account by applying the uniform criteria to the member states' different starting points.

It is important to point out that the approach is not meant to set sectoral targets (for the three different emission categories), nor to prescribe specific emission reduction measures to take. Only the total Member State target (the sum of the calculated sectoral emission allowances) is to serve as an indication of what would constitute a reasonable contribution of the individual Member State to a joint EU target on the basis of its national circumstances. member states retained full flexibility to pursue whatever emission reduction strategies they would see fit within their countries.

In addition, it must be emphasised that the approach was not meant to be a substitute for a negotiations process. Rather, it was intended as a tool to provide negotiators insights into the differences in national circumstances that existed between their countries, and how such differences impact emissions, reduction options and costs in the different countries.

Embedded in a negotiations process…

A key success factor in the EU Burden Sharing Agreement was that the approach described above was not a stand-alone analysis but embedded in an interactive process, combining both analytical and political activities and facilitation approaches.

The analytical activities included:

- analysis of different burden sharing approaches discussed and their pros and cons in the EU context;
- identification of important national circumstances and their variation across member states;
- analyses on the emission reduction potential and costs of a number of EU Common and Coordinated Policies and Measures (CCPMs), assessing potential emission reductions that could be attained at reasonable cost in the EU as a whole, if such policies were agreed upon at the EU level and implemented in each of the member states.

A number of dedicated multi-day workshops with negotiators from the member states were held, at which the results of the various analyses were presented and discussed. Professional facilitation was used (through interactive exercises) to get the participants to take a step back from their day-to-day task of negotiating specific text proposals and to allow out-of-the-box thinking. This approach revealed that, away from the normal way of conducting these discussions, focussing on narrow national interests, actually much more agreement existed on the headline positions than previously thought. Much to the participants' surprise, the first workshop led to an agreement that the joint EU negotiating position for Kyoto should be 'in the order of -15%' reduction of emissions in 2010 compared to 1990, with differentiated targets for different member states and an important role for CCPMs – all controversial points until that point.

The results of the analyses with the Triptych approach were also presented to negotiators in a workshop, including many sensitivity analyses of very specific circumstances in selected member states. An exercise asked the negotiators to (anonymously) indicate what they thought reasonable

contributions of each of the member states would be to the overall EU emission target. The results, shared with the negotiators, showed the range of expectations that existed of each Member State in the other countries. This, together with the results of the Triptych (sensitivity) analyses, resulted in an increased awareness in differences in national circumstances between member states and an increased willingness to allow these differences to be reflected in differentiated targets.

The outcome of the workshop was a request from the member states to the Netherlands Presidency to come up with a proposal for a burden sharing of the EU negotiating position for Kyoto. This led to a consultation/negotiation round between the Presidency and each individual Member State. With some changes in the proposal as a result, this led to an agreement on the burden sharing of the EU negotiating position of -15%. The differentiated efforts member states committed to in this Burden Sharing Agreement were substantially more ambitious than those made at the start of this process.

Different from other experiences…

The Triptych Approach was also used (in adapted form) in other discussions. First it was expanded to include the post-Kyoto reality (six gases, inclusion of forestry) and applied at the global level, as input to the international discussions on post-2012 targets. In addition, it was used in various countries in the discussions on how to distribute national targets (emission reductions or energy savings) over regions. In some of these cases (Canada, China) the analyses were considered by policy makers, while in others it remained a purely analytical activity.

In none of these cases, however, was a methodological burden sharing approach implemented. None of the analyses were embedded in a political process with negotiators from the different parties involved. They were either one-off analyses presented to policy makers or the wider public, or part of a broader analytical debate in which many different approaches were discussed. Where a link with policy makers existed, the principle of 'Common but differentiated responsibilities' was not accepted and/or no understanding of different 'national' circumstances was created. Ultimately this resulted in differentiations based on differences in political power between the regions.

Providing lessons learned…

While many differences exist between the 1997 EU burden sharing discussions and the current international negotiations, there are also similarities. First, there are different views amongst parties about whether climate change efforts should be framed top-down or bottom-up. Second, the main negotiation barriers are very similar: differences in level of development and standard of living (and the need for growth), difference in resource basis, differences in economic structure and energy efficiency. Third, a lack of understanding of the differences in national circumstances is reducing the window to reach an agreement.

Important lessons learned from the existing experiences include the following:

- A key success factor in the 1997 Burden Sharing Agreement was the embedding of the Triptych Approach in the negotiations process. Providing decision-makers with the results of technical analyses alone is not sufficient; involving them in the process, through interaction on issues and outcomes and iteration between analysts and negotiators, is crucial
- The institutional context in which negotiations take place is also important. The EU agreements were facilitated by existing institutions and negotiating structures. Further, the existence of a

shared financial structure agreed overall policy objectives creates common ground. The established role of the EU Presidency also created a natural lead entity to drive the negotiations.

- For an approach like the Triptych Approach to be effective, an acceptance of the basic principle of 'Common but differentiated responsibility and respective capabilities' is necessary.
- Parties can have a somewhat distorted perception of their own national circumstances, relative to those of other countries. Most countries are convinced that their national circumstances should warrant them more room for emissions, leaving no countries to transfer such room for emissions.
- In terms of the approach itself, the Triptych approach was the right mix of sophistication and simplicity/transparency for that point in time. It formed a middle ground between the other approaches discussed then, ranging from very simple but extreme approaches to the very sophisticated but approaches that were considered. Because of the transparency, confidence grew in the approach being sufficiently sophisticated to take into account the main differences in national circumstances.

For the international negotiations.

In translating the experiences with the Burden Sharing Agreement in the context of the international negotiations, the question is which part of the process is replicable: the use of the Triptych Approach in itself or the process in which the approach was developed? The latter refers to the process of identifying the main barriers to the negotiations between a specified group of countries, followed by an operationalisation of dealing with differences in national circumstances related to those barriers into an approach that determines reasonable contributions to mitigation efforts by individual countries and/or sectors.

The changing international landscape (shifting partly from targets-and-timetables to other types of commitments) may also influence the role of burden-differentiation approaches, like the Triptych Approach. In the context of targets-and-timetables such approaches could be used to support processes in which a distribution of a shared target is agreed on. With other types of commitments, their role could be more limited, e.g. they could be used to assess the 'fairness' of the resulting package of commitments (the equivalence of effort of the different parties). This is a similar role to what is described by CAN in its discussion paper on the Equity Reference Framework.

Another potential application could envision the use of the Triptych Approach to provide input for the discussions on how much each of the developed countries should contribute to the stated policy goal of providing US$100 billion in Climate Finance in 2020. In such a case, the reasonable contribution of each country determined by the approach to the joint target is not an emission reduction, but a financial contribution. Such links are now again being discussed in the context of Climate Finance.

Linking mitigation and adaptation (or even all four Bali pillars) through an adapted Triptych-like approach seems difficult. The question arises also whether such a combination should be attempted. The risk of a combined, more complex approach is that it loses the advantages of transparency and simplicity, which was in our view one of the success factors in the EU process. Such transparency may be better served by keeping the commitments for mitigation and adaptation separate, especially since no objective correlation between mitigation and adaptation commitments can be determined, and the fact that how they are weighed against each other is subjective. One thing that could perhaps be imagined is a parallel set of distributions for each of the four pillars: not one

combined target for each country, but a contribution of each country to the individual pillar given a set of criteria specifically developed for each pillar.

This could fit into the current discussions on the Equity Reference Framework (ERF), where 'Framework Parties need more explicit and quantitative guidance, based on the Convention's equity principles, regarding a fair allocation of both mitigation action as well as the provision of financial and technological support'. The Triptych approach is one potential operationalisation of the questions raised that such a reference framework should address. Existing 'effort/burden/risk/ resource-sharing approaches' are deemed 'to fail to adequately advance a clear moral justification, explain how these are translated into indicators and transparently quantifying these indicator into burden sharing frameworks.' An ERF is seen as a mechanism to address this failure, something that was explicitly done with the Triptych Approach (in the narrower context of mitigation only).

It certainly seems useful to feed the experiences with the Triptych approach (and the broader EU burden sharing/effort-sharing) into an expert-supported process of developing an ERF, e.g. in the context of the Basic Group of Experts (BGE) or under the COP, as called for by CAN. Here it is important, though, to keep two questions in mind following the lessons learned from those experiences:

- Can an ERF be a substitute for the negotiations process or should it be seen as a tool guiding and informing the process?
- How can the development of the ERF be sufficiently embedded in the political process for it (and its results) to be sufficiently acceptable?

Abbreviations used

BASIC	Brazil, South Africa, India, China
BEG	Basic Expert Group
CCPMs	Common and Coordinated Policies & Measures
COP	Conference of the Parties
DRCs	(Chinese) regional Development and Reform Commissions
GDP	Gross domestic product
EASD	Equitable Access to Sustainable Development
ERF	Equity Reference Framework
ERI	(Chinese) Energy Research Institute
ETS	(EU) Emissions Trading System
EU	European Union
FYP	(Chinese) Five Year Plan
IPCC	Intergovernmental Panel on Climate Change
LMDCs	Like-Minded Developing Countries
MAPS	Mitigation Action Plans and Scenarios
MS	(EU) member states
NDRC	(Chinese) National Development and Reform Commission
ppm	Parts per million
QELROs	Quantified Emission Limitation and Reduction Objectives
RE	Renewable Energy
UNFCCC	United Framework Convention on Climate Change

The abbreviations used for the different EU member states in the graphs are explained in Annex I.

Contents

1 Introduction

1.1 Background

Even before the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, there were discussions about the contributions that groups of countries and individual countries ought to make to the global effort to mitigate human-induced climate change. An important first achievement in this discussion was the Kyoto Protocol to the Climate Convention, in which developed countries agreed to quantified emission limitation or reduction targets for the year 2010.[1] For the European Union (EU), a joint target was included in the Protocol, which was shared among its member states in a differentiated way – that is, individual country circumstances were taking into account.

Since then, the first target period under the Kyoto Protocol has passed without the international community being able to agree on further quantified emission reduction targets beyond 2012. Discussions have become even more complex, with emission targets for developing countries now also on the table. Ministers from four large developing countries – Brazil, South Africa, India and China - (BASIC) meet regularly to coordinate their climate negotiation efforts and negotiators and experts meet on related issues in climate change. The group is supported in this by experts, which often meet in parallel, the Basic Group of Experts (BGE). The current work plan includes research on equitable access to sustainable development (EASD) with the aim of informing the post-2020 agreement, to be finalised at the end of 2015. The MAPS programme, run by the Energy Research Centre at the University of Cape Town and SouthSouthNorth, in turn provides support to BGE. In this context, the MAPS programme has expressed an interest in learning from the experiences in the EU in relation to the sharing of emission reduction efforts and targets.

The current paper describes the experiences in the EU for both the '1997 Burden Sharing Agreement' of the 2010 Kyoto target as well as the ' Effort Sharing Agreement' of the 2020 emission reduction target agreed to unilaterally by the EU. This section briefly describes the objective of the paper, the context for the EU process and the structure of the paper.

1.2 Objective of the paper

The objective of the current paper is to provide insights into the lessons that can be learned from the practical experiences in the EU with the sharing of climate change commitments that could be relevant for developing countries in light of the international post-2020 negotiations. The main focus of the paper will be on the 1997 EU burden sharing of the Kyoto target for 2010, while the 2020 EU effort-sharing experiences are also briefly discussed. The paper will focus on the concept and application of the approaches used and the political process. Less attention will be paid to the quantitative analyses used in the process, as this is of less relevance to the BASIC countries and has been reported sufficiently elsewhere (e.g. Phylipsen et al 1998).

[1] Actually, a five-year average target period around the year 2010 was used, to average out annual fluctuations, i.e. the target period ran from 2008-2012.

1.3 Context of the EU political decision-making process

In order to understand the EU experiences around the 1997 Burden Sharing and 2020 Effort Sharing Agreements and allow the identification of lessons learned that may be of use to developing country decision-makers, it is important to provide some background to the political decision-making procedures in the EU in the area of climate change. In this context it is important to point out that the decision-making procedures to be followed depend on the policy areas, according to the subsidiarity principle.[2] Certain areas (e.g. housing), are considered to be the responsibility of individual EU member states. Other topics, which are considered difficult to address on a solely national level, e.g. because impacts are cross-boundary or effective solutions can only be arrived at in a coordinated way, are coordinated at the EU level. In a so-called 'co-decision procedure', the EU as well as the individual member states[3] need to jointly agree on policy decisions.

In practice, the above means that both the European Parliament (on behalf of the EU) and the Council of the European Union need to agree on a proposed decision. The latter consists of the relevant ministers of each of the member states (ministers of environment, in this specific case) that meet regularly to discuss adopt laws and coordinate policies within their mandate. The decisions by the Council of European Union may ultimately need to be confirmed by the European Council (the council of state leaders of the EU), which meets four times a year.[4] The initiative for proposing a draft decision can come from either party, and is often prepared by the European Commission as the 'day-to-day management' of the European Union.

The EU used a rotating Presidency to set the agenda for the various policy areas and move policy dossiers forward. Member states would take turns to hold the Presidency for a six-month period, in which they were able to highlight their own priorities to a certain extent. To ensure a minimum level of continuance over time across the different Presidencies, in practice, work was always carried out in a so-called 'troika', i.e. a cooperation between the Presidency at that specific time, together with its predecessor and its successor. Since the reforms in the EU as a result of the entry into force of the Lisbon Treaty in December 2009, the role of the Presidency has lost weight, due to the stronger role of the newly established European Council and its permanent President.

Climate change is a policy area that is subject to the co-decision procedure. As a consequence, both the EU and its individual member states have signed and ratified the UNFCCC. Both EU and individual member states are also active in the international climate change negotiations, though a concerted effort is always made to come to a joint position on behalf of the EU in the international fora.

---

[2] Defined in Article 5 of the Treaty on European Union to ensures that decisions are taken as closely as possible to the citizen and that constant checks are made to verify that action at Union level is justified in light of the possibilities available at national, regional or local level. Specifically, it is the principle whereby the EU does not take action (except in the areas that fall within its exclusive competence), unless it is more effective than action taken at national, regional or local level.

[3] In 1996-1997, the period of the Burden Sharing Agreement, the EU comprised 15 member states. This was extended to 25 in 2004 (8 countries in Eastern Europe, as well as Cyprus and Malta), 27 in 2007 (Romania and Bulgaria), and 28 member states in 2013 (Croatia).

[4] 'Note that the 'Council of the European Union' (informally known as the 'EU Council', adopting laws, chaired by the relevant minister of the country holding the EU Presidency) is a different EU body to the European Council (government leaders, discussing political priorities, chaired by its President van Rompuy). Both are not to be confused with the 'Council of Europe' which is not an EU body, see: http://europa.eu/about-eu/institutions-bodies/council-eu/

1.4 Status prior to the EU Burden Sharing Agreement

In 1996, the EU was attempting to define its negotiating position for the 3rd Conference of the Parties (COP3) under the UNFCCC, to be held in Kyoto in the 2nd half of 1997. According to the Berlin Mandate, agreed upon during the 1st COP in 1995, an agreement had to be reached by then on quantified emission reduction or limitation targets for developed countries included in Annex I of the UNFCCC for the year 2010. Under the UNFCCC, Parties were to submit their proposals on any such targets during the first half of 1997, so they could be considered and discussed in time before COP3. With both the EU and its member states party to the Convention, both would be subject to such targets, and both could submit proposals. Within the EU, discussions were taking place under the Irish Presidency, while the Netherlands was to hold the Presidency in the period the submissions were due, and Luxemburg would chair the EU during COP3.

At this stage, many discussions were taking place in the EU, and member states had put forward various proposals for their own emission reduction commitment. Crucially, however, there was no agreement between member states on:

- the ambition level of an EU target for emission reductions for 2010;
- whether all member states would accept the same emission reduction target or whether a differentiation would be made between member states;
- whether, in addition to national policies, EU common and coordinated policies and measures would also be developed to contribute to reaching national and/or EU targets;
- which approach to target-setting should be used, i.e. bottom-up, in which identified emission reduction potentials in different areas would be added up to a realistic total emission reduction target, or top-down, in which the ambition level for an emission reduction target was set, after which the emission reduction measures required to reach such a target would need to be found.

It must be noted that, at this point, the EU position was that the emission targets to be agreed on in Kyoto were to include CO_2 emissions only, and should exclude emissions or removals from forestry.

1.5 Structure of the paper

The EU 1997 Burden Sharing Agreement is discussed in detail in Section 2, while the 2020 Effort Sharing Agreement is discussed in Section 3. Section 4 briefly discusses other applications of (adaptations of) the Triptych approach, e.g. for analyses of sharing mitigation targets at a global scale, or for discussions on using the approach to distribute national energy or emission targets over regions (Canada, Italy, Spain, China). Subsequently, Section 0 aims to draw lessons learned from the EU (and other) experiences that may be of use for the discussions among BASIC countries.

2 The EU burden sharing for Kyoto

In this section, we describe the experiences with the EU Burden Sharing Agreement reached in 1997 to distribute the joint EU emission target over its member states. First we discuss the Triptych approach to burden sharing that was used in the negotiations process and describe how it takes into account differences in national circumstances between countries. Secondly, we discuss the political process in which the Triptych approach was used, before concluding with some remarks on the impact the approach has had on the negotiations.

2.1 The Triptych approach to burden sharing

As the Netherlands were to hold the EU Presidency at the time the submissions to the UNFCCC for COP3 in Kyoto were due, the Dutch government was heavily invested in bringing the climate change dossier forward. As part of its preparations for holding the Presidency, the Dutch Ministry of Environment engaged independent experts[5] to support the negotiations process in the second half of 1996, when it was part of the troika. The support was used during the Irish and Dutch Presidencies of the EU, and to a lesser extent during the subsequent period.

On the basis of initial ideas of the head of the Dutch negotiating delegation, Bert Metz, the experts developed the so-called Triptych approach to burden sharing. The aim of the approach was to determine the 'reasonable' contribution of each Member State to a joint EU target for emission reductions, taking into account the main differences in national circumstances between the different member states. It was called the Triptych approach, as it was based on the three main barriers observed in the negotiations at the time for coming to a joint position among member states.[6] These were:

- differences in economic structure, where member states with an energy-intensive structure would argue that they needed more room for emissions than member states with a less energy-intensive sectors;
- differences in energy sector structure and renewable energy (RE) potentials, where member states with a coal-intensive resource base or limited RE potentials would argue a need for more lenient emission targets;
- differences between member states in standard of living, where member states with a comparatively low standard of living would argue the need to be allowed to grow their emissions as their living standards converged with those of the others.[7]

On the basis of these three negotiating barriers, emissions were divided into three categories reflective of the underlying differences between member states:

---

[5] The Department of Science, Technology and Society of Utrecht University, where the authors of the current paper were then employed.

[6] Triptych (from the Greek word for three-fold) is an art term, referring to a painting in three hinged parts.

[7] It should be noted that this convergence of living standards is formal EU policy supported by financial mechanism:
The Structural Funds and the Cohesion Fund are the financial instruments of EU regional policy, which is intended to narrow the development disparities among regions and Member States. In order to speed up economic, social and territorial convergence, the European Union set up a Cohesion Fund in 1994. It is intended for countries whose per capita GDP is below 90% of the Community average. The purpose of the Cohesion Fund is to grant financing to environment and transport infrastructure projects.
Source: http://europa.eu/legislation_summaries/glossary/structural_cohesion_fund_en.htm

- emissions from internationally-oriented heavy industry, considered to be the main determinant of differences in emissions due to differences in economic structure;
- emissions from the power sector;
- emissions from the remaining sectors, jointly referred to as the more domestically-oriented sectors (or 'domestic sectors'), considered to cover the emissions that were mostly influenced by differences in the standard of living.

Subsequently, an approach was devised to calculate an overall 'emission allowance' for each of the three categories in a way that takes into account the differences between member states, which then add up to an overall emission allowance, or emission reduction or limitation target, at the national level. It is important to point out that the approach was not meant to set sectoral targets (for the three different emission categories), nor to prescribe specific emission reduction measures each member state should take. Only the total member state target (the sum of the calculated sectoral emission allowances) was to serve as an indication of what would constitute a reasonable contribution of the individual member state to a joint EU target on the basis of its national circumstances. Member states would retain full flexibility to pursue whatever emission reduction strategies they would see fit within their countries.

In addition, it is important to realise that the approach was not meant to provide the 'silver bullet', i.e. the ultimate set of targets to be agreed on, as a substitute for a negotiations process, but, rather, intended as a tool to provide negotiators insights into the differences in national circumstances that existed between their countries, and how such differences impact emissions, emission reduction options and associated costs in the different countries.

For each of the emission categories, different criteria are used to calculate a 'reasonable' amount of emission allowances, in the light of relevant national circumstances. The criteria are applied uniformly to all member states, whereby the national circumstances are taken into account by applying the uniform criteria to the member states' different starting points. For example, a uniform criterion of reducing solid fuel use in power production with x% is applied to the different shares of coal use for power production across the member states, resulting in different amounts of coal that need to be replaced in each member state. How stringent the criteria are (the level of x, in the above example), depends on the overall ambition level for the joint emission reduction target.

The following categories were distinguished:

- **Power-producing sectors**

  Argument for approach: CO_2 emissions from power production differ greatly from country to country due to large differences in the shares of nuclear power and renewables and in the fuel mix in fossil-fuel-fired power plants. The potential for renewable energy is different for each country, as is the case for the public acceptance of nuclear energy. Furthermore, the emerging liberalisation of energy markets hampers a purely national approach to emission limitation in this category.

  Approach to determine emission allowances: The projected growth rate for total electricity production was reduced, taking into account a more efficient use of electricity in the various end-use sectors. With regard to the remaining electricity demand, minimum requirements were set for the share of renewables and CHP and maximum requirements for the shares of solid and

liquid fossil fuels. The development of nuclear power assumed in the calculations was according to national preferences, since the political acceptability strongly differed from country to country.

- **Internationally-oriented energy-intensive industry**[8]

  Argument for approach: Countries differ substantially in their economic structure. This is relevant for burden differentiation for different reasons. Industry, and especially heavy industry, has a relatively high CO_2/value added ratio. As a consequence, countries with a high share of (heavy) industry will have relatively higher CO_2 emissions than countries that focus primarily on light industry or services, even if the emission reduction potential is relatively small. Setting absolute national CO_2 emission targets that includes the internationally-oriented industries would disadvantage the competitiveness of industries in countries with a high share of such industries. Furthermore, industries operating on the international market are considered to be regulated best at the international level.

  Approach to determine emission allowances: The approach focused on the part of the internationally-oriented industry where competitiveness is most strongly determined by the costs of energy and of energy efficiency improvements: heavy industry, which comprises the building materials industry, chemical industry, iron and steel industry, non-ferrous metals industry, pulp and paper industry, refineries, coke ovens, gasworks and other energy transformation industries (excluding electricity generation). For these sectors an efficiency improvement criterion was chosen, assuming an *equal* annual efficiency improvement (%/yr) for all countries. The reason that differences in current efficiency levels were not taken in to account was the lack of data required to establish relative efficiencies for each sector.[9]

- **Domestic sectors**

  Argument for approach: The domestically-oriented sectors comprised the residential sector, the commercial sector, transportation, light industry and agriculture. Together they are referred to as the 'domestic sectors'. They were treated as one separate category for a number of reasons. First, countries were assumed to be more homogeneous in these sectors. Second, emission reductions can more easily be achieved in these sectors by means of national measures than in other sectors. Third, emissions in this category are assumed to be correlated with the number of people that live in dwellings, have a workplace, transport themselves, i.e. with population size.

  Approach to determine emission allowances: Because of the correlation with population size, a per capita criterion was used for the domestic sectors. We assumed that in the long run (climate-corrected) emissions in the domestic sectors will converge (e.g. in 2030) due to a convergence of the standard of living (e.g. number of cars, number of appliances) and a reduction in existing differences in energy efficiency. The use of such a convergence approach includes existing differences in the standard of living between member states into the considerations on emission

[8] According to the IPCC methodology emissions from electricity generation are attributed to the electricity-producing sector only, i.e. not to the sector consuming the electricity. For both the domestic sector and the industry, therefore, only fuel emissions are included.

[9] In later analyses, the impact of this on the overall distribution was assessed, when more data on differences in energy levels became available. See e.g. Groenenberg, Phylipsen and Blok (1999).

reduction commitments, with increasing per capita CO_2 emissions for those with the lowest current levels (see Figure 1 for illustration).

After calculation, the emission allowances for each of the above-mentioned categories by applying the criteria to each member state, the total national emission allowances for each member state was established by adding up the allowances for the three categories. For illustrative purposes, a table showing the different criteria, the member states' base data and the results are included in Annex II.

Different scenarios were developed, varying in ambition levels of the individual criteria, as well as the overall joint emission target. Here, the criteria can be seen as levers that can be pulled to influence the ambition level of the target. It must be noted that it is important that any increase or decrease in ambition level is similarly translated across the different emission categories. In other words, the criteria applied to the different categories should be comparably stringent in order to ensure that a similar effort is seen as reasonable across categories. Only in this way are the differences in national circumstances (reflected in different importance of the three categories, and differences in parameters to which the criteria are applied) taken into account in the resulting emission targets at the member state level.

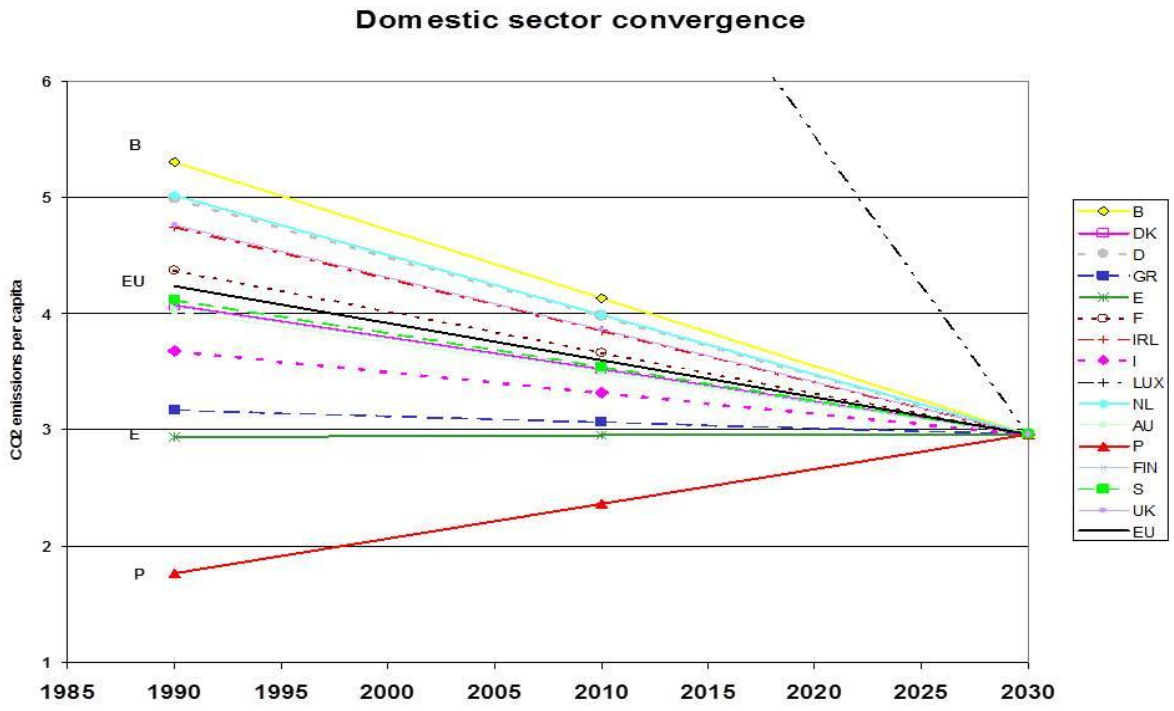


Figure 1 Concept of the CO_2 per capita convergence approach used to determine the emission allowances for the emission category of 'domestically oriented sectors'. Convergence is assumed to take place in 2030 from 1990 levels, with the amount of emission allowances in 2010 determined by multiplying the interpolated per capita emission allowance level with the projected population size in 2010 for each member state. Emissions are climate-corrected (on the basis of heating-degree days).

It must be noted that in later (post-Kyoto) analyses, the above approach was elaborated on, to reflect the broader scope of the Kyoto Protocol targets (more gases, inclusion of forestry emissions/ removals). In this approach (see also the next section), more national circumstances were taking into

account. Due to changes in the political landscape in Europe (different presidency, reduced role for the Dutch government, different negotiating dynamics) this approach did not play a strong role in the EU discussions.

2.2 Process in which the Triptych approach was used

It is important to realise that the approach described above was not a stand-alone analysis, but was embedded in an interactive process, combining both analytical and political activities and, at that point, relatively new facilitation approaches.[10] On the analytical front, this included:

- analysis of different burden sharing approaches discussed in the international negotiations and the literature,[11] and their pros and cons in the EU context;[12]
- identification of important national circumstances and their variation across member states;[13] and
- analyses on the emission reduction potential and costs of a number of EU Common and Coordinated Policies and Measures (CCPMs), assessing potential emission reductions that could be attained at reasonable cost in the EU as a whole, if such policies were agreed upon at the EU level and implemented in each of the member states.[14]

In the meantime, member states and the European Commission were meeting regularly in the so-called Ad-hoc Group on Climate Change for political discussions, and in an associated Expert Group on Climate Change for more technical discussions.[15] The work on CCPMs mentioned above was, for instance, discussed in detail in the Expert Group meetings. In addition, a number of multi-day workshops with negotiators from the member states were held under the Irish Presidency (Dublin, September 1996) and the Netherlands Presidency (Zeist, January 1997). During the workshops, the results of various analyses were presented and discussed. However, professional facilitation was also used (through interactive exercises) to get the participants to take a step back from their day-to-day task of negotiating specific text proposals and to allow more out-of-the-box thinking than usual.

---

[10] The process did not include explicit stakeholder consultations with the private sector. Their interests were in general taken on board in the member states' position, as demonstrated by the attention to the competitiveness position of industry in the negotiations. Also, in these days it was not that common yet to have explicit private sector consultations on climate change policies. This has become much more the case in Europe since then, with the establishment of the European Climate Change Programme in 2000 as the platform for such discussions between the European Commission, member states and other stakeholders (as well as ad-hoc consultations on specific topics, such as the ETS reform, 2030 targets, etc).

[11] Equal per capita emissions, equal emissions per GDP, flat-rate reduction targets, sectoral targets, multi-criteria approaches, equal marginal abatement cost approaches, cost-optimisation approaches; see e.g. Phylipsen et al (1998).

[12] In an analysis carried out later by ECN-CICERO (see (Ringius and Torvanger, 2000), comparing different approaches to burden sharing, the Triptych approach was evaluated as the best approach among those analysed, due to it performing well on two fairness principles ('need' and 'capacity') and on operational requirements. 'Need' since it builds on characteristics of three sectors in a country and emissions in a base period. 'Capacity' since countries in Southern Europe are given room to grow compared to other EU member states. In terms of operational requirements the method allows for future refinements, flexibility and country-specific circumstances.

[13] See Phylipsen and Blok (1996).

[14] This included topics such as renewable energy programmes, stimulation of combined generation of heat and power, support for more efficient appliances, voluntary agreements in heavy industry, and CO_2 emission standards for passenger cars, reduction of emissions from landfills. The analytical work was in principle carried out by volunteer Member States in the so-called Expert Group on Climate. A large part of the measures were taken up by the Netherlands, and in part outsourced to the authors (see Blok and Phylipsen, 1996; Phylipsen, Blok and Merkus, 1997).

[15] In practice, for many countries the same people were involved in both platforms. Only some MS with larger, more specialised staff was used for the different platforms. For the Netherlands, the authors were part of the Dutch delegation to the Expert Group meetings.

During the first workshop, such exercises sought to identify the negotiators' views on specific statements or questions. Examples of such statements included:

- Member states should all adopt the same quantitative emission target – targets should be differentiated.
- The EU negotiating position for Kyoto should be: -20% -10% 0 +10% +20% compared to 1990.
- CCPMs are important in reaching the target – targets should be reached mostly through national action.

The exercises required participants to (anonymously[16]) put stickers on flip-overs outlining the statements (and, where relevant, a range of possible answers) in line with their views. These exercises revealed that, away from the normal way of conducting these discussions, focussing on narrow member states' interests, actually much more agreement existed on the headline positions than realised. Much to the participants' surprise, the Dublin workshop led to an agreement that the joint EU negotiating position for Kyoto should be 'in the order of -15%' reduction of emissions in 2010 compared to 1990, with differentiated targets for different member states and an important role for CCPMs.

During the second workshop, the results of the analyses with the Triptych approach were presented to negotiators, including many sensitivity analyses. Questions or comments arising from the discussions could immediately be assessed for their impact on the overall distribution of emission reduction efforts and shared back with the negotiators. This included many assessments of very specific circumstances in selected member states.[17] In one of the exercises, the negotiators were asked, again anonymously, to indicate what they thought reasonable contributions of each of the member states would be to the overall EU emission target. The results, shared with the negotiators, showed the range of expectations that existed of each member state in the other countries. This, together with the results of the Triptych (sensitivity) analyses, resulted in an increased awareness in differences in national circumstances between member states, an increased awareness of how such differences affected emission reduction efforts and an increased willingness to allow these differences to be reflected in differentiated targets. The outcome of the workshop was a request from the member states to the Netherlands Presidency to come up with a proposal for a burden sharing of the EU negotiating position for Kyoto.

Subsequent to the workshop, a consultation/negotiation round was held, in which the Presidency discussed the burden sharing proposal bilaterally with each of the member states. The negotiations led to some changes to the proposal (partly also on the basis of further Triptych analyses), resulting in a slight increase in room for emissions for lower-income countries at the expense of higher-income countries. This led in the end to an agreement on the burden sharing of the EU negotiating position of -15% in the EU Council of Ministers of March 1997. As shown in Figure 2, the efforts member states committed to in this Burden Sharing Agreement were substantially more ambitious than those made originally under the Irish Presidency (see also the next section).

[16] Only a distinction was made between representatives of the European Commission and the Member States (by using different colour stickers).

[17] E.g. being an island state, having very low population density, very low public transportation rates, large shares of public sector or agriculture, high share of peat use in power production, etc.

It must be noted that the EU negotiating position for Kyoto was conditional on other developed countries taking on comparable commitments. When this condition was not met in its view, the joint target the EU finally committed to in Kyoto amount to a -8% reduction compared to 1990 levels. Furthermore, the negotiations in Kyoto also led to a larger basket of greenhouse gases covered by the target (six gases instead of only CO_2), and the inclusion of sinks in the targets, all of which were not included in the EU negotiating position. This meant that adjustments were also needed in the distribution of the emission reduction efforts as laid down in the Burden Sharing Agreement.

Further analyses with the Triptych approach were made, including the changed target and the inclusion of six gases and sinks for the Dutch government.[18] However, the Netherlands no longer held the Presidency of the EU. The new UK Presidency did not use the results of the analyses in the renegotiation of the Burden Sharing Agreement. Adjustments to the distribution agreed on this round were more based on views on who had been deemed to have contributed least in the earlier negotiations round (e.g. moving the least compared to their unilateral position declared earlier, see also the next section).

2.3 Impact of the Triptych approach on the negotiations

Application of the Triptych approach to the EU and its member states resulted in increased insight among EU negotiators concerning differences in national circumstances and their role in greenhouse gas emissions. On the basis of this improved understanding it was possible to come to an agreement on burden differentiation within the EU. The resulting target for the EU as a whole (as a negotiation position for Kyoto) is substantially higher than targets that had been stated earlier.

Before the analysis described in this paper was made, member states submitted emission projections for the year 2010 to the Irish Presidency. These submissions included scenarios with existing policies and measures only and scenarios including additional (national and EU common and coordinated) policies and measures not yet implemented (Phylipsen et al, 1997). The emission development in the latter scenarios represented the maximum 'offer' for emission reductions member states were willing to commit to.

As shown in Figure 2, member state submissions to the Irish Presidency only add up to only a 3% reduction compared to 1990 levels.[19] In the final agreement, most member states, whose original offer represented a lower emission reduction than calculated with the Triptych approach for their country, committed themselves to an additional emission reduction of about 10% (for Ireland even 20%). Exceptions are Greece, France and Portugal, who did not (substantially) improve their original offer.

[18] See Phylipsen, Groenenberg and Blok (1998).
[19] Both member states' submissions and the results of the Triptych approach are for CO_2 only. The final agreement also includes CH_4 and N_2O.

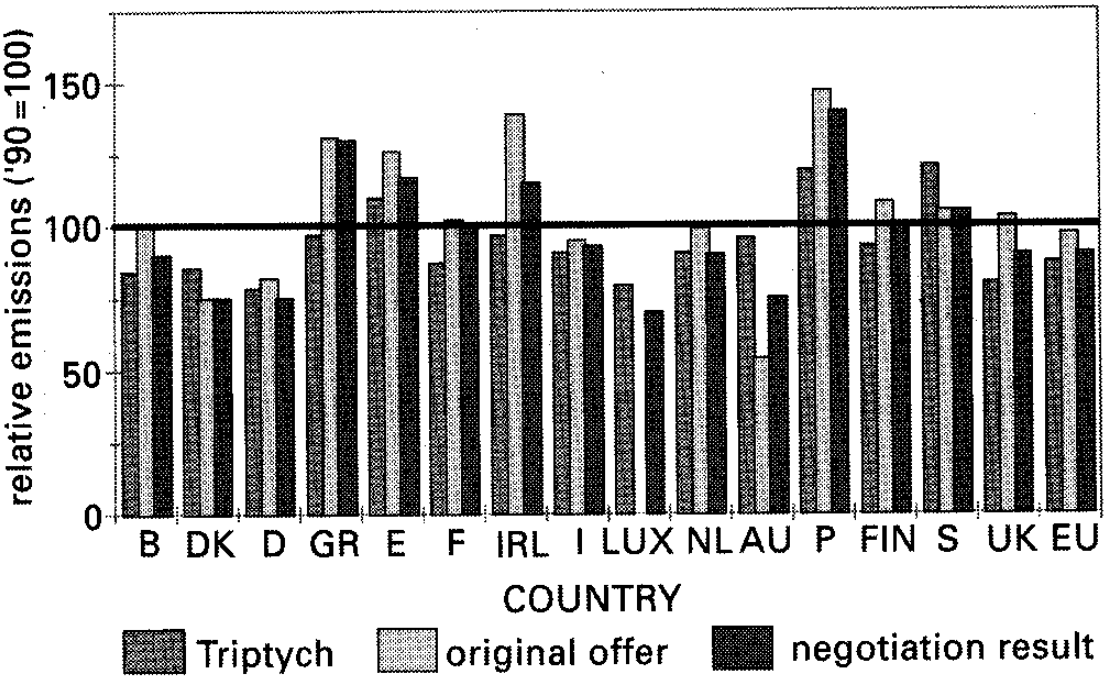


Figure 2 Comparing the negotiating result under the 1997 Burden Sharing Agreement with the original offer member states made under the Irish Presidency, as well as with the results of the main case under the Triptych Approach[20]

[20] It should be noted that the final burden differentiation as decided upon by the Environment Council in March is based on a multi-gas approach, i.e. methane and nitrous oxide are also included. Furthermore, the differentiated targets only add up to a 10% reduction. It was agreed that the differentiation of the remaining 5% would be dealt with at a later stage.

3 2020 EU effort sharing

In this section, we discuss the approach used in the EU to share the joint 2020 emission reduction target across its member states. First we describe a number of important differences between the situation in this discussion compared to that leading up to the 1997 Burden Sharing Agreement. The following section describes the approach used in the effort sharing, as laid down in the Climate and Energy Package. Section 3.3 describes the process towards reaching the agreement, after which some observations are made on how the 2020 Effort Sharing Agreement compares to the 1997 Burden Sharing Agreement.

3.1 Differences with the 2010 discussions

At the COP/MOP in Bali in December 2007, the international community formally started a new round of negotiations, this time on targets for the period beyond 2012. In preparation for this international process, the EU member states decided during the European Council meeting of March 2007 to adopt a joint target to reduce greenhouse gas emissions by 2020 with 20% compared to 1990 levels.[21] This target represents a 'firm commitment' the EU is willing to undertake, independently of the developments in the international negotiations.[22]

Subsequently, discussions were held in the EU on how to distribute the EU target for 2020 over the individual member states. These discussions were part of a broader discussion, including the relation of these member states targets to other commitments and plans, such as the EU renewable energy targets also agreed for 2020 by the March Council and the post-2012 developments within the EU Emissions Trading System (ETS). In January 2008, the European Commission published proposals on the sharing of the European climate change mitigation and renewable energy efforts, combined into the so-called 'Climate and Energy Package', also known as the 20-20-20 proposal.

During the Kyoto commitment period, it had been becoming increasingly clear that the operation of an EU-wide ETS, in which participants should be able to operate on a level playing field, is difficult to combine with strongly differing national emission ceilings. For that reason, the proposal separated the emissions from the EU ETS from the national emissions targets of the member states,[23] with the former being subject to a separate emissions ceilings (the cap).[24] Only the non-ETS emissions were covered in the national emission targets.[25]

There were a number of other important differences occurring in 2008 compared to the situation in 1997, relevant for this new round of discussions on distributing targets, including the following:

---

[21] See Council of the European Union (2007).

[22] The EU also indicated it is willing to accept a commitment of -30% in 2020, if other countries would be willing to make sufficient contributions as well.

[23] The EU ETS basically covered the power sector and the heavy industry, i.e. largely comparable to two of the three emission categories used in the Triptych Approach. A similar option was analysed in the 1997 Burden Sharing discussions as well. In case it would not have been possible to reach agreement on the differentiated target, an alternative scenario had been formulated into which emissions of the international industry would have been taken out of the national targets, basically creating 'a 13th MS' with its own emission target.

[24] See European Commission (2008; 2008b).

[25] Note that this is comparable to the category of 'domestically oriented sectors' as used in the Triptych approach, with the addition of non-CO_2 GHG emissions.

- More countries joined the EU (27 member states in 2008), resulting in more, and more varied, negotiating partners.
- Due to reforms needed because of this expansion, the influence of the rotating Presidency decreased, with a stronger role emerging for the European Commission in driving the agenda and carrying out supporting analyses.
- More tools for quantitative analyses (including economic models) were available to support political decision-making and assess potential impacts of policy proposals. The tools had become more sophisticated (geographical scope, scope in emission sources covered, level of technical detail, link with economic models), and their use in climate change policy-making had become more common.[26]

3.2 The Climate and Energy Package approach

The Energy and Climate Change Package proposes a distribution of efforts for GHG emission reductions in ETS sectors, for GHG emission reductions in non-ETS sectors and for increasing renewable energy (RE) generation over individual member states (for a discussion on the interaction between the GHG and RE targets, see Text Box 1). The Package was accompanied by an impact assessment, as is required for all EU policy proposals. In this Impact assessment, various models[27] were used to analyse the economic and environmental impacts of the proposals included in the Package. The analyses showed that a cost-efficient distribution of emission reduction targets[28] in the non-ETS sectors would result in relatively higher cost (as a percentage of national GDP) for member states with low income levels (see Figure 3).

Non-ETS sectors

Approaches that were analysed for distributing non-ETS emission targets included:

1. equal marginal abatement cost;
2. equal per capita emissions;
3. equal emission reductions with respect to historical emissions (in 2005); and
4. differentiated reduction targets depending on relative GDP/capita levels of member states.

As per the impact assessment results, approaches 1 and 3 above would result in disproportionately large efforts and associated costs in countries with below EU average GDP/capita levels, while approach 2 would lead to unattainable reduction targets in some countries. Approach 4 leads to

[26] Some models and scenario analyses were available in 1996-1997 as well (see e.g. Capros et al, 1995; Capros et al, 1996), and these were used to some extent in the process, e.g. by comparing the results of the Triptych approach to the outcome from modelling assuming a cost-effective distribution of emission reductions. However, coverage and quality were still a limiting factor. Most important though, models were seen as black boxes and the results were not trusted by the negotiating partners as the assumptions and modelling approach were insufficiently transparent.

[27] The PRIMES energy systems model from the Technical University of Athens ((Capros et al, 2008; Capros et al, 2008b) and IIASA's GAINS model on non-CO2 GHG gases (IIASA, 2008) were used for mitigation options, technologies and costs. GEM E3 (http://ipts.jrc.ec.europa.eu/activities/energy-and-transport/gem-e3/) was used to assess the overall macro-economic impacts and the indirect effect between sectors of the GHG target. It was also used to assess the impact of different allocation approaches in the ETS, different effort sharing approaches and different assumptions on GHG targets assumed outside the EU. The POLES model was used to examine the impacts of the EU-wide targets of 20-30% GHG emission reduction (http://ipts.jrc.ec.europa.eu/activities/energy-and-transport/documents/POLESdescription.pdf), with detailed representation of the energy systems on a global scale. The **PACE** model was used to assess sector specific impacts on energy-intensive industries of the GHG and RE targets. For more on the relation between the models and on how their respective results were integrated, see European Commission (2008d).

[28] In which emission reduction measures are implemented in order of increasing marginal abatement costs, independent of in which country they occur, until the EU targeted emission reductions have been reached.

slightly higher costs in high GDP/cap member states, but substantial reductions compared to approach 1.

The member state targets after redistribution were calculated as illustrated in Figure 4. The member states with the lowest GDP/cap (Bulgaria) was assigned a +20% target (compared to 2005), while the country with the highest GDP/cap (Ireland, Luxemburg) was assigned a -20% target. The EU average GDP/cap leads to a target of -12% compared to 2005 emissions. The targets for the other member states were interpolated between -20% and -12% for high GDP/cap countries and between -12% and +20% for the low GDP/cap countries.

Text Box 1 Interaction between GHG targets and RE targets in the Climate & Energy Package

The decision to adopt a two-pronged EU target for 2020 (in terms of GHG emission reductions *and* in terms of renewable energy) was much debated, especially as RE measures are in general more expensive than emission reduction measures. One school of thought in the debate was that an overall GHG target should be set, while leaving it to the market how to reach this target. The other school of thought argued that RE contributes to other policy aims than mitigating climate change, and that separate RE targets were needed for that reason. The latter argument, in the end, prevailed, with the Package

In the Impact Assessment, the mutual impact of GHG and RE targets and policies was assessed by developing three scenarios (with the PRIMES/GAINS models) in which:

1. the RE target is achieved in a cost-effective manner but without any specific policies to achieve the GHG commitment;
2. the EU-wide GHG target of a 20% reduction is achieved in a cost-effective manner but without any specific policies to achieve the RE target; and
3. both the RE and the GHG target are achieved in a cost-effective manner.

Comparing the results of these three runs allows for the assessment of the impact of both targets and the impacts on each other. Scenario 1 results in a GHG emission reduction of 10% compared to 1990 levels (and 20% RE), while Scenario 2 results in a 16% share in RE (and 20% emission reduction). Scenario 3 achieves both targets, with a higher contribution of energy-related CO_2 emissions in the overall GHG reduction than in scenario 2. In terms of costs, Scenario 2 would require a carbon price of 49 €/t CO_2 to achieve the target, while the introduction of RE policies Scenario 3) reduces this to 39 €/t CO_2. Similarly, Scenario 3 lowers the incentive required to achieve the RE target from 56 €/MWh to 45€/MWh through implementation of emission reduction policies.

Note that also for the EU-wide RE target, distribution across member states was assessed:

1. on the basis of member states' national resource potential; and
2. on the basis of a flat-rate increase in the share of RE in each member state weighted by GDP and modulated to take account of earlier development of renewable resources.

Overall, the impression is that the negotiations were mostly a package deal, where member states looked at the overall economic impact of the combined targets (RE, GHG in ETS and non-ETS sectors), aided by various trading/flexibility elements in the package (Guarantees of Origin for RE, ETS, transfer of emission allowances in non-ETS sectors to other Member States and the use of project credits in ETS and non-ETS sectors, see also Table 37 in the Impact Assessment).

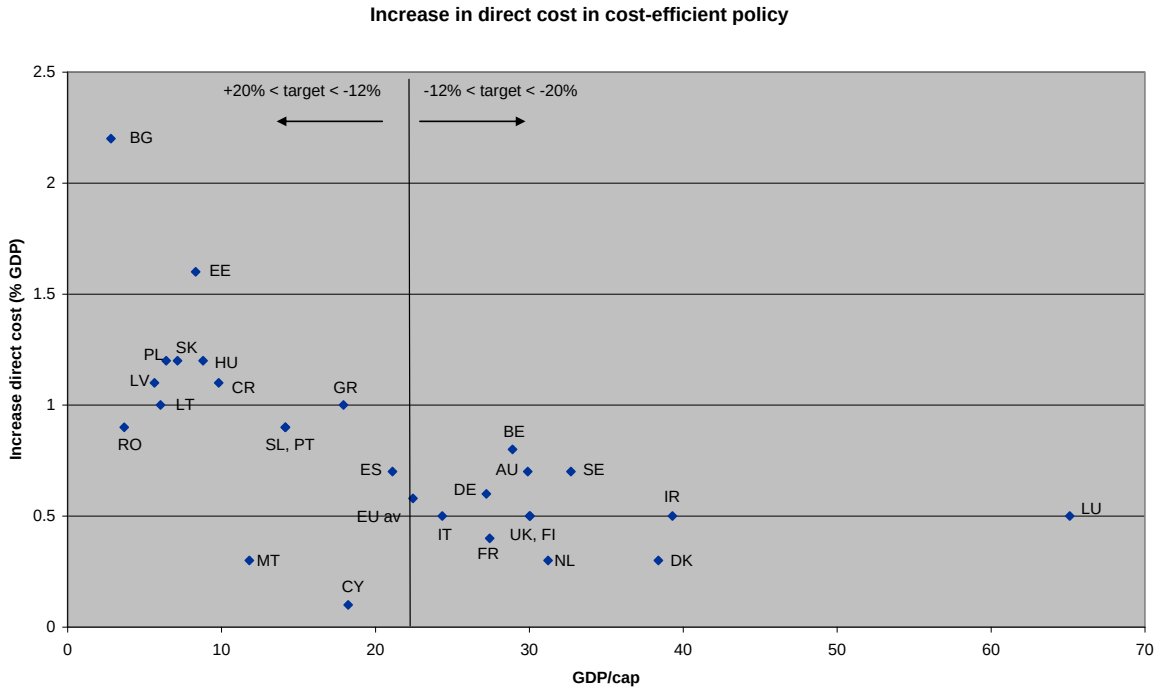


Figure 3 Increased direct costs (as % of GDP) in individual member states if emission reductions in the non-ETS sectors are distributed on a cost-efficiency basis as a function of GDP/cap (2005) (data from Commission Impact Assessment)[29]

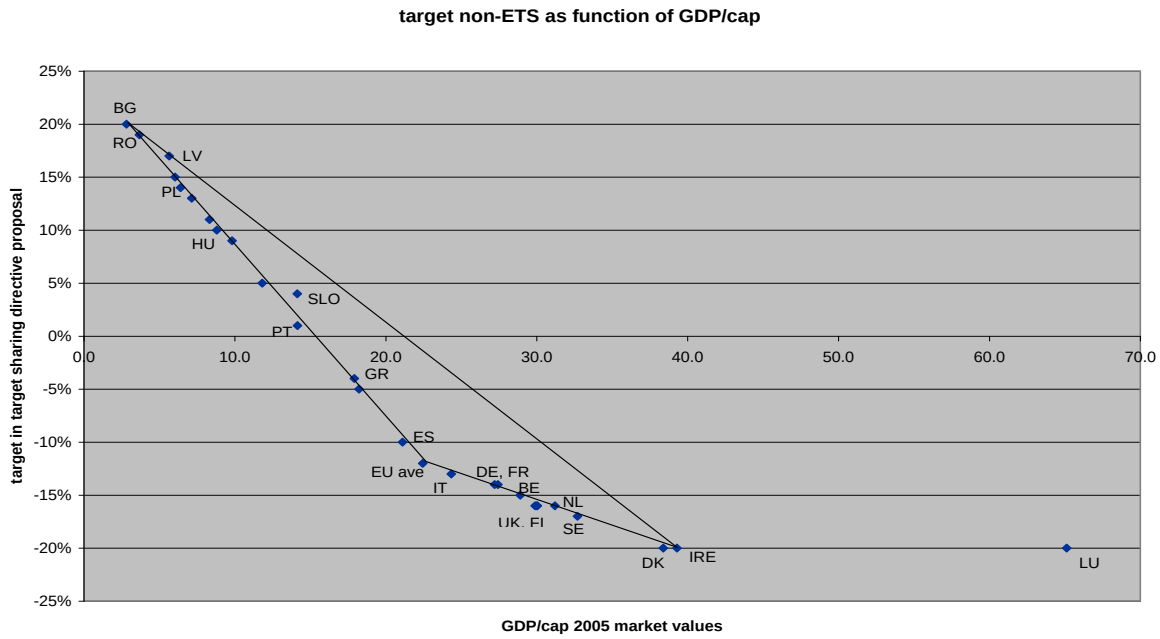


Figure 4 Calculation behind the 'target sharing' proposal for non-ETS sector emissions. If GDP/cap < the EU average, target is interpolated between +20% and -12%. If GDP/cap > the EU average, target is interpolated between -12% and -20%[30]

[29] From Phylipsen, et al (2008).
[30] From Phylipsen et al (2008).

Overall, the emissions in the non-ETS sectors will have to decrease by about 10% in 2020 compared to 1990 levels under the proposed targets. For a number of the EU-15 member states (Austria, Greece, Italy, Luxemburg, Portugal and Spain), the reduction targets for the non-ETS sectors in the European Commission proposal (which were expressed relative to 2005 emissions) actually represent an increase in emissions compared to 1990.

ETS sectors

The approach described in the previous section was possible for emissions in the non-ETS sectors, as competitiveness concerns related to such a redistribution are limited in these sectors. For the EU ETS sectors, a similar redistribution of emission allowances would lead to a distortion of competitiveness between similar industries in different countries, with unfair advantages for industries located in low GDP/capita countries. This would not be consistent with EU and international trade legislation and the requirements of the EU ETS Directive.

Therefore, in the EU ETS sectors, there is a distribution, not of EU allowances, but of the associated auctioning revenues. First, the amount of allowances to be auctioned is established, after which 90% of this amount is distributed over the member states on the basis of their share in 2005 verified emissions in the EU ETS. The remainder of the allowances to be auctioned is redistributed on the basis of per capita GDP and growth prospects. This maintains the same principle of redistribution to low GDP/capita countries as used for non-ETS sectors, without negative impacts on competitiveness.

In the EU ETS, member states are the recipients of the revenues obtain from the auctions they hold to sell emission allowances to the EU ETS participants. Within certain boundary conditions, each member state can spend these revenues according to their own priorities. Under the Package approach, first, the total amount of EU allowances to be auctioned for the EU ETS as a whole was established. The redistribution was carried out as follows:

- 90% of the amount of allowances to be auctioned is distributed to member states on the basis of their share in the total ETS emissions in 2005; while
- the remainder is distributed from countries with a high GDP/capita to member states with low GDP/capita and high growth perspectives according to the percentages included in Annex II of the proposal).

Overall results

The impact assessment of the 20-20-20 proposal carried out by the European Commission estimated the cost of the proposed targets for the EU and each member state in terms of loss of GDP in 2020. The analyses suggested that the difference between the cost-effective distribution of targets and the redistributed targets is negligible. member states with a GDP per capita below EU average benefitted substantially through an improvement in their private consumption[31] or GDP impact. Employment benefits were overall positive, certainly in the EU15 member states.

[31] Private consumption is defined as the value of the consumption goods and services acquired and consumed by households. It is used as a proxy for private income, i.e. the modelling estimates whether the targets have any positive or negative impact on income levels of citizens/consumers.

3.3 Process towards the Effort Sharing Agreement

The process though which the 2020 Effort Sharing Agreement was reached was very different from that used in 1997. The concept of differentiated efforts among member states was by now accepted practice. Also, the discussion about top-down versus bottom-up approaches to target setting was decided in favour of the former, also in light of the overall environmental ambitions of the EU, formulated since 1997 (limiting global temperature increase to 2°C, and the corresponding levels of GHG concentrations and emissions). In addition, the strengthened role of the European Commission and the availability of more extensive and better quality modelling tools contributed to a different negotiations process.

On the basis of stakeholder consultations around the 20-20-20 proposal, the European Commission had extensive modelling exercises carried out to assess the economic impacts of the 20-20-20 targets (separately and in combination with each other) in a variety of scenarios. On the basis of these scenario analyses, the Climate and Energy Package main proposal was constructed, with the different scenarios included as part of the impact assessment.[32] Subsequently, extensive discussions and further stakeholder consultations took place, focussing on the estimated economic impacts and the modelling approaches and assumptions underlying them.

The core bottleneck in these discussions, taking place at the height of the economic crisis, was the limitation of the economic impacts associated with achieving the various targets, i.e. limiting the costs of reducing emissions and/or increasing RE generation on the various stakeholders.[33] Countries in Eastern Europe especially were reluctant to adopt the proposal for fear of economic damage at home (and subsequent political damage). Therefore, the discussions did not focus on changing the proposed targets or the redistribution, but on limiting the impacts through increasing the allowed use of international emission reduction units towards reaching the targets, and for the EU ETS sector increasing the use of free allocation.[34] These changes in the proposal were sufficient to bring on board all member states as well as the European Parliament in supporting the revised proposal, which was adopted in the EU Council in December of 2008.[35]

The approach chosen in the package, and especially in the effort-sharing of non-ETS emissions, was cleverly chosen by the European Commission to maximise the changes of political success, i.e. adoption of the package. The expectation was that the member states that are usually more pro-active on climate change issues[36] would anyway be in support of the Package and the ambitious, long-term objectives it entailed. Member states having the most difficulties in reaching their Kyoto

[32] See European Commission (2008c; 2008d).

[33] Governments, the private sector as well as citizens. Costs increases could be directly, e.g. through required investments in emission reductions and RE for industry or increased energy prices for consumers (and associated financial support from government), or indirectly, e.g. through reduced competitiveness for industry or negative impacts on employment for citizens (and the associated costs for governments).

[34] Both for industry, for those that were considered vulnerable to international competition and carbon leakage, and for the power sector, where power producers in coal-intensive MS obtained a grace period in which they receive part of their allowances for free while the power sector is modernised.

[35] See Council of the EU, 2008; 2008b); The final versions of the different legal texts were formally adopted in April 2009, (see EU, 2009; 2009b).

[36] Mostly the North-Western MS, such as the UK, Germany, the Netherlands, the Scandinavian countries.

target[37] were expected to be more reluctant to adopt new stringent targets at the national level. Under the proposed approach, however, these are also the countries that 'benefit' from the choice of 2005[38] as the base year for emissions, as they are the ones whose emissions showed the strongest increase between 1990 and 2005.

[37] Spain, Austria, Luxemburg (depending on the use of Kyoto credits at a national level), Portugal and Italy among the EU-15 and Slovenia among the new member states

[38] Splitting up emissions into ETS and non-ETS sectors necessitated using 2005 as a base year for the targets, as no separate emission data for the two categories were available before then (the EU ETS became operational in 2005). Using 2005 as a base year for the proposal instead of 1990 awarded member states with the biggest gap with their Kyoto Protocol target.

4 Other uses of the Triptych approach

In this section, we briefly describe other discussions were (adapted versions of) the Triptych approach were used, including analyses used in the discussions on global effort sharing (Sections 4.1 and 0), the distribution of national emission targets over its regions (Section 0*) and the distribution of national energy savings targets in China over its provinces (Section 4.3). Here it must be noted that though the Triptych analyses in these cases were used in the political negotiations to a varying extent, none of them were ultimately employed in the actual setting of distributed targets as was done in the EU in 1997.*

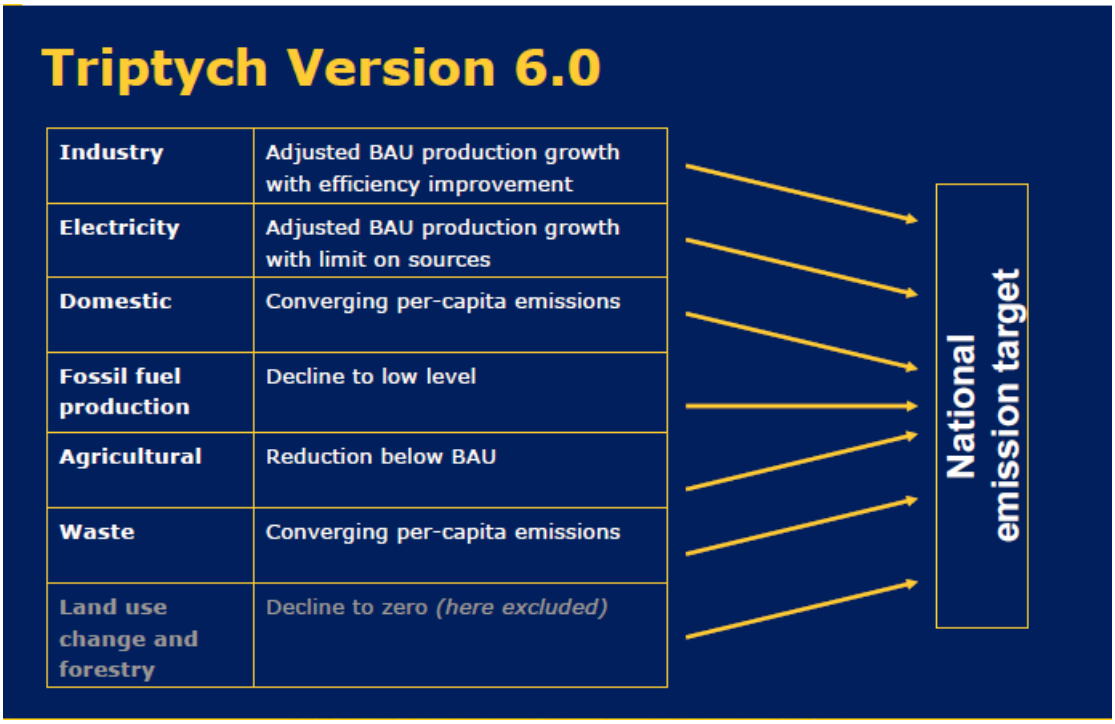
4.1 Global Triptych analyses

The use of the Triptych Approach in the EU Burden Sharing Agreement gained a lot of attention in subsequent years, due to its operationalisation of the 'common but differentiated responsibility' concept laid down in the UNFCCC. This led to the question as to whether the Triptych approach could also be used to inform negotiations at the global level. In this context, it should be noted that a number of complicating factors exist. Most important is the fact that the number of negotiating partners around the table is much larger and that the variation in national circumstances between countries is much larger. In addition, from a process point of view, the international community lacks some of the institutional platforms, procedures and financial mechanisms that formed a basis of commonality and shared purpose in the EU.

A first attempt to adapt the Triptych approach to discussions at the global level was done by, amongst others, using extending the timeline for converging per capita emissions to 2050.[39] In addition, industrial energy efficiency and the carbon intensity of electricity production were assumed to converge in 2050. Differences in development between different regions were also taken into account by using different per capita production levels for energy-intensive materials (to account for such things as the degree of physical infrastructure that still needs to be built up in a country). Due to data constraints, the analysis was carried out on a regional level, rather than country level.

In later years, the Triptych approach was revised more substantially, complementing the originally three emission categories with several more, to properly reflect the inclusion of additional gases and sources and to improve the ability to take into account additional national circumstances.[40] Emission categories that were added (or split off from the existing categories), included the fossil fuel production sector (coal mining, oil and gas extraction), the agricultural sector, waste and land use change and forestry. For each category, criteria were developed to be applied uniformly to the different starting points of the different countries. Figure 5 shows the approaches used for each of the seven categories, and an example of the parameters chosen for each of the 'levers' of the environmental ambition level of the scenario.

[39] See Groenenberg, Phylipsen and Blok (2001).
[40] See e.g. Hoehne et al (2002); Phylipsen et al, 2005; Hoehne et al (2005).



Parameters used

		450 CO_2	550 CO_2
Industry	- Adjusted BAU industry production growth - Energy efficiency index by 2050 better than current best technology (=1)	X 0.5	X 0.8
Electricity	- Adjusted BAU production growth - REN and emission free share in 2050 - Coal + oil absolute reduction	X 60% -75%	X 40% -40%
Domestic	Converging per-capita emissions in 2050 to...	0.7 tCO_2eq/cap	1.3 tCO_2eq/cap
Fossil fuel production	Emissions in 2050 decline by ...	-90%	-90%
Agricultural	Reduction below BAU in 2050 high income Reduction below BAU in 2050 low income	70% 50%	20% 40%
Waste	Per capita emissions in 2050 decline to ...	0	0
Land use change and forestry	Per capita emissions in 2050 decline to ...	0	0

Figure 5 The seven emission categories used scenarios under the global Triptych approach (top) and an example of the parameters used in different scenarios with different ambition levels, as presented in the context of the CCAP Dialogue on Future International Action to Address Global Climate Change[41]

However, the Triptych approach has not been able to play the role in the global negotiations that it had within the EU. In addition to the increased complexity of the analyses (more countries, larger

[41] See Phylipsen (2004).

differences, more complex model), also the setting in which discussions were held may have contributed to this lesser impact. With many competing and diverging interests around the table, it is more difficult to engage in a constructive process in which political negotiations and supporting technical analyses can strengthen each other. Many competing approaches were being discussed at the same time, often also in the same analytical reports. As a result, it may have been more difficult to bring across the approach's comparative benefits.

4.2 Regional Triptych analyses

Distributing a joint emission target over countries using the Triptych approach is basically no different from sharing a national target across its regional entities. Interest in this application of the approach emerged especially in countries with strong regional autonomy and strong differences in 'regional circumstances', such as Canada, Italy and Spain. In Spain, for instance, the autonomous region of Cataluña – responsible for a disproportionately large share in both Spain's GDP and GHG emissions – was a strong proponent of such an approach. Similarly, in Italy interest existed in using the approach to take into account such matters as differences in industrialisation and standards of living between the north and the south of the country.[42] In addition, it was thought that regional commitments would have a higher chance of success, as regional authorities are closer to the implementation of emission reduction measures.

In Canada, the National Climate Change Secretariat had the applicability of the Triptych approach assessed for distributing the Canadian Kyoto target over its provinces. In this context, the differences in relevant 'regional circumstances' between the different provinces were assessed and different distribution scenarios were developed with the Triptych approach.[43] The results were used in the negotiations the national governments held with the provinces. However, there was too strong resistance from the economically (and therefore politically) important provinces with high carbon intensity to take the distribution discussion any further. Instead, decision-making in Canada was ultimately based on purely political negotiations, with 'Provinces and territories ... implementing GHG reduction strategies that reflect their individual circumstances'.[44] Still, this did not fully remove the interest in the approach, as evidenced by hearings held by the province of Quebec held hearings on this.[45]

4.3 Chinese energy savings targets distribution over provinces

In 2010-2011, Lawrence Berkeley (LBNL), together with the Chinese Energy Research Institute, assessed the feasibility to use the (principle of the) Triptych approach to distribute the energy-saving targets in China's 11th Five-Year Plan (FYP, 2006-2010) and 12th FYP (2011-2015) over the provinces.[46] Targets in these plans are defined in terms of economic energy intensity (energy/GDP) in the 11th FYP, in the 12th FYP. To improve the chances of meeting the national target, they are allocated sub-nationally to provinces, cities, sectors and enterprises. For the 11th FYP, provincial

[42] See Gaudioso, De Lauretis and Phylipsen (2007).
[43] See Palmer, Moor and Phylipsen (2001).
[44] See Government of Canada (2012).
[45] See Phylipsen (2003).
[46] Funded by the China Sustainable Energy Program of the Energy Foundation, see Oshita, Price and Tian (2011).

targets were set based on a rapid assessment and negotiation, and most were set close to the national target.[47] Results varied strongly across provinces, both in terms of compliance with their targets as in terms of response strategies chosen. For the 12th FYP, the Chinese government sought to use a more scientific methodology to better estimate the varying potentials for energy saving across the provinces, to facilitate a change in development mode, as well as to achieve an equitable distribution of targets.

In the analysis, the Triptych approach was adapted to the Chinese context by addressing energy intensity rather than CO_2 emission targets. Further adaptations were made for the wider variation in provincial energy and economic structure in China.[48] The methodology combines top-down national target projections and bottom-up provincial and sectoral projections of energy and GDP to determine target allocation of energy intensity targets. Because energy intensity varies dramatically among different sectors of the economy, and because absolute energy consumption differs widely among provinces and economic sectors, energy use is categorised by end-use sector: industrial energy (heavy and light), residential energy, and other energy (transport, service sector, agriculture, etc.). Criteria are then applied uniformly across provinces for each of the categories As the FYP targets are expressed as final energy intensity, the power sector is not covered under the approach.

Conclusions of the analyses were that the adapted approach was:

- transparent, making connections between the choice of indicators, and resulting targets, enabling decision-makers to clearly set priorities and explain the targets;
- cost-effective, accounting for varying potential to improve energy intensity by identifying measureable indicators (the latter also facilitating the monitoring progress toward the targets);
- equitable, by aiming for a common level of residential energy and comfort for all citizens (convergence approach), and by encouraging the development of low-energy economic activity for all provinces, with extra encouragement for poorer provinces; and
- effective in that it allocates provincial targets that can achieve the national target, and it works within the constraints of available data.

It was concluded that, while relatively simple, the adapted approach was suited to data availability and the organisation of statistics in China, as well as the structure of energy use and economic output. The approach informed the decision-making process on the regional target distribution, but the results were not adopted outright, as other issues related to regional equity were also considered important enough to take into account.

ERI, the Chinese institution responsible for technical support for Chinese policy development and implementation developed their own approach, informed by the LBNL work regarding differences in circumstances between the regions. ERI proposed (draft) provincial targets by establishing four clusters of provinces, with targets either slightly below or above the national energy intensity reduction target of 16% between 2010 and 2015. The 31 provinces were then placed in a specific cluster on the basis of four criteria:

- The difficulty, covering regional circumstances that could be a limiting factor in improving energy intensity, such natural circumstances (e.g. availability of natural resources), industrial structure, projected (BaU) demand, capacity for technical innovation, etc.

[4747] A 20% reduction in economic energy intensity over the five-year period.

[48] The lead author of the current paper was involved by introducing the project team to the Triptych approach in detail, and by reviewing the results of the project.

- Capabilities/capacity to improve energy intensity, including indicators such as GDP/capita, the level of technology development (physical energy efficiency measures, parameters representing the provinces' technical and economic ability to improve energy intensity)'
- Responsibility, covering indicators such as the province's energy intensity compared to average, GDP, population.
- The potential to improve energy intensity.

Under each criterion, multiple indicators were used, with each assigned a weighting factor. After a first round of discussions with the provinces, a fifth cluster was added (with the lowest target) to account for additional specific circumstances in the least developed provinces, where further development will first result in an increase in energy intensity as industry develops. The five clusters intensity reduction targets ranged from 10-18% reduction.[49] Further weighted average analyses ensured that the sum of the provincial targets equalled the national target.

A draft target allocation plan was circulated to local DRCs and Economic Trade Commissions by NDRC in March 2011 to ask for comments before the national intensity target was officially announced ('十二五'节能 指标初步分解). The draft plan was said to 'emphasize the economic development level of each province', but details of the approach were not published at that stage.[50]

Analysis of the draft NDRC targets and three target scenarios included in the LBNL report shows that the official draft allocations 'vary in approach by province, with some provinces receiving a target based on economic capacity, others with targets based on energy savings potential, and still others not aligned with any of the LBNL scenarios.'[51] Provinces also conducted their own analyses and carried out 'tough negotiations with the central government' over the final 12th FYP intensity targets. In this, Western provinces called for a lighter burden, while low-intensity provinces like Guangdong asked for recognition of the investments and savings already accomplished.[52]

The approach used by the Chinese government has some elements reminiscent of both the 1997 EU Burden Sharing Agreement (use of different indicators to reflect different equity principles to distribute efforts) and the 2020 Effort Sharing Agreement (extrapolation of regional targets around the total average target). One strong similarity, emphasised by ERI, was that also in the Chinese process the methodology developed by ERI was not meant to provide the quantitative targets as an outcome. Rather it was a tool to inform the discussions between the central government and the provinces with data on differences between the different provinces.

At the same time, the analytical approach used for taking into account regional differences in the distribution of the national energy savings target over the provinces was not made public (and it is

[49] Information in this section is based on interviews with ERI staff involved.
[50] http://www.chinafaqs.org/blog-posts/targets-provinces-energy-intensity-12th-five-year-plan
http://china.lbl.gov/sites/all/files/march_2011_update_based_on_announced_16_percent_target_en.pdf.
[51] For Guangdong, China's second largest energy consumer and least energy-intensive province, the proposed 18% official target matches LBNL Scenario 3, emphasising Guangdong's economic strength rather than its potential for energy saving (a 14% target under Scenario 1). In contrast, the draft 17% target for Shandong—with the largest energy consumption and greater share of industrial energy—matches Scenario 1, emphasizing Shandong's energy saving potential. The proposed 16% target for Sichuan, a moderately poor province, is tougher than any of the sector-based scenarios (11%-13%); the basis for the official target is unclear. For the heavily industrial, fast growing province of Inner Mongolia, NDRC allotted a low target of 15% compared to scenario targets of 18% to 20%, despite Inner Mongolia's very high energy intensity and high GDP per capita.
[52] http://blogs.worldwatch.org/can-china-do-a-better-job-delegating-its-2015-energy-and-emissions-targets/.

not clear to which extent it was shared with the provinces). As the above description shows, the approach was rather complex, using many different indicators, some that overlapped between the different clusters and various weighing factors. This may have led to a somewhat limited transparency, reducing the insight that could have been gained from the exercise by the different parties involved. It is clear that the arguments raised by the provinces in response to the draft allocation are very similar to those in the European debate before the Burden Sharing Agreement.

4.4 2007 IPPC report of Working Group III

In the Working Group III report of the Intergovernmental Panel on Climate Change (IPCC) of 2007, a synthesis was made of different burden differentiation calculations, applying a variety of burden differentiation rules. One of these rules was a global Triptych approach.[53] For example, for a 450 ppm CO_2eq. stabilisation target the authors came to the following assessment (Gupta et al., 2007):

- Annex I: 25-40% emission reduction in 2020 and 80-90% emission reduction in 2050 (compared to 1990);
- Non-Annex I: substantial deviation from the baseline in some regions in 2020 and in all regions in 2050.

The results of this assessment have played a role in the further positioning, e.g. in the EU.

[53] See Höhne et al (2005).

5 Lessons learned for post-2020 discussions

5.1 Similarities and differences between 1997 and current discussions

Substantial differences exist between the situation around the 1997 EU burden sharing discussions and the current discussions on international climate change agreements for 2020. Here we discuss the main differences that are relevant for the identification of lessons learned.

First of all, there are substantial differences in the situation within the EU itself. As already set out in Section 3.1, EU policy making has evolved substantially since 1997. In the pre-Kyoto period energy and climate change policies were primarily a national concern. Since 1997, energy and climate policy has become much more a matter of common and coordinated policy making at the EU level. One of the most prominent elements in the EU policy package is its emissions trading system (EU ETS); the main participants in this system coming from the electricity sector and the energy-intensive industries. The EU ETS creates a uniform market for GHG emission allowances. Since 2013, the auction and allocation of emission allowances to companies is done on the basis of uniform EU rules. This means, in fact, that the sectors involved the EU ETS are no longer subject to the effort sharing between the EU member states. So, the effort sharing is no longer applied to two of the three categories included in the Triptych approach.

For the international climate negotiations, substantial changes have also taken place. The Bali Action Plan, adopted at COP13 in Bali in 2007, broadened the scope of the discussions to what has come to be known as the 'four pillars' of long-term climate action,[54] urging advanced action on mitigation, adaptation, technology development and transfer, and financing and investment. With respect to mitigation efforts, substantial changes occurred especially from Copenhagen onwards. In the period up to the agreement on the Kyoto Protocol in 1997, binding 'targets and timetables' were a central concept in the negotiations. This remained the case for many parties in the international climate negotiations until the failure to reach a full agreement based on this concept at COP-15 in Copenhagen. A year later at COP-16 in Cancún, an agreement was reached including voluntary pledges from all main countries. In the meantime, negotiations are continuing in different tracks in not necessarily converging directions.

Currently, there is not yet full clarity on what a future agreement should look like, but it will most likely be multi-layered, consisting of many components, of which targets-and-timetables is only one (key) element. Also, in Copenhagen, the concept of voluntary pledges was introduced, which is much more based on the analysis of what a country can do, or is prepared to do, unilaterally. In addition, many efforts are underway to develop NAMAs and (other) new carbon market mechanisms that can be implemented unilaterally or with links to international climate change agreements and/or international carbon markets.

At the same time, similarities exist between the current international situation and that within the EU in 1997. First, there are different views about whether climate change efforts should be framed top-down (starting from an environmental target, which is then translated down to individual

[54] A 'new, comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012' (see UNFCCC, 2007).

country and/or sector level) and bottom-up (individual actions summing up to an overall mitigation effort with uncertainty about the resulting environmental ambition level). Second, the main negotiation barriers are very similar: differences in level of development and standard of living (and the need for growth), difference in resource basis (domestic availability of fossil fuels, renewable energy potentials, forestry and land-use), differences in economic structure and energy efficiency. Third, a lack of understanding of the differences in national circumstances is reducing the window to reach an agreement.

5.2 Identified lessons learned

Here we identify a number of important lessons learned from the EU Burden Sharing and Effort Sharing Agreements, and the role of the Triptych approach in the discussions. From those lessons learned, we provide some suggestions on how such approaches and processes may be of use in the current negotiations.

Experiences have shown[55] that the Triptych approach was a very important *tool* in the negotiations, considerably increasing insight and understanding among EU negotiators. This led to a stronger willingness to accept differences between countries as well as to strengthen own mitigation efforts. The Triptych approach, however, did not (and cannot), take the place of the actual negotiations process. It should be seen as a tool to be used in a process, in which political negotiations are also an important element.

In our view, this is different from what is currently happening at the 'informal workshops under the UNFCCC' to improve understanding of mitigation activities and national circumstances[56]. These workshops generally take the format of unilateral presentations, discussing individual country experiences and circumstances. As a result, the comparative aspect of the European approach is lost. While understandable, given the political sensitivities of such comparisons, it reduces the insights created by looking at the relative importance of specific circumstances for mitigation efforts compared to other countries. It also misses the interactive process between the negotiators of different countries that in our view was a key success factor in the EU burden sharing negotiations.

In our view, one of the main reasons the Triptych Approach was successfully applied within the 1997 Burden Sharing Agreement, while other efforts described in Section 4 had less impact, was the *embedding* of the Approach (and other analyses, as described in Section 2.2) in such a process. Providing decision-makers with the results of technical analyses alone is not sufficient, involving them in the process, through interaction on issues and outcomes and iteration between analysts and negotiators,[57] is crucial. In this context, it is also important to note that the discussion on burden

[55] Not only based on the authors' impressions, but also confirmed by outside analyses, such as CICERO-ECN.
[56] See e.g.: http://unfccc.int/files/bodies/awg-lca/application/pdf/information_note_ws_on_namas_rev.pdf.
[57] It must be noted that the tools itself were, at that point, not shared with – or used by – the negotiators themselves. This was in part because - in the fast-paced, time-constraint environment of the negotiations at that point – the approach was implemented in a growing set of linked spreadsheets. Information about scenarios, input parameters, (sub-) results, and graphic output was shared with the negotiators. Sensitivity analyses were carried out at the request of the negotiators, after which assumptions used and results were shared with them on-site during the workshops described in Section 2.2. However, the question is whether, if a more user-friendly tool would have been available, it would have been (more) effective to share this with the negotiators at this point. In all likelihood this would have overwhelmed the negotiators, risking them to be bogged down in details, as suggested by later experiences with more advanced tools. Furthermore, the

differentiation was done after to an analysis of what emission reductions were feasible in the EU through concrete policy action (so-called common and coordinated policies and measures). This provided the member states with confidence that the emission reductions that were agreed upon were actually achievable at reasonable cost.

The institutional context in which negotiations take place is also important. The EU agreements were facilitated by existing institutions and negotiating structures and processes. Further, the existence of a shared financial structure (EU budgets, cohesion funds to support the least developed member states) and agreed overall policy objectives (such as the convergence of living standards) creates common ground. The established role of the Presidency (and later the European Commission) also created a natural lead entity to take the initiative and drive the negotiations. With regard to the current negotiations, the question is whether parallel structures and processes can be found (or perhaps developed over time) in the international context. Here it is also important whether an approach or tool like the Triptych approach would be used in a fully international setting (all parties involved) or in smaller groups (e.g. among developing countries, among BASIC countries, among the group of Like Minded Developing Countries - LMDCs).

For an approach like the Triptych approach to be acceptable, an acceptance of the basic principle of 'Common but differentiated responsibility'[58] (lower-income parties obtain more room to grow at the expense of higher-income parties) is necessary. In some of the cases described in Section 4, mainly parties that assumed they would 'win' under a burden sharing agreement (i.e. would be allowed more room for emissions relative to the other parties involved) were interested in such an agreement. The parties who would have had to create such room by reducing their emissions further were not. And where the latter are often the more politically powerful, decisions were based on other grounds.

In this context, it should also be noted that parties can have quite a somewhat distorted perception of their own national circumstances, relative to those of other countries. This was also observed in the EU process in 1997 prior to the work undertaken specifically to address this as described in Section 2.2. Most, if not all, countries were convinced that their national circumstances should warrant them more room for emissions, leaving no countries which were to transfer such room for

---

crucial element of the Triptych Approach is the balance between the different criteria applied to the different categories of emissions, which is how the whole set of national circumstances are taken into account. If negotiators were to use the tool independently, it is to be expected that they will use all the levers (the different criteria) to arrive at an optimal outcome for their own country, i.e. putting an emphasis on the national circumstances that are most beneficial for them, while undervaluing those that benefit other countries. As such, the whole basic tenet of the Triptych Approach would be lost.

[58] Note that the objective of the UNFCCC speaks about Parties protecting the climate 'in accordance with their common but differentiated responsibilities and respective capabilities'. At the time of the Burden Sharing Agreement it was more common to use the abbreviated form used here, with differing capabilities considered as one of the grounds for differentiation referred to in the principle. In Europe, the 'capability' consideration was also explicitly laid down in policy objectives and mechanisms such as the Cohesion Fund. In the international context this is not the case, and there was a need to explicitly include the 'capabilities' element when referring to the principle.

The Triptych approach takes 'capabilities' into account in a number of (implicit) ways. First, financial capability (ability to pay) is taken into account both in the per capita convergence approach in the 'domestic sectors' and the differentiated growth rates assumed in the scenarios for electricity consumption and industrial production (higher for lower GDP per capita countries). Technical capability (potential to reduce emissions) is taken into account in all three categories, either directly (power, industry) or indirectly (emission reduction potential estimates underlying overall EU negotiating position as well as the convergence level in the domestic sectors). See also the evaluation by ECN-CICERO, referred to in Footnote 12, where 'capacity' was one of the fairness considerations the Triptych approach scored best on).

emissions. Only extensive sensitivity analyses[59] gave more insight into the weight of the various national circumstances in the overall effort of to reduce/limit emissions, and revealed more balance between the different groups of countries. This tendency also exists in the international negotiations, as recognised by CAN which calls on Parties to go beyond 'asserting the uniqueness of their own national circumstances' in the negotiations on an equitable climate agreement.[60]

In terms of the approach itself, the Triptych approach was the right mix of sophistication and simplicity/transparency for that point in time (for a discussion on data needs, see Text Box 2 as well as the Tables in Annex II). It formed a middle ground between the other approaches discussed at that time, ranging from very simple but extreme approaches (such as equal GHG/cap, equal GHG/GDP) to the very sophisticated approaches that were considered untransparent ('black box' modelling). Because of the transparency, negotiators gained confidence that the approach was sufficiently sophisticated to take into account the main differences in national circumstances. The acceptance of the principle of differentiated commitments could, in later years, be built upon when better quality economic models became available. While extensive discussions were still held during the Effort Sharing Agreement on model assumptions and approaches, it allowed the modelling to play a role that would not have been accepted during the 1997 Agreement.[61]

A lesson learned in the years after the Burden Sharing Agreement was reached, is that situations change, and that working with scenarios always has its risks. This resulted in the Burden Sharing Agreement (and by association also the Triptych approach) to lose some of its lustre. What were considered to be relatively lenient growth targets at the time of the agreement turned out to still be relatively tight, due to a combination of higher than expected economic growth and less than assumed policy and mitigation effort. Also, policy changes occurring after the agreement had an impact, e.g. the reunification of Germany[62] and the decision to phase out nuclear energy in Sweden. The risk of working with scenario-based approaches will be larger in countries with large growth rates and rapidly changing policy directions.

[59] Ranging from being on island to having heated truck cabins in Nordic countries, to having large amounts of 'tank tourism', to printing relatively large amounts of money paper; see also Section 2.2.
[60] CAN discussion paper on the Equity Reference Framework (CAN, 2013).
[61] Given the limitations of the models available at that point and the lack of trust in the outputs of the 'black boxes', see also the discussion in footnote 26.
[62] With more low-cost emission reductions available in Eastern Germany than in Western Germany, for which the target was initially agreed, as well as a severe economic down-turn in the Eastern part.

Text Box 2 Data needs for the Triptych approach

Data needs in the original Triptych approach were relatively limited and concerned data that were in general readily available. Important data inputs at the country level were:

- Total national emission data for the base year by country, as well as the emissions for the 'domestic sectors' category of emissions. The latter is needed to determine the convergence levels. For the other emission categories such base year data are not necessary to calculate the sectoral allowances, but they can be helpful in communicating trends and providing confidence in the overall results by showing no extreme changes occur.
- Electricity production and generation portfolio (fuel mix) for the base year.
- Production and energy consumption for different heavy industry sectors in the base year.
- Projections for population, electricity consumption and industrial production for different heavy industry sectors (in physical units).
- Information about national positions regarding nuclear energy use and potentials to reduce emissions (including measure to reduce electricity consumption).

In addition to the above, data for specific sensitivity analyses were used (e.g. subsector data to assess the impact of different splits, data on degree days, etc). The notes listed with the Tables in Annex II show some of the assumptions and approximations that needed to be made to arrive at complete and comparable data for the EU (e.g. converting different base years between countries, on estimating emissions from light industry, on separating electricity generation from other energy sector).

Here it must be noted that the incorporation of differences in national circumstances would have been further improved if difference in the remaining potentials for renewable energy generation and industrial energy efficiency improvement could have been taken into account. This was not, however, possible, because of a lack of data at that point. In later revisions of the approach, the latter was to some degree included, with certain assumptions in case of missing data or by using regional energy efficiency levels (Groenenberg et al, 1999; Phylipsen, 2000).

For the global Triptych approach as described in Section 4.1, additional data are required, especially related to projections for more emission categories (industry, agriculture) and base year data (fossil fuel production, waste, land use, land use change and forestry).

In general, the data listed in the bullets above should be relatively easily available for most developing countries as well. Projections of industrial production (in physical units) may be an exception. Much effort has gone into the development of emission inventories and emission scenarios and the assessment of emission reduction potentials in developing countries in recent years. In general, scenarios with longer time horizons (more than 10-15 years) may be less available. Also, data for sensitivity analyses may be a limiting factor in the type of analyses carried out.

Other data for the extended Triptych approach for which data availability may be limited in a number of developing countries include the use of non-commercial fuels and non-CO_2 GHG emissions. Data quality of emissions related to land use and forestry may be limiting factor for all countries (developed and developing)

5.3 Considerations regarding the current negotiations

In the case of a potential interest in using the experiences with the Burden Sharing Agreement in the context of the international negotiations, the question is which part of the process is replicable. As mentioned above, embedding the use of a tool like the Triptych approach and other technical support in a political process is crucial. In addition, the question arises whether the use of the Triptych approach in itself is replicable,[63] or whether development process of the approach should be replicated. With this we mean the process of identifying the main barriers to the negotiations between a specified group of countries, followed by an operationalisation of dealing with differences in national circumstances related to those barriers into an approach that determines reasonable contributions to mitigation efforts by individual countries and/or sectors.

The changing international landscape (shifting partly from targets-and-timetables to other types of commitments) may also influence the role of burden differentiation approaches, like the Triptych approach. In the context of targets-and-timetables, such approaches could be used to support processes in which a distribution of a shared target is agreed on. With other types of commitments, their role could be more limited, e.g. they could be used to assess the 'fairness' of the resulting package of commitments (.e. the equivalence of effort of the different parties). This is a similar role to what is described by CAN in its discussion paper on the Equity Reference Framework.[64] In the context of NAMAs and/or sectoral approaches/mechanisms, approaches like the Triptych approach may also be useful domestically in the different developing countries, e.g. to assess what a reasonable contribution of different sectors could be to a country's overall effort.

Another potential application could envision the use of the Triptych approach to provide input for the discussions on how much each of the developed countries should contribute to the stated policy goal of providing US$100 billion in climate finance in 2020. In such a case, the reasonable contribution of each country determined by the approach to the joint target is not an emission reduction, but a financial contribution. It could be argued that the link between the bottom-up/sectoral indicators as used in the Triptych approach are less suitable for this purpose, as they are (in part) related to the potential to reduce emissions. On the other hand, (part of) the criteria are also related to past efforts and ability to pay, which are more relevant in the context of climate finance. Adaptations to the Triptych approach are also feasible, in which the ability to pay is also explicitly taken into account (e.g. GDP/capita).

A link between Triptych approach-like approaches and the other Bali pillars is more difficult to make. It was discussed at some point to link mitigation and adaption in a joint, quantified commitment. However, the only way that seemed conceivable at that stage was to do this through the costs associated with both. This would mean that a burden/effort sharing would be based on the total costs for mitigation and (impacts and) adaptation a country would face, i.e. on total net costs (mitigation costs minus adaptation costs). However, this was deemed to be unfeasible given the

[63] Potentially in its adapted form as described in Section 4.1.

[64] 'What's needed now is an equity process that can drive increased ambition on all fronts …. Minimally, this means a shared 'Equity Reference Framework' that embodies the Convention's core equity principles – one that's based upon well-designed and quantified equity indicators, one that's precise enough to guide Parties ex ante as they formulate commitments that are both fair and adequate, one that's useful ex post to both Parties and Observers as they evaluate commitments in equity-based and science-based terms.'

uncertainty in such numbers, especially for impacts and adaptation. Such links are now again being discussed in the context of climate finance.

Linking mitigation and adaptation (or even all four Bali pillars) through an adapted Triptych-like approach seems difficult. The question arises also whether such a combination should be attempted. The risk of a combined, more complex approach is that it loses the advantages of transparency and simplicity, which was in our view one of the success factors in the EU process. Such transparency may be better served by keeping the commitments for mitigation and adaptation separate, especially since no objective correlation between mitigation and adaptation commitments can be determined, and how they are weighed against each other is subjective. One thing that could perhaps be imagined is a parallel set of distributions for each of the four pillars, i.e. not one combined target for each country, but a contribution of each country to the individual pillar given a set of criteria specifically developed for each pillar.

This could fit into the current discussions on the Equity Reference Framework (ERF), where, according to CAN, 'Framework Parties need more explicit and quantitative guidance, based on the Convention's equity principles, regarding a fair allocation of both mitigation action as well as the provision of financial and technological support'. The Triptych approach is one potential operationalization of the questions raised by CAN that such a reference framework should address.[65] An ERF was seen by participants in a workshop on equitable access to sustainable development as a mechanism to address an identified failure of existing 'effort/burden/risk/resource-sharing approaches' to 'adequately advance a clear moral justification, explain how these are translated into indicators and transparently quantifying these indicator into burden sharing frameworks.'[66] This is something that the Triptych approach (in the narrower context of mitigation only) explicitly did.

It certainly seems useful to feed the experiences with the Triptych approach (and the broader EU burden sharing/effort sharing) into an expert-supported process of developing an ERF, e.g. in the context of the BEG or under the COP, as called for by CAN.[67] Here it is important, though, to keep two questions in mind following the lessons learned from those experiences:

- Can an ERF be a substitute for the negotiations process[68] or should it be seen as a tool guiding and informing the process?
- How can the development of the ERF be sufficiently embedded in the political process for it (and its results) to be sufficiently acceptable?

Here, the authors concur with the sentiment expressed in the MAPS workshop that 'the equity problem cannot be solved by adopting one quantitative principle or approach' and perceptions of fairness are important. Parties need to perceive that outcomes are sufficiently fair in terms that are

[65] How should responsibility be balanced against capacity? How should international obligations be balanced against domestic ones? How should sustainable development rights be understood, and how should they affect fair shares? (CAN, 2013)
[66] Organised by MAPS in Cape Town in March 2013 (MAPS, 2013).
[67] 'What is needed is an independent expert process, constituted by the COP in line with the submissions of the parties, and tasked with proposing an Equity Reference Framework that is based on a well-specified basket of indicators, all of which are themselves based on the Convention's equity principles.'(CAN, 2013)
[68] Which is how CAN's calling for 'standardised frameworks' could be interpreted (CAN, 2013).

important to them (MAPS, 2013). The approach suggested[69] echoes considerations and experiences from the EU Burden Sharing process. The importance of the process emphasised by the MAPS workshop is also fully shared by the authors.

[69] 'This 'fairness' Approach would also require Parties To develop a clear understanding of each others' perspectives, which would require the development of a dialogue process free of the strategic dimension dominant in any UNFCCC processes.' (MAPS, 2013)

References

- Blok, K., G.J.M. Phylipsen, 1996, *Common European Union Policies and Measures for Greenhouse Gas Emission Limitation and Reduction,* discussion paper for the informal workshop for the EU Ad Hoc Group on Climate, Dublin, September 2-3, Department of Science, Technology and Society, Utrecht University, Utrecht (96077).
- Blok, K., D. Phylipsen, *European Union Policies and Measures to Achieve the -15% Kyoto Negotiation Position*, Dept. of Science, Technology and Society, Utrecht University, 1997
- Blok, K., D. Phylipsen, 'Common and Co-ordinated Policies and Measures to Reduce Greenhouse Gas Emissions in the European Union', Int. J. of Environment and Pollution', 1998
- Blok, K., G.J.M. Phylipsen and J.W. Bode, 1997, *The Triptique Approach; Burden differentiation of CO_2 emission reduction among EU member states*, discussion paper for the informal workshop for the European Union Ad Hoc Group on Climate, Zeist, the Netherlands, January 16-17 (9740).
- CAN, 2013, *Equity Reference Frameworks at the UNFCCC Process – A Can Discussion Paper*, Climate Action Network, http://gdrights.org/wp-content/uploads/2013/06/CAN-ERF-discussion-paper.pdf
- Capros, P., L. Mantzos, V. Papandreou, N. Tasios, 2008, *Model-based Analysis of the 2008 EU Policy Package on Climate Change and Renewables – Appendix 1: Baseline scenario - Primes Model* – E3MLab/NTUA, for the European Commission – DG Environment, January 2008.
- Capros, P., L. Mantzos, V. Papandreou, N. Tasios, 2008b, *Model-based Analysis of the 2008 EU Policy Package on Climate Change and Renewables - Primes Model* – E3MLab/NTUA, for the European Commission – DG Environment, June 2008.
- Capros, P., E. Kokkolakis, S. Makris, L. Mantzos, Y. Antoniou and J.F. Guilmot, 1995, *Energy scenarios 2020 for the European Union*, report to the European Commission, Athens.
- Capros, P., and E. Kokkolakis, 1996, *CO_2 -10% target scenario 1990-2010 for the European Union: results from the MIDAS model*, report to the European Commission, Athens.
- COP-I, 1995, *Final declaration of the First Session of the Conference of the Parties under the Framework Convention on Climate Change*, Berlin.
- Council of the European Union, 2007, *Presidency Conclusions of the Brussels European Council (8 and 9 March 2007),* Brussels http://ec.europa.eu/enterprise/newsroom/cf/itemdetail.cfm?item_type=251&lang=en&item_id=510
- Council of the European Union, 2008, *Presidency Conclusions of the Brussels European Council (11 and 12 December 2008),* Brussels, published 13 February 2009, (OR. fr) 17271/1/08, REV 1, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/104692.pdf
- Council of the European Union, 2008b, *Energy and climate change – Elements of the final compromise,* Brussels, published 12 December 2008, 17215/08, POLGEN 142, ENER 472, ENV 1010, http://www.consilium.europa.eu/uedocs/cmsUpload/st17215.en08.pdf
- Environment Council Conclusions, December 1996, European Union Environment Council, Brussels.
- Environment Council Conclusions, March 1997, European Union Environment Council, Brussels.
- EU, 1993, *Ratification of the UN Framework Convention on Climate Change*, Brussels.
- EU, 2009, DIRECTIVE 2009/29/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community, Official Journal of the European Union, L140/63, published 5/6/2009 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0063:0087:EN:PDF
- EU, 2009b, DECISIONS ADOPTED JOINTLY BY THE EUROPEAN PARLIAMENT AND THE COUNCIL DECISION No 406/2009/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the effort of member states to reduce their greenhouse gas emissions to meet the

Community's greenhouse gas emission reduction commitments up to 2020, , Official Journal of the European Union, L140/136, published 5/6/2009 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0136:0148:EN:PDF

- European Commission, 1996, *European Energy to 2020 - A scenario approach*, EC-DG Energy, Brussels.
- European Commission, 2008, Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community, {COM(2008) 30 final}, {SEC(2008) 52}, {SEC(2008) 53}, {SEC(2008) 85}, European Commission, Brussels, January 2008. http://ec.europa.eu/environment/climat/emission/ets_post2012_en.htm http://ec.europa.eu/environment/climat/emission/pdf/com_2008_16_ia_en.pdf
- European Commission, 2008b, Proposal for a DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the effort of member states to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020, {COM(2008) 30 final}, {SEC(2008) 85}, European Commission, Brussels, January 2008.
- European Commission 2008c, COMMISSION STAFF WORKING DOCUMENT - IMPACT ASSESSMENT, Document accompanying the Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020. Proposals for
  - DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC so as to improve and extend the EU greenhouse gas emission allowance trading system
  - DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the effort of member states to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020
  - DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of use of renewable energy sources

  {COM(2008) 16}, {COM(2008) 17}, {COM(2008) 19}, European Commission, Brussels, January 2008.
- European Commission, 2008d, COMMISSION STAFF WORKING DOCUMENT - ANNEX TO THE IMPACT ASSESSMENT (provisional); Package of implementation relating to the EU's objectives on climate change and renewable energy for 2020, {COM(2008) X final}, {SEC(2008) XX}, European Commission, Brussels, January 2008.
- Gaudioso, D., R. De Lauretis, D. Phylipsen, 2007, 'Metodologie per un burden sharing regionale delle emissioni di gas-serra' (Methodologies for a regional burden sharing of green house gas emission targets in Italy), *Qualenergia* (in Italian)
- Government of Canada, 2012, Canada's Climate Change Mitigation Plan Government of Canada, presentation by Guy Saint-Jacques, Government of Canada to the UNFCCC Ad-hoc Working Group on Long-term Cooperative Action under the Convention, May 17, 2012, http://unfccc.int/files/bodies/awg-lca/application/pdf/20120517_canada_1749.pdf
- Groenenberg, H., D. Phylipsen and K. Blok, 1999, 'Differentiation of Greenhouse Gas Reduction Objectives Based on Differences in Energy Efficiencies in Heavy Industry', proceedings of the *ACEEE Summer Study on Industry 'Innovation in the 21st Century*', Saratoga Springs, NY, 14-18 June 1999.
- Groenenberg, H., D. Phylipsen, K. Blok, 2001, 'Differentiating commitments worldwide: global differentiation of GHG emissions reductions based on the Triptych approach-a preliminary assessment', *Energy Policy*, vol.29, issue12, pp 1007-1030
- Gupta, S., D.A. Tirpak, N. Burger, J. Gupta, N. Höhne, A. Ivanova Boncheva, G. Kanoan, C. Kolstad, J.A. Kruger, A. Michaelowa, S. Murase, J. Pershing, T.Saijo, A. Sari, 2007: 'Policies, Instruments and Co-operative Arrangements', Chapter 13 in: B. Metz, O. Davidson, P. Bosch, R. Dave, L. Meyer (eds.): *Climate Change 2007 – Mitigation of Climate Change*, Cambridge University Press, Cambridge, UK.

- Hoehne, N., G.J.M. Phylipsen, J. Harnisch and K. Blok, 2002, *Involving newly industrialised economies and developing countries in further commitments under the UNFCCC*, Ecofys GmbH, Cologne, commissioned by the German Environmental Protection Agency.
- Hoehne, N., D. Phylipsen, S. Ulrich, K.Blok, R. Janzic and C. Galleguillos, 2005, *Options for the second commitment period of the Kyoto Protocol*, Ecofys, Cologne, commissioned by the German Federal Environment Agency (UBA).
- IIASA, 2008, Emission scenarios for non-CO_2 greenhouse gases in the EU-27 Mitigation potentials and costs in 2020, IIASA, Vienna, authors: M. Amann, L. Höglund Isaksson, W. Winiwarter, A. Tohka, F. Wagner, W. Schöpp, I. Bertok, C. Heyes.
  See also: http://webarchive.iiasa.ac.at/rains/gains-methodology.html
- Janzic, R., and G.J.M. Phylipsen, 2004*, Future commitments: sensitivity analyses with the Triptych Approach for Japan*, Ecofys, Utrecht, commissioned by the Central Research Institute for the Electric Power Industry, Japan.
- MAPS, 2013, *Equitable Access to Sustainable Development - Reflections on Operationalising EASD - Reflections on a workshop held in Cape Town, 5-7 March 2013*, University of Cape Town, SouthSouthNorth, Cape Town.
- Palmer, W., P. Moore, G.J.M. Phylipsen, 2001, *Review of the Triptych Approach for allocating greenhouse gas emission reductions; its applicability for Canada*, Cheminfo, Ecofys, Toronto, commissioned by the Canadian National Climate Change Secretariat.
- Phylipsen, D., 2000, *International Comparisons & National Commitments; analysing energy and technology differences in the climate debate*, PhD thesis, Utrecht University, Utrecht.
- Phylipsen, D., 2003, *The Triptych Approach: Elaboration of burden differentiation among European Union member states*, presentation to the Quebec National Assembly, February 18, 2003, http://www.bibliotheque.assnat.qc.ca/DepotNumerique_v2/AffichageFichier.aspx?idf=38597
- Phylipsen, G.J.M., 2004, *Differentiation of future commitment in climate change for Annex-I countries*, Ecofys, Utrecht, commissioned by the Dutch Ministry of Environment.
- Phylipsen, G.J.M., K. Blok, 1996, *National Circumstances of EU member states Related to Greenhouse Gas Emission Limitation and Reduction,* discussion paper for the informal workshop for the EU Ad Hoc Group on Climate, Dublin, September 2-3, Department of Science, Technology and Society, Utrecht University, Utrecht (96078).
- Phylipsen, G.J.M., K. Blok and H. Merkus (eds.), 1997, *The Expert Group's Work on EU Common and Co-ordinated Policies and Measures,* in commission of the Netherlands' Presidency, Dept. of Science, Technology and Society, Utrecht University, Utrecht, 1997, (97039)
- Phylipsen, G.J.M., J.W. Bode, K. Blok, H. Merkus and B. Metz, 1998, 'A Triptych Sectoral Approach to Burden Sharing: GHG emissions in the European bubble', in: *Energy Policy,* 26, 12, pp.929-943, 1998.
- Phylipsen, D., M. Buttazzoni, C. Colamonico, S. Moltmann, N. Hoehne, 2008, *Evaluating the Italian Contribution to the EU Greenhouse Gas Reduction Target for 2020*, Ecofys Srl Italy, Rome, commissioned by the Italian Ministry of the Environment, Land and Sea Protection.
- Phylipsen, G.J.M., H. Groenenberg and K. Blok, 1998*, The EU burden sharing after Kyoto; Renewed Triptych calculations*, Department of Science, Technology and Society, Utrecht University, Utrecht, 1998.
- Phylipsen, G.J.M., N. Hoehne, R. Janzic, R. Bruinsma*,* 2005*, Implementing Triptych 6.0 – technical report to a spreadsheet model for post-2012 climate commitments*, Ecofys, Cologne, commissioned by RIVM.
- Torvanger, A,, and L. Ringius, 2000, *Burden Differentiation: Criteria for Evaluation and Development of Burden Sharing Rules - The Joint Cicero-ECN Project on Sharing the Burden of Greenhouse Gas Reduction Among Countries*, Centre for International Climate and Environmental Research Oslo (CICERO), Oslo.
- UNFCCC, 2007, Bali Action Plan, Decision 1/CP/13, in: FCCC/CP/2007/6/Add.1,14 March 2008, http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf

Annex I: EU country codes

In the various graphs, common EU country codes are used to indicate the different member states, according to the list below.

Country	Code	
	Used in Triptych Approach	Used in Effort Sharing
Austria	AU	AU
Belgium	B	BE
Bulgaria	-	BG
Croatia	-	-
Cyprus	-	CY
Czech Republic	-	CZ (CR)
Denmark	DK	DK
Estonia	-	EE
Finland	FIN	FI
France	F	FR
Germany	D	DE
Greece	GR	GR
Hungary	-	HU
Irish Republic	IR, IRE, IRL	IE (IRE)
Italy	I	IT
Latvia	-	LV
Lithuania	-	LT
Luxembourg	LUX	LU
Malta	-	MT
Netherlands	NL	NL
Poland	-	PL
Portugal	P	PT
Romania	-	RO
Slovakia	-	SK
Slovenia	-	SI
Spain	E	ES
Sweden	S	SE
United Kingdom	UK	UK

Annex II: Example assumptions, results Triptych approach

Population and disaggregated basic emission data for 1990

Country	**Population**		**Co_2 emissions** (mt)							
	1990	*2010*	Power generation	Other Energy conversion	Industry (fuels only)			Transport	Domestic/tertiary	Total
	(million)				Total	Of which				
						Heavy industry	*Light industry*			
B	10	10	21	13	25	19	6	21	27	106
DK	5.1	5.3	29	3	6	3	3	11	7	57
D	79.4	83.6	374	62	170	126	44	159	220	984
GR	10.1	10.8	41	3	10	7	3	16	8	78
E	39	40.6	68	11	52	42	10	63	30	223
F	56.4	59.9	38	23	71	43	28	128	90	349
IRL	3.5	3.6	10	1	5	2	3	5	8	29
I	57.7	57.8	116	22	91	69	22	96	76	401
LUX	0.4	0.4	0.4	1	7	6	1	3	1	13
NL	15	16.5	43	8	49	26	7	27	43	170
AU	7.7	8.2	12	5	12	10	2	16	12	57
P	9.9	9.5	15	5	6	4	2	10	3	39
FIN	5	5.3	24	2	14	11	3	11	8	60
S	8.6	9.1	4	3	13	9	4	23	11	55
UK	57.4	60.2	215	16	97	55	42	121	112	561
Total	365.2	380.8	1010	178	628	709	182	709	655	3183

Notes: Data on 1990 emissions are taken from the European Union communication for the FCCC. Where EU communication data [EC, 1996b] differed by more than 1% from the 1990 projection baseline [Irish presidency, 1996], data from the National communications have been used. This was the case for Denmark, Finland and the Netherlands. Deviations between the two sources are caused by emissions related to imported electricity (DK, FIN) and actual feedstock emissions (NL). During calculations we excluded these additional emissions. In the final results these emissions (6.5 Mt CO_2 for Denmark, 7.1 Mt for Finland and 14.8 Mt for the Netherlands) were added to both 1990 emissions and to the emissions calculated for 2010. With regard to the domestic sectors and the heavy industry sector only fuel-related emissions have been included. Electricity-related emissions in these sectors have been included in the electricity sector. For industry no 1990 emission data broken down by subsector were available. Here, 1990 total industry emissions were disaggregated into subsectors using the 1992 relative share of individual subsectors in total industry emissions [Capros et al., 1995]. The share of emissions in the light industry is calculated on the basis of the fuel consumption in 'other industries' [Capros et al., 1995]. National communication data do not distinguish between emissions from power generation and other energy conversions (like e.g. refineries). Emissions for the electricity sector have been calculated using national fossil fuel input in electricity generation [EC, 1996] and CO_2 emission factors of 94, 75 and 56 kg CO_2/GJ for coal, oil and gas respectively. No CO_2 emissions were allocated to biomass. The CO_2 emissions of other energy conversion processes are included in the heavy industry. These emissions have been calculated by subtracting the emissions from electricity generation from the CO_2 emissions of the total energy conversion sector.

Sectoral and total allowance for 2010 and relative emission reduction compared to 1990 levels for the base case scenario. Note that sectoral *allowances* are not used as sectoral *targets*, but only to calculate a total allowance.

	Power generation		Heavy industry		Domestic sectors		Total	
	Emissions in 2010 (Mt)	Reduction compared to 1990 %	Emissions in 2010 (Mt)	Reduction Compared to 1990 %	Emissions In 2010 (Mt)	Reduction Compared to 1990 (%)	Emissions In 2010 (Mt)	Reduction Compared to 1990 (%)
B	18.5	-11.5	29.6	-7.8	41.4	-22.4	89.5	-15.8
DK	23.8	-18.6	5.2	-7.8	19.4	-10.5	48.3	-14.4
D	272	-27.3	145.7	-22.1	352.9	-16.5	770.7	-21.7
GR	36.7	-10.4	10.8	12.3	27.6	2.8	75.1	3
E	78.6	15.9	59.7	12.3	106.1	4.1	244.4	9.6
F	26.1	-32.1	60	-7.8	218.6	-11.2	304.7	-12.9
IRL	11.4	14	3.2	12.3	13.5	-16.8	28.1	-3.3
I	105.1	-9.7	83.5	-7.8	175	-10	363.6	-9.4
LUX	0.4	2.8	6.2	-7.8	3.3	-38.8	10	-20.8
NL	39.8	-6.5	32.1	-7.8	67.2	-12.9	154	-9.4
AU	12.4	3.3	13.3	-7.8	29	-5.6	54.7	-4.3
P	16.8	14.5	9.7	12.3	19.6	28	46.1	19.4
FIN	22.8	-6.3	12	-7.8	20.7	-7.4	55.5	-7
S	19.9	414	11.7	-7.8	34.9	-9	66.6	21
UK	150.6	-29.8	66.1	-7.8	232.2	-15.3	449	-19.9
EU	821.6	-17.6	549	-9.8	1361.5	-12	2760.2	-12.9