

Squaring the Circle of Mitigation Adequacy and Equity: Options and Perspectives

Marion Vieweg⁴, Wolfgang Sterk², Markus Hagemann¹, Hanna Fekete¹, Vicki Duscha³, Martin Cames⁵, Niklas Höhne¹, Bill Hare⁴, Marcia Rocha⁴, Hanna Schmole¹

DRAFT for public comment

We are mainly seeking comments on content, especially completeness of discussed options and evaluation arguments.

To submit comments please use the review form provided with this draft report and send to marion.vieweg@climateanalytics.org

¹Ecofys Germany GmbH

Am Wassermann 36

50829 Köln

²Wuppertal Institut für Klima,
Umwelt, Energie GmbH

Döppersberg 19

42103 Wuppertal

⁴Climate Analytics gGmbH

Friedrichstr. 231 Haus B

10969 Berlin

³Fraunhofer-Institut für System-
und Innovationsforschung ISI

Breslauer Straße 48

76139 Karlsruhe

⁵Öko-Institut e.V.

Schicklerstr. 5-7

10179 Berlin

Table of Contents

1 Introduction..... 1

2 Methodology..... 2

3 Participation 3

4 Types of commitments..... 5

 4.1 Scope of commitments 5

 4.1.1 Outcome-based Commitments..... 6

 4.1.2 Behaviour-Based Commitments..... 7

 4.1.3 Evaluation of Options..... 8

 4.1.4 Synthesis 12

 4.1.5 Support commitments..... 13

 4.2 Time aspects of commitments..... 14

5 Allocation and effort-sharing..... 15

 5.1 Dimensions of effort-sharing 16

 5.1.1 Responsibility..... 17

 5.1.2 Capability and needs..... 17

 5.1.3 Equality..... 17

 5.1.4 Cost effectiveness 18

 5.2 Existing effort-sharing approaches..... 18

 5.3 Quantitative implications of effort-sharing approaches 19

 5.4 Country positions on equity in the 2015 agreement 21

6 Process considerations 22

 6.1 Conceptual considerations..... 22

 6.1.1 Top down..... 23

 6.1.2 Bottom-up with negotiated outcome vs. bottom up with transparent review 24

 6.1.3 Pure bottom-up..... 27

 6.2 Options to enhance ambition after 2015 27

 6.2.1 How to organise a review to assure ambition level increases after 2020?..... 27

 6.2.2 How could complementary initiatives be used to raise ambition? 27

7 Conclusions and way forward..... 28

 7.1 Synthesis of different elements of differentiation..... 28

 7.2 The UNFCCC process - Agreeing on 2015 commitments..... 30

8 References 33

1 Introduction

The Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) aims to "*develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties*" (UNFCCC, 2011). The agreement is to be adopted in 2015 and is meant to come into force from 2020, just as the second commitment period of the Kyoto Protocol ends.

Under the ADP, Parties discuss elements of the 2015 agreement, their design, and the processes how to get there. Negotiations will need to agree on questions of legal form and structure and the agreement will encompass all elements outlined in the Bali Action Plan including, for example, finance, MRV, and capacity building. In addition to the workstream on the 2015 agreement, the ADP also has a workstream 2 that focuses on options and means to enhance the pre-2020 ambition.

This negotiation comes at a time where the second commitment period of the Kyoto Protocol has just been agreed, although with substantially reduced participation, and where it is clear that the aggregate of the pledges made under the Copenhagen Accord and the Cancún Agreements are not sufficient to limit global warming below 2°C. This year's UNEP Gap report again confirmed that the gap between pledges and pathways consistent with 2°C is not being closed and remains at a high 8-12 GtCO_{2e} (UNEP, 2013).

This report focuses on one of the aspects of the future agreement - mitigation ambition: ways for differentiation and participation. The principles of equity and of "*common but differentiated responsibilities and respective capabilities*" are embedded in the framework convention (United Nations, 1992) and form the basis for the work under the ADP.

Over the years, a host of literature has discussed what these principles could mean for mitigation and how they could be operationalised within the UNFCCC (Elzen, Schaeffer, & Lucas, 2005; Höhne, den Elzen, & Escalante, 2013; Phylipsen, Bode, Blok, Merkus, & Metz, 1998a; see for example Winkler et al., 2011a). Approaches span from pure focus on historic responsibility to capability-based metrics with a growing focus on the need to ensure sustainable development (see for example Ngwadla, 2013). This discussion has continued to inform the international negotiations and is at the core of a successful conclusion of the ADP 2015 negotiations.

Differentiation of the scale of mitigation effort of each Party to the UNFCCC has long been the main focus of this discussion. However, participation and compliance are also important aspects to the effectiveness of the new agreement (Aldy, Barrett, & Stavins, 2003; Bodansky, 2012).

Compliance aspects are, however, outside the scope of this study. The problem can be seen as a multi-dimensional optimisation problem, where the outcome of each aspect determines the others. This delivers a matrix of possible combinations between participation, scope and time aspects of commitments, equity dimensions, and negotiation process considerations. Optimisation of the effectiveness formula is complex in itself and made more complex by the fact that purely national considerations are also undergoing constant change, and negotiations

under the UNFCCC with the linked public awareness and discussion will ideally help to move national considerations towards higher ambition.

We will start our analysis looking at different options and aspects of participation. The next section then discusses types of commitments, followed by a comprehensive assessment of the available literature on equity principles and approaches. We then take a look at process-related aspects from a conceptual point of view as well as within the concrete negotiation context, and provide a synthesis of the findings in the conclusions.

2 Methodology

This study aims to provide a comprehensive overview of the dimensions and options around the differentiation of mitigation commitments. We base this on existing literature, and the expert knowledge of the writing team. The analysis provides the full set of options, even though some are seen as less realistic for implementation, to demonstrate the full toolset available and hopefully enable new combinations of elements that can move negotiations forward.

We describe different dimensions and options and, in most sections, discuss their respective advantages and disadvantages based on the criteria for the evaluation of climate policy instruments applied by the IPCC's Working Group 3 (Gupta et al., 2007):

- **Environmental effectiveness:** The extent to which an instrument promises to achieve the intended environmental objective.
- **Cost-effectiveness:** The extent to which an instrument promises to achieve the environmental objective at a minimum cost to society. This includes not only direct costs and transaction costs such as impacts of administering and implementing an instrument but also dynamic cost-effectiveness, ie, how well an instrument drives cost-reducing technological change. This criterion takes the environmental objective as given. By contrast, economic efficiency, which is often used as an evaluation criterion, also involves variation of the goal itself in order to maximise the balance of costs and benefits.
- **Distributional considerations:** The extent to which a proposal can be expected to have distributional consequences, including dimensions such as fairness and equity. In political discussions, distributional impacts are often more important than aggregate cost-effectiveness.
- **Institutional feasibility:** The extent to which a proposal is likely to be viewed as legitimate, to gain acceptance, and be adopted and implemented. This includes political as well as administrative and technical aspects of feasibility.

Other criteria that are often used such as impacts on competitiveness and administrative feasibility are subsumed within these four.

3 Participation

The level of participation has been evolving over time and has become an integral part of the UNFCCC negotiations. While the Convention applies to all, the commitments related to mitigation are on a very general level and amongst others ask Parties to *"Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change"* (UNFCCC, Article 4).

To more concretely define commitments and demonstrate ambition, the Kyoto Protocol in 1997 set quantified economy-wide emission limitation and reduction targets for a number of countries, mainly developed countries and economies in transition.

This historic development not only reflects different types of commitments (see section 4 for further discussion) but also different levels of participation and how they link to the level of ambition.

Reflecting this situation and the experiences made over recent decades, literature has identified two main options (e.g. (Aldy et al., 2003)(Bodansky, 2012)):

- "Broad-but-shallow": similar to the approach taken in the Convention, an agreement following this approach would achieve relatively little mitigation per country, but would allow nearly full participation.
- "Narrow-but-deep": structured more 'Kyoto-like,' this approach would achieve ambitious mitigation reductions per country, but would be limited in participation.

These two options define extremes of a potential continuum. The general commitments under the Convention are very broad. The mitigation commitments under the Kyoto Protocol are a narrow approach, but the level of ambition is certainly not at the extreme end of 'deep.'

Evolutionary pathways - that start with broad participation and weak commitments, and then attempt to deepen the commitments over time - are considered possible. Another option for development over time is to start with strong commitments and narrow participation, and then attempt to broaden participation (Bodansky, 2012). Also possible would be intermediate solutions that start with a medium level of ambition and participation and then evolve to increase ambition and/or participation.

In this context, we need to clearly differentiate between the aggregate level of ambition and the individual level of ambition required from Parties. Decisions on participation (and compliance) of countries will ultimately depend on the mix of the individual effort required and the effort required from other countries, mainly peers or such countries that are seen as important partners or competitors. So even low levels of aggregate ambition can result in non-participation if the individual effort is judged to be 'unfair' compared to others. Conversely, a high level of ambition could encourage high participation if the effort is seen to be distributed equitably.

So there is not necessarily a coercive relationship between participation and aggregate level of ambition, although of course it is much more likely that under low ambition scenarios, more countries would see their share as being a fair contribution, especially since the perception of equity is not necessarily linked to objective criteria but can be a relatively subjective evaluation. It strongly depends on sets of values reflected in different priorities for categories of equity (see

chapter 5.1). It further depends on the overall political situation of a country and its relationship with other countries, which are mostly determined by activities and politics outside the UNFCCC.

Another important aspect in this discussion is the metric that is used to differentiate various groups of participants. Participation is not a simple yes/no decision. It also covers the question on differentiation of groups of countries. In the past this differentiation has been dominated by the Annexes of the Convention, which are the result of negotiations rather than application of agreed metrics. Overcoming this static differentiation especially in relation to commitments, which have so far differentiated Parties in those "with binding commitments" and those "with voluntary actions" is at the core of the ADP negotiations.

Although the new agreement is meant to apply to all, the need for differentiation on types of commitments and stringency remains. Essentially all industrialised countries argue that the world has changed significantly since 1992 and that this needs to be reflected in the new climate agreement. They therefore want to remove the so-called "firewall", the distinction between on the one hand commitments for industrialised countries and on the other hand voluntary action by developing countries that has so far characterised the climate regime (Sterk, Arens, Kreibich, Mersmann, & Wehnert, 2012). This view is generally supported by Ethiopia, which suggests revising Annexes in five-year periods according to countries' GDP and per capita GDP (Ethiopia 2013). The newly formed AILAC (Independent Association for Latin America and the Caribbean) also calls for a more flexible handling. In contrast, the so-called group of like-minded developing countries, which consists of China and India, several Arab and left-leaning Latin American countries, such as Bolivia, Cuba and Venezuela, and further middle-income countries such as Malaysia, Pakistan and the Philippines, is strongly opposed against any explicit or implicit opening of the Annexes (Sterk et al., 2012).

While there are a number of proposals on the table to differentiate stringency for indicators and criteria (see section 5), there is little discussion on how to differentiate types of commitments. The LDC group, for example, called for a differentiation of "developed countries, emerging economies, middle income countries, the most vulnerable and the least developed countries based on agreed criteria" (Nepal on behalf of the Least Developed Countries Group, 2013). The question then becomes which criteria to use.

A further variation of the topic is the option of introducing small groups inside or outside the UNFCCC that take on a more progressive role. These 'clubs' could be placed outside the UNFCCC within existing settings, such as the MEF, the G20 - or new ones. Progressive players could also form such groups within the UNFCCC, such as The Majuro Declaration (Pacific Island Forum, 2013).

Environmental effectiveness: theoretically both broad-but-shallow and narrow-but-deep approaches could have the same environmental outcome, depending on the countries that participate and the level of ambition. Effectiveness will finally depend on the ability to move ambition and participation towards the ideal situation of a broad-and-deep scenario.

Combinations of a 'medium-medium' approach with frontrunner "clubs" could be a possibility in speeding up movement towards this ideal situation (Weischer & Morgan, 2013). Broad participation could mitigate the fear of emissions leakage which is likely to be an issue with smaller groups (Aldy et al., 2003).

Cost-effectiveness: as described above, broader participation is mostly seen as resulting in lower levels of ambition. Under this assumption it is often seen as more likely to deliver dynamic economic efficiency, since the lower level of ambition implies lower marginal abatement costs, given that these increase steeply with increased ambition (Aldy et al., 2003). In particular in connection with trading systems, broad participation allows for regional flexibility, which also increases cost-effectiveness for higher levels of ambition. Narrow participation with high ambition can, however, also lead to enhanced technology development and rapidly decreasing cost for important mitigation technologies.

Distributional considerations: While leakage is likely to be an issue with smaller groups due to potential loss of competitiveness, at the same time small groups with high ambition can also generate first-mover advantages and positive spillover effects. This can be observed in the renewable energy sector, where a number of frontrunners with support schemes triggered a rapid development and finally mass production with sharply dropping global technology prices.

Institutional feasibility: broad-but-shallow approaches may be easier to negotiate. In this case no individual Party is required to make commitments at a level of ambition where economic implications are not fully clear, e.g. due to increasing marginal abatement cost, or competitiveness effects. At the same time fears of free-riding and leakage are (at least partly) alleviated. However, if “broad” means “universal,” countries with no interest in climate protection whatsoever would still have blocking power. The advantage of smaller groups negotiating more ambitious commitments is that similar interests can speed up negotiations (Aldy et al., 2003) and help to demonstrate leadership and move others to eventually participate (Weischer & Morgan, 2013).

4 Types of commitments

4.1 Scope of commitments

Commitments may in principle be behaviour-based or outcome-based. That is, commitments may refer to what countries are supposed to do or to what they are supposed to achieve. While the climate regime has so far mostly focused on emissions outcomes, the World Trade Organisation is one example that prescribes desired behaviour rather than desired outcomes.

Within these two basic types there are different sub-types. For example, outcome-based commitments may relate to intermediate outcomes such as the energy intensity of the economy, the emissions intensity of energy supply, or market shares of specific technologies such as renewables.

The following sections give an overview of the main proposals of types of commitments that have been made in literature.

This synopsis mostly relies on existing overviews of proposals (Aldy et al., 2003; Aldy & Stavins, 2007; Gupta et al., 2007; Kuik et al., 2008; Philibert, 2005) and the expert judgement of the authors.

4.1.1 Outcome-based Commitments

The following types of outcome-based commitments have been proposed in the literature:

Economy-wide GHG emission limitation/reduction targets (absolute/relative)

Under this approach economy-wide emissions are limited either in absolute terms as in the Kyoto Protocol, relative to a certain index such as GDP, or to business as usual as in a number of NAMAs submitted under the Cancún agreements. So far, absolute targets have usually been defined in relation to a historical reference year. There are various proposals on how to define national targets top-down in the future, based on first establishing a global emission trajectory or budget and then allocating country shares according to a set of equity criteria to be agreed internationally (see section 4).

Sectoral emission limitation/reduction targets (absolute/relative)

Possibilities for scaling up the CDM to the sectoral level or introducing new mechanisms that would be based on sectoral targets have been discussed for more than ten years (starting with Samaniago & Figueres, 2002). Many of the current non-Annex I pledges are sectoral. In the most far-reaching form of this approach, countries would disaggregate the entirety of their national emissions and commit to separate targets for each non-CO₂ gas and to separate targets for each CO₂-emitting sector (e.g. Barrett & Toman, 2010). There has also been some discussion about introducing transnational sectoral approaches/agreements, wherein internationally uniform benchmarks would be agreed for specific sectors.

Targets for intermediate outcomes (e.g. energy intensity of the economy, emission intensity of energy supply, specific technologies)

In addition to or as replacement of emission-based reduction targets, targets may be set for intermediate outcomes, preferably addressing key emission drivers. Taking the example of energy-related CO₂ emissions, which account for about 60% of global emissions, these are determined by: size of the population, size of the economy, energy intensity of the economy, and CO₂ intensity of energy supply. Mathematically, these emission drivers may be expressed as:

$$\text{CO}_2 \text{ emissions} = \text{Number of People} \times \frac{\$ \text{ GDP}}{\text{Person}} \times \frac{\text{kWh energy}}{\$ \text{ GDP}} \times \frac{\text{CO}_2 \text{ emissions}}{\text{kWh energy}}$$

Economic and population trends are largely beyond the influence of governments and are unlikely to be made the subject of any international agreement. Governments could therefore commit to reducing the energy intensity of the economy and reducing the CO₂ intensity of energy provision (Verbruggen, 2011).

The EU provides a real-life illustration of this approach with its internal targets for renewables and energy efficiency. A number of current non-Annex I pledges also contain targets for intermediate outputs. For example, China, in addition to its emission intensity target, also pledged to increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020.

4.1.2 Behaviour-Based Commitments

As achievement of targets requires the introduction of new - or strengthening of - existing policies and measures (PAMs), some propose that the climate regime should cut out the middle man and directly negotiate PAMs. Many of the current pledges from non-Annex I countries are also behaviour-based, especially those from LDCs and other low-income countries. Coordinating PAMs was one plank of the original Kyoto negotiations in 1995-1997, but this process was not successful. The proposals and existing pledges can be grouped and are described in the next sections.

Emission price commitments (possibly coordinated)

Under this approach countries would commit to imposing a certain price on their national emissions. National implementation could be done in various ways, for example through a tax or through an emissions trading system with a minimum allowance price. These are essentially equivalent approaches, cap-and-trade induces an emission price, and taxing emissions at that price would reduce emissions to that cap. Politically, however, there are strong differences between the two instruments. Some authors (e.g. Cramton, Ockenfels, & Stoft, 2013) argue that, for the international level negotiating price commitments, ideally a commitment to a globally uniform carbon price would be preferable to negotiating emission targets.

Technology-oriented agreement(s)

Some proposals suggest a focus on research, development and diffusion of climate-friendly technologies, arguing that these provide higher incentives for participation than emission targets and timetables. Technology-oriented agreements may relate to collaborative research and development and/or to requirements for common standards for key technologies, such as performance standards for power and other industry plants, vehicles, fuel quality and others. Joint R&D and joint standard-setting are usually proposed to be implemented as a package, in particular to use standard-setting to promote the diffusion of the results of the joint R&D. Standards could be phased in over time, starting with new plants and later extension to existing plants, and phased application to different groups of countries.

Packages of policies and measures

While the price commitment and technology-oriented proposals are some particular variants, there are also more general proposals to base the climate regime on packages of policies and measures (PAMs) rather than targets. Winkler et al. propose that stronger participation of developing countries should take the form of committing to certain sustainable development PAMs (SD PAMs) that promote development objectives while at the same time reducing emissions, for example low-energy housing programmes (Winkler, Spalding-Fecher, Mwakasonda, & Davidson, 2002). Many developing countries have proposed with their NAMAs to implement specific policies. While in the SD PAMs proposal by Winkler et al. Annex I countries would continue following the Kyoto approach, for example Victor proposes to shift the entire climate regime to a PAM basis (Victor, 2011).

Individual actions and projects

Many current non-Annex I pledges are essentially lists of projects or activities.

4.1.3 Evaluation of Options

Tab. 1: Evaluation of environmental effectiveness of different types of commitments

Commitment type	Specification	Impact on environmental outcome
Economy wide / sector-based	Absolute targets	Highest ex-ante clarity about the envisaged environmental outcome (if accounting is done properly), but the effectiveness depends on the stringency. Absolute targets are not automatically more environmentally effective than other commitment types. Historically, some countries have been allowed substantial emission growth both under the Kyoto Protocol and under the EU effort-sharing agreement.
Economy wide / sector-based	Absolute/relative targets	If tradable and bankable, emission-based reduction targets constitute not only the minimum but also the maximum emission reduction. This may block doing more in case reductions turn out to be easier than expected and may thus inhibit the development of a dynamic race to the top. One may perhaps draw an analogy to the impacts of feed-in tariffs and quota models for promoting renewables. Quotas give certainty on the outcome, but have not engendered anything close to the dynamics engendered by feed-in tariffs.
Economy wide / sector-based	Relative targets	May be as stringent as absolute targets but do not provide the same ex-ante clarity of outcome.
Sector-based targets / intermediate outcomes / behavior-based approaches		The effectiveness of the approaches depends on the share of emissions covered and the ambition of the targets or policies. In principle, managing an ensemble of targets or policies in concert can be as effective as an overall target if their interaction is taken into account appropriately. When it comes to implementation, a country-wide target has to be broken down to individual sectors and implemented through a number of policies anyway.
Intermediate outcomes / behavior-based approaches		Emissions outcomes can be projected, but only with a degree of uncertainty.
Emission pricing (also applies to emission-based reduction targets with cap-and-trade)		There are many non-price barriers that stand in the way of the necessary investment decisions or behavioural change, such as risk aversion against new solutions, split incentives, lack of information and technical capacity, personal preferences etc. (see e.g. International Energy Agency, 2012). Emission pricing should therefore be complemented by other instruments, nationally or internationally.
Technology oriented	Technology standards	Adoption of technology standards by a critical mass of countries may be sufficient to ensure global diffusion. Even if manufactured according to internationally agreed standards, sizes and uses of equipment and appliances, and thus the related emissions, may differ strongly among countries.
Individual actions and projects		Individual investments may have strong impact locally, but can usually not achieve the necessary sector-wide transformations.

Tab. 2: Evaluation of cost-effectiveness of different types of commitments

Commitment type	Specification	Impact on economic effectiveness
Economy wide targets	Absolute/relative targets	In theory allows reducing emissions where costs are lowest, especially if used as basis for establishing emissions trading systems, for which they are the most conducive basis. However, in practice additional price signals alone will not be able to lift the full mitigation potential, e.g. energy efficiency measures that are already today profitable, but not taken up due to non-price barriers. In practice, national distribution of effort is often more strongly influenced by lobbying rather than the aim of maximising cost effectiveness. Examples are the allocation of emission allowances during the first and second phase of the EU ETS or the development of benchmarking criteria for industry for the third phase of the EU ETS.

Commitment type	Specification	Impact on economic effectiveness
Economy wide targets / emissions price	Absolute/relative targets	Country-wide emission-based reduction targets and emission pricing may entail a risk that the focus of action may be laid on short-term rather than long-term considerations and hence dynamic cost-effectiveness is not met. For example, new technologies may be neglected that in their infancy have high costs but may ultimately become the most cost-effective option, see e.g. the rapid cost decrease of renewables in recent years. Also, some solutions such as re-organisation of urban settlement structures and transport systems as well as industry or power generation infrastructure need a very long time to fully implement; implementation therefore needs to start now to achieve the desired effect by 2050.
Sector-based / intermediate outcomes / policies		Approaches allow to calibrate actions according to specific needs of sectors regarding short-term and long-term costs, implementation timelines etc. However, they do not allow equalisation of marginal abatement costs and thus reduce the ability to compensate between sectors with higher and lower cost.
Emissions price		Directly setting an emission price rather than emission-based reduction targets equalises marginal abatement costs ex-ante.
Technology oriented	Technology standards	International technology standards would allow to harness network externalities, i.e. a country's benefit from adopting a certain standard increases in line with the number of other countries adopting the same standard.
Individual actions and projects		The cost effectiveness of individual actions may be very positive or very negative depending on the design of the individual project.

Tab. 3: Evaluation of distributional effects of different types of commitments

Commitment type	Specification	Impact on international distribution
Economy wide	Absolute/relative	Compared to the other options, country-wide emission-based reduction targets are the least complex and hence probably the easiest commitment option to calibrate internationally according to equity considerations. With country-wide targets countries have full flexibility on where to reduce emissions, there is thus a risk that they may largely or fully exempt sectors that face international competition from emission control obligations. Even national targets that have comparable stringency therefore do not automatically constitute a "level playing field" for internationally competing industries.
Sector-based	Absolute/relative	Efforts would be calibrated at sector level instead of country-wide, which would allow to internationally co-ordinate mitigation actions in sectors that are competing internationally.
Emissions price (also applies to emission-based reduction targets with cap-and-trade)		Some argue that an internationally uniform carbon price would be the fairest possible approach. However, since countries usually also have other relevant taxes, subsidies and regulations, a uniform carbon price does not automatically constitute a "level playing field" for internationally competing industries. Countries might offset the carbon price by lowering other taxes or introducing new subsidies. Minimising competitive impacts would therefore require a broader coordination of policies. In addition, due to national and international differences in capacity to pay, a uniform carbon price is socially regressive. Treating dissimilar cases alike is as inequitable as treating similar cases differently (Verbruggen, 2011).
Technology oriented	Technology standards	While all countries would profit from the development and diffusion of more efficient technologies, international technology standards might strongly favour technology exporters while most countries are technology importers. On the other hand, making standards international and providing an export market would reduce the incentive for technology developers to keep new innovations a secret out of fear of higher standards.
Policies		With a policy-based approach, probably at best a qualitative international calibration of levels of effort would be possible.

Tab. 4: Evaluation of feasibility of different types of commitments

Commitment type	Political (national)	Institutional and technical	Negotiations
Economy wide (absolute / relative)	<p>Country-wide targets give countries flexibility on where to reduce emissions and thus allow tailoring of national policy according to national preferences which minimises possible concerns about infringement of sovereignty.</p> <p>With a focus on overall national ambition, national discussions may be stymied by competitiveness concerns of some industries even though they account only for minor shares of total national emissions. There is a risk of reaching only the lowest common denominator.</p>		<p>Transforming emissions into a valuable tradable commodity exacerbates the distributional controversy among countries on who should contribute how much to the global effort¹. This seems to be borne out by the historical experience, where a number of countries have wanted to join the Kyoto Protocol mainly in order to gain surplus AAs.</p> <p>With emission-based reduction targets, individual countries' incentive to participate hinges on level of mitigation that is required from them. Participation of key countries has in the past been bought by allocation of substantial surplus allowances. This approach is not compatible with the requirement of steep global reductions.</p>
Economy wide (absolute)	Absolute emission-based reduction targets are risky for governments as there is substantial uncertainty on what the costs of mitigation options really are. In addition, key emission drivers such as economic and population development are largely beyond government control. This incentivises weak targets and/or "safety valves" such as offsetting mechanisms to minimise the risk of a cost explosion.	Emission-based reduction targets require strong institutional capacity for accounting.	For the same reasons as described under political feasibility, absolute targets are seen as a potential "cap on development" by non-Annex I countries, making them difficult to negotiate for developing countries.
Economy wide (relative)	Relative targets can partially address concerns discussed above for absolute targets. All emerging economies have in fact pledged relative targets for 2020.	MRV of relative targets requires even more effort than absolute targets since not only emissions but also the index value needs to be monitored.	
Sector-based	<p>Approaches based on sectors, intermediate outcomes or policies could allow actions to move forward in some sectors without being held back by problems in other sectors.</p> <p>Compliance mechanisms that are geared towards individual sectors might be easier to agree than compliance mechanisms addressing the entire country.</p>	The sectoral approach would allow to focus on sectors where MRV of emission outcomes is most feasible with limited technical capacity (large point sources); other sectors could be covered by targets for intermediate outputs or behaviour-based approaches.	The transnational sectoral approach has in the past been strongly rejected by non-Annex I countries as an attempt to impose foreign standards.
Intermediate outcomes / policies	Do not transform emissions into a valuable resource and may thus generate less perverse incentives to	The feasibility of MRV of intermediate outcomes depends on the specific target. It is relative easy if expressed	International negotiations would be more complex for sector, intermediate outcome or policy-based approaches than for country-wide emission-based reduction targets -

¹ Stiglitz opines that, "If emissions were appropriately restricted, the value of emission rights would be a couple trillion dollars a year – no wonder that there is a squabble over who should get them." (Stiglitz, 2010)

Commitment type	Political (national)	Institutional and technical	Negotiations
	<p>set weak targets.</p> <p>Non-emission based approaches may be politically more attractive as they may generate less fear of becoming a “cap on development” and many countries have a strong interest to promote certain technologies or energy efficiency.</p> <p>Intermediate outcomes such as scale-up of certain technologies or efficiency improvements are easier to influence for governments than emission outcomes. Delivery of policy implementation is easier for governments than delivery of outcomes.</p>	<p>in terms like emission intensity of or renewable energy share in energy supply, or specific rate of energy efficiency improvement, more difficult if expressed in terms of deviation from BAU, such as the EU’s efficiency target.</p>	<p>though these are arguably sub-complex if the aim is to achieve a level playing field for internationally competing industries as comparable country-wide targets do not guarantee that the individual sectors will also be addressed in a comparable manner by national governments.</p>
Emissions price	<p>The proponents of a price commitment maintain that it is not a tax commitment, as an international price commitment could be implemented in various ways nationally, for example through a tax or through an emission trading system with a minimum price, thus creating the required flexibility to make it an acceptable approach at national level.</p>		<p>Policy-makers are nonetheless likely to see this as an attempt to harmonise taxation, and taxation issues are usually seen as being at the core of country’s sovereignty. One reason why the PAM approach failed in the 1990s was that it was seen as an attempt to harmonise energy taxation.</p>
Technology oriented	<p>Joint R&D yields direct positive benefits for participating countries.</p>	<p>MRV of implementation of technology standards and R&D activities is feasible, MRV of compliance with standards is more challenging.</p>	<p>The transnational sectoral approach has in the past been strongly rejected by non-Annex I countries as an attempt to impose foreign standards</p>
Policies		<p>MRV of policies depends on the specific policy and whether only policy inputs or also outputs are to be MRVed. MRVing a feed-in tariff or implementation of certain performance standards is relatively easy, MRVing energy savings achieved by certain policies is difficult. As a way out, complex policies could be MRVed in terms of their inputs (such as dedicated budget, staff etc.) and intermediate outcomes while emission outcomes could be MRVed at the level of the national inventory.</p>	<p>International negotiation of policies would be especially complex, especially if not only broad headlines but also details of specific PAMs were to be negotiated. Some proponents maintain that this is indeed the adequate level of complexity, given that climate negotiations are effectively economic negotiations.</p> <p>On the one hand, the policies and measures approach was tried in the Kyoto negotiations but was not successful. On the other hand, the WTO coordinates policies and measures at a very high level of very prescriptive detail. The difference can probably be explained by the fact that countries see direct benefits for themselves in trade negotiations while in the climate regime there is no such possibility of a direct quid pro quo. As Bodansky notes, the result is that most countries have so far been “more concerned about binding themselves than they have been desirous of binding others.” (Bodansky, 2012)</p>

Commitment type	Political (national)	Institutional and technical	Negotiations
Individual actions and projects	Individual projects can be very contentious locally, but compared to the other options only limited political commitment is required.	In terms of technical feasibility individual actions may be the most adequate option for least developed and similarly poor countries.	The COP would probably not be the appropriate body to assess whether what may potentially be very long lists of individual projects and actions constitute an adequate contribution by the respective country.

4.1.4 Synthesis

The table below summarises the main advantages and disadvantages of each type of commitment. The analysis shows that there is no silver bullet: each approach has its strengths and weaknesses. While emission-based approaches provide environmental clarity and the potential to maximise cost-effectiveness, they are not politically attractive as such. Comparable country-wide emission-based reduction targets also do not automatically constitute a “level playing field” for internationally competing industries.

The other approaches may be politically more attractive since many countries have an inherent interest in promoting energy efficiency or certain technologies and these approaches might generate less fear of constituting a “cap on development.” They would, however, be more difficult in terms of judging their environmental impact and international negotiation.

A combination of approaches may provide the best way forward. Real-life examples are provided by the EU’s 20-20-20 targets (targets on greenhouse gases, efficiency and renewables) and some non-Annex I pledges such as those of Brazil and China, which combine country-wide emission-based reduction targets with some sectoral targets. Emission-based reduction targets could be set as the floor or ambition and commitment on technologies or policies could support them, possibly even overachieving them. A multi-dimensional approach combining various types of commitments could also be more failsafe than focusing only on one single approach. If one approach falls short, as the carbon price currently does, this deficit may be compensated by the other approaches.

	Environmental Effectiveness	Cost-effectiveness	Distributional considerations	Institutional feasibility
Economy-wide targets	Highest ex ante clarity, effectiveness depends on stringency If tradable and bankable, minimum = maximum reduction, may stifle dynamic	Maximum flexibility Risk of focusing on low-hanging fruit, neglecting long-term perspective	Easiest option to calibrate internationally Risk that governments may exempt sectors facing international competition If tradable and bankable, exacerbates distributional controversy	Maximum flexibility Feasibility differs among sectors Absolute targets arguably risky for governments, relative targets less so Strong MRV capacity required
Sectoral targets	Depends on stringency and coverage of sectors If tradable and bankable, minimum = maximum reduction, may stifle dynamic	Allows calibration of actions to sectoral needs No equalisation of marginal abatement costs	Efforts would be co-ordinated at sector instead of country level, may help to address competitiveness concerns	Helps to deal with differences in feasibility among sectors Compliance may address individual sector rather than entire country More complex negotiations Transnational sector approach in past strongly rejected by non-Annex I
Targets for	Depends on stringency	Allows calibration of	Efforts would be co-	Helps to deal with differences in

	Environmental Effectiveness	Cost-effectiveness	Distributional considerations	Institutional feasibility
intermediate outcomes	and coverage of sectors Emission outcome can be projected but with uncertainty	actions to sectoral needs No equalisation of marginal abatement costs	ordinated at sector instead of country level, may help to address competitiveness concerns	feasibility among sectors Compliance may address individual sector rather than entire country Many countries have strong interest to promote certain technologies Intermediate outcomes easier to influence than overall emissions No incentive to maximise emission allocation Feasibility of MRV depends on types of targets More complex negotiations
Emission price commitments	Direct reduction incentive Emission outcome can be projected but with uncertainty Emission pricing no panacea	Marginal costs equalised from outset on Risk of focusing on low-hanging fruit, neglecting long-term perspective	Uniform emission price does not automatically constitute level playing field Uniform price is socially regressive	Delivering policy inputs easier than delivering certain outcomes No incentive to maximise emission allocation Taxation lies at core of national sovereignty
Technology-oriented agreement(s)	May be high but difficult to predict Adoption of standards by critical mass sufficient to ensure global adoption Not all sectors amenable to international standards May not foster behavioural changes	Allows calibration of actions to sectoral needs No equalisation of marginal abatement costs Allows to harness network externalities	May strongly favour technology exporters, but provides incentives to enhance development and share information	Delivering policy inputs easier than delivering certain outcomes No incentive to maximise emission allocation Direct positive benefits for participating countries Transnational sector approach in past strongly rejected by non-Annex I
Packages of PAMs	Direct reduction incentives Emission outcome can be projected but with uncertainty	Allows calibration of actions to sectoral needs No equalisation of marginal abatement costs	Probably at best qualitative international calibration possible	Delivering policy inputs easier than delivering certain outcomes No incentive to maximise emission allocation MRV depends on specific policies More complex negotiations
Individual actions and projects	May be strong at project level but usually no transformative sectoral impact	May be positive or negative at project level No equalisation of marginal abatement costs	Depends on individual project and finance	May be contentious locally but less international commitment required than for other options May be most adequate for countries with low capacity COP probably not adequate body to assess proposals

4.1.5 Support commitments

This paper focuses on mitigation commitments and does not provide a comprehensive discussion of support. However, the question is how far mitigation commitments and support commitments are exchangeable and which role this could play in agreeing mitigation commitments.

Any real trade off between finance commitments and activity/result-based commitments would require that support needs are fully quantified and are shared between donor countries through a formula or by negotiation. Under the assumption that this was done in line with the determination of mitigation commitments, i.e. using the same allocation framework, a limited

trade off between domestic mitigation and support commitments would be an option. This is, however, far from where negotiations on the provision of support are heading at the moment.

One area to take a closer look at is that of market based mechanisms such as the Clean Development Mechanism and the New Market Mechanism that is to be developed under the Convention. They allow countries with a target to finance mitigation activities outside their national borders to attribute results towards the fulfilment of their commitment. Since these mechanisms are meant to provide not only financial support, but also capacity building and technology transfer to developing countries, they could be seen as an overlap between mitigation and support commitments. In this case larger support directly results in lower domestic mitigation.

Market based mechanisms have a number of widely discussed shortcomings (for details see e.g. Haya, 2009; Michaelowa & Purohit, 2007; Schneider, 2007; Spalding-Fecher et al., 2012; Wara & Victor, 2008). They do, however, provide some flexibility for countries with a quantified economy wide target to reduce cost of mitigation. Depending on the design of the mechanisms, they can also contribute to a net reduction by, for example, including requirements for domestic reduction or discount factors to offset units (Bolscher et al., 2012; Schneider, 2008). The availability and extent of such mechanisms may therefore play a role in the willingness of Parties to accept ambitious targets. However, one may note that the current vast oversupply of CDM credits has so far not had the effect of inducing industrialised countries to strengthen their mitigation ambition.

4.2 Time aspects of commitments

For quantified, results-based commitments, the time aspect is important for the final environmental outcome and thus the level of ambition. The question of short term vs. medium and long term is an important element in the discussion. While the main starting point for this was the negotiation around the length of the second commitment period of the Kyoto Protocol, it has evolved beyond that and provides interesting possibilities.

For example, in their September 2013 submission the Least Developed Countries (Nepal on behalf of the Least Developed Countries Group, 2013) called for a more pathway-oriented approach reflecting "historical, current and future trend of emissions," pointing to commitments with a longer time horizon and multiple targets in the short, medium and long-term. The idea is to find a balance between more uncertain long-term targets and more concrete short term commitments. Given the physical processes underlying climate change the important variable in mitigation is aggregate GHG emissions. Therefore long-term trajectories are what finally determine the impact on our climate.

Long-term targets are in many cases politically easier to agree to, as they go far beyond election cycles and individual officials' careers. While ambitious long-term target also require immediate action to be achieved, concrete measures are easily postponed and achievements are hard to measure due to the long time horizon and many assumptions needed to assess future effects of measures.

Short-term commitments, on the other hand, can be more easily monitored and, if sufficiently ambitious, require direct action. However, this includes the risk that the focus of action may be laid on short-term activities only, neglecting the need for action in sectors where planning and

implementation take a long time, like transport systems and urban structures. Also many activities that are connected to high short-term cost may ultimately become the most cost-effective option, see e.g. rapid cost decrease of renewables.

A combined approach therefore seems appropriate to serve the need for short-term action and measurability with the need for a long-term perspective. Such a combined approach could be based on a commitment period approach, with a number of commitment periods with more and more ambitious targets over time; a number of point-in-time targets or even a mix with, for example, short-term targets following a commitment period approach and medium- and long-term targets being point in time.

From the environmental outcome perspective a commitment period approach therefore has several advantages. It allows a relatively clear prediction of aggregate emissions (assuming compliance and adequate accounting), while it allows sufficient flexibility for countries to compensate individual events that drive emissions up or down. If sufficiently ambitious in scale, it will require policies and measures to be implemented on a permanent or at least multi-year time frame to enable compliance, while a point in time target could be reached by chance (e.g. economic crises) or through targeted short-term activities. In a combined approach this could, however, serve to provide an indication for long-term level of ambition and would allow aggregate assessments on the adequacy of commitments towards achieving the objective of the Convention.

5 Allocation and effort-sharing

The concept of "effort-sharing" attempts to respond to the questions of how action needs to be distributed across countries, assuming the need to stay on a global emission path in line with long term climate objective. In the last decade or so, an ever-growing body of literature on "effort-sharing," "burden sharing" or "resource allocation" approaches has attempted to answer this question (collectively referred to as "effort-sharing" in the following).

These studies usually take two steps. First they start in defining a global pathway or level of GHG emission that is in line with a certain temperature or CO₂ concentration target (in most cases 2°C and 400 – 450 ppm). Second they apply a set of calculations based on rules and assumptions that distribute this global pathway to a country or region level.

The results are national and/or regional emission pathways or targets. However, depending on the rules applied, the results will not be in line with a cost effective distribution of emission reductions from a global planning perspective. In order to ensure that a globally cost effective emission reduction pathway can be achieved, the trading of emission allowances or other sorts of financial transfers can be undertaken between these countries. This difference between emission allocation pathways/ targets and the actual emission reduction pathway that a country will follow in the end is important in the interpretation of results, as the results of effort-sharing approaches are often mistaken as implying globally inefficient outcomes.

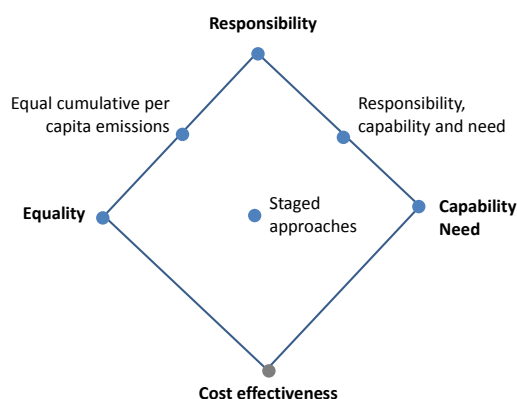
In this section² we provide a short description of the main principles that have been identified in the past as common elements within existing effort-sharing approaches. These principles help understand the diversity of equity considerations considered for effort-sharing (Section 5.1). We then move on to show how these principles are reflected in existing effort-sharing approaches, and show how these approaches compare to each other. We also aim to show what assumptions are made to practically implement effort-sharing and what positions countries take towards these (Section 5.2). Last, but not least, we show what implications the effort-sharing approaches have on the distribution of emission reduction targets per country/region (Section 5.3).

5.1 Dimensions of effort-sharing

(Höhne et al., 2013) have identified four main effort-sharing or allocation dimensions found repeatedly in the literature: responsibility, equality, capability and cost-effectiveness. In effort-sharing calculations, these can either be regarded separately or combined. As observed in Figure 1, certain dimensions are more frequently combined in effort-sharing calculations than others and therefore need to be pointed out separately. This includes “equal cumulative per capita emissions,” which group the carbon budget approaches, and “responsibility, capability and need,” including approaches that put a high emphasis on historical responsibility while simultaneously taking account of the capabilities on the ground. The “staged approaches” category summarises approaches that combine all four principles. It is important to note that cost effectiveness cannot be regarded as an equity principle in a strict sense³. However, since a number of approaches have used this principle to undertake effort-sharing calculations we have included it here as an effort-sharing principle.

² The section is largely based on the scientific publication of (Höhne et al., 2013) and earlier Ecofys work (Moltmann, Hagemann, et al., 2010)

³ See also the discussion in 5.2. on the difference between allocation of emission allowance and emission reductions, which explains that cost effectiveness can be achieved from any initial allocation through trading or allowing other means of flexibility, thus actual emissions reductions pathways after trading might differ from the initial emissions allowance pathways which are based on effort-sharing.



Source: (Höhne et al., 2013)

Figure 1. Seven categories for effort-sharing approaches;

5.1.1 Responsibility

Responsibility represents “the historical contribution to global emissions or warming.” A large number of effort-sharing approaches include this principle in one way or another. The historical contribution can manifest itself in the cumulative historical emissions of a particular country, which represents its contribution to global warming.

Sometimes the beginning of industrialisation is used as a starting point; in other cases it is argued that historical contribution begins at the point when countries became aware of the climate change problem - often the year 1990 is used, which was also chosen as the reference year for the Kyoto Protocol. It is one of two principles (the other is capability) that the UNFCCC directly refers to when mentioning that countries should take action according to “common but differentiated responsibilities and respective capabilities, CBDR-RC.”

5.1.2 Capability and needs

Capability represents the ability to pay for mitigation. As with “historical responsibility” it originated from the UNFCCC request to Parties to take action according to “common but differentiated responsibilities and respective capabilities,” (CBDR-RC). Capability is represented either by GDP (per capita) or the Human Development Index (HDI). Other approaches that address capabilities can focus on “basic need” or emphasise the “right to development” of a particular country. These approaches argue that the less capable a country is, the more such country should have a right to fulfil its basic needs first before undertaking an effort to reduce emissions.

5.1.3 Equality

Under the equality principle a group of approaches can be summarised that emphasise equal rights to development for each person in the world. In effort-sharing approaches, this often translates into equal emission allowances allocation per person, i.e. that each person on the globe has the same right to emit as everybody else. This can either refer to one particular point in time (e.g. today) or to an average over a time period (e.g. from 1990 till today).

5.1.4 Cost effectiveness

Cost effectiveness is an effort-sharing principle but not an equity principle like the other three principles above. Approaches that base effort-sharing on cost effectiveness allocate emission on the basis of emission reduction potential: countries with a high emission reduction potential have to undertake more actions than countries with a low emission reduction potential. Marginal abatement costs, representing the additional costs for reducing emissions over a given baseline situation, are often used as a basis to determine this cost effective allocation of emission reductions. This dimension is highly contested, partially because past exercises to harmonise abatement costs across modelling groups have proven difficult as the numbers differ tremendously between them.

The next section shows how these effort-sharing dimensions are reflected in actual effort-sharing approaches as can be found in literature.

5.2 Existing effort-sharing approaches

The principles described above are included in existing effort-sharing approaches in various ways. The table below highlights a number of relevant approaches and how they have taken account of the various principles.⁴ They are grouped into 7 categories. In the implementation they make use of different indicators that serve as proxies for the underlying principles. These indicators are represented in the table below.

Table 1: Overview of Effort-sharing approaches

Category				Description	Application in approaches	Indicators applied (examples)
	Responsibility	Capability	Equality			
Responsibility	X			The concept to use historical emissions to derive emission reduction targets was first directly proposed by Brazil in the run-up of the Kyoto negotiations (UNFCCC, 1997), without allocations. Allowances based only on this principle were quantified by only a few studies.	Brazilian Proposal	Cumulative emissions (per capita), emission trend
Capability		X		Frequently used for allocation relating reduction targets or reduction costs to GDP or human development index (HDI). This includes also approaches that focus exclusively on basic needs.	Convergence of emissions per GDP Equal reduction of emissions per GDP Percentage reduction based on indicator or capacity Equal cost per GDP Satisfying basic needs	Emissions per GDP GDP per capita HDI national income distribution? Costs
Equality			X	A multitude of studies provide allocations based on immediate or converging per capita emissions (e.g. (Agarwal & Narain, n.d.)). Later studies refine the approach using also per capita distributions within countries (e.g.(Chakravarty et al., 2009)).	Contraction and Convergence Reduction based on emissions per capita	Emissions per capita
Responsibility, capability and need	X	X		Approaches use responsibility and capability as a basis.	Greenhouse Development Rights Responsibility, Capability and Sustainable Development (Winkler et al. 2011b)	Emissions per capita GDP per capita National income distribution

⁴ We only include approaches here that deliver quantified emission allocations as only these can be used to make comparisons among the results of effort-sharing.

Category	Responsibility	Capability	Equality	Description	Application in approaches	Indicators applied (examples)
Equal cumulative per capita emissions	X		X	Studies that allocate equal cumulative per capita emission rights based on a global carbon budget (Pan, Zhu, & Chen, 2005). Studies diverge on how they assign the resulting budget for a country to individual years.	Carbon budgets Equal cumulative per capita emission rights	Carbon budget Cumulative emissions per capita
Staged approaches	X	X	X	Studies that propose or analyse approaches, where countries take differentiated commitments in various stages. Also approaches based on allocation for sectors such as the Triptych approach (Phylipsen, Bode, Blok, Merkus, & Metz, 1998b) or sectoral approaches are included here. Categorisation to a stage and the respective commitments are determined by indicators using the three equity principles responsibility, capability and equality and additionally cost-effectiveness. Finally, studies using equal percentage reduction targets, also called grandfathering, are also placed in this category.	Multistage Common but differentiated convergence EU commission illustrative calculations for Copenhagen Convergence of sectoral efficiencies (Triptych)	Mix of indicators , e.g. For multistage: emissions per capita, GDP per capita, % reduction below base year For Triptych: various sector specific indicators such as "Share of renewables and emission free fossil in 2050" for electricity
Cost-effectiveness (for reference)				Studies that assume that all countries are supposed to have similar relative mitigation costs and on that basis distribute targets	Equal marginal mitigation costs	Marginal Abatement cost (USD/tCO2)

Source: adapted after (Höhne et al., 2013) and (Moltmann, Höhne, & Hagemann, 2010)

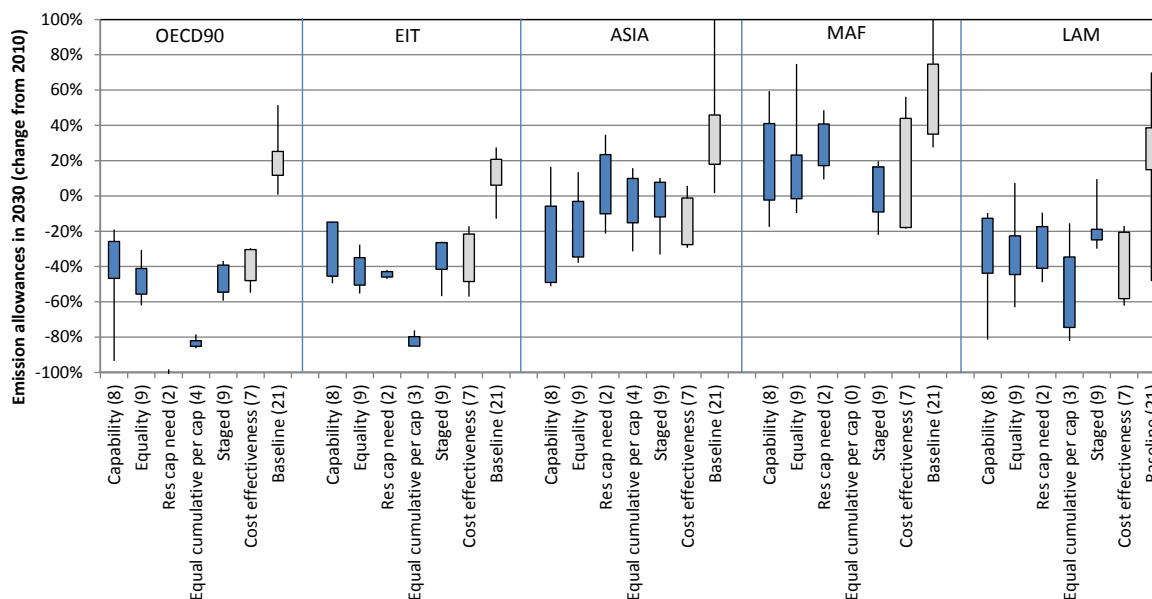
A number of observations can be made from the table. First of all, certain effort-sharing approaches have clearly been calculated more often than others. A large number of studies have evaluated what is summarised under the equality principle here. This might be explained by the fact that equality issues are closest to the climate negotiations.

On the other hand, only a limited number of studies have focused on historical responsibility as the only principle. The reason might be that the proposal put forward by the Brazilian delegation was very difficult to quantify as no concrete indicators for implementation were available. Second, certain indicators are used repeatedly in different contexts, often combined in different manners. These include per capita emission.

The table also illustrates that even with agreement on the broader equity principles, there is still a large range of indicators and interpretations, e.g. on starting year, making it difficult to agree on the effort-sharing in more detail.

5.3 Quantitative implications of effort-sharing approaches

(Höhne et al., 2013) have reviewed the latest effort-sharing calculations available. An overview of the implications on emission allowances by IPCC region for the year 2030 is provided in Figure 2.



Source (Höhne et al., 2013)

Figure 2 Emission allowances by allocation category for Cat 1, i.e. 425-475 ppm CO₂e, in 2030 relative to 2010 emissions (minimum, 20th percentile, 80th percentile, maximum value). Number of data points in brackets. GHG emissions (all gases and sectors) in GtCO₂e in 1990 and 2010 were OECD90 13.4, 14.2, EIT 8.4, 5.6, ASIA 10.7, 19.9 For the category “Responsibility, capability, need” the emission allowances in 2030 are -106% to -128% (20th to 80th percentile) for OECD below 2010 level (therefore not shown here). MAF has no data for “equal cumulative per cap” as the original studies had a different regional aggregation.

A number of interesting observations for the effort-sharing debate under a global climate agreement in 2015 can be drawn from the figures and the calculations undertaken (text below is adapted from (Höhne et al. 2013)).

- **The way a principle is used in the calculation might be more important than the principle itself:** The figures show large ranges for each principle as well as overlaps between the principle ranges. This implies that many times the assumptions made in the implementation of a principle are more important than the different principles. For instance, for the equality approaches the target year has an important influence on the outcome.
- **Effort-sharing outcomes under two categories differ tremendously from the other approaches.** “Responsibility, capability, need” as well as “Equal per capita accumulative emissions” lead to very low emission allocation to the region defined as OECD1990, i.e. a major share of the developed world. The reason for this lies with the fact that these approaches put a *“heavy weight on the larger responsibility and capability of developed countries”* (Höhne et al., 2013). At the other end of the extreme the cost effective distribution (reminder: not an equity based distribution) leads to relatively stringent emission reductions in Asia as a large mitigation potential has been identified there by the studies examined.
- **For low stabilisation levels financial transfers become more important.** Financial transfers depend on the difference between the cost effective approach and

any given effort-sharing approach: A large difference hints at more financial transfer to make the overall global outcome cost-effective. Approaches that would lead to large financial transfer volumes include the “Equal per capita cumulative emissions,” “Responsibility, capability and need” as well as some “Staged approaches” while approaches based on “equality” tend to lay in the same range as the “cost effective” approaches and therefore hint to less financial transfer required.

- **The results between the effort-sharing approaches differ most for countries that are different from the global average.** Regions such as the EU tend to be very close to the global average for each indicator due to their size. These countries are less sensitive to differences in the effort-sharing approaches or assumptions for a given global emission limit than other countries. Especially those with a “particular” emission profile or other national circumstances that are reflected by some indicators and not by others are most sensitive to the effort-sharing approaches and how they are implemented.

5.4 Country positions on equity in the 2015 agreement

When analysing parties’ submissions to the ADP, it becomes clear that there are different stances on equity and respective details on the design of a future agreement.

While parties agree that the efforts should be distributed according to the principle of common but differentiated responsibilities and respective capabilities, a faultline between countries is how to quantify the distribution of emission reduction efforts. Various developing and emerging countries in the past have pleaded to incorporate historic emissions as an indicator for responsibility, e.g. Brazil in their proposal in 1997 (UNFCCC, 1997) or a number of studies from Chinese research organisations (“Greenhouse gas emissions reduction A theoretical framework and global solution,” 2009). These views are partially also reflected in the recent submissions. Brazil maintains its past proposal that historic responsibility should be the main criterion to determine future targets under the 2015 agreement. It suggests 1850 as a starting year and that the indicator takes into account the accumulation effect of emissions on global temperature increase (Brazil, 2013).

In the run- up to the climate negotiations in Copenhagen in 2009 a number of countries presented proposals for effort-sharing among Annex I countries. The EU proposed to use an approach based on four indicators that are largely in line with the dimensions listed in Section 5.1 (Commission, 2009), while Japan proposed an approach based on the convergence of sectoral efficiencies (Moriya, 2009). While their positions might have changed since then, this illustrates the re-occurring explicit role effort-sharing plays in the negotiations.

A number of countries such as the United States and Japan in their latest submissions to the ADP propose that it should be up to the country to determine their fair share instead of basing commitments on top-down approaches (United States, 2013) (Japan, 2013). The latter however does not necessarily exclude a role for effort-sharing approaches as these could be used to compare the proposed submissions.

6 Process considerations

6.1 Conceptual considerations

This section briefly discusses different options to arrive at final commitments and their respective advantages and disadvantages. There is a spectrum of possible approaches to arriving at final commitments in the 2015 agreement, ranging from a pure top-down approach to a complete bottom-up arrangement.

The two end members of this spectrum may be described as:

- *Top-down*: Determining commitments through development and application of an agreed effort-sharing formula or system;
- *Pure bottom-up*: Determining commitments completely bottom-up, with no international review or negotiation, as in the Copenhagen/Cancún pledges.

Between these two options lie a range of different options containing a variety of features or principles. Within this framing it is important to distinguish how commitments are to be adopted within a new legal agreement. There is a significant distinction between commitments that can be unilaterally inscribed into an agreement, even if reviewed by all parties first, against those which must be agreed and adopted by all parties. The former approach, for example, may be more consistent with a bottom-up approach, whereas the latter implies a stronger multilateral approach to commitments, irrespective of the manner in which the targets are set, and hence may have sense in which it is more towards the top-down end of the spectrum.

To capture these options two hybrid approaches may be considered:

- *Bottom-up with negotiated outcome*: An approach where commitments are offered “bottom up,” reviewed for consistency with the 2°C goal and then negotiated as part of the final adoption of an agreement; the negotiation may or may not involve development of an effort-sharing framework or equity reference framework to guide the negotiations;
- *Bottom-up with transparent review*: An approach where commitments are offered “bottom up,” reviewed for consistency with the 2°C goal and then after any revision inscribed in an agreement.

The first of these options would involve a higher level of political pressure on parties to improve their initial offers than the second, where political pressure would come from the transparent review process rather than from the final pressure to agree an outcome multilaterally.

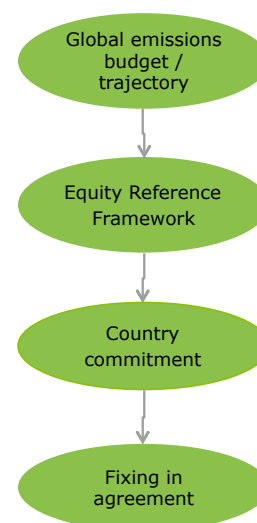
A common metric applied to the discussion of each of these is how they may approach the goal of ensuring that the aggregate level obligation commitments undertaken in the new 2015 agreement are consistent with the internationally agreed goal of holding warming below 2°C.

The options are again discussed against the criteria environmental effectiveness, cost-effectiveness, distributional considerations, and institutional feasibility.

6.1.1 Top down

A top-down approach would consist of the following steps:

- First, Parties agree on global emission budget or trajectory, ideally one that gives a high chance of staying below 2°C in line with the objective agreed in Copenhagen and Cancún or even 1.5°C as demanded by some Parties.
- Second, Parties agree on an effort-sharing approach or a range of approaches to allocate individual commitments to Parties. Agreeing on a formula would require agreement on effort-sharing principles, indicators expressing these principles and data sources to quantify the indicators. Parties could, for example, constitute an expert body to develop the formula and resulting (ranges for) allocations.
- Based on the agreed budget or trajectory and the effort-sharing framework commitments would be allocated to individual Parties and fixed in the agreement.



Environmental effectiveness would depend on the level of ambition of the overall budget or trajectory rather than individual countries' commitments, if one assumes that all Parties would adhere to the allocations resulting from the effort-sharing formula. Assuming that the emission pathway constraining the initial allocation of parties emission commitments is consistent with scientific understanding of what is needed to limit warming below 2°C, the environmental goal should be able to be met.

Regarding **cost-effectiveness and distributional considerations**, as discussed in the previous chapter, the global distribution of effort would most likely not reflect the global distribution of mitigation potential and costs. However, in most effort-sharing proposals this is a feature rather than a bug since their aim is explicitly to achieve distributional equity, not cost effectiveness. Many effort-sharing proposals result in allocations for Annex I countries that are much more stringent than they could ever hope of achieving through domestic reductions. Annex I countries would thus have to achieve their commitments partly through financing emission reductions in other countries, either via market mechanisms or non-market climate finance.

Regarding **institutional feasibility**, Parties have so far favoured vastly different effort-sharing proposals. In essence, approaches that have been found acceptable by Annex I countries have been deemed unacceptable by non-Annex I countries and vice versa. Some Parties have fully rejected any notion that a "formulaic" approach could work. It might thus be politically impossible to even launch a process to discuss establishing an effort-sharing formula, and even if a process was launched, its ultimate success would probably be far from guaranteed. Nonetheless, even if ultimately unsuccessful, the process as such might play a useful catalytic role for national discussions.

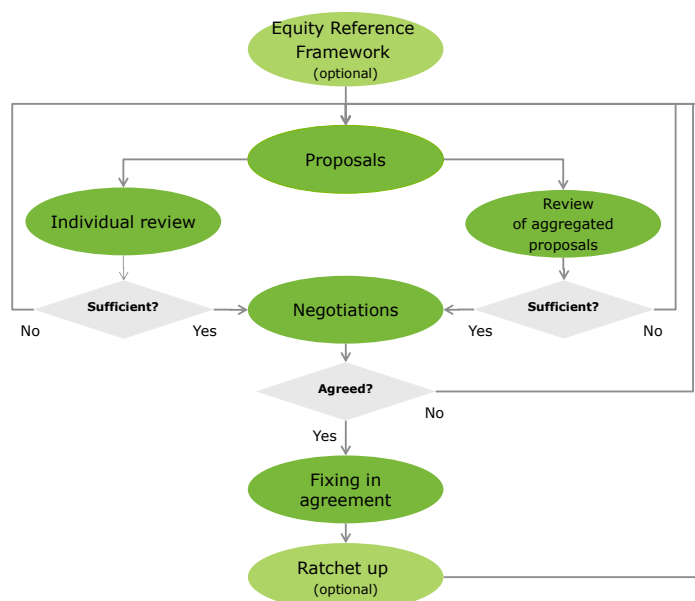
The work to establish the effort-sharing formula would be both highly political and technical. Principles would need to be translated into indicators, allocations would need to be quantified, which would in turn again require political scrutiny to determine whether the outcome is indeed generally agreeable. The work would thus probably be very time consuming. A possible

way forward would be to explore several approaches and as a result present ranges and not single numbers.

6.1.2 Bottom-up with negotiated outcome vs. bottom up with transparent review

In these approaches, it is more than likely that the initial commitments put forward by parties would exceed in aggregate terms the emission pathways scientifically consistent with holding warming below 2°C. The subsequent process of negotiating on these initial commitments and/or political consideration of a review of the proposals would likely be driven in part by the gap between the initial emission commitments and the aggregate level of emissions required to be consistent with the agreed global goal. For either of these approaches to improve upon the pure bottom up approach there would need to at least be an implicit understanding that parties would be open to improving upon their initial commitments in order to collectively approach the global goal, based upon the give-and-take with other parties.

In either of these approaches, countries might be required to justify why their offers represent their fair share of a global effort. The process may involve development of an effort-sharing framework or equity reference framework to guide the negotiations over the adequacy of initial commitments in relation to the global goal. With the review process guided by need to bring aggregate emission commitments close to all within the global pathway required to hold warming below 2°, the ultimate outcome of this negotiation would be a political understanding on the extent to which this goal could be achieved at this step of the negotiations.



Possible approaches to reviewing emission commitments within either of these approaches are for example:

- Each Party assesses the other Parties' offers on its own, without establishment of an international institution to support the negotiation process. Discussions would then probably proceed mostly bilaterally, or plurilaterally in fora such as the G-20 or the Major Economies Forum. Within this framework there may still need to be an agreed qualitative assessment of the extent to which initial and subsequent proposed commitments move towards the emission pathway consistent with holding global warming below 2°C: this could be outsourced to, for example, UNEP, or could be the subject of a technical paper process under the UNFCCC secretariat. However, it may well be the case that Parties will not be able to agree on providing such a mandate to UNEP, the Secretariat or others. Nonetheless, interested organisations may also take on this task on their own initiative, as UNEP is already doing with its annual "gap" report.

- The ADP could establish a process, including an expert working group, and/or mandate an existing body, such as the Secretariat, to support the process of reviewing proposed commitments offers. This could have one or several of the following functions:
 - Synthesising the information made available by Parties in one uniform format;
 - Assessing the technical robustness of all data, assumptions and calculations put forward by Parties;
 - Assessing the global level of effort that would result from Parties' proposed commitments and their overall consistency with holding global warming below 2°C;
 - Assessing the proposals against an agreed effort-sharing framework or equity reference framework, if applicable.

The Climate Action Network (CAN) has proposed an independent expert process to develop an "Equity Reference Framework." This Framework would then be used by Parties to formulate their initial offers and as basis for a review of these offers by international experts and for the negotiation among Parties (CAN 2013).

Instead of trying to develop an agreed framework *ex ante*, one might posit, especially regarding the major emitters, that their justifications should not only relate to their own proposal but include a description as to how it would be applied to all countries. This would result in a (potentially very large) set of effort-sharing proposals, which might then be discussed among Parties with the aim to progressively narrow down the number of alternatives in the course of conducting a review of the initial proposed commitments.

The major difference between these approaches will occur after a review of the initial emission commitments is conducted. In the stronger approach there would need to be negotiated agreement on the extent to which initial offers are modified for inclusion in the final agreement, whereas in the weaker version parties would be free to decide how they respond to the review process and its findings.

The environmental effectiveness of the outcome would depend on the degree of Parties' willingness to improve on initial offers if these do not add up to the globally necessary level of effort. In the case of a negotiated outcome, where there is substantial political pressure to reach a final agreement in the context where all other parties are under similar pressure, and with a visible and transparent review process that would indicate the adequacy of the overall achievements against the agreed global, there may be a higher likelihood of aggregate emissions being lower than in the unilateral response to the review case.

Agreement of a global emission budget or trajectory might facilitate such a ratcheting up. The emission pathways by which aggregate levels of commitment could be measured in relation to the 2° goal would best be determined by the Intergovernmental Panel on Climate Change AR5, which will include analyses of these pathways. A negotiation over which pathway is consistent with the agreed global goal may not be productive and consequently there would need to be a consideration as to how to ensure that the IPCC findings are embedded and accepted in this process.

Regarding **cost-effectiveness and distributional considerations**, many Parties would probably use projected economic impacts as key criterion for what levels of ambition they would offer. Distributional equity would depend on the extent to which Parties would be willing to be guided by equity considerations even if these result in comparatively ambitious commitments for themselves. In the past, only few Parties have been willing to adopt ambitious commitments.⁵

An important consideration in the overall outcome is how damages from climate change committed by the agreement are distributed. This points to the need for those least responsible for these damages to be involved in a decision on the overall level of commitments. Such a consideration would tend to support the stronger of these options.

Regarding **institutional feasibility**, this approach would impose less initial constraints on the flexibility of Parties than the top-down approach. However, the process of negotiating from initial commitments towards an outcome with lower aggregate emissions implies significant technical and secretariat support, as well as a functioning negotiating process built upon a good-faith understanding that initial commitments are to be negotiated towards a better outcome collectively.

⁵ See e.g. the assessment of Parties' Copenhagen/Cancún pledges by the Climate Action Tracker, <http://climateactiontracker.org/>, last accessed 14 October 2013.

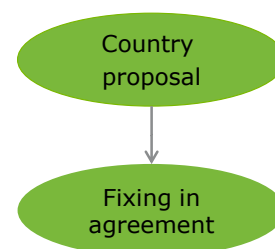
6.1.3 Pure bottom-up

In this approach, countries might be asked to justify their commitments but there would be no international review or negotiation.

Regarding **environmental effectiveness**, as shown by the Copenhagen/Cancún pledges, a pure bottom-up process without even a formal possibility to ratchet up commitments is very unlikely to deliver the necessary level of ambition.

Regarding **cost-effectiveness and distributional considerations**, many countries might be likely to make projected economic impacts rather than equity considerations the main criterion for what levels of ambition they would offer.

Regarding **institutional feasibility**, this approach puts the least constraints on Parties and does not require establishment of an international body or process to agree on commitments.



6.2 Options to enhance ambition after 2015

6.2.1 How to organise a review to assure ambition level increases after 2020?

Regardless of the process to fix a first set of commitments for some or all countries, it will be essential to review them periodically in order to reflect recent changes in the economies and to incorporate recent scientific and technological advances. The review would ensure the original commitments are still sufficiently ambitious and incentivise the further increase of ambition. To keep track of recent developments, short review cycles (e.g. 2 years) are important.

An important element therefore in the new agreement, is that emission commitments are time bound (five years) and that each subsequent set of commitments are also linked to a scientific assessment process.

Independently of those review cycles, countries should always be able to increase their commitments. Just as for the first round of proposed commitments, independent review of those new proposals is necessary to guarantee an increase in ambition when changing the commitment. The review could include only technical aspects or could also include a check against a possible equity reference framework.

The targets and associated rules have to be set in a way that incentivises an increase in ambition rather than presenting a barrier. In the Kyoto Protocol system, increasing the ambition of a target would mean losing emission allowances that could be transferred to future periods or sold to other countries. This is a barrier to increasing ambition. One option could be to allow allowances to be used only by the same country and only in the distant future. Another option could be to set the future stringency of targets based on a common endpoint, so that reaching it earlier is a benefit.

6.2.2 How could complementary initiatives be used to raise ambition?

Activities on non-governmental levels or on regional or city level can substantially impact emission reductions of countries. Although the initiatives are not driven by national government incentives, national circumstances can play a role in to what extent the initiatives

decrease emissions and the activities tap into the potential of the countries. They also all contribute to achieving the national commitments. These reductions can therefore not be separated from the countries and should be accounted to achieving the target. However, the existence of complementary initiatives should not refrain national governments from implementing mitigation activities. Countries should therefore transparently document where complementary initiatives contribute to moving towards the target. The UNFCCC could play a role in gathering the information provided by the initiatives.

7 Conclusions and way forward

7.1 Synthesis of different elements of differentiation

Previous chapters discussed many different aspects that are relevant for the differentiation of commitments and ultimately the success of the negotiations for the new agreement and its environmental outcome. This paints a complex picture, where each element influences the other. Figure 3 provides an overview of the different aspects that interlink with each other and where the different options have been discussed.

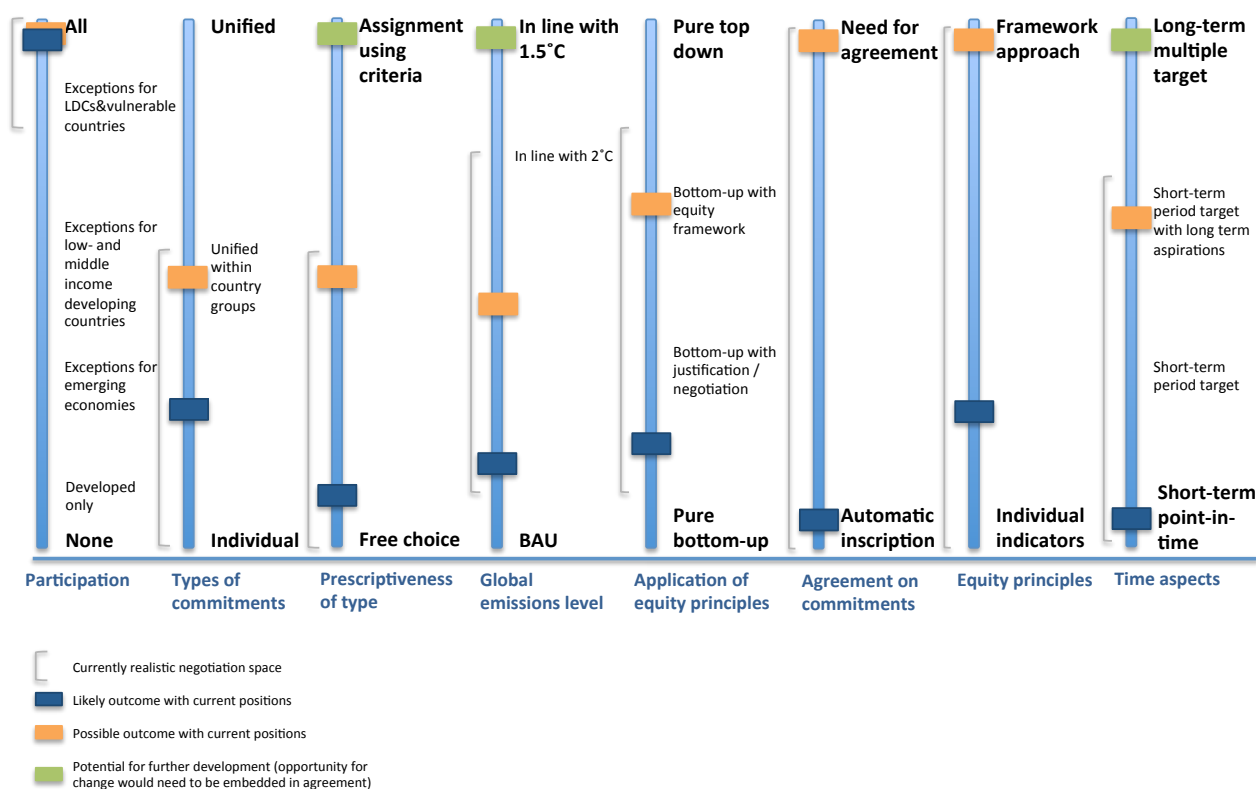


Figure 3: Overview of different aspects of differentiation

The illustration does not try to capture the linkages and trade-offs between different elements, but concentrates on defining the extreme ends and potential intermediate steps. It also provides a first assessment on where we see current boundaries to the negotiation space and likely outcomes given current negotiation positions if there is no strong and concerted push towards more ambitious outcomes.

We also provide a potential mix of elements that seem to be within a realistic negotiation space and that could deliver an overall more effective agreement. Going beyond that the illustration also highlights desirable elements that we judge to be outside the realistic sphere for this round of negotiations until 2015, but where it is paramount that appropriate text is included in the final agreement that opens the door for further improvements in the future. Designing the system in a dynamic way that ensures increases in ambition and further development of methodologies and principles remain open during a defined commitment period is essential. Revisions that result in reduced ambition need to be effectively barred.

Given the mandate of the ADP, participation needs to be broad. Exceptions for LDCs and the most vulnerable countries would theoretically be politically feasible, but the groups themselves have called for universal participation in the past, so this is not very likely. Differentiation for these groups will be through different types and stringency of commitments.

Regarding types of commitments we have identified a whole range of different options, each with their own advantages and disadvantages. The question remains whether countries will have the free choice which of those commitment types to apply or if there are rules that limit this choice. At the extreme end the type of commitment could be allocated automatically based on defined criteria.

Our analysis of possible commitment types shows that there is no silver bullet. Each approach has its strengths and weaknesses. While emission-based approaches provide environmental clarity and the potential to maximise (short-term) cost-effectiveness, they are not politically. On the contrary, decisionmakers frequently associate emission commitments with constraints on development potential and risks to competitiveness and employment. Comparable country-wide emission reduction targets also do not automatically constitute a “level playing field” for internationally competing industries as governments are free to partially or fully exempt trade-exposed industries from emission control obligations.

Other approaches may be politically more attractive since many countries have an inherent interest in promoting energy efficiency or certain technologies and these approaches might generate less fear of constituting a “cap on development.” They would, however, be more difficult in terms of judging their environmental impact and could increase the complexity of international negotiations.

A combination of approaches may provide the best way forward. Real-life examples are provided by the EU’s 20-20-20 targets (targets on greenhouse gases, efficiency and renewables) and some non-Annex I pledges such as those of Brazil and China, which combine country-wide emission-based reduction targets with some sectoral targets. Emission-based reduction targets could be set as the floor or ambition and commitment on technologies or policies could support them, possibly even overachieving them. A multi-dimensional approach combining various types of commitments could also be more failsafe than focusing only on one single approach. If one approach falls short, as emission-based reduction targets and related carbon prices currently do, this deficit may be compensated by the other approaches.

Currently we see a situation where developed countries have adopted economy-wide emissions targets in the tradition of the Kyoto Protocol. For those countries not participating in the second commitment period of the Kyoto Protocol this has been a voluntary choice and a lack of clarity related to rules who is eligible for which types of targets leads to fears that industrialised

countries could opt to choose other types of targets in the future that are even more difficult to monitor.

Developing countries have made their own individual choices. A further differentiation could be possible depending on the development status of countries in narrowing down the options of choice. Many do not see it as very likely that a formalised spectrum of commitments could be agreed which would assign certain commitment types to certain groups of countries.

Regarding the application of equity principles, we can differentiate two main elements: the question of which principles and indicators to apply (see section 5) and the process of how to apply equity principles (see section 6.1). As shown in section 5.4, countries have expressed very different priorities for equity principles. In the past, many have focused on one specific element of equity, usually one that favours less ambitious targets for the country proposing it. Some even oppose the whole idea of establishing clear indicators and 'calculate' required reductions.

More recently, the idea of more complex equity frameworks based on a larger number of indicators that reflect the whole spectrum of equity principles has come up. While such an approach can help ensure all countries find their own priorities reflected, it seems challenging to negotiate on the individual indicators and assumptions required for such a framework. In the current context this would need to be developed with the help of experts and could likely only serve as a guidance to evaluate bottom-up pledges.

A central question with diverging positions is whether commitments need to be adopted within a new legal agreement by all Parties or if they will be automatically and unilaterally inscribed into the new agreement once proposals are made and potentially reviewed and / or negotiated. The latter is consistent with a bottom-up approach, whereas an agreement by all Parties implies a stronger multilateral approach to commitments, irrespective of the manner in which the targets are set.

How different options regarding several of these elements could work out in practise within the UNFCCC negotiation process is discussed in the next section.

7.2 The UNFCCC process - Agreeing on 2015 commitments

The Conference of Parties at the end of 2015 is scheduled to finalise the agreement. The process will depend on many different factors, especially the overall political landscape, which goes beyond the scope of this paper. Here, we have concentrated on a few aspects and outline how different choices impact the negotiation time line.

We assume that the process involves, as a first step, individual proposals by countries on their possible commitments. Guidance could be developed on what information would be necessary when countries report their proposals, like for example outlined in the submission by the EU (Lithuania on behalf of the European Union, 2014) or in Morgan et al. (2013). This could decrease the need for clarifications of the pledges after they are made.

In a pure bottom-up scenario the commitments put forward in this way would be fixed within the new agreement and there could be a ratchet-up mechanism to review the commitments after some time as outlined in section 6.2.

More interesting is the question of process if we assume that the aim is to

- a) incorporate an assessment of commitments before fixing them in the new agreement;
or
- b) agree on a common equity reference framework to use for the evaluation of proposals.

Demands on the negotiation process increase with the different options. A pure bottom-up approach requires not much prior negotiation, apart from potential demands on the type of information, level of detail and quality of data provided as discussed above. In a pure bottom-up process this would, however, be optional as no real consequences would arise from the additional information beyond potentially increasing political pressure on countries.

For the two options a) and b) which involve at least an assessment of proposals guidance on information to be provided would be essential to enable subsequent steps. In both cases proposals for commitments need to come on the table well in advance of the COP in 2015 to allow for assessment. Most agree that for such options to be feasible initial proposals would need to be submitted in 2014 (Lithuania 2013, Morgan et al. 2013) or early 2015 (Haïtes, Yamin, & Höhne, 2013).

The process to negotiate an agreed equity reference framework adds to the negotiation agenda workload. Timing of agreement on such a framework would need to be closely aligned with the commitment proposals. By when initial proposals would be required to still have sufficient time for subsequent steps mainly depends on the question of how a potential review process would be structured and which decisions can be agreed in 2013.

Options on how the review process would work centre around the question of who would conduct the assessment of proposals. There are a number of options, including a pure peer review process, i.e. Parties review each other's proposals and report on their findings or use them within the subsequent negotiation process. An even more informal process could include external experts and institutions that undertake the assessment on their own account and publish results, which can then be used by Parties in the process.

More formalised approaches include the use of already existing processes under the UNFCCC that could be mandated to broaden their scope of work. These include the ICA/IAR process, the clarification of pledges process and the periodic review, each with their own advantages and disadvantages (Morgan et al., 2013). ICA/IAR and the periodic review are likely to be operational too late while the clarification of pledges process would need to be expanded in scope and time line, as it is meant to end in 2014. In any case experts with a high international reputation and standing would be required to support such a technical assessment. These could either feed into one of these (or other) existing processes or into a newly created process that could for example mandate the Secretariat to coordinate the technical input.

If we assume a fast operationalisation, Parties under the UNFCCC would agree on a process in 2013. This would ideally include guidance on information needs by types of commitments and institutional setup for review processes. If applicable this would ideally also include an agreement on the equity reference framework. Throughout 2014, countries could then submit their targets. The summit organised by the UN General Secretary Ban Ki Moon in 2014 could be a defined moment by when initial proposals should be made. In 2015, these would be assessed, negotiated, if necessary increased, and agreed upon. It is clear that this timeline is extremely

ambitious. Nevertheless, it would include all relevant elements to achieve a sound agreement on mitigation commitments in 2015.

8 References

- Agarwal, A., & Narain, S. (n.d.). *Global Warming in an Unequal World, a case of environmental colonialism*. Delhi; India: Centre for Science and Environment.
- Aldy, J. E., Barrett, S., & Stavins, R. N. (2003). Thirteen plus one: a comparison of global climate policy architectures. *Climate Policy*, 3(4), 373–397. doi:10.1016/j.clipol.2003.09.004
- Aldy, J. E., & Stavins, R. N. (2007). *Architectures for Agreement*.
- Barrett, S., & Toman, M. (2010). *Contrasting Future Paths for an Evolving Global Climate Regime*. Washington, D.C.
- Bodansky, D. (2012). *The Durban Platform: Issues and Options for a 2015 Agreement*. *Center for Climate and Energy Solutions (Dec. 2012)*. Retrieved from <http://ssrn.com/abstract=2270336>
- Bolscher, H., et al. (2012). *Design options for sectoral carbon market mechanisms*. Retrieved from http://ec.europa.eu/clima/policies/ets/linking/docs/study_20120831_en.pdf ##das ist dasselbe wie die folgende Quelle
- Bolscher, H., van der Laan, J., Slingerland, S., Sijm, J., Bakker, S., Mikunda, T., ... Conway, D. (2012). *Design options for sectoral carbon market mechanisms and their implications for the EU ETS*. Rotterdam.
- Brazil. (2013). Views of Brazil on the implementation of all the elements of decision 1/cp.17, (a) matters related to paragraphs 2 to 6, on the work of the ad hoc working group on the Durban Platform for enhanced Action (“workstream 1”). Retrieved from http://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_brazil_workstream_1_brazilian_proposal_20130912.pdf
- Chakravarty, S. P., Chikkatur, A., Coninck, H., Pacala, S., Socolow, R., & Tavoni, M. (2009). Sharing global CO2 emission reductions among one billion high emitters. *Proceedings of the National Academy of Sciences USA*, (106), 11884–11888.
- Commission, E. (2009). Commission Staff Working Document accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Towards a comprehensive climate change agreement in .
- Cramton, P., Ockenfels, A., & Stoft, S. (2013). *How to Negotiate Ambitious Global Emissions Abatement. A Statement of Key Principles and an Explanatory Note*.
- Elzen, M. G. J., Schaeffer, M., & Lucas, P. L. (2005). Differentiating Future Commitments on the Basis of Countries’ Relative Historical Responsibility for Climate Change: Uncertainties in the “Brazilian Proposal” in the Context of a Policy Implementation. *Climatic Change*, 71(3), 277–301. doi:10.1007/s10584-005-5382-9
- Greenhouse gas emissions reduction A theoretical framework and global solution. (2009). Retrieved from http://www.gci.org.uk/Documents/China_Research.pdf
- Gupta, S., Tirpak, D., Burger, N., Gupta, J., Höhne, N., Boncheva, A. I., ... Sari, A. (2007). Policies, Instruments and Co-operative Arrangements. In B. Metz, O. Davidson, P. Bosch, R. Dave, & L. Meyer (Eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, New York: Cambridge University Press.
- Haites, E., Yamin, F., & Höhne, N. (2013). *Possible Elements of a 2015 Legal Agreement on Climate Change*. Paris. Retrieved from http://www.iddri.org/Publications/Collections/Idees-pour-le-debat/WP1613_EH_FY_NH_legal_agreement_2015.pdf
- Haya, B. (2009). *Measuring Emissions Against an Alternative Future: Fundamental Flaws in the Structure of the Kyoto Protocol’s Clean Development Mechanism*. Berkeley, CA.
- Höhne, N., den Elzen, M., & Escalante, D. (2013). Regional greenhouse gas reduction targets based on effort sharing approaches – a comparison of studies. *Climate Policy*. Retrieved from uw3ldhb1.doc ???
- International Energy Agency. (2012). *World Energy Outlook 2012*. Paris: OECD/IEA.
- Japan. (2013). Submission by Japan - Information, views and proposals on matters related to the work of Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP). Retrieved from http://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_japan_workstream_1_and_2_20130910.pdf
- Kuik, O., Aerts, J., Berkhout, F., Biermann, F., Bruggink, J., Gupta, J., & Tol, R. S. J. (2008). Post-2012 Climate Policy Dilemmas : A Review of Proposals. *Climate Policy*, 8(3), 317–336.
- Lithuania on behalf of the European Union. (2014). *Further elaboration of elements of a step wise process for ambitious mitigation commitments in the 2015 agreement* (Vol. 2007, pp. 1–6). Retrieved from

- http://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_eu_workstream_1_mitigation_20130916.pdf
- Michaelowa, A., & Purohit, P. (2007). *Additionality Determination of Indian CDM Projects. Can Indian CDM Project Developers Outwit the CDM Executive Board?* London.
- Moltmann, S., Hagemann, M., Eisbrenner, K., Höhne, N., Sterk, W., Mersmann, F., ... Watanabe, R. (2010). Quantifying emission reduction contributions by emerging economies - to be published soon. Retrieved from <http://www.umweltdaten.de/publikationen/fpdf-l/4097.pdf>
- Moltmann, S., Höhne, N., & Hagemann, M. (2010). Sharing reductions of greenhouse gas emission not covered by the ETS between regions in Spain. Cologne, Germany. Retrieved from [e2z1zd5t.pdf](#) ??
- Morgan, J., Tirpak, D., Levin, K., & Dagnet, Y. (2013). *A Pathway to a Climate Change Agreement in 2015 : Options for Setting and Reviewing GHG Emission Reduction Offers* (pp. 1–20). Washington D.C. Retrieved from http://www.wri.org/sites/default/files/options_for_setting_and_reviewing_ghg_emission_reduction_offers_hi_res.pdf
- Moriya, M. (2009). Japan's perspective on Mitigation Potentials. (J. T. S.-R. M. (via R.-E. Ministry of the Environment, Ed.).
- Nepal on behalf of the Least Developed Countries Group. (2013). *ADP Work Stream 1 : The 2015 Agreement, Building on the Conclusions of the ADP 1 - 2* (pp. 1–7). Retrieved from http://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_ldcs_20130903.pdf
- Ngwadla, X. (2013). *Equitable Access to Sustainable Development*. Cape Town.
- Pacific Island Forum. (2013). *MAJURO DECLARATION FOR CLIMATE LEADERSHIP*. Retrieved from <http://www.majurodeclaration.org/>
- Pan, J., Zhu, X., & Chen, Y. (2005). Fulfilling basic development needs with low emissions: China's challenges and opportunities for building a post-2012 climate regime. In T. Sugiyama (Ed.), *Governing Climate: The Struggle for a Global Framework Beyond Kyoto* (pp. 89–106). Winnipeg; Manitoba; Canada: International Institute for Sustainable Development.
- Philibert, C. (2005). *APPROACHES FOR FUTURE INTERNATIONAL CO-OPERATION*. Paris.
- Phylipsen, D., Bode, J. W., Blok, K., Merkus, H., & Metz, B. (1998a). A Triptych sectoral approach to burden differentiation; GHG emissions in the European bubble. *Energy Policy*, 26(12), 929–943.
- Phylipsen, D., Bode, J. W., Blok, K., Merkus, H., & Metz, B. (1998b). A Triptych sectoral approach to burden differentiation; GHG emissions in the European bubble. *Energy Policy*, 26(12), 929–943.
- Samaniago, J., & Figueres, C. (2002). Evolving to a Sector-Based Clean Development Mechanism. In K. A. Baumert, O. Blanchard, S. Llosa, & J. Perkaus (Eds.), *Building on the Kyoto Protocol: Options for Protecting the Climate* (pp. 89–108). World Resources Institute.
- Schneider, L. (2007). *Is the CDM Fulfilling Its Environmental and Sustainable Development Objective? An Evaluation of the CDM and Options for Improvement*. Berlin. Retrieved from www.oeko.de/oekodoc/622/2007-162-en.pdf
- Schneider, L. (2008). *A Clean Development Mechanism (CDM) with atmospheric benefits for a post-2012 climate regime*.
- Spalding-Fecher, R., Achanta, A. N., Erickson, P., Haites, E., Lazarus, M., Pahula, N., ... Tewari, R. (2012). *Assessing the Impact of the Clean Development Mechanism*. Luxemburg.
- States, U. (2013, November). ADP Workstream 1: 2015 Agreement: Submission of the United States. *Submission of the United States*. Retrieved from http://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp_usa_workstream_1_20130312.pdf
- Sterk, W., Arens, C., Kreibich, N., Mersmann, F., & Wehnert, T. (2012). *Sands Are Running Out for Climate Protection*. Wuppertal. Retrieved from <http://wupperinst.org/en/publications/details/wi/a/s/ad/1979/>
- Stiglitz, J. E. (2010). Overcoming the Copenhagen Failure by Joseph E. Stiglitz - Project Syndicate. Retrieved July 02, 2013, from <http://www.project-syndicate.org/print/overcoming-the-copenhagen-failure>
- UNEP. (2013). *The Emissions Gap Report 2013*.
- UNFCCC. (1997). Paper no. 1: Brazil; Proposed Elements of a Protocol to the United Nations Framework Convention on Climate Change. Bonn. Retrieved from <http://unfccc.int/cop4/resource/docs/1997/agbm/misc01a3.htm>
- UNFCCC. (2011). *Decision 1 / CP . 17 Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action* (pp. 1–86). Bonn.
- United Nations. (1992). *United Nations Framework Convention on Climate Change* (Vol. 62220).
- Verbruggen, A. (2011). A Turbo Drive for the Global Reduction of Energy-Related CO2 Emissions. *Sustainability*, 3(12), 632–648. doi:10.3390/su3040632

- Victor, D. (2011). *Global Warming Gridlock. Creating More Effective Strategies for Protecting the Planet*. Cambridge et al.: Cambridge University Press.
- Wara, M., & Victor, D. G. (2008). *A Realistic Policy on International Carbon Offsets*.
- Weischer, L., & Morgan, J. (2013). *The Solar Economy Club : Implementing a leadership club approach to international climate policy* (pp. 1–36). ??
- Winkler, H., Jayaraman, T., Pan, J., Oliviera, A. S. de, Zhang, Y., Sant, G., ... Raubenheimer, S. (2011a). Equitable access to sustainable development: Contribution to the body of scientific knowledge. *Contribution to the body of scientific knowledge*. Beijing, Brasilia, Cape Town and Mumbai.
- Winkler, H., Jayaraman, T., Pan, J., Oliviera, A. S. de, Zhang, Y., Sant, G., ... Raubenheimer, S. (2011b). Equitable access to sustainable development: Contribution to the body of scientific knowledge. *Contribution to the body of scientific knowledge*. Beijing, Brasilia, Cape Town and Mumbai. Retrieved from http://www.erc.uct.ac.za/Basic_Experts_Paper.pdf
- Winkler, H., Spalding-Fecher, R., Mwakasonda, S., & Davidson, O. (2002). Sustainable Development Policies and Measures: Starting From Development to Tackle Climate Change. In K. A. Baumert, O. Blanchard, S. Llosa, & J. Perkaus (Eds.), *Building on the Kyoto Protocol: Options for Protecting the Climate* (pp. 61–88). World Resources Institute.