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Reasoning Goals of Climate Protection.

Specification of Article 2 UNFCCC

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Abstract International politics has widely accepted the general but unspecified goal to prevent possible dangers from anthropogenic climate change according to art. 2 of UNFCCC. Nevertheless, finding of further concrete measures with respect to decisions on tolerable concentrations and emissions of greenhouse-gases seems to be necessary for the upcoming commitment periods of the Kyoto-Protocol. This study is devoted to working out a sound, legitimate and policy compatible base for the specification of the Climate Convention's ultimate goal and respective decisions in international negotiations.		
Keywords Climate Change Convention, art. 2, stabilisation goal, dangerous interference, specification, conflicting positions, trade-offs, technological options, ethical evaluation, criteria		

Foreword

Despite of the widely accepted but general goal of the Climate Convention to prevent dangerous human interference with the climate system, its interpretation with regard to further international commitments is still pending. This situation gives reason for investigations towards reasonable specifications of the Convention's ultimate goal.

The Europäische Akademie welcomed a corresponding invitation to tender of the Federal Environmental Agency of Germany (UBA) and awarded a respective contract in May 2002. The interdisciplinary study group constituted itself on the occasion of the final presentation of a scientific publication on *climate prediction and climate precautions*[1] on 6th May 2002 in Berlin. The findings of a corresponding former project built - at the same time - the basis for this study, which may be therefore considered as a follow-on investigation. Consequently, several experts of the former project group joined the new study team. After its extension, the study group consisted on the following members: Professor Gernot Klepper, Ph.D. (Institut für Weltwirtschaft, Kiel), Professor Dr. Konrad Ott (University of Greifswald), Achim Schäfer (DUENE e.V., Greifswald), Dr. Jürgen Scheffran (Postdam Institute for Climate Impact Research/PIK), Detlef Sprinz, Ph.D. (Postdam Institute for Climate Impact Research/PIK) and Dr. Stephan Lingner (Europäische Akademie Bad Neuenahr-Ahrweiler GmbH), who coordinated the study. Petra Mahrenholz (UBA, Berlin) was responsible from the side of the customer of the study.

The study progress was accompanied by six regular meetings of the study team. An additional advisory meeting on specifications of the project outline was organized in Berlin by Petra Mahrenholz and Martin Weiß (both at UBA) in the early study phase. Later-on, Professor Dr. iur. Meinhard Schröder (University of Trier) submitted an expertise to the study group on the juridical term "danger" with respect of the meaning of the Framework Convention's objectives. In late October 2002, Dr. Jürgen Scheffran participated the Delhi Conference of the Parties to the Convention (COP-8) as representative of the study group, where he got insights into the negotiation practise and into most prominent positions of actors. He conducted corresponding guided interviews of the conference participants in agreement with the study team. Corresponding questions were also coordinated with Petra Mahrenholz (UBA) and Dr. Harald Kohl (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit). In

[1] M. Schröder et al. (2002) Klimavorhersage und Klimavorsorge. Berlin Heidelberg.

early December 2002 a first interim report was prepared and submitted to selected experts from outside the group.

The study group is grateful to Professor Dr. Armin Grunwald (Forschungszentrum Karlsruhe), Dr. Gerd Hanekamp (Europäische Akademie), Professor Dr. Christoph Lumer (University of Firenze), Petra Mahrenholz (UBA), Dr. Benito Müller (Oxford Institute for Energy Studies) and Dr. Sebastian Oberthür (ECOLOGIC e.V., Berlin) for their constructive comments in favour of the completion of work. A proof-reading of the final draft was conducted – again – by Petra Mahrenholz and her colleagues at UBA. Special thanks are due to her for valuable advice as well as to the UBA for funding a great deal of this study.

The authors express their thanks to Sevim Kiliç (Europäische Akademie) for her professional editorial support.

Bad Neuenahr-Ahrweiler, March 2004 Stephan Lingner

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Glossary

Term/Acronym	Explanation
AOSIS	Alliance of Small Island States
CBA (BCA)	Cost Benefit Analysis
CDM	Clean Development Mechanism; flexible instrument in climate politics
CF_4	Carbon tetra-fluoride; “climate gas”
CH_4	Methane; “climate gas”
CO_2	Carbon dioxide; “climate gas”
Contractianism	Ethical theory based upon given contractual obligations
COP	Conference of the Parties (to the Climate Convention)
Deontology	Ethics based upon obligatory principles
Ecocentrism	Ethical theory claiming the right for living beings to exist
EU	European Union
FAO	Food and Agriculture Organization of the UN
FIP	Future-Individual Paradox: confusion of persons with individuals
GDP	Gross Domestic Input
GHG	Greenhouse Gas
Hobbesian	Worldview which gives credit to factual social contracts, only
Holistic ethics	Claims the “right” for natural entities to exist and develop naturally
IMAGE	Integrated Model to Assess the Greenhouse Effect
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation (of emission reduction obligations)
Kantian	Worldview which appeals to prudence and universal obligations
NGO	Non-Governmental Organisation
NOA	No-Obligation Argument
Pathocentrism	Ethical theory considering sentient creatures or their pain
PCPR	Principles, Criteria, Priority Rules
ppmv	parts per million (volumetric ratio)
Rawlsian	Ethical theory focusing on justice considerations
SD	Sustainable Development
SRES	Special Report on Emission Scenarios (Nakicenovic et al. 2000)
SRTP	Social Rate of Time-Preference

THC	Thermohaline circulation: Climate sensitive oceanic flow regime with regional to hemispherical climate feedbacks
Tutioristic	Risk averse position
TWA	Tolerable Windows Approach
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VOSL	Value of a Statistical Life
WAIS	West-Antarctic Ice Shield; may collapse due to climate change
WaterGAP	Water Global Assessment and Prognosis model

Summary

Art. 2 UNFCCC

> "The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

The article as integral part of the whole Convention was adopted in consensus of the negotiating nations and is - although being an ultimate and "universal" objective of a global environmental regime - open for probably *conflicting interpretations.* The specification of the global climate protection objective, given by the UN Framework Convention on Climate Change becomes especially urgent with respect to worrying scenarios of potential future environmental conditions emerging from scientific projections of climate change and its impacts. Efforts on corresponding specifications have to prove for appropriateness and fairness, as societal problems are deeply involved.

Concrete targets beyond the Kyoto perspective have not yet been commonly considered (see also UNFCCC 1997) and *few efforts* had been devoted to the question of how Art. 2 might be understood. Thus, a reasonable specification of the overall climate protection objective is needed for an acceptable implementation of the Convention and the realization of its goal.[2] Recommendations for comprehensive and integrated research on the task to interpret art. 2 had been recently confirmed (Izrael et al. 2002). This situation might give reason for research on the problem to develop an acceptable strategy to specify the ultimate but yet to be interpreted goal of the Framework Convention.

Defining a desirable long-term climate goal as a problem-driven task is only in part an effort of science, as societal questions arise concerning (normative) evaluations of reasons, justifications and relevance decisions of any action as well as related risk or uncertainty assessments and feasibility considerations of politics and economics, which have to be included and integrated. Therefore, approaches towards acceptable specifications of the climate protection objective have to overcome disciplinary barriers as well as obstacles from

[2] Corresponding work may make specific problems of interpretation explicit but will not question the art. 2 or the Convention as a whole, as the Convention had been already adopted and ratified and is therefore seen as legal basis for further specifications.

the obvious conflict potential of any specification attempt. The task may be therefore only conducted in an *integrative interdisciplinary manner*.

The purpose of this study is – on the basis of the legal meaning of UNFCCC's Art. 2 - to uncover the general conditions, problems and consequences of specifying the Convention's meaning. They are then objects of ethical evaluation in view of the formulation of further conclusions. Subsequent reflections on the convergence potential of the relevant ethical theories and principles are expected to improve corresponding normative orientation. Finalising messages for decision makers submit sound statements towards the political practise of specification as well as recommendations for further research on relevant normative issues. The study results should therefore contribute to the development of feasible *and* acceptable strategies of specifying the ultimate goal of the UNFCCC. [3]

I. Major results and their reasoning

I.I Why should we specify?

Some actors or parties seem to be reluctant to any specification effort. Nevertheless, it has to be recalled that specifications are *constitutive for any political objective* and thus for the objective of the Parties to the FCCC. Otherwise, there would remain only the broad but vague objective to reduce emissions without binding obligations for any Party. And no-obligation to anyone might be seen as equivalent to a business-as-usual claim. Calls for specification in decisive parameters, like quantities, time-frame and actors are therefore *implicitly embedded in the FCCC and its Art. 2* as a political aim.

Concluding from this means, that specifying should be a *common interest of the Parties*, which is expressed by their membership to the Convention and its ratification. Claims of any Party *not to specify should be therefore rejected* (chapter A.4.3).

I.II Legal framing of the specification task

The obligatory interpretation of Art. 2 FCCC has to be thus conducted along its common *intended objective*, which is a binding claim from internationally adopted legal rules of the Vienna Convention of the Treaties (Art. 31)(B.1, B.3). This would mean an obligation to interpret Art. 2 in good faith and with regard to its original purpose, which corresponds also to

[3] This task presupposes the principal feasibility of an effective climate protection regime as well as consented interpretations of art. 2. However, failures of respective processes may not be excluded (Müller 2002).

the Kantian norm to act reasonably. Consequently, any *strategic or particularistic reasoning in this sense would not be acceptable*. The Climate Convention and related provisions might serve - in this sense - as a rule for interpretation.

Putting the Convention's ultimative goal in concrete terms must be related to risks explicitly. The comparison of different danger or risk standards, mentioned in the Climate Convention might lead to the conclusion, that *dangerous interference* as stated in Art. 2 in relation to the "adverse effects" of climate change (Art. 1) constitutes *a basic benchmark*, *which is oriented towards general obligations to prevent threatening damages* and not towards a dispensable avoidance of mere disadvantages.

Moreover, where there are threats of *serious, not to be compensated* or *irreversible* damage, lack of full scientific certainty should not be used as a reason for postponing precautionary measures. Corresponding commitments to action are constituted by the sphere of dangers and are backed by the precautionary principle of Art. 3.3. Therefore, *scientific uncertainty* basically cannot be used by any Party of the Convention as reasonable argument against regulations to cope with potential but severe dangers and corresponding threats.

The grounds of specifying a "danger standard" lie in the end in the *negotiation and decision competence of the Parties* for climate protection. This conclusion necessarily implies also a universal moral competence of the Parties and their Subsidiary Bodies if *legitimacy* of negotiations and *acceptability* of their results should be achieved. In the yet mostly undetermined legal framework of this climate regime, relevant universal ethical norms might become guidelines for the orientation of the Parties and their reasonable argumentation. Corresponding negotiations have to be distinguished from merely rational bargaining in a narrower sense. Fair procedures and a set of universal grounds are therefore surely the basis for *acceptable negotiation results* with long-term validity.

I.III Current positioning of political actors

The interpretation und implementation of the ultimate objective in Art. 2 UNFCCC is becoming a key issue in climate negotiations beyond the first commitment period. On the national *German level* there is a comparatively ambitious positioning of relevant institutions regarding emission reductions and concrete GHG levels. These are mainly justified by explicit reference to Art. 2. Quite similar positions are occupied by *European actors*, but mostly with less reference to Art. 2. On the *global level*, there is a lack of positioning on Art. 2 or long-term emission reduction goals by political actors.

Recent positioning of actors may already shape the current negotiation process and contribute to a *clustering of key players* into potential coalitions although the Parties have not officially positioned themselves on all crucial issues. Those who want to push the agenda towards the stabilization goal - such as the member states of the EU - are facing strong resistance by those who want to refuse or postpone any commitments (such as the US or key countries of the G77). Countries such as *Russia and some members of the Umbrella Group could become a tip in the scales* in setting the future agenda in one or the other direction.

The *heterogeneity of G77 induces potential conflicts within this group* that may contribute to slowing further progress on achieving the ultimate objective. Nevertheless, with increasing attention of developing countries to their own vulnerability to climate change the need for speeding up the process may prevail. A unifying crucial element within G77 seems to be *"equity" which develops into a cross-cutting issue* in negotiations, allowing to form coalitions between EU, G77 and other countries – thus challenging the US position. Nevertheless, the factual diversity of corresponding proposals towards realization of equity might unease this effort to some extend.

There has been argued that science should contribute to clarifying key terms and linkages in Art. 2 as part of the 4th IPCC Assessment Report. But the evaluation of dangerous climate change is widely perceived as a predominantly political task among the interviewed experts. Any prescriptions concerning the tolerability of dangers that may affect the *interests of key players* are not intended by the actors. The latter seems to be in strong contradiction to the above mentioned conclusions from the spirit of the ultimate goal of FCCC and the general rules of international treaties. Nevertheless, normative orientation on the grounds of ethical considerations is seen as necessary and is therefore strongly recommended for implementation.

I.IV Compliance with the ultimate goal: consequences and trade-offs

Any definition of the three provisions (ecosystem adaptive capacity, food production, sustainable economic development) that should be met along the path towards a stabilized level of greenhouse gases needs to be aware of the consequences that a particular decision imposes. The range of potential specifications of the three provisions is by now limited by the already ongoing climate change and its consequences. That means *certain reasonable definitions are in fact not feasible anymore*, e.g., with respect to already damaged ecosystems.

Among the feasible definitions it is helpful to consider the consequences of a particular definition of the three provisions if they were need to be met. *Any definition will have a particular set of consequences to societies* with respect to their quite different regional and distributional burdens. Hence, one cannot assume that defining a provision - e.g. what is meant by a food production that is not threatened - will be merely a technical consideration. It will not only influence food production itself, it will also affect the well-being of people in different locations and in different times. *Differentiated value judgements will be therefore necessary*. In addition, any definition will create the need to *balance one definition with the definitions of the other two provisions* since there are obvious trade offs between them. E.g., a restrictive definition of ecosystem adaptation will result in a threat to economic development and vice versa.

Moreover, many of the consequences of a particular definition of the three provisions are difficult to assess (for reasons of complexity), very uncertain, and often materialize with a long and possibly unknown time lag. Given these difficulties, it is *unlikely that a calculation of costs and benefits by numbers will come to satisfactory results*. This result and the necessity of value judgements may be put against argumentations that stress cost-benefit analyses as solely means to assess (future) impacts from climate change.

Therefore, outstanding challenges to address the meaning of the Convention's constraints properly are reasonable decisions about the appropriate size of ecosystems, food production entities and economic systems to be considered as well as the adequate notion of "natural adaptation" which will influence the practical implementation of the ecosystem constraint in specific, especially with respect to managed and/or unmanaged ecosystems.

I.V Technological options

Future technological options are seen as *relevant for the interpretation of Art. 2* UNFCCC with respect of (a) prospects for mitigation of dangerous human-induced climate change and (b) potentials for adjustment to expected adverse climate impacts.

On the level of specific options it can be stated, that:

- most currently discussed technological concepts may contribute to the Convention's ultimate goal. Few options (geo-engineering, nuclear technologies) are not applicable here, according to the provisions of UNFCCC and related documents.
- options which are necessary to exploit and feasible in the near-term are energy saving and efficiency improvements on all steps of the energy chain. Adaptation measures in

already endangered regions and the prevention of re-mobilisation of fixed carbon (forest and soil protection) should be considered, too.

- in the medium-term, options to reach the stabilization goal might be the progressive substitution of fossil energy supply by renewables in combination with appropriate energy distribution infrastructures (e.g., hydrogen and fuel cell technologies). For this, corresponding developments have to be conducted in time.

Overall, projections of climate change *and* technology development will pose a two-fold uncertainty on actors. Thus, the *potentiality of technological advance* and its direction will therefore rather reason its role in climate politics as complementary element than as an alternative to it.

I.VI Ethical evaluation

The term „dangerous“ in Art. 2 as well as its constraints have no strict scientific meaning. They are inherently related to normative problems. Thus, *no reasonable interpretation of Art. 2 can avoid to address ethical questions*.

The task of specification is often questioned by sceptical argumentation, but any Party having affirmed the commitment of Art. 2 can hardly defend extensive scepticism upon its implementation. Especially the sceptical emphasis of existent uncertainties combined with a general optimism about technological progress and adaptive capabilities of the future seems inconsistent. Additionally, it would be unsound to be highly critical about the “arbitrariness” of any specification but to accept the arbitrary outcomes of a “muddling through” in climate politics. Therefore, *sceptical conclusions on specification cannot be reasonably supported.*

There are deep disagreements about the *ultimate principles of ethics*. Despite those theoretical divides, reasonable *practical convergences* might be found on the layer of applied ethics. Such convergence is to be regarded as being sufficient to justify an overlapping consensus in the ethics of climate change.

Given some modest premises about intergenerational obligations and precaution, almost all current ethical theories and approaches converge towards a consensus with regard to the ultimate objective of Art. 2. They may speak in favour of *low stabilization levels and in favour of food security* (being a more stringent interpretation of „food production“). Moreover, the formulation of Art. 2 lacks any requests for maximising of utility. Therefore, *deontological ethics may prevail* as a means to interpret Art. 2. The results concerning appropriate stabilization levels would be possibly more ambitious than an utilitarian approach.

With regard to the problem of *moral standing for non-human beings* (demarcation problem) only pathocentrism seems to be well justified. This might have some consequences of how the „adaption-of-ecosystems"-constraint should be interpreted since pathocentrism may imply a moral obligation to conserve or preserve habitats of sentient creatures.

This presupposes, that moral obligations towards future generations are also given, which can be clearly reasoned (chapter E.). Therefore and according to a comparative standard, future persons have a strong moral claim to living conditions which are, on the average, not worse than those of our contemporaries. To egalitarians, this principle holds prima facie between generations in regard to natural resources. If "comparative" standards are to be combined with the precautionary principle, relatively low stabilization levels can be justified. If "absolute" standards (e.g., basic needs) are combined with some optimism about adaptation to climate change, stabilization levels might be somewhat higher.

The three restrictions mentioned in Art. 2 are seen as more *general objectives of a "universal society"* than the „ultimate goal" itself. They are constraints which must be fulfilled *prima facie* as well as in the case of human-induced climate change and in subsequent periods of reaching „safe" GHG-levels.

Different approaches in environmental ethics provide various grounds of how strict the *"ecosystem-adaptation"-constraint* should be interpreted. If pathocentristic obligations with regard to habitats of sentient wildlife are justified, as pointed out above, the „ecosystem"-constraint cannot be restricted to global cycles. Therefore the need to protect natural habitats on regional or even local scales is to be seen as an argument in favour of low stabilization levels.

Food availability is only partly a function of climate change; therefore, low stabilization levels can only be claimed by the food production constraint by adequate co-evaluation of all social, economical and cultural drivers of potential food shortages.

There are different interpretations of the *"sustainable-development"-constraint* of Art. 2 according to different theoretical approaches towards "sustainability". Correspondingly, evaluations of natural systems relative to the production of goods and services would lead to quite different results. This is especially relevant for balancing the needs of ecosystem adaptation and of sustainable economic development.

A coherent and ethically sound justified interpretation which parallels food security (as combination of global markets and local self-reliance), habitat protection and low GHG-levels

can be lined out. The *crucial ethical problem remains to give the „economic-development"-constraint an interpretation* which fits into this picture. If the first two constraints are interpreted more ambitiously, the interpretation of the third constraint could be weakened.

Considering the SRES report, quite *different emission paths* are conceivable, which might be assessed quite differently. However, the working group would favour future developments towards scenario B1,[4] with respect to the above mentioned convergence hypothesis and the obligatory objective and provisions of the Framework Convention. Nevertheless, a meta-ethical theory on prioritising specific aims of future developments is lacking. Therefore, an *assessment tool for evaluation* of possible future scenarios is proposed, which enables decision makers to make reasonable and transparent choices on the basis of a set of relevant criteria and principles (see E.15.5).

II. Meaning of the study results for the political practise

IPCC TAR (2001) indicates that *stabilization of GHGs would not yet materialize within the 21st century*. Variation in emission trajectories, climate sensitivity and other parameters together have a tendency to widen the envelope of potential impacts. Current legal interpretation does not provide specific guidance as to the rejection or acceptance of *particular solutions* considered by policy-makers. The *challenge for decision-makers* is to choose emission trajectories that are both feasible and represent reasonably ambitious levels of stabilization.

II.I Basic options

The ultimate goal of the UNFCCC can be achieved by mitigation, adaptation or by both. Adaptation may be necessary due to the time-delayed impacts of historical emissions. As adaptation proposals are associated with many uncertainties, proponents of those strategies should be willing to shoulder the burden of their feasibility. Decision makers will have to decide *which mix of mitigation and adaptations* to pursue – keeping in mind that mitigation has largely global effects, whereas the benefits of adaptation can reaped more exclusively by those, who invested into such policies.

Technological options for mitigation are of particular relevance to infrastructure awaiting retirement in the near future. The next decades will be most decisive for determining whether

[4] B1 resembles developments towards global decarbonization for sustainability and equity improvement.

lower vs. higher stabilization trajectories can be achieved. Above all, the development and utilization of *energy saving potentials* in different sectors is expected – esp. in the short-term – to enable significant mitigation of fossil fuel needs and related emissions worldwide.

II.II. The challenge of the ultimate objective

The goal of stabilization of concentrations of greenhouse gases at a "safe" level is augmented by *three additional constraints*. There is a strong interrelationship between these constrains which may lead to *trade-offs* between (i) ecosystems to be permitted to adapt naturally, (ii) secure food production, and (iii) sustainable economic development. Each of these three constraints can be assessed with respect to the spatial and inter-temporal scales, the uncertainties associated with each of the three constraints, as well as the distributional effects associated with climate impacts and policies considered to limit such impacts.

Policy-makers may impose restrictions on any of these trade-offs between the three constraints as well as the aforementioned four categories used for the assessment of the three constraints (see chapter D.1). These *restrictions* limit the set of available policy options. Decision-makers will have to find operational ways to deal with the question which scale of regional and temporal disruptions are acceptable to them or how to bridge the distributional implications of unequal climate impacts. This may, for example, become evident concerning the question on which level food production has to be secured (local – regional – global?).[5]

II.III. Messages from ethical analysis

Above all, the *concept of a political goal* entails the requirement that *it should be specified* in its decisive parameters (quantity, time-frame, actors).

There is a strong ethical presumption against victimization and a moral obligation to refrain from injury – applicable to both present and future generations. Conflicting assumptions about "comparative vs. absolute" standards are decisive for the specification of intergenerational responsibility. Application of most ethical theories on global environmental risk evaluation comes to the result to *better err on the side of caution*. If so, more safety-oriented criteria should be favoured. The main approaches of environmental ethics *converge strongly towards low stabilization levels* and clearly favour secure food supplies. The more moral requirements are entailed in the constraints of art. 2, the more the obligations tend towards low stabilization levels.

[5] Respective evaluations may have consequences for the role of global trade for balancing of local food shortages.

Nevertheless, different ethical approaches provide different grounds of how strict the "ecosystem-adaptation"-constraint should be interpreted. There are also different reasonable interpretations of the "sustainable development"-constraint according to different basic approaches in interpreting "sustainability" (weak – intermediate - strong). The measures depend on the approach being chosen. The trade-offs between the interpretations of the three requirements are to be considered, too: If the first two requirements are interpreted more ambitiously (food security, nature conservation), the interpretation of the third constraint (sustainable economic development) may be weakened (see I.VI).

Possible *prescriptions in favour of different emission paths* are conceivable, which might be justified quite differently. Considering the SRES report, an evaluation matrix for evaluation of possible future scenarios is proposed, which enables decision makers to make reasonable and transparent choices on the basis of a set of relevant criteria and principles (see I.VI and E.15.5). Concluding from this exercise and considering the aforementioned convergence of ethical reasoning towards low stabilization levels, *the working group recommends to aim at scenario B1, which resembles developments towards global decarbonisation* for sustainability and equity improvement. Nevertheless, other evaluations may be possible, too.

II.IV Political feasibility of further commitments

While German and European political actors are generally willing to publicly announce specific stabilization levels, many governments outside Europe and many other political actors have not yet publicly positioned themselves on Article 2. Major developed countries (e.g., the USA) and nearly all developing countries currently eschew to specify publicly their preferred stabilization goal.[6] An exploratory questionnaire on the interpretation of Article 2 indicates that Russia and the G77 plus China group hold a transitional position in between the ambitious EU-attitude and a less motivated standpoint of the USA, on average. The same principal ordering (EU → Russia and G77 plus China → USA) applies to the suggested timing *when to start to negotiate* Art. 2 UNFCCC questions. Only on *equity issues* associated with Article 2, the G77 plus China give higher values on its importance than the EU does. In terms of global coalition building for specifying Article 2, the future *behaviour of the intermediate group* consisting of Russia as well as G77 plus China will determine whether or not a relatively ambitious goal on Article 2 will be defined in time.

[6] Moreover, political actors normally give no indication how the three additional constraints of Article 2 are to be taken into account - except for some statements on absolute and/or decadal permissible changes in temperature, which might be interpreted as a measure for ecosystem adaptability.

Feasibility as well as acceptability considerations may lead to the following statements for the political practise:

- The equity issue will strengthen the ethical interpretation of art. 2 moral entailments. Therefore and according to the *ethical convergence* thesis the "intermediate group" together with the EU are expected to agree on early and ambitious acting, which would be favourable from a safety-oriented point of view, too.
- This will not exclude other parties. Proactive negotiators might recall that art. 2 as a political goal entails the requirement that it *should be specified* in quantity and time-frame. So, all Parties to the Convention – incl. the USA – are urged to further the specification process.
- The evaluation of distributional effects would speak in favour of those long-term policies which pursue mixes of mitigation and adaptation with *emphasis on mitigative strategies*. Corresponding decisions will have to be made in time with regard to energy infrastructures awaiting retirement in the near future.
- The assessment of distributional effects may also tend to interpret the "food production"-constraint in terms of (local to regional) food security. This would have positive trade-offs for the "ecosystems"-constraint, too. Nevertheless, *the strict interpretation of both constraints may weaken the interpretation of the economic development constraint*. This trade-off might be an obstacle for further negotiations.
- Concluding, the working group proposes to the actors to *aim at the global decarbonisation scenario "B1"* of the SRES (Nakicenovic 2000).

Irrespective of strategic considerations of single Parties, it seems desirable to allow for fair negotiations. Transparency, consistency, and universal validity of any argumentation put forward towards specification of Art. 2 may support its acceptability and preferably its factual long-term acceptance. Whether pursuing the long-term aspirations of Art. 2 is compatible with the often shorter-term negotiation horizon remains – however - an open question.

A. Preliminaries

1 The Convention's objective and its further development as background of this study

The central part of the framework convention - the objective - is described in art. 2 of the treaty. This article introduces also to the substantial matters of the convention and will give orientation and reason for further specifications and implementations:

Art. 2 UNFCCC

> "The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

The article as part of the whole convention was adopted in consensus of the negotiating nations and is - although being an ultimate objective of a global environmental regime - open for probably *conflicting interpretations.* Concrete targets beyond the Kyoto perspective had not yet been commonly considered (see also UNFCCC 1997). Thus, a reasonable specification of the overall climate protection objective is needed for an acceptable implementation of the convention. This is of specific importance, as the objective should not only be "in accordance with the relevant provisions of the Convention" but also in line with "any related legal instruments that the Conference of the Parties may adopt" (UNFCCC 1992). The latter means obviously the level of specifications, which will be especially relevant for the preparation of the upcoming commitment periods and for which the FCCC's objective will explicitly be valid. Consequently, this should also hold true for any specifications of the climate convention objective, which will finally result in more or less strong ambitious measures. In summing up, specification of this objective is a need but also a difficult challenge. A corresponding call for specification of "dangerous anthropogenic interference with the climate system" has been already formulated by the EU after reception of the stronger evidences for a human-induced climate change reported by the IPCC (IPCC 2001). This requires also an active participation of the German side[7] in the process of

[7] The need for specification of „absolute goals" have been also formulated by four German NGOs (Kier 2002).

adequate specification of Art. 2 UNFCCC to which this study – among others - may contribute. [8] Corresponding work may make specific problems of interpretation explicit but will neither question the art. 2 nor the convention as a whole, as it had been already adopted by the international community and is therefore seen as legal basis for further specifications.

2 Study logic and relevant scientific competence

Specifying a desirable *long-term climate goal* as a problem-driven task is only in part an effort of science, as societal questions arise concerning (normative) evaluations of reasons, justifications and relevance decisions of any action as well as related risk or uncertainty assessments and feasibility considerations of politics and economics, which have to be included and integrated. Therefore, methodologies for acceptable specifications of the climate protection objective have to overcome disciplinary barriers as well as obstacles from the obvious conflict potential of any specification attempt. It may be therefore only conducted in an integrative interdisciplinary manner.

The purpose of this effort is – on the basis of the legal meaning of UNFCCC's Art. 2 - to uncover the general conditions, problems and consequences of specifying the Convention's meaning. They are then objects of ethical evaluation in view of the formulation of further prescriptions. Subsequent reflections on the convergence potential of the relevant ethical theories and principles are expected to improve corresponding normative orientation. Concluding messages for decision makers submit sound statements towards the political practise of specification as well as towards further research on relevant normative issues. The study results should therefore contribute to the development of feasible and acceptable strategies of specifying the ultimate goal of the UNFCCC. [9]

In detail and following this section (A.) about the overall problem of interpretation and specification of Art. 2 as well as its preliminary implications and projections, the sections B. to D. reflect the description of the framing conditions and foreseeable consequences of the specification goal. Consequently, clarifications of the term "danger" with respect of the

[8] The need for legitimacy and acceptability of any future target and difficulties thereupon may be imaginable, when considering actual proposals for a 30% emissions reduction of the EU in 2020. The problem might be, that corresponding agreements will be made in a much larger EU with more dissent potential and with quite different challenges – the latter due to the expected extension of the EU to countries with market economies in transition.

[9] This task presupposes the principal feasibility of an effective climate protection regime. However, failures of interpretation of Art. 2 or missing compliance to it may be imaginable, thus leading possibly to a non-performance of the ultimate goal of UNFCCC. Corresponding problems how to manage not avoided climate change impacts have been analysed by B. Müller (2002).

meaning of “dangerous anthropogenic interference with the climate system” had to be made from the perspective of the international and national law (B.). Section C gives an overview upon the actual positioning and reasoning of actors in climate politics, its evaluation and possible consequences with respect of equity questions. Trade-offs from interpretations of the three constraints of Art. 2 UNFCCC as well as projected emission trajectories and the relevance of technological options will be discussed in section D.

Finally, normative orientation will be developed in sections E. and F. on the basis of the before mentioned chapters. Section E. is on the assessment of acceptable prescriptions and principles from relevant ethical theories as well as on their potential violation by dangerous interference of societies with the climate system. The closing section (F.) starts with a synthesis of the study results and with conclusions for politically feasible action in the EU. It ends up with conclusions for politically feasible action in the EU by giving recommended guidelines for decision making and with prospects for favourable research, especially with respect to environmental ethics.

For the aims of supporting any reasonable interpretation and specification of Art. 2 UNFCCC, certain scientific expertise had to be gathered: Ethical besides some juridical competence was surely necessary for the central tasks of the study. However, feasibility and operational considerations needed urgently for political and economical expertise, too. Additionally, capability for interdisciplinary work had to be installed due to the problem-oriented scope of the study goal. Correspondingly, the above mentioned preconditions are found to be reflected by the expertise of the study contributors, ranging from professional philosophy and jurisprudence over world economy and political science to science and technology assessment.

3 On interpretation

Any interpretation must rely on something “given”. However, the meaning of which may not be perfectly clear. Here, the FCCC is the given “object”. Its Art. 2 leaves room for interpretation in the light of a better understanding of climate change, of trade-offs and of risks that the global “community” might not be willing to accept. An interpretation of the ultimate goal of the UNFCCC which might try to “view together” several articles (for instance, Art. 2 in conjunction with the five principles of Art. 3) will thus be rather hermeneutical than absolutely stringent.

In order to understand Art. 2 (better), the principles of Art. 3 must be understood and *vice versa:* in order to understand these principles Art. 2 must be interpreted. So, the very meaning of Art. 2 is not independent from the five guidelines of Art. 3 (Schröder et al. 2002, p. 380) as well as from some obligations of Art. 4. If there are now such linkages between several articles, the process of interpretation seems endless and a "*regressus ad infinitum*" seems unavoidable("hermeneutical circle"). So the process of interpretation is to be restricted in a pragmatically reasonable way. A promising attempt to avoid a regress would be to state that the precautionary principle of Art. 3 - for instance - might be seen rather as a guideline to reach the ultimate goal to „prevent dangerous interference" (Art. 2) than a precondition.

Any interpretation of Art. 2 - as about the meaning of dangerous levels - is intrinsically related to assumptions about climate sensitivity, adaptation, technological options, vulnerabilities, non-linear damages and the like. Thus, any determination of dangerous levels will be somewhat *hypothetical.* If the arbitrariness of choice of dangerous levels shall be reduced by argument some premises must to be make explicit.[10] Corresponding argumentations need to have a certain structure in order to *avoid deterministic fallacies*. Any reasonable prescriptive conclusion – like the expression of dangerous levels - must therefore rely on certain premises from which at least one premise must be a moral obligation - which has to be justified separately. This strategy to reduce arbitrariness is in perfect accordance with concepts of judgement-formation in applied ethics.

4 Preliminary remarks on Art. 2

4.1 Key terms

The term „**stabilization**" implies that *Art. 2 envisions a new equilibrium* of the climate system by which - on the average - sources of GHG-gases and removal processes are balanced (IPCC 1994, p. 11). Stabilization of GHG-concentration should be therefore principally not impossible (IPCC 1994, p. 12) howsoever hard it may be to reach it politically and economically.

The crucial proposition „prevent **dangerous interference**" obviously means that humans can interfere with the climate system in a way which might be too *dangerous* to themselves, to different societies or even to other living beings suffering from impacts of climate change. Art. 2 entails a commitment to avoid a certain GHG-level which „is" (too) dangerous. This

[10] However, some hypothetical residuals may still remain.

implies that there must „be“ any such dangerous level. This is even true if one argues that stabilization targets should not fix a certain level but should better fix a certain range.[11] Any range entails a ceiling; it necessarily will have an upper limit and therefore some other levels beyond it, which might be not safe.

According to Art. 2, a safe stabilization level should be achieved “within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.“ It should be noticed, that the three topics – **ecosystems adaptation, food production, economic development** - are not directly related to the ultimate goal itself, but are related to an unspecified time frame within which this “safe” level should be achieved. The three topics had been commented by IPCC (TAR WGII 2001, pp. 84) and will be discussed in close detail in section “Trade-offs” (chapter D.1).

This safe “level has to be achieved within a **time-frame** which complies to the overall goal.[12] Being too late has to be avoided anyway as well as being too early for economic reasons. But it is difficult to determine dangerous points of no return due to the inertia of the climate subsystems and uncertainties thereupon. These circumstances might give reason for risk precaution.

Possible *categories of serious concerns* may be: unique and threatened ecosystems, distributional impacts (justice), aggregate impacts (side-effects), extreme climate effects and large-scale singularities (IPCC 2001). O’Neill and Oppenheimer (2002) propose another methodology: They differentiate between effects of low probability but high *societal disruption potential* and those of *high probability* but lower disruptive force. Examples are the collapse of the West-Antarctic ice shield (WAIS) with related massive sea-level changes and the eradication of unique and locally valuable coral reef-systems, respectively. The authors state, that the latter may be even hardly prevented although it would be desirable to protect them for their beauty or at least as eco-indicators. According to O’Neill & Oppenheimer (2002) the shut-down of the thermo-haline circulation (THC) of the Atlantic and its consequences would range between both categories.[13] The concept of Dessai et al. (2003) recommends to include experience-related indications for dangerous climate change in parallel to the above mentioned theoretical definitions of vulnerability.

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[11] For example with respect to natural oscillations of atmospheric GHG-concentrations.

[12] An interval in this respect might be defined by arguing: “as soon as possible” and “as late as necessary”.

[13] This view conflicts with the IPCC (2001) view, which concerns on WAIS and THC in quite similar way.

Dangerous human-induced temperature changes and sea-level rise are hoped to be avoided by further global development in "tolerable windows" or "safe (landing) corridors" (IPCC 2001). But it has to be recalled, that the semantic shift from "dangerous" to "safe" does not solve the problem of specification of either term.

4.2 The role of ethics

Dangerous levels cannot be observed or measured scientifically, but must be „set" by practical but reasonable judgement. In fact, the determination of the ultimate goal will have to take the state-of- the-art in climate science into full account (IPCC 2001). But it will have to rely essentially on the acceptability of moral and risk-related arguments being given as well as on trading-off certain goods and chances against each other. *Therefore, any naturalistic specification of dangerous levels should be rejected* because they are ethically not sound. No interpretation of Art. 2 can therefore avoid to address ethical questions (Toman 2001, p. 1)[14] as value judgements and considerations of justice are relevant for the formulation and meaning of dangerous climate impacts (see also Art. 3.1 UNFCCC). This holds even true, if one argues that any interpretation of Art. 2 will be "political" because of the underlying ethical conceptions of political sciences (see chapter C.3). *General environmental objectives must be therefore transformed into consistent structures of ethical argumentation.*

4.3 The needs for specification

From its meaning Art. 2 should be considered as political goal because it implies certain (but still to be determined) dangerous levels as decisive parameters. For explanation one should distinguish between the substance of an objective ("*that* GHG-concentration should not raise indefinitely"), and its specifications (thresholds). Normally, there will be a broad agreement on general but vague environmental objectives ("*that* emissions should be reduced"). But such statements are "pointless" although they have the semantic structure of objectives. "That"-objectives without specifications do not entail binding legal obligations for any agent. The formula "*no binding obligation to anyone*" is almost equivalent to "*everybody is permitted to act as he likes*". But if everybody is entitled to act as he likes, the "that"-substance to which all agents have agreed upon will be implicitly denied. Accordingly, there seems to be an internal inconsistency in unspecified objects. If so, specifications are constitutive for political objectives. Thus, it is assumed that *the concept of a political objective (goal, target) entails the requirement that it should be determined in its decisive parameters (quantity, time-frame,*

[14] The term „ethical" shall be understood in a broad sense here.

actors). Accepting FCCC including Art. 2 in conjunction with this concept of political objectives seems to be incompatible with any claims not to specify Art. 2 (see chapter E.3).

Concluding from this rejection, it may be presupposed that there should be a *common interest of the Parties of the UNFCCC* to specify dangerous levels by means of argument. Thus, *the Parties as members of an international regime*, which is devoted to the use of a common pool good should take a commonly shared interest in serious attempts to specify Art. 2 from the moral point of view independently of the economic or political interests of any single member of *the Parties*. If any member of *the Parties* cannot be completely indifferent to proposals of how to understand Art. 2, such general interest is *pragmatically entailed* in the membership in the *Conference of the Parties*.[15] If so, members of *the Parties as such* should be interested whether it can be „known" which GHG-level might be too dangerous. Accepting such „Vernunftinteresse" would constitute *the Parties* as a moral community (Kantian worldview) instead of a more Hobbesian definition of them as competing "rivals" which tend to maximize their shares. Acceptance to either position makes a difference in how the goal of FCCC will be understood.

5 Stabilization scenarios for policy advice

5.1 Selected assessments

5.1.1 The Tolerable Windows Approach

The Tolerable Windows Approach (TWA) and similar concepts explore the implications of a set of constraints on global greenhouse gas (GHG) emissions and associated impacts.[16] The associated corridor can be perceived as the room to maneuver for global climate policy over the long term. The objective for the TWA is to provide an assessment framework that can help to test any climate protection proposal and policy measure formulated through selected climate attributes. Based on climate-impact response functions that represent reactions of climate-sensitive socioeconomic and natural systems to climate change forcing, social actors can specify

[15] In other societal realms it will be expected that citizens as members of a society should take some interests in its constitution.

[16] See G. Petschel-Held, H.-J. Schellnhuber, T. Bruckner, F. L. Toth, K. Hasselmann, 1999: The Tolerable Windows Approach: Theoretical and Methodological Foundations, Climatic Change, **41**, 303-331; T. Bruckner, T., G. Petschel-Held, F. L. Toth, H.-M. Füssel, M. Leimbach, H.-J. Schellnhuber, 1999: Climate Change Decision-Support and the Tolerable Windows Approach. Environmental Modeling and Assessment, **4**, 217-234. See also the recent contributions by the same authors in the special issue of Climatic Change **56** 2003.

their willingness to accept a certain amount of climate change, in terms of cost-benefit analysis, burden-sharing principles and international implementation schemes.

With the help of integrated models it should be possible to determine whether there exists a corridor of emission paths over time that keeps the climate system within the permitted domain. The specification of the tolerable window and the choice of emission paths within this window is – in the end - left to decision makers involved in climate policy making at the global and national levels.[17] Figure A.1 depicts - for example - an emission corridor from the WBGU assessment, which means that through any point of the corridor at least one permitted emission path should pass. However, it is a crucial question whether a prescribed corridor is accessible, or - if not - how much climate change may be adapted to for particular regions.

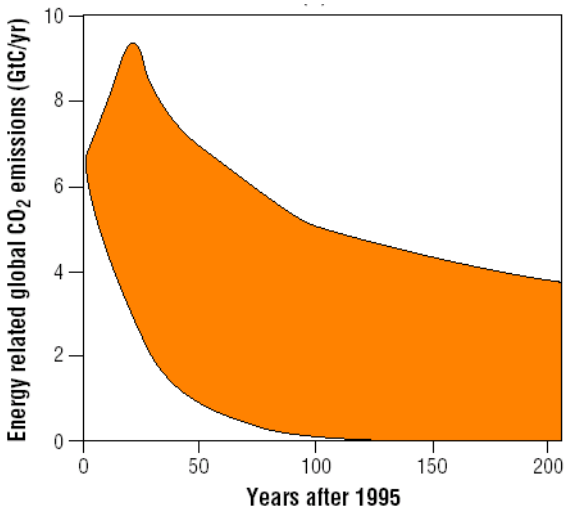

Figure A.1: Basic emission corridor for the WBGU tolerable window (Source: IPCC 2001, Vol. III, p. 617)

5.1.2 The IPCC assessment

In its Third Assessment Report and in its Special Report on Emissions Scenarios, the Intergovernmental Panel on Climate Change (IPCC) has laid out possible future emission paths and their resulting effects on the climate under the assumption that no additional climate commitments and measures would be implemented.[18] Global emissions rise at least until the

[17] To illustrate a potential range, the German Advisory Council on Global Change (WBGU) proposed a tolerable magnitude of 2°C global temperature increase compared to the pre-industrial era, and a rate of temperature increase of 0.2 °C per decade. Concerning costs, it is assumed that to reduce GHG emissions at a rate faster than 4% per year would be economically not acceptable to be implemented.

[18] Intergovernmental Panel on Climate Change (IPCC), Climate Change 2001, Third Assessment Report, three volumes, Cambridge University Press: Cambridge, UK, available at http://www.ipcc.ch/pub/tar/index.htm.

middle of the century under all considered scenarios. CO_2 concentrations do not stabilize within the century and would range from 500 to 900 ppm by volume in 2100 (Figure A.2). Depending on the emission scenario and the climate model used, the global average surface air temperature would increase by the end of the century between 1.4°C and 5.8°C.

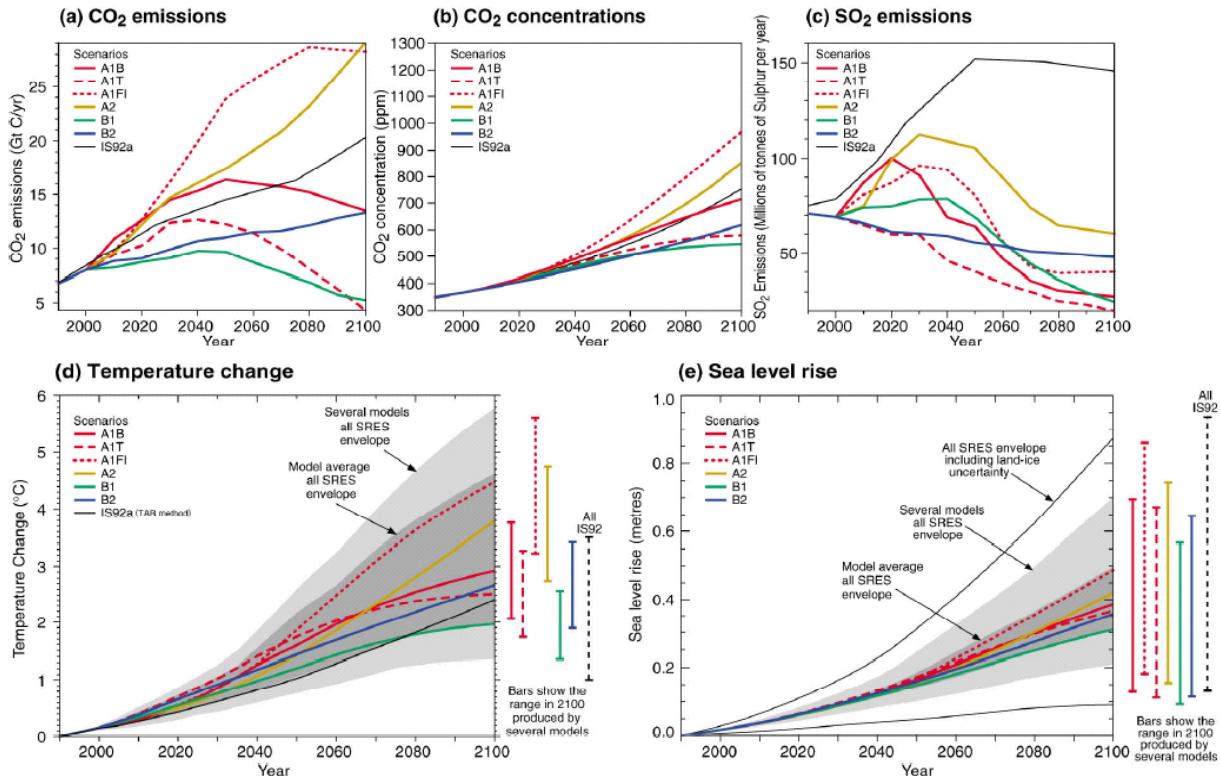

Figure A.2: Possible future emissions, concentrations and consequences (IPCC 2001, WG I)

Figure A.3 provides some stabilization paths from the IPCC, in which CO_2 concentrations would require substantial reductions of emissions below current levels, slowing the rate of warming. A more complete analysis would have to consider not only the absolute magnitude of the global average temperature changes but also regional changes and the associated socio-economic impacts. Rates of change exceeding the ability of ecosystems to migrate would be particularly damaging. The IPCC made clear that for any relevant stabilization level, global emissions of CO_2 have to be reduced below 1990 levels in the order of 50% and ultimately drop to very low levels. The time-frame depends on the stabilization level, ranging from a few decades for a stabilization level of 450 ppm CO_2 to about two centuries for 1000 ppm.

5.1.3 The integrated model IMAGE

IMAGE is an integrated model which enables the calculation of global and regional climate change impacts. Coupled with a global water model (WaterGAP), IMAGE 2.1 can compute the change in water availability caused by a stabilization of GHG concentrations. IMAGE also delivers the background data for the "safe emission corridor" software which was used to calculate emissions that are allowable on the short term to achieve the long term goals for temperature and sea level rise stated above. IMAGE 2.1 includes future sulfur emissions that could have a significant impact, using the "Pollutant Burden" approach, and it involves the participation of developing countries in GHG mitigation, under various "burden sharing" schemes and decision rules.

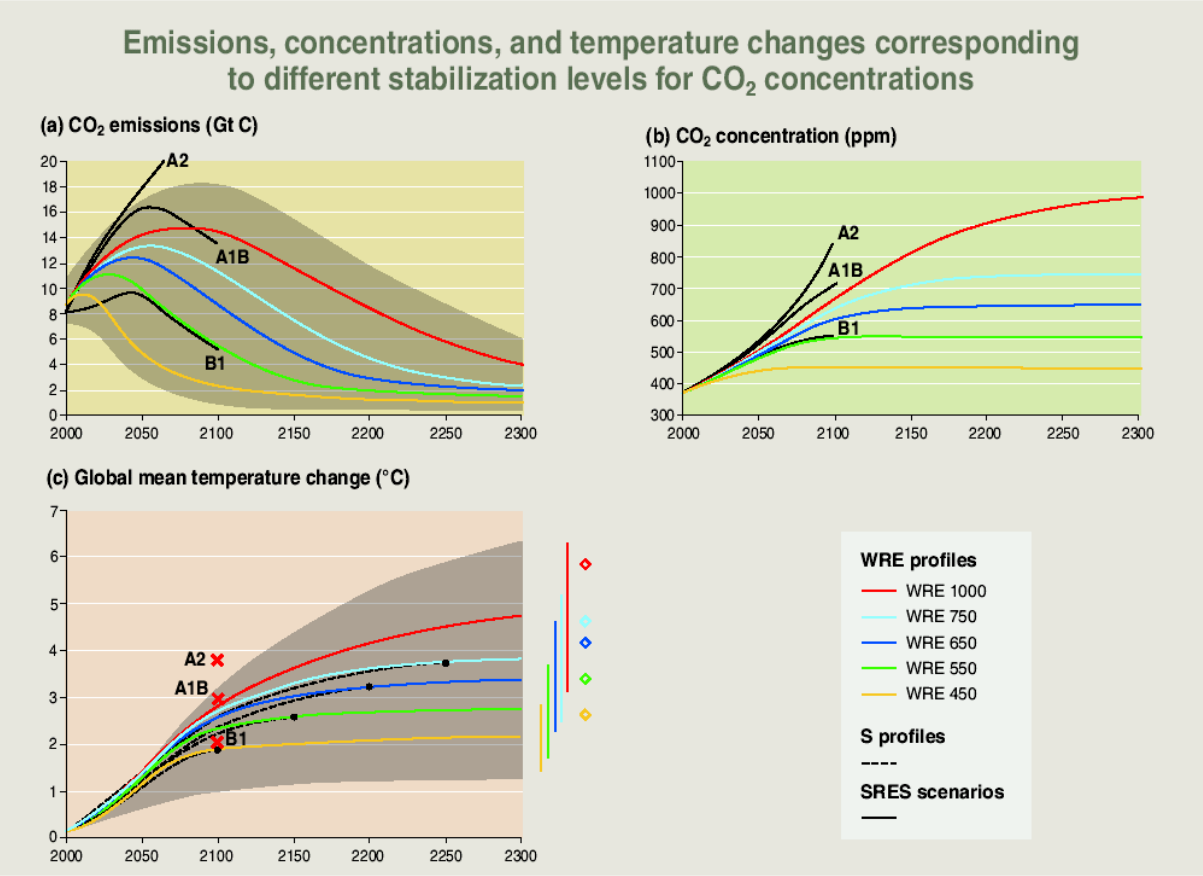

Figure A.3: Stabilizing CO_2 concentrations would require substantial reductions of emissions below current levels (Source: IPCC 2001, Synthesis report, p.20).

Using the IMAGE model, the study of Onigkeit and Alcamo (2000) analyzes the allowable global and regional GHG emissions to achieve two CO_2 concentration targets and studies the

impacts on important natural and socioeconomic systems.[19] The study concludes that a strict control of global greenhouse gas emissions is necessary to achieve a stabilization target of 550 ppm or 450 ppm CO_2 in the atmosphere. In order to achieve a long term stabilization of the atmospheric CO_2 concentration at 550 ppm, CO_2 emissions cannot be any higher than 148% of 1990 emissions in 2030. Towards 2100 emissions have to be decreased to 107% of the 1990 emissions level. However, further emission mitigation might be necessary after 2100, since a stabilization at 550 ppm will not be reached before 2150. Reduction measures will have to be carried out or financed, mainly by the Annex B parties if Annex B and non-Annex B countries will be given the same right of (per capita) emissions in the long term. In the long term, a participation of non Annex B countries in taking emission reduction measures is seen as inevitable in order to achieve a stabilization of GHG concentrations. To model this case, some equity considerations have been included into stabilization scenarios.[20]

5.2 Possible consequences from the scenarios

The potential impacts of various emission and stabilization scenarios, as well as the impacts of particular mitigation and adaptation measures, are important indicators to evaluate and prevent dangerous climate change. The IPCC-TAR has made some efforts to estimate these impacts in terms of risks, costs and benefits which require further investigation in the Fourth Assessment Report. Research has been devoted to understand the risks associated with an average global surface air temperature increase of 1.5 to 6.0 $^{\circ}$C by 2100:[21]

- According to TAR, the average sea level is expected to rise 14 to 80 cm by 2100. The warming will be accompanied by changes in regional precipitation and climate variability, and changes in the frequency and intensity of extreme climate phenomena.
- Many natural systems are vulnerable to climate change and have limited adaptive capacity, including glaciers, coral reefs, mangroves, arctic and mountainous ecosystems, wetlands as well as biodiversity hot spots, among others. Some of these systems may undergo significant and irreversible damage.

[19] J. Onigkeit, J. Alcamo, Stabilization Targets for Atmospheric Greenhouse Gas Concentrations: An Assessment of Impacts and Emission Mitigation Pathways, Center for Environmental Systems Research, University of Kassel, Commissioned by the German Federal Environmental Agency, April 2000.

[20] See for instance the FAIR Model, which is based on IMAGE 2.1 scenarios: Marcel M. Berk, Michel G. J. den Elzen, Options for differentiation of future commitments in climate policy: how to realise timely participation to meet stringent climate goals?, Climate Policy, Vol.1, Issue 4, December 2001, pp. 465-480.

[21] see Report of IPCC WG II, Summary for Policymakers, Climate Change 2001, Impacts, Adaptation and Vulnerability.

- Human societies are sensitive to the effects of climate change which will affect human well being, income distribution, and adaptability to climate change. Vulnerable systems include water resources, agriculture, forestry, human health, human settlements, energy systems, industry, and financial services.
- Since extreme weather events are already projected to increase in frequency and/or severity during the 21st century, their impacts may also increase with global warming.

Cost-effectiveness studies with a century timescale estimate that the costs of stabilizing CO_2-concentrations in the atmosphere increase as the targeted stabilization levels decline. Different baselines may have a strong influence on absolute costs. While there is a moderate increase in the costs when passing from a 750 ppmv to a 550 ppmv concentration stabilization level, there is a *larger increase in costs passing from 550 ppmv to 450 ppmv* unless the emissions in the baseline scenario are very low.

The costs which have to be payed to meet the Kyoto targets range from about US$ 20/tC up to US$ 600/tC without emissions trading, and from about US$ 15/tC up to US$ 150/tC with trading (Annex B countries). For several countries, GDP effects range from negligible to a several percent increase, The exact magnitude, scale, and scope of ancillary benefits and costs will vary with local geographical and baseline conditions. Under some circumstances, where baseline conditions involve relatively low carbon emissions and population density, benefits may be low.

5.3 Limitations of stabilization scenarios

5.3.1 Difficulties to specify the ultimate objective

A key problem is to translate the ultimate objective into a stabilization level and time-frame that prevents dangerous interference and violation of the three conditions. At present, there is no common perception of the long-term goals and which aspects (concentrations, rate of change, temperature change, other impacts) are relevant to evaluate dangerous interference.[22] The impact of rates of change and the adaptive capacity of ecosystems is a matter of actual research. As long as the climatological, ecological, and social impacts associated with any level of atmospheric GHG concentration are uncertain, the required level is still unclear. And even if impacts were exactly known, it would be a matter of value judgments to determine whether a change is a dangerous interference or not. Establishing acceptable atmospheric

[22] See Brian C. O' Neill, Michael Oppenheimer, Dangerous Climate Impacts and the Kyoto Protocol, Science, Vol. 296, Issue 5575, p. 1971.

stabilization levels is difficult, but avoiding discussions thereupon may induce even more difficulties.

5.3.2 Time lags and inertia of the climate system

There can be a considerable time lag between emission reductions and their impact on the climate system from multiple cause-effect relations connecting both (see Figure A.4): maximum temperature effects may be expected 20 to 50 years after peak emissions of CO_2 whereas sea level changes will occur thousands of years after concentrations have stabilized (see Figure 4). The problem of time lags is aggravated by the fact that due to inertia of the socio-economic system, the effect of policies will be delayed, too. This concerns in particular the replacement of infrastructure and technology, such as buildings, power stations or transport systems, which can take several decades or even more. As a consequence, considerations of time lags seem to be essential for adequate political decisions.

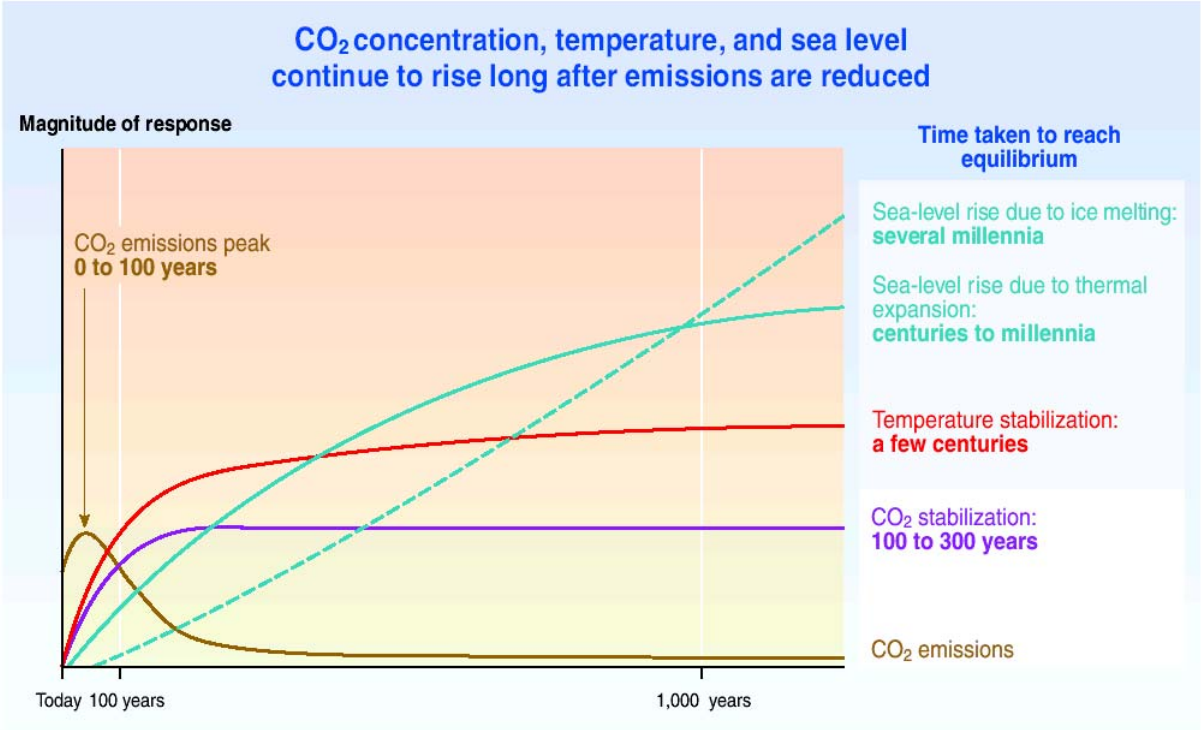

Figure A.4: Time scales for stabilization at CO_2 concentration levels between 450 and 1000 ppmv (Source: IPCC 2001, Synthesis Report, Fig. SPM-5)

5.3.3 Uncertainty of prediction

Despite substantial research efforts for almost two decades and increasingly complex climate models, the range of uncertainty about climate sensitivity has not been reduced at all. Major

causes of uncertainty are:[23] precipitation patterns which determine the regional distribution of severe impacts; the capacity of the biosphere and oceans to remove CO_2 from the atmosphere; the physiological reaction of plants on increasing CO_2 concentrations; and the regional impact of climate change on ecological and social systems.

Uncertainties are still an obstacle to reaching agreement on a certain concentration level, but they do not justify to delay or avoid necessary action (see section E.3.2). One way to deal with decision making under uncertainty would be to define goals for different time-periods, sequentially, whereupon later goals are made dependent on the achievement of goals in earlier periods (hedging strategy).

[23] Onigkeit/Alcamo, 2000.

B. The Convention's ultimate goal and its legal interpretation

1 Background

According to the *General Rule of Interpretation in Art. 31 of the Vienna Convention on the Law of Treaties*, a treaty based upon international law shall be interpreted in good faith according to the common meaning of the relevant terms of the treaty and with regard to its object and purpose. Provided that *the authorization for binding interpretation* has not been transferred to international courts*, it lies with the Parties.* In the context of FCCC, the Conference of the Parties, as stated in Art. 7, is here explicitly considered (see Art. 7 par. II a in particular).

In so far as the interpretation raises scientific and technological questions, as is – among others - the case with the standard of the "dangerous anthropogenic interference with the climate system", the Parties and/or their conference may make use of *informed subsidiary bodies*. This applies in the case of the Intergovernmental Panel on Climate Change (IPCC) as well as in the case of the Subsidiary Body for Scientific and Technological Advice stated in Art. 9 FCCC. But even if *statements* of these bodies cannot claim any *binding force,* they nevertheless are - due to international expertise - of particular importance when those elements of Art. 2 of FCCC must be put in concrete terms, which have also a (natural) scientific background, like the standard of the "dangerous anthropogenic interference with the climate system".

2 Present state of opinions

2.1 International bodies

In the *Third Assessment Report (TAR) of the IPCC* (2001), the following is stated about this standard (see also section 1.2 in the IPCC Synthesis Report 2001):

> "The basis for determining what constitutes 'dangerous anthropogenic interference' will vary among regions, depending both on the local nature and consequences of climate change impacts, and also on the adaptive capacity available to cope with climate change. It also depends on mitigative capacity, since the magnitude and the rate of change are both important."

In the 16th session of the Subsidiary Body for Scientific and Technological Advice, June 5th to 14th 2002, the participants of the Subsidiary Body workshop expressed rather different views

on whether the scientific information presented in the TAR is adequate for making definitions regarding what constitutes "dangerous anthropogenic interference" (Report of 16/05/2002 FCCC/SBSTA/2002/INF.4, pt. 13 (p. 5).

2.2 Statements given in the literature

The conclusion, that Art. 2 of UNFCCC allows "various possibilities for interpretation" which lead to conflicts of interests that cannot be solved or avoided on the grounds of the Convention,[24] implies a legal obligation whose contents, are generally indiscernible if the problem is more than the urgent necessity of discussing and evaluating the greenhouse problem from an international scientific perspective.[25] This is perhaps the reason why a "real, legally binding commitment of the Parties" of Art. 2 is partially denied here, whereas a certain legal importance, is admitted, because Art. 2 determines the object and purpose of the Climate Convention in-line with the spirit of Art. 31 *of the Vienna Convention on the Law of Treaties.* And this is the reason why all provisions and further regulations of the Climate Convention are to be interpreted in the light of Art. 2.[26]

The interpretation of Art. 2 of FCCC, in its function as a regulation for interpretation, has recently been renewed and it has been added that concrete obligations of the states arose only from the principles of Art. 3 and specific obligations.[27] In accordance with that, the term "dangerous anthropogenic interference with the climate system", which is not defined in the FCCC any further, has to be clarified by the Conference of the Parties in the light of scientific knowledge, and - in doing so - ecological and social indicators are to be considered, such as risk thresholds for irreversible environmental damage and the threat to food production in certain areas.[28]

The *English speaking literature* emphasizes, in relation to Art. Art. 2 of FCCC, that "[the] Convention does not specify what that level [of dangerous anthropogenic interference] might

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[24] *R. Schwarze*, Internationale Klimapolitik, 2002, S. 72; compare. *Schröder et al.*, Klimavorhersage und Klimavorsorge 2002, p. 380

[25] In this context: *Dolzer*, Die Internationale Konvention zum Schutz des Klimas und das Allgemeine Völkerrecht, Festschrift für R. Bernhardt (1995), 957 (961 f.)

[26] *H. Ott*, Völkerrechtliche Aspekte der Klimarahmenkonvention, in: H. G. Brauch (ed.) Klimapolitik, 1996, S. 64

[27] *R. Geres*, Nationale Klimapolitik nach dem Kyoto-Protkoll 2000, p. 83

[28] *Ch. Bail*, Klimaschutz und rechtspolitischer Ausblick, in: Rengeling (ed.), Handbuch zum Europäischen und Deutschen Umweltrecht, 1998, Bd. II § 56 Rn. 10

be."[29] Furthermore, a distinction is made between an "expansive" and a "restrictive" interpretation, which may have different consequences for obligations of developed countries (Rowbothham 1996, p. 33).

The expansive interpretation presupposes that anthropogenic interference with the climate system definitely has a dangerous nature, whereas the restrictive interpretation of Art. 2 takes first of all into account, that there is no definition, and that such a lack of definition is only consistent in the light of a lack of consensus on the standard of "dangerous anthropogenic interference". The restrictive interpretation assumes that it is for the Parties to determine this standard. This interpretation complies with the character of the framework of the Climate Convention that banks on continuous negotiations (Rowbothham 1996, p. 34).

3 Guidelines for interpretation

3.1 Article 2 of FCCC as explicit objective of climate protection

Art. 2 of FCCC indisputably determines the *ultimate goal of climate protection* which shall be achieved with the treaty. According to general rules for the interpretation of treaties under international law, those interpretations must be chosen under which the treaty, or the provisions of the treaty, give most effectiveness[30]. Therefore the *intended objective of Art. 2 is binding for the Parties*. However, apart from the obligation to meet the overall objective of the treaty, this definition literally does not define further obligations for action of the Parties which would put the objective in concrete terms. These obligations arise only from further provisions of the Convention and protocols referring to it. Therefore, and only in the light of this last mentioned formal aspect it may be stated that Art. 2 lacks a real, legally binding force for itself.

On the other hand, the ultimate objective of the treaty might be stated more precisely or be complemented by *standards which put the objective in concrete terms and which are therefore part of its binding character*. Along with the general objective, they form the *primary criteria for concrete obligations of the Parties*. Correspondingly, those authors who interpret Art. 2 in that way, may have thought that the Convention should function as a "rule

[29] *Birnie/Boyle*, International Law and the Environment, 2nd ed 2002, p. 524

[30] *Harris*, Cases and Materials on International Law 5 ed. 1998, p. 1998; *Heintschel von Heinegg*, in: Ipsen, Völkerrecht, 4. ed. 1999, § 11 Rn. 16

for interpretation". The prevention of "dangerous anthropogenic interference with the climate system" can be considered one of these standards with respect of the stabilization goal.

3.2 Considerations on how to put "dangerous interference" in concrete terms

The Convention deals with three different danger or risk standards towards which climate protection shall be oriented: In Art. 2 it is the dangerous anthropogenic interference with the *climate system* which is to be prevented. It is not defined any further in the Convention. According to Art. 3 pt. 3, cause-related and those precautionary measures should be taken which mitigate adverse effects of climate change – specified in more detail in Art. 1 pt. 1. Where there are threats of *serious* or *irreversible* damage, lack of full scientific certainty should not be used as a reason for postponing precautionary measures. The comparison of these standards might lead to the conclusion, that *dangerous interference* as stated in Art. 2 *in relation to the adverse effects of climate change* constitutes *a basic benchmark*, *which is oriented towards the threatening damage* and not towards mere disadvantages. This view corresponds to the relation of danger and precaution which is common within environmental law. Precaution starts consequently before the actual danger threshold. Therefore, the fact, that threatening serious, not compensable or irreversible damage, which is assigned to the sphere of danger, should constitute a commitment to action even when there is a lack of full scientific certainty, goes along with that. Instead, refraining from adequate action would have to be reasoned, according to the spirit of the precautionary principle. Therefore, legal obligations may be deduced from interpretations of Art. 2, only – but cannot be literally derived from this article (as of 3.1).

The task of putting the standard of dangerous anthropogenic interference with the climate system in concrete terms *must be related to the dangers, explicitly.* Thus, appropriate definitions cannot be expected by just noting the current (natural) scientific knowledge with regard to the timing, magnitude and regional patterns of climate change (see also the Preamble to the Convention and Report of the Workshop of the Subsidiary Body of 16/05/2002 pt. 13 p. 5, cited in section 2.1).

From the perspective of international law, it is rather *the Parties' negotiation and decision competence connected to the standard* which is to be taken into consideration. It emerges from the fact, that putting danger- or risk-related standards in concrete terms always includes evaluations (see section 1). In the end, the Parties decide whether the (natural) scientific knowledge is sufficient enough to take measures according to the spirit of the danger-related objective of the Convention (see above), considering on how the concrete ecological,

economic and social circumstances in the individual regions of the world would turn out in relation to the occurrence of dangerous interference with the climate system (section 1).

This may lead to more extensive or more restrictive results having relevant effects on the individual implementation of the principles and obligations of the Convention in every country and on measures which are taken by all the Parties within the body of the Conference (Art. 7).

One cannot rule out that concluding evaluations of dangerous interference are also determined to a certain extent by the opportunities of the individual Parties to prevent them. Depending on their geographic, economic, technologic and social circumstances, dangerous interference might seem to be nearer or further. Therefore, there may be a somewhat unsatisfactory tension between the definition of the standard and measures combating anthropogenic climate change. However, this relationship is the result of the decision competence of the Parties and is indirectly accepted in Art. 2 of the FCCC.

Namely, it foresees to qualify the standard of dangerous interference by combating this unwanted interference "within a time frame", which is short enough to ensure that food production is not threatened and – at the same time - which is long enough to enable economic development to proceed in a sustainable manner. That corresponds to the basic principle of the Climate Convention, which reasons value-dependent danger and risk standards with societal factors such as sustainable development, specific needs of the developing countries and cost-effectiveness.[31]

4 Conclusions and perspectives for climate politics

The considerations stated above confirm the fact that specifying the standard is influenced by the concrete possibilities of combating dangerous interference. In corresponding negotiations, the Parties have to realize, what is politically feasible, considering trade-offs and constraints of different strategies as well as other reasonable competing goals.

This conclusion necessarily implies also some universal moral competence of the Parties and their subsidiary bodies if *legitimacy* of negotiations and *acceptability* of their results should be achieved. Without ethical reflection, climate negotiations would become merely the structure of pure and hardly justifiable bargaining processes, thus favouring those Parties, which may

[31] See here considerations by *M. Schröder*: Anwendung des Vorsorgeprinzips im Klimaschutz. In: Festschrift für J. Baur, 2003, p. 649.

dominate by their power. *Fair procedures and a set of universal ethical grounds* are therefore surely the basis for adequate negotiations.[32]

Günther (2001) argues, that there is an *universal legal code* which is ultimately rooted in certain ethical theories and which must be presupposed in international law by all actors who take part in international regime formation. This „universal legal code" consists of some presuppositions, which entail - among others - the system of human rights (Günther 2001, p. 558). Economic globalisation and international regime formation are seen as interrelated processes by which this universal legal code could become the general framework for legal communication. This framework has to be further specified by concrete regime formation, as for instance the Parties of the UNFCCC. Since human rights are part of the universal legal code, they must be taken into account by any interpretation of Art 2. If so, the respect for a system of human rights will be presupposed in FCCC as it is the case for the Vienna Convention, mentioned in section 1. This presupposition may have consequences for interpretations of Art. 2, e.g., regarding its food claim.

But unlike purely moral discourses, political debates about climate change or others have to encompass several types of arguments. Due to the diversity of argumentation types, political debates have to address the *problem of weighing* in this "pool" of arguments, which may give way for fair discourse procedures. They *should be able to make some room for negotiation and for contract-formation*. Contracts may be accepted by all parties although the reasons for accepting might be completely different. This convergence on the level of results may give hope for operable decisions among the diverse Parties of the Convention.

[32] For detailed ethical reflection, see chapter E.

C. Positioning of actors in long-term climate politics

Negotiating the (ultimate) objective of the UN Framework Convention on Climate Change went into its decisive phase in the second half of 1991. During the summer of 1991, a small group of core negotiators brought together the core elements of Article 2 during a weekend session at the Palais des Nations in Geneva. These negotiators agreed to settle for concentrations of GHGs rather than emissions, the yardstick of preventing "dangerous anthropogenic interference" for any legal treaty to be concluded (incorporating the UNFCCC and subsequent treaties), and the pace of climate change to be limited by way of inserting three additional constraints (adaptation of ecosystems, food production, and sustainable economic development).[33] Nevertheless, the precise shape of Article 2 UNFCCC remained severely contested until the end of 1991.

In particular, there were still eight substantially different versions of the objective proposed by 15 October 1991, some of which clearly state obligations for the developed countries and their historical contributions of GHGs over the 20th century as well as the goal of contraction and convergence of emissions (see section C.2 for more detail).[34] Ten days later, a single version of Article 2 had surfaced with the convergence criteria for emission relegated to bracketed text and two of the three additional constraints included.[35] By 19 December 1991, negotiators arrived at the final draft phrasing of Article 2 with bracketed text for the convergence of emissions.[36] The bracketed provision was nevertheless dropped when the UN Conference on Environment and Development took part in June 1992 at Rio de Janeiro where the UNFCCC was signed by many heads of states.

Much of the ambiguities of what Article 2 means in operational terms is perhaps best captured in the 1993 commentary of Bodansky of the UNFCCC:

> The exact legal status of the Convention's stabilization objective may be the subject of future discussions. Some early proposal relating to the objective phrased it as a collective commitment, binding on all parties. Although the Secretariat categorized the proposals on objectives as 'general obligations' in a compilation document, as ultimately adopted Article 2 uses declaratory language and

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[33] Personal communication with Raul Estrada-Oyuela, 02 July 2000.

[34] UN General Assembly, A/AC.237/WG.I/WP.1, 15 October 1991.

[35] Intergovernmental Negotiating Committee for a Framework Convention on Climate Change, A/AC.237/Misc.12, 25 October 1991.

[36] Intergovernmental Negotiating Committee for a Framework Convention on Climate Change, A/AC.237/Misc.17, 19 December 1991

> does not characterize the objective as a commitment. Also unclear is whether Article 2 falls under the category of 'object and purpose' contained in the Vienna Convention of the Law of Treaties. If so, signatories to the Climate Change Convention would have a duty not the defeat the stabilization objective. In what may have been an attempt to prevent 'objective' from being equated with 'object and purpose,' the Convention adds the qualification 'ultimate' (Bodansky 1993, 500).

In this chapter, we will provide an overview of the positioning of political actors with respect to Article 2 UNFCCC, including the justification of their positioning with respect to the stabilization goal as well as the three additional constraints mentioned in Article 2.[37] Few actors openly position themselves explicitly on this issue, and we also included actors which proposed very substantial emission reductions of greenhouse gases over part or throughout this century – even if interpreting Art. 2 UNFCCC is not their purported goal. This overview comprises three groups: governmental and non-governmental German, European, and other international actors, the latter including non-European governments, international non-governmental organizations, and international governmental organizations (section C.1). Why so few actors actually let their position be known eschews easy interpretation. Thus, there are clear gaps in this survey, and many of the goals advanced below may not be accomplishable under realistic assumptions about global climate policy. Given that equity considerations will play a major role in reaching stabilization goals in line with Art. 2 UNFCCC, we will also summarize a few policy-relevant models to accomplish this (section C.2). Finally, we will report results of an exploratory survey on Article 2 UNFCCC distributed on occasion of COP-8 at New Delhi to focus on the main dimensions attended to in this study (Section C.3).

1 Positioning on Article 2 UNFCCC – An overview

The positioning of *German* actors has been powerfully influenced by the two Enquête Commissions of the Federal German Parliament (Bundestag) in the 1980s and early 1990s (see Table C.1). Based on a broad analysis and hopes for technical feasibility, recommendations were made such that CO_2 equivalent concentrations shall not to exceed 550 ppm, global mean temperature shall not increase by more than 2°C relative to pre-industrial levels in 1860, and changes in temperature shall not exceed 0.1°C per decade. Industrialized countries would take the role in reducing their CO_2 emissions by 80% until 2050, whereas developing countries would be allowed to increase their emissions by 70% over the same time

[37] This chapter does not investigate the internal consistency of the positions taken by actors and the relevant alternatives they considered, in particular, the trade-off faced by such actors. See also chapter D for trade-offs.

frame. Other German actors have not dramatically differed from such positions, except for their expressed reasoning. Either Article 2 UNFCCC is directly mentioned or the fear of extreme impacts leads to calls for substantial emission reductions, primarily for CO_2. Germanwatch lists the most ambitious goal of aiming at CO_2 concentrations substantially below 450 ppm, other actors accept positions between 450 and 550 ppm CO_2; the German Advisory Council on Global Change (WBGU) accepts twice the rate of decadal temperature change as compared to the Enquête Commission and supports its quest for a 1% yearly long-term reduction policy for CO_2 by way of its economic feasibility. With the exception of the two Enquête Commissions, the three additional constraints mentioned in Article 2 UNFCCC are not attended to in the reasoning provided by governmental and non-governmental actors.

European actors occupy similar positions as found in the German case (see Table C.2). In fact, 550 ppm of CO_2-equivalents of the relevant greenhouse gases provide the upper limit;[38] relevant emission reductions are roughly of the same magnitude as in the German case. Similarly, the goal of a 2°C change in global mean temperature is acceptable. Only the EU Presidency (represented in 1996 by the Netherlands), The EU Council (in 1996 and 2002), the European Parliament, and the Climate Network Europe make direct reference to Article 2 UNFCCC for guiding their positions, and the three side-constraints are never mentioned (except verbatim quotation; see also Table C.3). It is noteworthy that the European Commission also mentioned the 1% yearly reduction policy advanced by the German Advisory Council on Global Change, yet the time horizon is substantially reduced to end in 2020.

More ambitious than the political institutions of the European Union is the policy dialogue spearheaded by the Dutch RIVM Institute on the "Climate OptiOns for the Long Term (COOL)" which takes a 450 ppm CO_2 concentration plus 100 ppm CO_2 concentration equivalent for other greenhouse gases as the benchmark for its policy dialogue on the feasibility of a low carbon transition.

In elaborating the Third Assessment Report of the IPCC, the member countries of the European Union were considering the role of Article 2 UNFCCC in guiding their policies. The discussion can be summarized as follows:

- Article 2 UNFCCC shall be treated from a methodologically-oriented perspective to avoid opposition from non-Annex I countries (stabilization criteria).

[38] The European Parliament mentions CO2 *equivalents*, the European Presidency and the EU Council only mention CO2.

- There is a need for a comprehensive EU-strategy on Art. 2 UNFCCC prior to further activities
- It may be advisable to split the issue along the following lines:
    - work on risk levels (technical and scientific) and
    - work on how to agree on such risk levels (political).

On the *global* level beyond Europe, there is generally a lack of positioning on Article 2 UNFCCC or long-term emission reduction goals by many political actors (see Table C.3). The EU prefers a 550 ppm concentration level for CO_2, while the USA reaffirms its interest in honoring Article 2 UNFCCC and pursues a domestic energy efficiency goal. Diplomatic institutions such as the UNFCCC Secretariat or the meetings of UNFCCC institutions refer to interest in the subject matter, yet eschew specification of what it entails. Only Trinidad and Tobago provided clear positioning for the negotiations process leading to Article 2 UNFCCC as part of the negotiations on the Kyoto Protocol. While the IPCC clearly acknowledges the importance of Article 2 UNFCCC, there is lack of specification and only very general wording to be found in their Third Assessment Report (TAR). The specialized IPCC workshop on Article 2 at Fortaleza in 1994 provides an overview of the issues and offers examples of vulnerable ecosystems, yet a systematic approach to specifying Article 2 UNFCCC is clearly lacking. All of this may reflect the considerable unease to raise the issue of Article 2 UNFCCC on the international agenda as potentially far-reaching obligations might follow from any internationally agreed upon specification. The fear of far-reaching and binding obligations will give rise to sceptical arguments (see chapter E). Some developing countries as well as some OPEC countries aim at avoiding that Article 2 becomes part of the diplomatic agenda, whereas the European Union is most clearly positively inclined about long-term attention to and specification of the ultimate objective of the UNFCCC. This hesitation by several actors may reflect a consideration that once international consensus is achieved among the major political actors, it may become universally binding (see also chapter E).

Table C.1: Germany: Actor positions on Article 2 UNFCCC or deep cuts in emissions

Actor	**Position (emission reductions relative to 1990 emissions)**	**Justification via Article 2 UNFCCC?**	**Source**
German Federal Ministry of the Environment	Permitting only a doubling of CO_2 concentrations relative to the pre-industrial level implies – from respective research results - worldwide reduction of emissions by about 30%. A minimum share of 70% will have to be achieved by industrialized countries (no specific base year).	Indirectly; avoidance of serious damages; no mentioning of three additional constraints.	http://www.bmu.de/de/1024/js/sachthemen/energie/klimaschutz_uebersicht/?id=581&nav_id=6298&page=1 (Klimaschutz im Überblick, accessed 03 Oct. 2003)
WBGU	Annex-I countries: -77% GHG reduction until 2050. Recommendation to reduce global emissions of CO_2 by 1% yearly until 2155; stabilization of concentrations at ca. 410 ppm (CO_2 only); developing country emissions follow business-as-usual until equal per capita emissions as developed countries are reached; subsequently parallel emissions reductions by both groups.	Explicit reference to Art. 2 UNFCCC; Use of tolerable windows (ecological, economic, social and legal) for CO_2, N_2O and methane; Emission reduction goal is based on allowing global warming of 2°C and 0.2°C per decade as well as up to 5% of world GDP for damage and abatement costs; Major societal change needed; Ultimately: per capita approach (target year omitted); no mentioning of three additional constraints.	http://www.wbgu.de/wbgu_sn1997_engl.html (German Advisory Council on Global Change (WBGU) 1997)
Enquête Commissions I & II of the German Bundestag	Forecast of 550 ppm CO_2 equivalents until 2030 (expected) and change in temperature by 2-5°C until 2100 is perceived an extreme impact (Deutscher Bundestag 1992, 14); Industrialized countries: -80% energy-related CO_2 emissions until 2050 relative to 1987, developing countries: +70% until 2050, global: -50% of energy-related CO_2 emissions until 2050 (Deutscher Bundestag 1991, 868); + 2°C relative to pre-industrial levels in 1860, max. 0.1°C/decade during 1980-2100 (Deutscher Bundestag 1995, 97-97).	yes; mentioning of three additional constraints which might, in turn, lead to further strengthening of the emission reduction goals (Deutscher Bundestag 1995, 97).	See respective bibliographic entries

Table C.1: continued

Actor	**Position (emission reductions relative to 1990 emissions)**	**Justification via Article 2 UNFCCC?**	**Source**
The German Council of Environmental Advisors (SRU)	Stabilization of CO_2 concentration at 500 ppm; contraction and convergence for modified egalitarian transition.	Yes; no discussion of three additional constraints.	Rat von Sachverständigen für Umweltfragen (2002) (p. 252-253)
German Council for Sustainable Development	500 ppmv CO_2 concentration; Reduction of CO_2 emission in Germany by 50% until 2050; involvement of developing countries for long-term goals.	Reference to IPCC and Enquête Commission of the German Bundestag.	http://www.nachhaltigkeitsrat.de/service/download/pdf/RNE_Dialogpapier.pdf (pp. 16-17)
Germanwatch	Substantially below 450 ppm CO_2 (420-430 ppm CO_2); + 2°C relative to pre-industrial levels, max. 0.1°C/decade; implies 60% emission reductions for stabilization of CO_2 concentration; industrialized countries shall reduce by 80% (CO_2 implicitly) until 2050.	Yes; reference to Enquête Commissions and IPCC; no mentioning of three additional constraints.	Personal communication (19-20 Sept. 2002) [position has not yet been officially published]

Table C.2: European Union: Actor positions on Article 2 UNFCCC or deep cuts in emissions

Actor	**Position (emission reductions relative to 1990 emissions)**	**Justification via Article 2 UNFCCC?**	**Source**
European Commission	"… Kyoto Protocol to cut greenhouse gas emissions by 8% below 1990 levels by 2008-12. This is considered to be the first step to a long term target of a 70% cut." 1% emission reductions every year until 2020.	No direct mentioning of Article 2; sustainable economic growth is mentioned.	http://europa.eu.int/comm/environment/climat/official_sec_2001_2053_en.pdf, p. 64
European Parliament	"…agreement to have a worldwide binding limit on global emissions consistent with a maximum atmospheric concentration of 550 ppmv CO_2 equivalent, initial distribution of emissions rights according to the Kyoto targets, - progressive convergence towards an equitable distribution of emissions rights on a per capita basis by an agreed date in the next [21st] century, …"	No, but can be inferred; no mentioning of three additional constraints.	http://www3.europarl.eu.int/omk/omnsapir.so/pv2?PRG=DOCPV&APP=PV2&LANGUE=EN&SDOCTA=6&TXTLST=1&POS=1&Type_Doc=RESOL&TPV=PROV&DATE=170998&PrgPrev=PRG@TITRE|APP@PV2|TYPEF@TITRE|YEAR@98|Find@%63%6c%69%6d%61%74%65|FILE@BIBLIO98|PLAGE@1&TYPEF=TITRE&NUMB=1&DATEF=980917
Climate Network Europe	Position of the IPCC (SAR): 50-70% CO_2 reduction.	Direct mentioning of Article 2 UNFCCC; lists three additional constraints verbatim, but does not elaborate.	http://sme.belgium.eu.net/climnet/mainleaflet.html
RIVM COOL Project (Climate Options for the Long Term)	Use of 450 ppm CO_2 concentration plus 100ppm CO_2 equivalent for other GHGs as reference levels for the policy dialogue (stabilization in 2100).	No mentioning of three additional constraints.	http://www.rivm.nl/bibliotheek/rapporten/490200003.html (Climate OptiOns for the Long term (COOL) - Global Dialogue Synthesis Report, RIVM Rapport 490200003, 2002)

Note: The EU Presidency and the European Council are listed in Table C.3 below.

Table C.3: Global: Actor positions on Article 2 UNFCCC or deep cuts in emissions

Actor	**Position (emission reductions relative to 1990 emissions)**	**Justification via Article 2 UNFCCC?**	**Source**
EU Presidency	1997 (Netherlands on behalf of the EU): +2°C global mean temperature, lower than 550 ppm CO_2 (all GHGs).	Direct link to Article 2; no mentioning of three additional constraints.	http://unfccc.int/resource/docs/1997/agbm/misc01a2.pdf (p. 35)
European Council	(1) 1996: "… the Council believes that global average temperatures should not exceed 2 degrees above pre-industrial level and that therefore concentration levels lower than 550 ppm CO_2 should guide global limitation and reduction efforts. This means that the concentrations of all greenhouse gases should also be stabilized. This is likely to require a reduction of emissions of greenhouse gases other than CO_2 in particular CH_4 and NO_2." (2) 2002: " … emphasising climate change as an outstanding challenge of the next 10 years and beyond and contributing to the long term objective of stabilising greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Thus a long term objective of a maximum global temperature increase of 2° Celsius over pre-industrial levels and a CO_2 concentration below 550 ppm shall guide the Programme."	(2) makes direct reference to Art. 2 UNFCCC; no mentioning of three additional constraints.	(1) http://ue.eu.int/Newsroom/LoadDoc.asp?MAX=21&BID=89&DID=43617&LANG=1 (CFSP Presidency Statement: Luxembourg (25/6/1996) - Press:188 Nr: 8518/96); (2) http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_242/l_242200020910en00010015.pdf (Decision No. 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme)

Table C.3: continued

Actor	Position (emission reductions relative to 1990 emissions)	Justification via Article 2 UNFCCC?	Source
USA	President George W. Bush (2002): "I reaffirm America's commitment to the United Nations Framework Convention and it's central goal, to stabilize atmospheric greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate. Our immediate goal is to reduce America's greenhouse gas emissions relative to the size of our economy."	Yes, but no specification what this would entail in terms of obligations; settles for energy intensity goal for USA and developing countries as the basis for pursuing climate politics; no mentioning of three additional constraints.	http://www.whitehouse.gov/news/releases/2002/02/20020214-5.html
UNFCCC Secretariat	"The ultimate objective of the Convention is … [Article 2 UNFCCC verbatim]. The Convention does not define what levels might be "dangerous", although it does state that ecosystems should be allowed to adapt naturally, food supply should not be threatened, and economic development should be able to proceed in a sustainable manner. Defining what we mean by "dangerous" is a tough political question, involving social and economic considerations as well as scientific judgement.	Yes, but no answer provided; verbatim quote of Art. 2 UNFCCC; explanatory text refers to sustainable (economic) development.	http://unfccc.int/resource/guideconvkp-p.pdf
Geneva Ministerial Declaration (COP-2)	"Stabilization of atmospheric concentrations at twice pre-industrial levels will eventually require global emissions to be less than 50 per cent of current levels".	Implicitly in text (stabilization) and with reference to IPCC Second Assessment Report; no mentioning of three additional constraints.	http://unfccc.int/resource/docs/cop2/15a01.pdf
Trinidad and Tobago (on behalf of AOSIS)	1997: mean sea level shall not exceed 20 cm above 1990 levels and global average temperature does not exceed 2 degrees Celsius above pre-industrial level.	Reference to "objective" and repeated under "guiding objectives", the *latter* under Article 4.2(a) and (b); draft text for negotiations.	http://unfccc.int/resource/docs/1997/agbm/misc01a2.pdf (p. 69)
Climate Action Europe	Increase in global mean temperature below 2° Celsius, returning decadal change to below 0.1° Celsius; 450 ppm CO_2 plus 100 ppm non-CO_2 GHGs.	Yes, no mentioning of three additional constraints.	http://www.climatenetwork.org/

Table C.3: continued

Actor	**Position (emission reductions relative to 1990 emissions)**	**Justification via Article 2 UNFCCC?**	**Source**
IPCC TAR, WG II, Ch. 1; IPCC TAR Summary for Policymakers & Synthesis Report, Q.1	"With mean warming of 1–2°C by 2100, some regional changes would be significant enough so that adverse impacts to some of these highly sensitive species and systems would become more severe and increase the risk of irreversible damage or loss, and additional species and systems would begin to be adversely impacted." Very unclear on the other constraints Complex answer, factually sidestepping advice.	Yes, verbatim, but no answer.	http://www.grida.no/climate/ipcc_tar/wg2/057.htm#1211; http://www.ipcc.ch/pub/SYRspm.pdf, http://www.ipcc.ch/pub/SYRtechsum.pdf
IPCC Special Workshop Article 2 UNFCCC	Mentioning of some thresholds by way of example; no general reasoning.	Yes, and explicit mentioning of three additional constraints (in detail).	IPCC (1994)

Note: The Brazilian Proposal, CSE, and the Global Commons Institute will be covered in the following section.

2 Policy-relevant "models" of equity

The previous section outlined the various ambitions of political actors in Germany, Europe and globally on achieving atmospheric concentrations which could ideally fulfill the ultimate goal of Article 2 of the UNFCCC. Given the trajectory of GHG emissions witnessed until now, this will require considerable emission reductions, both in absolute terms as well as in comparison with so-called baseline emission trajectories. As chapter E on "Ethical Analysis" will show, ethical consideration mandate limits on permissible GHG concentrations under most circumstances. Yet in order to stabilize greenhouse gases at such levels, any international accord will involve some sort of burden sharing among developed and developing countries. Such, ethical considerations in sharing the burden among various

groups of countries will be relevant. In the following, we will review policy-relevant models of equity as they pertain to implementing Art. 2 UNFCCC.[39]

The most pronounced and best known approach has been advanced by the *Centre for Science and Environment (CSE)* in New Delhi, India. While the aim of CSE is to advance a "zero-carbon emission economy", it wishes to reconcile the disparity in pollution intensities by advocating an equal per capita allocation of entitlements to carbon emissions (Agarwal, Narain et al. 1999, ch. 1). As a practical consequence, developing countries – which hitherto have not yet taken over emission reduction obligations – would be included in the global allocation of emission permits. Their basic scheme includes four components, *each* of them refer to equal per capita allocations of carbon equivalents:

- share of the oceans sink capacity,
- budget approach in line with a pre-set stabilization goal (see also section C.1),
- moving entitlements which are of an ad hoc nature under constant scientific review, and, ultimately
- convergence of per capita emissions between developing and developed countries over time (Agarwal et al. 1999, 109-117).

To the degree that developing countries do not use their per capita allocations, they are free to trade them under the Kyoto Mechanisms. CSE is perhaps the best known advocate of per capita allocations, and their vigorous approach has had considerable influence on decision-makers, however, no country has yet volunteered to be bound by such obligations in the form of specific, short- to medium-term obligations under the UNFCCC.

A much more direct and practical role has been assumed by the so-called *Brazilian proposal* on the distribution of emission reductions (FCCC/AGBM/1997/MISC.1/Add.3.).[40] As part of an overall 30% reduction of the emissions of the industrialized countries between 1990 and 2020, Brazil proposed to allocate emission reduction obligations in relation to the effective emissions of CO_2, cumulated and "depreciated" over the past. As an indicator for the effective emissions, the impact on the rise in the mean global temperature was chosen. If countries were to violate their emission reduction obligations, they would have to pay a fixed fine per unit of emissions in excess of their allowances. In effect, if the proposal were enlarged to take

[39] While "burden sharing" often refers to the distributional rules for implementing (emission reduction) policies across countries, "equity" is more often used to allocated rights (e.g., emission permits). One term is the mirror-image of the other, and we will use the term "equity" in line with the larger mandate of this study.

[40] See http://www.unfccc.int/resource/docs/1997/agbm/misc01a3.pdf (07 Oct. 2002).

developing *and* developed countries into account, the polluter-pays-principle would be operationalized within the confines of a global emission target.

A post-hoc analysis of the implied equity principles underlying the Kyoto Protocol (Annex-B) was undertaken by Yanagi, Munesue and Kawashima (2001). Their statistical analysis shows that the emission reductions subscribed to in Annex-B are the *higher* if the projected emissions for CO_2 emissions for the period 1990-2010 decrease, the lower the rate of afforestation is during 1990 - 1995 (sic!)[41], and the higher the per capita GNP was in 1997.[42] This study indicates, inter alias, that countries with increasing emissions are able to receive recognition for this fact in contractual form, whereas the capacities of richer countries (all other factors held constant) oblige them to take over more demanding obligations.

In addition, the proposal by the *Pew Center for Global Climate Change* on the distribution of emission obligations has received political attention. Three major components are included in their proposal: responsibility for historical emission and related effective GHG concentrations, wealth (measured as per capita GDP) and the opportunities for inexpensive emission reductions (measured as energy intensity per unit of GDP) (Claussen and McNeilly 1998). Based on empirical calculations, the world is divided into three groups, namely those which "must act now" (at least high scores on the first two variables), "could act now" (low scores on at least two variables), and "should act now, but differently" (all other combinations) (Claussen and McNeilly 1998). While the basic idea of grouping countries is laudable, a more stringent system of deriving group membership would clearly be desirable. It is noteworthy that nearly all EU countries belong to the first group as do Japan and the USA; Brazil, China, Finland, India, Russia, Sweden, Switzerland etc. belong to the group with should act now, but differently.

The concept of "contraction and convergence" originated with the *Global Commons Institute* in London and has resonated well with political actors, including those of the European Parliament (see above). Two basic ideas are merged into one scheme: (i) contraction of emissions and (ii) convergence of entitlements to emit CO_2. The fundamental idea behind this proposal is the conviction that only very ambitious emission reductions leading to 350 – 450

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[41] This result defies easy interpretation. It could be the case that countries with larger rates of past absorption by sinks anticipate that such capacities will not be available in the future. For this reason, they may ask for additional leeway in their obligations. Retrospectively, i.e., after the Yanagi et al. article was published, it merged that allocating sink permits at the Bonn Agreements and the Marrakech Accords in 2001 actually permitted diplomatic agreement.

[42] An alternative analysis would have focused on the derivation from business-as-usual emissions rather than the emission reductions relative to 1990.

ppm CO_2 can adequately prevent dangerous interference with the climate system in line with Art. 2 UNFCCC; this shall be reached by a specific target year, e.g. the year 2100. In addition, equity is solely interpreted as equal per capita entitlements to be achieved by a transition from present day per capita emissions to equal emission rights by a convergence year, either in a rapid non-linear fashion or as a linear transition between present day per capita emissions and equal per capita emissions.[43] This conception of long-term climate policy also led to a proposal communicated to the Ad-Hoc Committee on the Berlin Mandate in September 1996 in order to influence negotiations on the Kyoto Protocol. While explicit reference is made to Art. 2 UNFCCC and a broad range of impact domains is mentioned, yet no specific advice is offered when relevant thresholds would be passed. Following the precautionary principle, a 350 ppm CO_2 stabilization (contraction) target until 2045 is advised. In addition, a year for the convergence to equal per capita emissions is suggested, e.g., the year 2045.[44] While the Global Commons Institute undoubtedly influenced political discourse with its contraction and convergence reasoning, its idea has not yet materialized in treaties or protocols.

Perhaps the most encompassing approach to taking equity approaches in climate policy into account in combination with long-term emission targets is the Framework to Assess International Regimes for Burden Sharing (FAIR), advanced by the *Dutch National Institute for Public Health and the Environment* (RIVM).[45] In effect, its origin is the operationalization and further development of the Brazilian proposal (see above). Its use in the context of the COOL project (see section C.1) clearly makes it relevant in the context of Article 2 UNFCCC, yet the documentation of FAIR itself eschews any concrete policy advice about the interpretation of Article 2 UNFCCC. Therefore, we solely summarize the basic functioning of the FAIR module.

Given a long-term goal for a comprehensive climate change regime encompassing developed and developing countries, FAIR considers three modes of operation relevant to the work of this project:

- increasing participation of countries, starting with the Kyoto Protocol's Annex-B countries and extending to non-Annex I countries of the UNFCCC based upon a set of "graduation rules" (see below),

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[43] See http://www.gci.org.uk/contconv/Ideas_behind_cc.html (11 Nov. 2002).

[44] See http://www.gci.org.uk/contconv/protweb.html#15 (proposal as of 06 Sept. 1996; accessed 11 Nov. 2002).

[45] See http://arch.rivm.nl/fair/index.html for a description and downloads (11 Nov. 2002).

- convergence of emissions towards equal per capita emissions (see above under Global Commons Institute), and
- the triptych approach of deriving sector-specific contributions to emission reductions (domestic sector with national regulation, internationally-oriented energy-intensive industries, and the power-producing sector).

In particular, the first approach of increasing participation among industrialized and developing countries for long-term climate policies would include

- a business-as-usual scenario until countries meet a decarbonization threshold (to be determined),
- pursuit of decarbonization target (e.g., carbon intensity per unit of GDP) until they meet a threshold for the
- stabilization of their emissions (to be determined) for a specific time period until they, as at a final stage,
- participate in actual (absolute) emission reductions.[46]

While the FAIR model allows the user to define each of those stages, its approach towards successive engagement in progressively more stringent contributions to stabilizing the climate system is of political relevance.

A review of a variety of approaches towards deducing country-specific contributions to long-term climate policies can be found in UBA (2003)[47]; the study evaluates different approaches along a broad range of criteria, yet equity is only one of the evaluative and only few of the approaches are primarily based on equity principles covered in this section.

3 Evaluation of current positions on Art. 2

With progress in implementing the Kyoto Protocol, the interpretation of the ultimate objective in Art. 2 UNFCCC is becoming a key issue in international climate negotiations beyond the first commitment period, involving a number of conflicting viewpoints that need to be addressed. Different actors are affected differently, both by the impacts of climate change and by preventing it. Asymmetries make the evaluation and implementation of the ultimate objective a highly controversial issue. This involves multiple dimensions and criteria such as

[46] See http://arch.rivm.nl/fair/index.html?methodology/increasing_participation.html for details (11 Nov. 2002).

[47] UBA (2003) Evolution of commitments under UNFCCC: Involving newly industrialized and developing countries. UBA-series Climate Change 01/2003, Umweltbundesamt, Berlin.

the expected benefits, risks and costs of realizing the preferred concentration levels and the timing for stabilization; furthermore it incorporates assessments of potential conflicts between ecosystem adaptation, food production and sustainable economic development and statements on equity, uncertainty and clarity of terms themselves. To achieve agreement on such a wide range of questions requires a complex negotiation and conflict resolution process.

3.1 Conflicting positions in climate negotiations – The case of COP-8

The conflict on the ultimate objective outlined in Art. 2, which had played a less significant role at earlier occasions, became visible at the 8th Conference of the Parties of the UNFCCC (COP-8), held in New Delhi October 23 to November 1, 2002, together with the Subsidiary Body for Implementation (SBI 17) and the Subsidiary Body for Scientific and Technological Advice (SBSTA 17).[48] COP-8 took place at a critical juncture between short-term commitments and longer-term obligations: after the 2001 Marrakesh Accords, completing three years of negotiations on the operational details of the Kyoto Protocol and before the Kyoto Protocol enters into force, which is expected for 2004. Accordingly, COP-8 focused on practical steps in the Kyoto Framework, such as national communications, financial mechanisms, "good practices", research and systematic observation as well as methodological issues.

On the other hand, COP-8 became "politicized" by conflicts about the future direction of the global climate negotiation process, and turned into a forum where the range of different viewpoints on the ultimate objective of Art. 2 UNFCCC unexpectedly shaped the negotiations. Increasingly, key actors took positions on this issue which may influence the future negotiation process:[49]

1. The *European Union* (EU) emphasized that effective climate protection would first of all require a reduction or limitation of greenhouse gas (GHG) emissions, in addition to the adaptation to the consequences of climate change. EU called for a common dialogue on the level of non-dangerous concentrations and on "future action", i.e. the question by which measures after 2012 global GHG-emissions could be drastically reduced. Germany called for "absolute" emission reductions, noting that a failure to address climate change would result in economic harm, and committed itself to a 40%

[48] A report on COP-8 can be found in: Summary of the Eighth Conference of the Parties to the UN Framework Convention on Climate Change, 23 October – 1 November 2002, Earth Negotiations Bulletin, Vol.12 No. 209, 4 November 2002, Online at http://www.iisd.ca/linkages/climate/cop8/.

[49] The information has been collected from various sources by J. Scheffran, who attended COP-8 and performed several interviews, in addition to distributing a questionnaire on Art.2 (see Annex).

emission reduction from 1990 levels by 2020 if all developed countries committed themselves to further reductions and if overall EU emission reductions reached 30% in the same interval. Sweden called for a dialogue on developing country commitments.

2. Most *developing countries (G77/China)* used COP-8 to shift emphasis towards topics favoured by themselves, such as adaptation towards the consequences of climate change, technology and resource transfer as well as capacity building and equity. G77/China refused any commitment on „future action“, supposedly due to concerns that this would lead to early reduction commitments for themselves. This would not be acceptable in their view since most industrialised countries had not yet implemented their own reduction commitments. Many developing countries emphasized their fundamental right for sustainable economic development, as if this were in contradiction to the ultimate objective. Due to a wide range of interests within G77/China, the position of the group was not consistent. The oil exporting countries, which are sceptical about the Kyoto process, played a major role as speakers of the group. Venezuela, supported by Saudi-Arabia, attacked Annex-I States not to fulfil their obligations and refused “further action”, together with a call for compensation for „adverse effects“ on their economies. Other countries complained about their high vulnerability on climate change and its effects (AOSIS-states, Bangladesh, Bhutan, Cambodia, Malawi, Mozambique, Nepal, Peru, Ruanda, Thailand, Chad). These states signalled at COP-8 that their position was closer to the European position than was expressed in the negotiation situation. AOSIS called for an immediate reduction in global emissions of 50-80%. Speaking in the name of the African States, Uganda expressed the need to talk about „future commitments”, after implementation of the Kyoto Protocol. Large states in transition, such as China and India, were conscious about the need for climate protection measures and a long-term UNFCCC process in the interest of humankind, but internationally binding legal obligations so far had been strictly refused for themselves as long as they had not achieved a sufficient share of the environmental change. More moderate and flexible had been Brazil, Mexico and South Korea, recognizing that their emission path has to be changed in their own interest. Argentina pleaded to overcome the unproductive North-South confrontation.

3. The *USA* noted its commitment to reduce the greenhouse gas intensity of its economy by 18% over ten years and supported the G77/China position to refuse further commitments towards the ultimate objective. This position is based on the central

argument that economic growth had a first priority and would be a precondition for fighting climate change. The argument omits the fact that climate change could induce damages which effectively weaken economic development, while active climate policy might offer economic opportunities and might create jobs. It was remarkable that most of the *Umbrella Group* states (Japan, New Zealand, Norway, Russia) were closer to the EU than to the USA in the key issues of Kyoto Protocol ratification and future action.

4. *Non-governmental organizations,* largely supporting the EU position, were concerned that the COPs could loose the ultimate goal out of sight and demanded that it would now be necessary to identify upper limits for emissions, to prevent dangerous climate change and guarantee that the global mean temperature would not exceed critical thresholds. The Climate Action Network (CAN) referred to the argument of the IPCC Third Assessment Report (2001) that developing countries are most at risk of climate change and will suffer from damages already at low levels of warming. They supported the developing countries' view that human activities leading to dangerous climate changes are caused largely by levels of consumption and associated production by wealthy industrialized countries, yet climate effects are expected to fall disproportionately upon the poor. As a consequence, setting strong climate targets was seen by most NGOs as an equity issue, both within current and future generations. For CAN, the dangers of climate change are already visible (for instance in the 2002 floods in Europe) and require urgent action to minimize the adverse impacts on health, food security, water supply, storminess and sea level rise. The Centre for Science and Environment, an Indian NGO, blamed the Southern leaders for their "failure of political leadership to articulate and develop a coherent vision of a greener and equal world".[50]

Even though the implementation of Art.2 was not a major negotiation issue at COP-8, the potential conflict lines became visible on a few occasions:

- The *High Level Segment*, which took place in the form of three „Ministerial Round Tables", was largely shaped by North-South discussions on further obligations. From the beginning the EU tried to push the process towards "further action" towards Art. 2 and to initiate a dialogue on broadening commitments, but the voice of non-Annex I

[50] Southern Leaders: No Idea, Equity Watch, Special Edition #4, UNFCCC/COP-8, Centre for Science and Environment, New Delhi, October 30, 2002.

countries in favor of such a declaration was drowned by calls from more powerful developing countries in favor of a declaration focusing on adaptation. Thus, not fulfilled was the hope of COP-8 President Baalu that the conference declaration would become a historic milestone towards the ultimate objective of the UNFCCC, strengthening the inherent connection between preventing climate change, fighting poverty and sustainable development. In a sharp turn, the Indian Prime Minister Vajpayee highlighted the importance of adaptation, vulnerability, and capacity building for developing countries, but in face of asymmetries between industrialized and developing countries postponed commitments of its own for several decades to avoid economic damage. The *Delhi Declaration on Climate Change and Sustainable Development,* [51] which was not concluded until the very last moment of the conference, generally recalls the UNFCCC ultimate objective in the preamble but does not call for any follow-up action or the initiation of a dialogue. It reaffirms development and poverty eradication as overriding priorities in developing countries and implementation of UNFCCC commitments according to the Parties' common but differentiated responsibilities. The USA supported the G-77/China position and were the only Annex I country to state its complete satisfaction with the Declaration.

- At COP-8 major results of the 2001 *IPCC Third Assessment Report* (TAR) were presented and introduced into the negotiation process through the Subsidiary Body for Scientific and Technological Advice (SBSTA). In order to allow SBSTA to set future research priorities, the EU had suggested to ask the Parties for submissions on special workshops with international research programmes in SBSTA 17 which focused on *Research and Systematic Observation*. The goal of Germany and the EU in Delhi was to initiate a discussion process on Art. 2 UNFCCC and the ultimate objective, in order to prepare negotiations for the second commitment period and convince SBSTA to launch a common research initiative, based on the results of TAR and directed at the stabilization of GHG concentrations. After a discussion panel with IPCC and international research programmes and organisations, SBSTA concluded that improved research coordination would be required in the future. Despite support from the EU, Russia and other members of the Umbrella Group, it was not possible to directly mention the ultimate objective of Art. 2 or the phrase „dangerous interference" due to opposition from the USA and G77/China. One of the most frequent arguments was: The definition of "dangerous" is not a scientific but a

[51] Source (website)

political question. Finally, SBSTA 17 agreed in an all-encompassing compromise "that a more coordinated and multidisciplinary approach was needed to address research on cross-cutting issues such as the relationship between climate change, sustainable development and equity, stabilization of atmospheric greenhouse gas concentrations, and uncertainty".[52] Furthermore, it was agreed to increase collaboration among international research programmes and to provide a forum for consideration of research needs and priorities. In order to prepare decisions for COP-9, all Parties were invited to provide submissions on the policy-relevant aspects of the TAR, including the ultimate objective and dangerous interference with the climate system.

The question of further development of the international climate protection regime beyond 2012 has been discussed publicly for the first time within a COP-meeting. Given the entry-into-force of the Kyoto Protocol expected for the foreseeable future as well as the still increasing emissions in most industrialized countries, it was unlikely at this stage that the developing countries would accept a roadmap towards further commitments. The rift at COP-8 between those who pushed for further commitments and those who tried to postpone them raised concerns about a new North-South divide, despite the variety of interests within non-Annex I countries. It became clear that developing countries would not give up their "right" for increasing emissions without serious concessions in other fields of the development agenda which satisfy the demand for global equity and poverty reduction. The implementation of financial mechanisms under the "Global Environmental Fund", the „Least Developed Countries Fund" and the „Special Climate Change Fund" might be essential.

Concluding for German and European diplomacy, it may be essential to build up political support for implementation of Art. 2 and to avoid a North-South divide and confrontation in future negotiations, intensify contacts and support confidence-building measures with constructive groups and countries within G77/China, in particular the group of Least Developed Countries (LDC). Bridges may be built to those states from G77/China and the Umbrella Group which are aiming at effective climate protection, like the EU. For the near future it could be a major issue to learn to which degree the IPCC is entitled to investigate the ultimate objective, given the resistance by G77/China and others.

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[52] Research and Systematic Observation, SBSTA 17th session, New Delhi, 29 October 2002, FCCC/SBSTA/2002/L.27.

The empirical basis on positioning of actors on Art. 2 and their clustering thereupon was extended by an exploratory expert survey, which confirms most of the above mentioned observations. Selected details of the survey's evaluation may be read in the annex (X.) of this study.

D. Consequences

1 Interpreting the provisions

1.1 Introduction

Art. 2 of the UNFCCC provides as an overall objective the "stabilization of greenhouse gas concentrations in the atmosphere" (UNFCCC). Whereas no exact level is formulated, the desired concentration is described by a qualitative provision, i.e., a "dangerous anthropogenic interference with the climate system" (Art. 2) is to be prevented. This dangerous interference is further qualified by three provisions which should be met along the path towards this desired stabilized level.

The desired concentration should be reached along a path at which

1. ecosystems can adapt naturally to climate change,
2. food production is not threatened,
3. economic development can proceed in a sustainable manner.

Since a stabilization of greenhouse gas concentrations can not be achieved at once, Art. 2 recognizes this by referring to a time-frame over which the three cited objectives need to be secured.

The specification of a certain greenhouse gas concentration which the parties to the UNFCCC will need to aim at in order to meet the three constraints of ecosystem adaptive capacity, securing food production, and sustainable economic development is not a task in which each objective can be assessed separately. The interdependencies between these objectives need to be considered and the trade-offs inherent in this interdependent structure needs to be made transparent.

The specification of Art. 2 UNFCCC therefore requires a careful consideration of several dimensions of the issues addressed:

First, the most important topic, of course, is the formulation and interpretation of the three constraints. It will also include a measurable concept in order to be able to quantitatively assess whether a certain constraint is violated or not. This is a prerequisite if Art. 2 is to be transformed into an operational concept for policy making. In practice this would e.g. mean

that a definition of sustainable economic development needs to be stated in order to detect a violation of that principle.

Second, in the process of defining the constraints it is necessary to recognize and to take account of the fact that these constraints will not only be influenced by climate change, but also by a multitude of other factors. E.g., food production and food demand is influenced by population growth, economic development, technical change, land use patterns, and many more. Climate change itself may only be of minor influence. As a consequence, the relative influence of climate change and the other factors should be kept in mind when defining the constraints. In fact, meeting the constraints of Art. 2 UNFCCC may then involve much more than just policies directed at reducing emissions of greenhouse gases.

Third, it is not only within one constraint that many interacting factors need to be considered in the process of choosing an appropriate definition and with this choice a specific restriction on mitigation options. Such a choice also has repercussions on the other two constraints. E.g. a strict requirement for ecosystem stability may by itself threaten food production and vice versa. Hence, making precise the three objectives should be done with taking account of the trade offs among them.

Hence, on the way towards a precise and measurable interpretation of the three constraints that should be met on the path towards a stabilization of greenhouse gas concentrations, trade-offs with other dimensions of the problem should be taken into account. These include the interaction with objectives other than climate stability and the trade-offs between the ecologic, economic and nutritional constraint. These aspects will be organized in this chapter along four dimensions which seem to be relevant building blocks for deciding on an appropriate interpretation of Art. 2.

We will start by discussing the implications of choosing certain definitions for the three aims of Art. 2, i.e. ecosystem change, food production, and economic development. In order to do this in section 2, we identify four aspects which we believe to summarize the relevant areas that need to be considered in the process of making precise what is meant by

- making sure that ecosystems can adapt naturally to climate change,
- a threat to food production, and
- a sustainable economic development.

The aspects that we use for clarifying the three concepts are

- the regional scope of a particular definition,
- the degree of uncertainty that one is faced with when defining a concept,
- the inter-temporal consequences of particular definitions, and
- the impact of a definition on the distribution of costs and benefits of controlling the climate.

We discuss the possible consequences of particular definitions in terms of these different aspects. We also highlight the normative judgments that one might implicitly make in seemingly technical decisions such as a regional scale for which ecosystems are defined. Finally, in section 3 we illustrate the trade offs that one faces if all three aims are to be achieved simultaneously.

1.2 The dimensions for assessing unacceptable changes

With the four dimensions listed above it should be possible to cover the main issues for specifying the three constrains – Ecosystem Stability, Food Security, and Sustainable Development. Table D.1 schematically illustrates the approach. The first three issues are evident. For each of the three constraints it is clearly necessary to define the geographical coverage. E.g., should local food production be secured or should the world supply be able to meet world demand for food. Uncertainty poses a major problem as the provisions of Art. 2 are to be defined for several coming decades, a time frame over which some provisions may become infeasible and others may be achieved without any effort. Yet, it is not known today which state of the world will prevail. Inter-temporal scales are important since it is often the case that costs and benefits, rather than being influenced in their size, are often shifted along the time axis, i.e. short term effects are traded against longer term effects.

Table D.1. Specifying the conditions for acceptable greenhouse gas concentrations

	Regional Scales	Uncertainty	Inter-temporal Scales	Distribution Effects
Ecosystem Adaptation				
Secure Food Supplies				
Sustainable Economic Development				

The inclusion of distribution effects is conceptually not entirely correct since it is a consequence of particular decisions. We have included them here since we believe them to be important to recognize not only the intergenerational and regional impacts, but also to take into account effects and obligations for different human beings within a region at some point in time. This dimension is essential for the political acceptance of any measures derived from interpreting Art. 2.

1.2.1 Defining the constraints – ecosystem stability

The time path towards a stabilization of greenhouse gas emissions should allow "ecosystems to adapt naturally to climate change" (Art. 2). This provision essentially determines the allowable speed at which climate change should be allowed to occur. Since the definition of ecosystems itself determines the degree of vulnerability, one can assume that there is a strong interaction between the allowable greenhouse gas emission trajectory and the way in which ecosystems are defined. Hence, defining ecosystem stability is not just a technical issue, it has wide-ranging consequences for the interpretation of Art. 2.

1.2.1.1 Ecosystem stability – regional scale

The requirement that greenhouse gas concentrations should be limited to a level such that ecosystems can adapt naturally to climate change is open to many interpretations. One of the most important questions concerns the definition of an ecosystem. Without going into detail, such a definition could include all ecosystems from local to large regional ecosystem or the ecosystem of the earth overall. The IPCC reports with high confidence that many local to regional ecosystems are already in the process of undergoing drastic changes (WGII 2001). These changes take place in terrestrial as well as marine ecosystems. A prominent example is the reaction of coral reefs to increasing water temperatures (O'Neill/Oppenheimer 2002).

A narrow and local definition of ecosystems therefore seems to impose severe limitations to increases in the concentration of greenhouse gases. Such a definition might even require a lowering of concentrations existing already. It may even be the case that this constraint is already violated as some ecosystems are in the process of becoming destroyed. A workable definition of adaptation capacities for ecosystems would therefore need to accept some local disruption but no large scale disruption of ecosystems.

Since it is apparently impossible to limit climate change to a degree such that all, i.e. local as well as regional and global, ecosystems can adapt naturally, a choice needs to be made as to for which ecosystems the provision shall be relevant. This choice essentially determines the

necessary degree and path of climate policy since the emission path of greenhouse gases in the future translates more or less directly in the ability for ecosystems to adapt naturally. This process is subject to a high degree of uncertainty which is discussed below.

If not all local can be preserved through any climate policy – be it preventive or adaptive in nature – and the choice of ecosystems which should be preserved in their capacity to adapt naturally strongly influence the climate policy path to be chosen, decisions need to be made as to which of the parts of an ecosystem are to be preserved with priority and which could be given up. This requires a balancing or valuing of the importance of ecosystems against the cost of climate policies. It may then turn out that a small scale regional focus may not be a desirable – let alone a feasible – policy. The limits for natural adaptation may then be defined on a larger scale.

Another aspect concerns the fact that most ecosystems are either directly managed or are indirectly influenced by human activity, e.g. through the transport of substances into unmanaged ecosystems. Thus, they are undergoing adjustment processes which are unrelated to climate change but which may or may not be aggravated by climate change. The notion of "natural adaptation" needs to be reconsidered especially for managed ecosystems. One could define "natural adaptation" of a managed ecosystem as adaptation at a given and unchanged human management. Such a technical definition, however, completely misses the very essence of managed ecosystems, namely the fact that the goal of human interference is exactly the forced adaptation of these ecosystems to serve the human needs. Hence it would not be helpful to ignore adaptive measures by assumption if such ecosystems are subject to climate change. One would rather expect that the goal for managed ecosystem would be an adaptation to climate change through human management. Hence, the above given formal definition for "natural adaptation" is somewhat artificial and not very informative in the context of managed ecosystems.

One option may be to completely exclude managed ecosystems from the requirement to adapt naturally. The focus of the condition in Art. 2 would only rest on largely untouched and unmanaged ecosystems. This approach would be in line with the implicit notion that natural adaptation requires a system that is in a sense natural, i.e. not predominantly determined by human interference. This restriction to unmanaged ecosystems would, of course, eliminate from Art. 2 all problems that managed ecosystems might encounter when climate change is accelerating. The other option would be to define natural adaptation of managed ecosystem in

such a way that optimal management is included. This option, however, will then require an evaluation of the ecosystem services that are provided through the human interference.

1.2.1.2 Ecosystem stability – uncertainty

One of the most complex issues in the understanding as well as the management of ecosystems is the degree to which such systems remain intact despite external changes or influxes into them. Many ecosystems exhibit adaptive capacities up to a certain threshold beyond which they will quickly become destroyed. This imposes a special threat as this threshold is often difficult to determine.

In general, the IPCC report (2001, WGII TAR) comes to the conclusion that managed ecosystems are better able to adapt to climate change and that ecosystems with poor resource endowments are more vulnerable. In conclusion, the risks to natural ecosystems are greater and need to be analysed most carefully. In addition, managed ecosystems in poorly endowed economies are more exposed to climate change because of their limited capacity to adapt. These findings suggest that the criteria for ecosystem stability should focus on the two most sensitive areas mentioned, natural ecosystems and poorly endowed managed systems.

The laws governing the pressure on ecosystems and their adaptation are extremely complex and not yet well understood. It is therefore rather unlikely that a quantifiable analysis of costs and benefits of particular ecosystems can be performed and that such an analysis could be the basis for decisions about ecosystems whose functions need to be saved. It is more likely that some form of precautionary principle needs to be used for defining the limits that climate change should be allowed to influence ecosystem stability and ecosystem adaptation.

1.2.1.3 Ecosystem stability – inter-temporal aspects

In many ecosystems climate change results in a slow change of external factors. These may instantly influence fragile systems, but it may also have no directly observable effects to many ecosystems as long as critical thresholds are not reached. Hence, looked at the system over a short time horizon, the latter ecosystems would be considered as being able to adapt to the changes in their environment. With a longer time horizon, one would need to recognize that such ecosystems have been moved into a state of less stability and closer to a situation where they are threatened to become destroyed or irreversibly damaged.

One aspect of a more long-term view is related to the natural alternation of ecosystems in contrast to the adaptation to climate change through the replacement of one ecosystem by

another one. It is not clear a priori, why an ecosystem should not be replaced by another one or continue to exist in a modified way by the influence of climate change. Therefore, there is a need to become more precise in defining the term “natural adaptation”. If this means any succession of ecosystems in the long-run, the objective is meaningless since by definition a destroyed ecosystem will be replaced by another ecosystem. If it means, ecosystems should in the long-run remain unchanged, it would force a stability on to ecosystems which they may not possess, even without the influence of climate change.

The choice of an appropriate timeframe therefore, is a critical one. A short time horizon could lead society to underestimate the pressure of climate change on ecosystems and to lull herself in a false sense of security. A long time horizon, to the contrary, runs the risk of leading to a meaningless notion of natural adaptation or to a misdirected conception of ecosystem stability.

1.2.1.4 Ecosystem stability – distribution effects

The decisions about the size, location, and time horizon over which ecosystem stability shall be measured and their impacts are assessed can have considerable distribution effects. Since ecosystems are most vulnerable when they are managed in poorly endowed economies and often when they exist as yet untouched natural ecosystems – which often also reside in poor economies – the benefits of preservation and the costs of adaptation or mitigation are distributed unevenly between rich and poor economies. By ignoring the potential destruction of such local ecosystems under threat rich economies may impose economic and social costs on specifically threatened societies.

1.2.1.5 Ecosystem stability – summary

Allowing for a natural adaptation of ecosystems to climate change raises a number of conceptual issues which are intrinsically linked to the definition of eco-systems in a geographical and time dimension and also to the notion of natural adaptation. The decision about an appropriate geographical dimension or several different geographical dimensions directly influences to notion of natural adaptation. Without a common geographical scope for ecosystems a common concept of natural adaptation is difficult to imagine. In small scales several ecosystems have already adapted to climate change by moving, by changing their internal flows, or by being replaced by different ecosystems. In large geographical scales, ecosystems may not yet have reacted to climate influences since their stability is still stronger than the climate signal.

The time dimension relates to an underestimation of threats to natural adaptation if short horizons are considered over which ecosystems might still preserve their internal stability. If long time horizons are considered the question arises as to how one might distinguish between natural adaptation and some "non-natural adaptation", e.g. destruction. Such destruction would not result in no ecosystem at all, but in a different ecosystem. An evaluation of such a change could not be made on a ecosystem based definition. It rather needs an assessment of the value of different ecosystems to society.

1.2.2 Securing food production

Keeping greenhouse gas concentrations at a level such that food production is not threatened – as required in Art. 2 UNFCCC – is open to many interpretations. It has already been mentioned that managed ecosystems which provide most of the food produced are less vulnerable to climate change than natural ecosystems. This is essentially due to the fact that modern food production has become less dependent on climatic factors. Instead, production technologies, modified crops, and optimised inputs are the most important determinants for the amount of food that can be produced on an area of land. "Current agricultural technology enables one person to be fed from food grown on no more than 2000 square metres. In Malthus's time it was nearer to 20.000 square metres" (Trewaras 2002). On the other side, agriculture close to subsistence levels relies more heavily on climatic factors.

If the focus of securing food production is on the quantity of nutrients, e.g. calories, food production can substantially be expanded even under more unfavourable climatic conditions. There is more or less consensus that 8-10 billion people can be fed even with today's technologies (Tilman et al. 2002). The fact that despite these technological potentials still a substantial number of people suffer from hunger indicates that social and economic aspects need also to be taken into consideration. These factors determine the composition of food production and the regional structure thereof.

1.2.2.1 Securing food production – regional scales

Today the world production of food would suffice to feed the today's world population. Still, there is wide-spread under-nutrition in many parts of the world. The definition of a measurable concept for determining a situation in which food production is threatened may have little to do with the actual availability of food in certain regions. This is an economic issue which depends more on available incomes for purchasing food than with the physical availability of food supplies.

The selection of indicators for a threatened food production may therefore be concentrated on the climatic conditions for producing food products and the adaptive capacities to react to climatic change. Onigkeit/Alcamo (2000) report that up to 30% of the world's available land will be affected by a decrease in crop productivity through climate change when the Kyoto-targets or an even stronger target of 550 ppm GHG is reached. They also find that the most wide-spread impacts will be in North America. This contrasts remarkably with other findings which predict an increase in agricultural production in North America (Deke et al. 2001, Adam et al. 1999).

A major reason for such seemingly contradictory results comes from the fact that there may by negative impacts on crop-productivity but these are compensated by other adaptive reactions such as changes in technologies, in crop patterns etc. The adjustment of local as well as world market prices also plays an important role. Deke et al. (2001) find an increase in agricultural production in North America and Western Europe despite a negative climate impact which is due to the increased world market prices for food creating incentives for a more intensified and enlarged agricultural production. The rise in world market prices, on the other hand, is due to larger negative climate impacts in other parts of the world. Simulations with computable general equilibrium models also show that the adjustment processes on world markets can to a large degree compensate the negative regional climate impacts through price adjustments and increased trade (Deke et al. 2001).

Choosing an appropriate indicator for threats to food production through climate change therefore is not obvious. Relying on threats to regional production or productivity impacts would ignore local adjustment processes as well as the interregional exchange of surpluses and deficits through trade. In contrast, a sole focus on the availability of food on a worldwide scale would tend to ignore the fact that not only a sufficient food supply is necessary for the international trade in food products, but also a demand supported by a sufficient income to afford these imports. Defining the indicators for what is meant by a sufficient food production will probably need to focus on a multi-dimensional set-up for which the final judgement across the different dimensions would need to rely on ethical considerations.

Examples would be a decision that each country should be able to produce a certain percentage of its food products at home, or that the current situation in food production should not be affected through climate change by more than a certain percentage. It is also possible to relate the stringency of the regional constraint to the degree of economic development, i.e. a

wealthy country could well afford a threat to its food production capacity, whereas a poor country could not.

1.2.2.2 Securing food production – uncertainty

Food production is an economic activity which depends more than any other major economic activity on the vagaries of nature. Agriculture is exposed to stochastic weather events in each growing season as it is subject to the uncertainties of long-term climate change. At the same time, agriculture is a managed ecosystem which is perceived to be less sensitive to changes in external conditions than are other unmanaged ecosystems. This is not due to the fact that agricultural production systems are inherently more stable, to the contrary, especially high productivity intensive agriculture is a rather fragile enterprise. The robustness comes from the fact that managed systems can more easily be stabilized through changes in the human interference, i.e. through adaptation to external changes. This adaptive ability has long been underestimated.

The current situation with respect to these adaptations is summarized in a report by the FAO (2002). Population growth world wide has slowed down from 1,7% per annum in the last 30 years to 1.1% for the next 30 years thus relieving somewhat the pressure to produce increasing amounts of food. The major three sources for expanding output, consist of expanding the area used, increasing the frequency of cropping, and boosting yields.

However, these are more or less exhausted. The FAO still sees some land reserves in Latin America and Sub-Saharan Africa, but the conversion of these reserves into land for food production may run into conflict with the objective of ecosystem preservation (see section above). Increasing cropping frequency is often equivalent to adding irrigation to the agricultural practices. Hence, water availability will become a major concern to increasing output per area of land. Whereas the FAO does not see a world-wide shortage of water for irrigation, many developing countries are already short of water and some more will be faced with regional shortages and will be facing difficult choices between different water uses. The FAO is also optimistic that crop yields which have been falling from a roughly 2% yearly increase in the last decade will continue to grow at somewhat over 1% per annum.

Overall, the FAO is optimistic that a continuous adaptation of farming practices together with continued innovation in crops and farming technologies will suffice to meet the growing demand up to the year 2030. As far as the uncertainty about the impact of climate change on

these processes is concerned the impact of the farming practices on food production seems of much greater importance than the yield changes due to a changing climate.

The FAO discusses climate change scenarios including their uncertainties and comes to the following conclusion:

> "In the next three decades, climate change is not expected to depress global food availability, but it may increase the dependence of developing countries on food imports and accentuate food insecurity for vulnerable groups and countries" (FAO 2002).

Hence, up to 2030 a threat to food production world-wide is not expected. Even if climate change comes out stronger than expected adaptation measures and the dominance of management techniques in agricultural managed ecosystems over the impact of climate change will not expose food production to large risks. Only the regional variability may be of concern.

Appropriate indicators for assessing the interaction of climate change to a secure food production could, therefore, be found more in the areas of agricultural innovation in crops and farming practices than in the focus on the current output of agriculture and climate impacts. Since the opportunities for adaptation are wide-spread the focus in terms of uncertainty should be on the likelihood of future advances in technologies in the agricultural sector. The uncertainty about the time beyond 2030 comes mainly from the very limited knowledge about future agricultural production and less from inconclusive results of climate models. The interaction of the future development in soil fertility, water availability, advanced crop designs, land availability is too complex as to allow an educated guess for the long-term global food supply. This will be even more difficult for regional predictions or scenarios.

1.2.2.3 Securing food production – inter-temporal issues

Many of the long-term issues of securing food production are connected to the uncertainties about the development of agriculture discussed above. However, one additional concern that is often raised in the quest for increasing agricultural yields through improved practices, crops, and life stock is concerned with trade-off between near-term benefits and long-term costs or risks.

Ecologists claim that improved crop varieties provide higher yields – often together with an expansion of other inputs such as fertilizers or pesticides – but they also become more susceptible to adverse impacts such as varying climatic conditions or diseases. This is mainly

due to the selective breeding which focuses on maximum yield but gives up on long-term stability of varieties with respect to changing environmental conditions.

In terms of meeting a growing need for additional food supplies the above mentioned advances may be advantageous in the short-run but may also reduce biodiversity and thus future options in the long-run. A short to medium term maximization of yields through advanced crop varieties would therefore need to be balanced with the sustainability of such yields in the long run. An impressive negative example is the expansion of irrigated crop production which when done unsustainably has led to a destruction of soil conditions and subsequent losses in yield. The objective of securing food production could also – if it is met with the help of advanced crops and life stock – run into conflict with the other goal of the ability of ecosystems to adjust to climate change. This interaction will be discussed below.

1.2.2.4 Securing food production – distribution effects

In the section on regional aspects the option was described that the securing of food production can be defined on different regional scales. This not only has important implications for the degree of climate change that would be acceptable, it also has consequences for the distribution of costs and benefits of such restrictions. Since the world food supply reacts less sensitive to climate change than the local food production in climate sensitive localities a larger degree of climate change would be possible if the criterion for food production would be the global food production. The economic consequence would be an increase in international trade in food products since especially the agricultural sector in temperate zones would be less vulnerable.

On the demand side, especially economies in the tropics will need to rely on incomes high enough to finance these imports. This is especially important because these regions often rely to a significant degree on subsistence agriculture which does not require a cash income for meeting nutritional needs. Hence, an expansion of the share of agricultural products which is exchanged on markets will disproportionately hurt the poorer parts of these societies. This process may become even more severe, if the overall food supply slightly decreases. In this case due to the low price elasticity of demand, prices for food will increase strongly. As a consequence there is an increase in income of the food exporting countries at the expense of the importing countries.

In the opposite, such adverse distributional consequences would be reduced if the local food production were to be secured through a constraint on climate change much stronger than

under the global food production constraint. Yet, the strong constraint on climate change itself probably requires drastic cutbacks in the emissions of greenhouse gases which itself carries significant costs. E.g., such cutbacks may limit economic growth to such an extent that local food production may be preserved but incomes would be insufficient to generate the necessary demand. Hence, it threatens the other restriction in Art. 2 UNFCCC, the ability to pursue economic growth in a sustainable manner. This will be discussed in the following sections.

1.2.2.5 Securing food production – summary

Securing food production is hardly a problem of a shortage of world wide production capacities. Even a growing world population could theoretically be supplied with sufficient food. The main problem consists in regional imbalances and insufficient purchasing power of people in poor regions. The decision over which regional scale food production should be secured therefore involves a trade-off between a strong focus on local food availability through subsistence agriculture and a world market for agricultural products.

Whereas a choice to secure local food production might impose a very restrictive climate policy with potentially high negative impacts on incomes due to comparatively high costs of climate policy, a global focus on food production tends to ignore the distributional ethical aspects of people having no access to affordable food supplies.

1.2.3 Sustainable economic growth

The third qualification for the degree and speed of reduction in the emissions of greenhouse gases relates to economic welfare. The timing of climate policies should be set in such a way that it enables "economic development to proceed in a sustainable manner" (Art. 2. UNFCCC). The obvious presumption that a restriction on the emissions of greenhouse gases will slow down economic growth is taken as a fact, although there may be instances in which this is not the case.

There has been a discussion about the question whether the wording of Art. 2 ("economic development to proceed in a sustainable manner") could be interpreted as a requirement to enable sustainable development. The essential difference is the following: "Sustainable development" encompasses economic, ecologic, and social objective, whereas "sustainable economic growth" would only require to achieve relatively undisturbed economic growth in the long-run, i.e. sustainable economic growth.

Although this issue is open to interpretation, we choose the narrower definition of sustainable economic growth in the sense of long term economic growth. The main reason is the observation that the three constraints – natural adaptation of ecosystems, secure food production, and sustainable economic growth – together could be interpreted as a commitment to sustainable development. Enlarging the focus of this last constraint to sustainable development would make the interpretation of the other two constraints difficult. It would be hard to distinguish the constraints on ecosystems and food production from the last on sustainable development. In the following, the discussion is purely in the realm of sustainable economic growth.

1.2.3.1 Sustainable economic growth – regional scales

In the context of the UNFCCC which is a treaty signed by sovereign states it appears to be obvious to restrict the regional scales to areas such as nation states. As obvious as this definition of regional scales may sound at first, it may result in strong implications if taken literally. For some of the Small Island States the requirement of limiting GHG concentrations to levels such that climate change impacts should be limited so such a degree that economic development can proceed in a sustainable manner may be impossible to achieve. Some of these states are threatened to be erased through sea-level-rise and extreme weather events, probably even if strong actions for reducing the emissions for GHG were taken worldwide. In addition adaptive measures against climate change impacts may be so costly that they most likely are detrimental to sustained economic development. Consequently, such states will inevitably need to rely on international support. For the interpretation of an appropriate regional scale for determining the provision of sustainable economic development it seems necessary not to apply the principle of nation states literally but to use larger regional scales.

The opposite extreme to the regional disaggregation at the level of the nation state would be the condition that the world economy should be able to grow in a sustainable manner. Although, at first sight, such a global approach may look as if it were to ignore regionally differing outcomes, it focuses on an important issue in climate policy, namely efficiency. Since GHG emissions and the subsequent climate change are global problems in terms of the causes, it is clear that a reduction of GHG emissions should be considered with a global focus as well.

The presumption that the concentration of greenhouse gases should be stabilized and this can only be achieved with a significant reduction of GHG emissions means that on a worldwide scale economic activities need not be adjusted and most likely need to be scaled down

somewhat. The requirement of not interfering with sustainable economic development first of all means that climate policies should be designed in a way which achieves a desired path of emissions at lowest costs. All economic models find that this would require the participation of practically all economies in the emissions reduction efforts. Hence, policy proposals such as the first commitment period of the Kyoto-Protocol with only partial reduction commitments can not reach efficiency. As a consequence they impose a larger burden on sustained economic growth of the world economy than in a case, where all economies able to participate are involved. The Kyoto-Protocol, of course, was not intended to be a cost minimizing policy, but was a compromise on a first step, acknowledging the special responsibilities of industrialized countries as laid out in Art. 3.1 of the FCCC, of a long-run series of treaties. This example of a worldwide focus on the constraint for stabilizing the concentration of greenhouse gases shows how much the impact of meeting such a constraint depends on the actual policy chosen. Economically inefficient policies would therefore result in a slower path towards a desired level of greenhouse gas concentrations in order not to violate the ability to assure sustainable economic growth. Even if growth concerns of single economies are ignored for the moment and only the world economy is considered, the provision in Art. 2 on sustainable economic growth is conditional to the actual policies pursued. This indicates a trade-off between the GHG concentration that can be achieved without violating the economic growth constraint and the efficiency of climate policies chosen.

The choice of policy instruments not only influences global economic growth, it also distributes the cost of emission reductions differently across the economies. A more disaggregated focus on national economies instead of the world economy as a whole would therefore still depend on the trade-off between efficiency of policy instruments and the achievable path of GHG concentrations. However, a number of policies, which under a global constraint would still be permissible, would now either need to be ruled out because they might violate the condition of sustainable economic development for specific countries. Or they would require a less ambitious goal in terms of GHG concentrations.

A third possibility lies in mitigating adverse economic consequences of climate policy for an economy through appropriate transfers. The commitment of the Annex B countries in the Kyoto-Protocol could be interpreted as such a policy as developing countries are not obliged to reduce emissions. In international economic affairs, it has turned out to be particularly difficult to agree on monetary transfers between sovereign states which go beyond more or

less symbolic levels. The current level of development aid is an example for this. Extending the constraint of sustainable economic development to each country – may be without such extreme cases as the above mentioned Small Island States – would then either require a less ambitious goal in terms of GHG emissions, or a much stronger burden sharing than those under discussion, or a political commitment to more efficient climate policies.

1.2.3.2 Sustainable economic growth – uncertainty

Economic development is driven by a few basic factors. First of all, long-run economic growth depends on the rate of technical progress, both in terms of increased labour productivity and in terms of the productivity of natural resources. A second major factor is the savings rate of an economy which determines the growth of the capital stock, both in terms of human and of physical capital. Thirdly, the institutional structure of a country to a considerable degree influences the efficiency with which the resources of an economy can be utilized. The development of all these influencing factors is not well understood, i.e. there is considerable uncertainty with respect to the driving forces for the rate of innovation, capital accumulation, and institutional reform. Consequently, making predictions about long-term economic development is almost impossible. And this does not yet include the occurring surprises such as civil unrest, wars and other natural disruptive events.

The interaction between climate change, climate policy and economic development is so far predominantly modelled with the help of scenario analyses, mainly because potential future innovation, especially in the energy sector and in food production, can hardly be assigned by probabilities. Similarly, savings rates – although changing only slowly over time – are very difficult to predict since they depend not only on economic but also on cultural and institutional influences. Scenario analyses are therefore the only way to illustrate and analyse potential future paths of development. However, they are persuasive only to those who share the underlying assumptions about the crucial parameters of long-term growth.

Similar to the uncertainties about technological developments there is little known about institutional changes of societies. This, however, has been found to be an important factor influencing economic growth and human welfare. In fact, most of the very poor countries suffer not only from a lack of resources and human capital, but most importantly they suffer from a lack of institutions which support and enable economic activity, i.e. legal protection, property rights, functioning markets, infrastructure, etc. (Rodrik et al. 2002).

All in all, when looking ahead on economic development over the next three to five decades, the range of possible pathways for the world economy remains quite large. The more optimistic scenarios will most likely allow quite substantial reductions of GHG emissions without a threat to sustainable economic growth. This is especially true if the optimistic scenario entails significant progress in non-fossil fuel technologies. On the other hand, under the more pessimistic expectations with a substantial rise in energy prices and a non-accelerating technical progress, a reduction of GHG emissions may involve a larger sacrifice in terms of economic growth.

If one confines the requirement of a sustained economic growth to the state level predictions become even more difficult since country-specific developments play an increasing role. Such changes depend much more on singular political events than the growth of the world economy. The range of different paths of development is larger, and consequently the vulnerability to more stringent reductions of GHG emissions may become stronger. On the other hand, if only one or a few economies are exposed to unfavourable conditions international cooperation could manage to alleviate the burden of climate policy measures on such economies.

1.2.3.3 Sustainable economic growth – inter-temporal scales

The securing of sustainable economic development addresses issues of economic growth beyond the fluctuations of business cycles, i.e. issues with a time horizon of ten or more years. Yet, even in this long-run horizon there are trade-offs and conflicts if one looks at different time scales. In the scale of 10 to 20 years the threat to economic growth will predominantly come from the preventive measures since the climate change impacts will not yet slow down economic growth. The costs of preventive measures are composed of

- the reduction of GNP due to a reduced input of fossil energy sources,
- the investment and user costs of alternative energy sources,
- the consumption loss due to higher outlays for research and development for new energy sources, and
- the adjustment costs on the way to new energy systems.

These components exert different impacts on economies depending on the time path over which the reduction of fossil fuel use and its replacement through alternative energy sources or through a more efficient energy use takes place. The faster the replacement of fossil energy by non-fossil sources is sought, the higher are the adjustment costs because existing capital

stocks with high energy intensities need to be depreciated faster than planned. On the other hand, the longer the time horizon over which the introduction of non-fossil energy supplies is planned, the more capital is directed towards fossil energy extraction and conversion installations which usually have a long life-time of several decades. This conservative technology implementation policy may give up future options for negative cost benefits (e.g., first-mover benefits). Hence, there is a trade-off between a fast move away from fossil energy sources with high scrapping costs for existing capital higher investment levels and more R&D, and a slower process that will further fix capital stocks in the fossil energy sector well into the mid of this century.

In the very long-run, i.e. over many decades, a different environment will determine economic activities. This will be characterized by a degree of scarcity of fossil energy sources which will depend on the policies pursued with respect to the extraction of these resources in the decades before. The other new aspect is the likely occurrence of climate change which will have a so far not yet quantifiable dimension. These two impacts will most likely be correlated. The more intensive climate policies have been pursued in the meantime the less climate change is to be expected and the less the scarcity of natural resources will negatively influence economic activities.

The basic trade-off between the shorter and the longer time horizons, therefore, is the following:

- Policies which impose little constraints on short term economic growth coincide with higher emissions and an increasing scarcity of fossil energy sources in the longer run.
- Policies which start mitigation early and to a significant degree will slow down economic growth in the short-run but improve the growth potential in the long-run by preserving natural resources including fossil sources and by reducing the negative impacts of climate change.

In this trade-off, the valuation of short-term versus long-term well being will be a decisive factor. This is intrinsically related to the choice of a social discount rate for comparing costs and benefits at different points in time. Trying to secure sustainable economic growth in the very long-run through today's actions is equivalent to a very low discount rate. Under a higher discount rate the economic situation far into the future would not matter. Hence, the time frame over which one chooses to make sure the economic development can proceed in a sustainable manner is intrinsically related to the discount rate which a society has chosen to adopt.

In all, securing economic development with a very long-term view may be desirable. It has, however, the problem that it can be controlled by today's actions only to a limited extent. If the increased uncertainty about long-term developments is also taken into account, it seems clear that attempts to influence economic development over half a century or more are bound to fail because of today's limited knowledge and limited influence of current activities. A focus on time scales of one or two decades will for practical reasons be more appropriate and it will be less susceptible to failure.

1.2.3.4 Sustainable economic growth – distribution effects

The choice of regional disaggregation has already been discussed above and it was argued that a global view would take account of the globalizing world economy in which negative regional impacts could be alleviated through international economic adjustment processes as well as international transfers. This rests on the more optimistic view that economies integrated into the world economy face smaller costs from negative impacts than isolated ones. In other words, a strongly unequal distribution of cost and benefits of climate change and of climate change policies is unlikely to occur or can quite easily be dealt with. This presumption, however, may not be realized in all cases. Hence, by putting emphasis on distribution effects across geographical areas one would be well advised to focus on a regionally disaggregated view of economic development.

There are also distribution effects on an inter-temporal scale as intergenerational distribution issues increasingly get the attention in the public. One of the core problems of sustainable economic development is in fact the intergenerational distribution of opportunities for economic activities and of the consequences that arise from these opportunities. These trade-offs have already been touched upon in the previous section and it has been argued that it is quite difficult to control these inter-temporal distribution effects.

All in all, if one considers the fairness of the distribution of costs and benefits of both climate change and mitigation to be an important constituent of Art 2 UNFCCC then a more disaggregate focus regionally, and even across sectors within a society, will be well advised. Similarly, concerns about intergenerational justice would suggest to both evaluate short- to medium-term development potentials and their trade-offs with the sustainability of long-term growth paths.

1.2.3.5 Sustainable economic growth – summary

The requirement to assure that economic development can proceed in a sustainable manner involves essentially two basic decisions in terms of focus, namely that on the regional focus, and that on the time scales over which this constraint is to be achieved. Both are to a large degree influenced by the uncertainties with respect to

- the factors influencing growth,
- the impact of climate change on economic growth
- differing vulnerability of economic systems to climate change.

A focus on the world economy in contrast to a regional focus on growth would make it manageable to balance the trade offs between climate policy and climate change. Such a policy would also require corrective actions for those regions losing under such a regime. These would involve international transfers which so far have not been implemented successfully in the international community to an extent necessary for ameliorating expected regional imbalances. A more regional focus, on the other hand, could lead to mitigation options where for some regions a slower climate change can be more desirable than for others. Since the greenhouse effect is a global phenomenon requiring coordinated action, these differences need to be settled in climate negotiations.

1.3 The trade-offs between ecosystem stability, food production and economic development

Meeting the three constraints of ecosystem stability, a save food production, and sustainable economic development can have conflicting but also complementary aspects. In the following the trade-offs between each pair of issues will be discussed.

Allowing ecosystems to naturally adapt to climate change and ensuring food production have surely elements of conflict. The stability of ecosystems depends to a large degree on the space available and the degree of outside influxes of energy and materials. Similarly, adaptation of ecosystems to climate change often requires space for these ecosystems to migrate to locations where they can cope with the new environmental conditions. This adaptation requires additional space unless a further loss of biodiversity is accepted. In the same way, producing food depends on the area devoted to agriculture and on the intensity of land use. Both, area and intensity, in principle conflict with the needs of ecosystems for natural adaptation.

These conflicts can take on different forms. In a very simplified fashion one could say that in industrialized countries with an agricultural sector relying on intensive practices with a high capital intensity and high-yielding crops, there is little room for biodiversity and the preservation of natural systems. This negative effect is partly compensated by the fact that the high productivity leaves room for policy measures which preserve significant areas from intensive agricultural use thus giving more space to natural ecosystems.

To the contrary, many less developed countries face a clear shortage of arable land such that little to no area is left for natural ecosystem preservation. In addition, many of the economies are located in tropical and subtropical zones in which ecosystems tend to be more vulnerable than in the temperate zones thus threatening these ecosystems further. On the other hand, the agricultural practices often exhibit a larger biodiversity and less stress to natural processes than in the intensive agriculture of temperate zones.

Securing food supplies and enabling economic development to proceed in a sustainable manner does not seem to be in conflict if one considers the historical experience. High agricultural productivity and sufficient food supplies are highly correlated with per-capita incomes, i.e. rich economies also produce sufficient food – in many cases even too much as the example of the EU shows. This happens for two interacting reasons:

- High incomes go hand in hand with advanced technological knowledge. Hence, agriculture also participates in technical progress. In fact, productivity growth in agriculture has outpaced that in industry in practically all industrialized countries.
- High incomes create sufficient effective demand and thus sufficient price incentives for the development of a profitable and modern agricultural sector.

Despite this high correlation, there remains the problem that in a situation of low incomes with little effective demand and low productivity in agriculture a regionally disaggregated focus will need to deal with strategies for moving from a stagnant economy with insufficient food supplies to a dynamic one in the face of climate change. This vicious circle of insufficient price incentives due to low incomes and low agricultural productivity has been the subject of research for a long time. The exploitation of the agricultural sector for financing industrial development has been a failure prior to World War II in the Soviet Union and in India after the war. Today it seems clear that a balanced growth policy is the most appropriate. It stabilizes traditional agriculture through programs supporting small farmers and also provides sufficient savings for the development of industry.

The question as to whether sustainable economic development can proceed without conflicting with the ability of ecosystems to adapt naturally to climate change obviously depends on the definition of sustainable economic development. If the term "sustainable" encompasses the notion that ecological constraints are to be respected in the growth process, by definition there can be no conflict. If, on the other hand, "sustainable" refers to economic development that can be maintained over the long-run in terms of only economic and social parameters, a conflict may occur. Economic growth relies to a considerable degree on the use of natural resources, either by the use of space, by the use of raw materials, or by the use of nature as a sink for emissions from production and consumption processes. Hence, ecosystems may undergo additional stress in the process of economic growth which is not directly related to climate change. Such stress would evidently reduce the ability of ecosystems to adapt naturally to climate change.

Besides the direct effect of economic growth on ecosystem stability, there is a more indirect link through the climate system. Economic growth in general goes hand in hand with increased emissions of GHGs which than negatively influence ecosystems. The relationship between economic growth and environmental degradation has been intensively studied under the heading of the so-called "Environmental Kuznets Curve". Although weak evidence has been found of an inversely u-shaped relationship between economic development and emissions of many pollutants, this has not been confirmed for CO_2. That means, one can not expect that almost automatically economies with rising incomes, will at some income level start reducing their GHG-emissions. Consequently, the trade-off between economic growth and ecosystem stability with respect to climate change will not be reduced at higher income levels.

Art. 2 also refers to the time frame over which the greenhouse gas concentration is to be stabilized at a certain level. The choice of the time frame over which the desired goal is to be reached also presents some trade offs for the three constraints discussed above. Suppose a relatively short time frame is chosen together with a moderate greenhouse gas concentration of, say, 500 ppmv CO_2-equivalents. This would surely require a fast reduction of emissions of greenhouse gases thus considerably slowing down the process of climate change.[53] Such a time frame would help to meet the constraint of a natural adaptation of ecosystems and probably that of an undisturbed food production. However, it would place considerable

[53] We ignore the case in which a further increase in emissions is then followed by a drastic reduction in order to meet the desired concentration since it is obviously not efficient to do so. A short term increase of emissions until policy initiatives bite is natural, of course.

burden on the process of economic development as it would need to be accompanied by a process of drastically increasing prices for fossil fuels and large investments in a new non-fossil dominated capital stock. Hence, it could increase the likelihood for economic development to proceed for a while in an unsustainable manner.

On the other hand, the choice of a very long time frame for achieving a certain greenhouse gas concentration could involve a prolonged process of increasing emissions and then at a later time a turn towards the desired greenhouse gas concentration. Such a strategy has been put forward with the argument that low cost non-fossil energy sources first need to be developed before the world economy can dispense with oil, gas, and coal. It is also argued that a better understanding of the climate system would also help solving the problem and would thus ask for a more long-term focus. Such a strategy would accept a continued or even accelerating process of climate change for some time and thus could threaten the adaptation of ecosystems as well as the security of food production. It would surely not disrupt the process of economic development.

These examples of alternative time frames show that not only for a specific time frame certain trade offs should be kept in mind. In addition, the choice of alternative time frames for the stabilization of greenhouse gases introduces different trade offs between the securing of natural ecosystem adaptation, food production, and economic development.

1.4 Conclusions

The three provisions of Art. 2 UNFCCC which restrict the path to and the level of GHG-concentrations in such a way that

- ecosystems can adapt naturally,
- food production is not threatened, and
- economic development can proceed in a sustainable manner

require a definition which both is precise and can serve as a means for measuring the future developments. It has turned out that in all three cases there exists quite a wide range of possible interpretations of this part of Art. 2. This problem is aggravated by the fact that different definitions will most likely result in substantially different restrictions on GHG-concentrations over time.

Different options for defining the three constraints more precisely reveal different trade-offs between different components and aspects of the ecological, nutritional, and economic spheres. Major themes that influence these trade-offs are

- the regional scales at which the constraints are to be defined,
- the degree of uncertainty that one is willing to accept when a practical definition is to be decided on,
- the inter-temporal scales over which the constraints will be looked at, and
- the extent in which distribution effects are to be included in the working definition.

These issues are intrinsically interrelated. E.g., uncertainty and time scales, or regional disaggregation and distribution effects are prominent examples for that.

It turns out that in the face of the many options there does not seem to be an obvious answer as to how to make the three constraints more precise. To the contrary, it appears as if in the process of coming to a workable definition of constraints not only technical issues such as the uncertainty and measurability of certain phenomena are of importance. Such decisions also involve ethical judgement with respect to the focus that is implied by a specific definition and with respect to the issues that have been ignored.

This essentially ethical problem has become evident by looking at each of the three constraints separately, but also when the trade-offs between the three constraints are considered.

The ecosystem constraint involves two major contentious issues:

- The decision about the appropriate geographical size and the time dimension over which the natural adaptation of ecosystems is to be met can hardly be determined on the basis of criteria from the natural sciences nor from an economic maximization perspective. Yet it has consequences for the acceptability or non-acceptability of certain changes in ecosystems.
- The notion of "natural adaptation" in an important way determines the stringency of the constraint. In the one extreme, one could define any unmanaged change in ecosystems as natural adaptation. Then any climate change induced change in ecosystems would be considered natural adaptation. Hence, the constraint is not really binding. On the other extreme, one could argue that "natural adaptation" only takes place if ecosystems are not disturbed by climate change. Then the constraint is practically impossible to meet in all cases since climate change is already influencing many ecosystems. The decision about a workable definition of "natural adaptation" somewhere between these extremes seems to involve some judgement about the value

that societies attribute to the existence and to the change of certain ecological situations. This will be subject of discussion in the next chapter.

The constraint on food production involves mainly a decision about the geographical dimension over which this constraint is met. Behind this geographical dimension is hidden a trade-off between distributional aspect of food availability and the efficiency aspect of world food production. A world production of food sufficient to theoretically feed all mankind does not seem to present a real problem. The real issue is one of local food availability which is partly but not completely a function of climate change. Some may even argue that it is predominantly a purchasing power problem and thus not in the realm of climate change. A decision about the geographical scope of the constraint will therefore also involve judgements about causes of existing and expected food shortages.

The constraint on economic development to proceed in a sustainable manner has been interpreted as a constraint focussing on sustained economic growth instead of an interpretation more in the line of "sustainable development", mainly because the three constraints together seem to encompass the notion of sustainable development.

Similar to the security of food production, sustainable economic growth when imposed on a regional level leads to a stronger constraint than when it is imposed globally. This is the case because potential regional disturbances in economic development could on a global scale be compensated by a stronger development in other regions – even though that compensation need not necessarily take place. The basic underlying ethical judgement concerns the need to actual or potential compensation for specific costs imposed on individuals or economies by climate mitigation or climate adaptation activities.

The trade-off between ecosystem adaptation and food production becomes important in those regions where there is a shortage of land and both natural areas and agriculture compete for this land. Again, this problem appears if one resorts to a relatively small geographical definition of ecosystems and regions for which food production is to be preserved. In such a case, economies with comparatively low incomes may be more exposed to this trade-off than high income economies.

There does not seem to exist an apparent conflict between securing food production and sustained economic development as far as climate change is concerned. Situations where such conflicts have arisen or might arise in the future are most likely more related to institutions which are insufficiently able to strike a balance between allocating resources towards the agricultural sector and towards industrial development.

The balancing of the need to allow ecosystems to adapt naturally to climate change and the preservation of sustained economic development presents the most obvious trade-off. The lower economic growth the lower are the expected emissions of GHG's hence the less climate change will require adaptation of ecosystems. This trade-off asks for an ethical judgement with respect to the balance between the existence and preservation of natural systems relative to the availability of goods and services produced with resources from nature.

2 Technological options

2.1 The relevance of technological options

The apparent conflict between natural ecosystem adaptability and sustained economic development gives reason to reflect the role of technology use and development as driver of the relevant emissions and as enabling means for economic development. Balancing the needs for economic development and ecosystems adaptability must therefore include questions of technological practise and innovation, too.

In consequence and more concrete: correlations of *emissions and production/consumption will have to be decoupled* by appropriate innovation and technology use. This would be favourable with respect to overall acceptability as well as specifically with regard to possible dilemmas given by interpretations of the Convention's ultimate goal and its constraints. Climate politics will therefore have to include those issues of technology use and development, which are *crucial to future emissions and accumulation of greenhouse gases*. This may be even literally deduced from the FCCC's goal to *stabilize* greenhouse gas concentrations. Among the "Kyoto-gases" to be stabilized in the atmosphere, *carbon dioxide* plays a predominant role on climate forcing. Any policy to mitigate climate change will thus have to be directed towards mitigation of CO_2-emissions if it should be *effective*. Corresponding politics will have to focus especially on the global energy system as it is the main source of anthropogenic CO_2-emissions from burning of fossil fuels. Corresponding mitigation of climate relevant emissions would include improvements, on both, the demand and supply side of energy.

However, effective mitigation of climate change may probably not be sufficient, especially with regard of potential damages from already ongoing climate change and its consequences. Therefore, considerations of technology use and development will have to be expanded to the issue of adaptation to (inevitable) climate change, too. This demand may not only result from

general prudence considerations but also from the concrete FCCC goal to prevent *dangerous* interference with the climate system (art. 2). Correspondingly, the different options to ease adaptation to some climate change effects as well as to mitigate future emissions and to immobilize greenhouse gases will have to be reviewed in more detail. Recall that respective developments towards mitigation, immobilization and adaptation are expressively demanded by art. 4 (1.b) FCCC.

2.2 Overview of relevant options

The following review of relevant technological options will consider criteria of significance, feasibility, availability and efficiency of respective conceptions. Furthermore, their compliance to the provisions of the UNFCCC and the post-Rio commitments will also be decisive for their consideration.[54] Moreover, more detailed actual assessments of technological options may be available from UBA (2002), ICCEPT (2002) and COORETEC (2003).

2.2.1 Mitigation of GHG-emissions

Basically, mitigation might be achieved by combined strategies of (enabling) rational use of end-energy as well as of efficient energy transmission and conversion from primary energy, thus improving the whole energy chain. This procedure is hoped to cut the emissions of developed countries as well as to reduce the (inevitable) emission growth of the developing countries (ICCEPT 2002). The subsequently lowered total energy demand may then be supplied by low-carbon primary energy, which might substitute conventional energy carriers in the longer run (UBA 2002), thus approaching the ultimate stabilization goal of UNFCCC.

2.2.1.1 Improvement of overall energy efficiencies

Efficiency improvements on all stages of the energy chain – although necessary as described by ICCEPT (2002) - will not prevent the release of (residual) and long-lived CO_2. But it may be favourable for getting better-off by enabling transitions towards lower GHG-emission paths. Options for lowering energy demands and reducing carbonaceous emissions encompass cost-efficient savings, mostly in transport and building sectors (e.g., by considering benefits of discharge lamp technology or measures to avoid stand-by losses of electric devices etc.) over changes of centralised energy infrastructures (use of combined heat and power stations

[54] Geoengineering conceptions, like conditioning of Earth`s albedo are thus not seen as relevant here, as they cannot be deduced from the formal demands of art. 4 (1.b) - apart from other severe objections.

and fuel cell technology in different sectors, where appropriate) to process innovations in industrial production towards integrated, energy and heat saving processes as well as in energy conversion (UBA 2002; ICCEPT 2002)[55]. Expected bulk energy efficiency improvements may approach 30 - 50% (SRES 2000).

Especially the potentials for efficiency gains of fossil fuelled power plants are remarkable, allowing for corresponding CO_2-emissions reduction. Gasification(coal)plants may reduce emissions by 50% compared to conventional coal plant technology at reasonable costs (Riemer 1995). Potentials for process innovations exist especially in most developing countries (Steger et al. 2002). Efficiency reserves of the developing world should be therefore urgently determined and consequently utilized *before* emerging infrastructures may pose locked-in dilemmas or adverse pressures to further process innovations (Dhakal 2002). Nevertheless, these benefits and gains from technology innovation may be counteracted by future increases of global energy consumption and - consequently – GHG emission (Metz 2001 et al.). According to Steger et al. (2002) a 50% decrease of specific energy intensities is necessary in the next decades solely for the compensation of projected growing per-capita and cumulative world energy demands. The authors state, that this could be achievable without disruptive effects to the economies. However, even higher efficiencies would be needed with regard of the ultimate stabilization goal. Corresponding energy intensity decreases of 75% seem technically feasible up to year 2050 but probably costly and economically challenging (Hendricks/Turkenburg 1997; Keith/Parson 2000). These projections as well as the historical record of (energy) efficiency development show, that process innovations will give necessary but limited potentials for the solution of the problem to stabilise GHG concentrations. Developments towards better energy efficiencies could therefore only serve as complementary element of a combined strategy towards the ultimate goal of art. 2 FCCC.

2.2.1.2 Fuel switching

Past substitutions of primary coal-based energy sources to energy carriers with lower carbon content (oil/gas) had already favourable side-effects for GHG-emissions. However, further fuel-switching potentials from oil to gas still exist for stationary as well as mobile energy supply, thus promising further reduction of specific CO_2 emissions, at least in the medium term (Metz et al. 2001). Corresponding paths towards extended use of natural gas seem to be cost efficient and desirable but the economic implications are more difficult: Long-term

[55] This may also include considerations on energy-saving potentials of high temperature superconductor devices to be installed in future electric power grids.

market effects of enhanced gas demands in connection with foreseeable limitations of corresponding resources might lead to increasing cost and price developments in this sector. These fears and politically hardly desirable dependencies on few suppliers might result in alternative world energy scenarios with possibly worse climatic consequences. An unfavourable scenario could be a shift towards a second coal era, enabled by the exceptionally large resources of this fuel (Nakicenovic 1998). An early indicator might be for instance, that "Russia is (already) envisaging a shift from gas to coal" for its domestic energy supply (Poussenkova/Wieczorek 2002). Anyhow, significant improvements of coal burning technology concerning CO_2-emissions are conceivable, at least in the longer run (Riemer 1995), which might reduce adverse emissions. Especially developments towards respective coal gasification plants seem promising with respect to their specific emissions (COORETEC 2003).

So, the necessary decarbonisation of energy supply and its partial decoupling from production might be initiated by quite different but complementary strategies of appropriate substitution of fuels and/or efficiency improvements of conventional energy systems.

2.2.1.3 Towards carbon-free energy systems

Aiming at overall decarbonisation will consequently have to consider backstop-technologies, with the potential to cut-off any anthropogenic CO_2 emissions – at least in theory. Nevertheless, the build-up of corresponding energy infrastructures would probably still need for fossil powered energy.

Basically, climate-neutral energy supply might be obtained from nuclear facilities. But in view of related manifold risks, the Parties to the Conference decided in 2001 to refrain from using nuclear technologies to meet the commitments for future emission reductions, which are prescribed by art. 2 of the Kyoto-Protocol (see decisions 16 and 17 CP.7). Therefore, options for nuclear fission or fusion would not be seen as relevant for the specification of the ultimate goal of UNFCCC. This leaves room for considerations of regenerative options for carbon-free energy supply.

The development and utilisation of *renewable energy options* is based on quite different sources for power conversion from solar, wind and water as well as biomass and geothermal energy. As carbon-free technologies they may be expected to be highly effective in contributing to stabilisation of GHG levels if their share reached 50% or more of the energy supply mix at the mid of this century (Hendricks/Turkenburg 1997). Anyhow, this realisation

may be questioned because of severe disadvantages of respective technologies, which could be only partially compensated: A pending problem of the majority of corresponding concepts is their relatively low energy density (Hoffert et al. 2002),[56] which would lead to substantial consumption of space and thus to potential conflicts with other land-users as well as to other environmental impacts. Another severe problem concerns the need for continuous energy support of modern societies, which may be affected by the temporal output fluctuations of most regenerative power plant types. In fact, this may be mitigated by build-up and operation of sophisticated distribution networks (Steger et al. 2002) and/or adequate storage capacity, but corresponding conceptions and infrastructures have to be developed and realised with probably high efforts. In a transitional phase, conventional power plants would have to buffer the corresponding fluctuations even beyond their energy efficiency optima. However, the above mentioned structural deficits may turn to benefits in those regions of developing countries, where *decentralised power supply* may be the adequate means to serve the specific needs of local rural communities there. Corresponding decisions and investments should therefore make use of this potential (Steger et al. 2002, UNEP 2002).

Other structural problems to be solved concern related innovative energy conversion concepts, e.g., storage and fuelling of solar generated hydrogen for fuel cell operation (ICCEPT 2002). These efforts and the problem of negative cost effects of new technologies may complicate the introduction of corresponding innovative goods and services to the energy markets (Hendricks/Turkenburg 1997). Their *market diffusion* – if reasonable and desirable – would probably need for adequate instruments, which may enhance demands for "climate friendly" options towards manufactured technology, thus leading to reduction of specific costs - favourably at levels that may be competitive to supplies from conservative technologies (Steger et al. 2002). Possibly and technically spoken, the broad establishment of (natural) gas utilization infrastructures according to the above described fuel-switching step (see section 2.2.1.2) – together with an early introduction of fuel cell technology - might ease the solution of structural problems of establishing a hydrogen energy economy to some extend.

More concrete, Steger et al. (2002) recommend especially the development of *wind power*, comparing the market potentials among different renewable energy options. Respective off-shore conceptions may solve most acceptance problems. Sustainable short-rotation cropping of trees and biomass utilisation is only seen as attractive in certain regions. Hydroelectric power is state-of-the-art and thus already at the energy market; its further extension of

[56] Low energy density, however, may also have positive consequences concerning security issues.

corresponding capacities is limited mainly due to natural and societal factors (Romiero 2002). Geothermal power supply seems to be limited to few regions. Solar power options are especially cost-intensive and currently far from broad use. Nevertheless, in connection with reliable energy storage or fuel cell technology they may be favourable for energy supply of isolated rural communities. The identification of corresponding *strategic niches* for demands of new technologies might foster further innovation also towards other promising fields of application (Stamboulis/Tsoutsos 2002). Currently, it is hardly predictable, if effective incentives for enhanced innovation have to be offered or if emerging socio-economic and technological change might automatically "lead to a more rapid displacement of fossil fuels than is conceivable" today (Rayner/Malone 1998). Installations towards low-carbon energy systems would be most cost-effective in 10 - 20 years, when larger amounts of power plants will have to be regularly replaced (industrialised countries) or built-up (developing countries), which gives reason for adequate early action of the responsible decision makers and planners (Metz et al. 2001).

2.2.1.4 Carbon capture and storage technologies

Carbon capture and storage aims also at stabilization of atmospheric carbon dioxide and might thus be seen as additional option to renewable technologies. Decarbonisation seems here achievable at the end-of-pipe and may thus serve for corresponding improvements of conventional plants. Moreover, appropriate carbon sequestration techniques may also allow to generate a transport market for hydrogen energy (ICCEPT 2002).

The principle here is the physical or chemical separation of carbon dioxide from effluent gases and its long-term storage in appropriate media. Carbon capture technologies are especially promising for application at compact and immobile emitters, like fossil fuelled power plants, where effluent gases can be efficiently processed. Anyhow, the carbon capture step is particularly *energy demanding*, thus leading to a decrease of energy efficiency around 10%. This would result in significant higher costs for energy generation and distribution. Energy costs would possibly increase around 50% for the consumers (Herzog et al. 2000). Diverse technological capture options do already exist as state-of-the-art for other industrial applications. They comprise different absorption technologies, optimised for specific partial pressures of CO_2 in the flue gases as well as cryogenic separation methods. Recovery of any sorbents is technically feasible and favourable but corresponding state-of-the-art technologies are energy intensive. Another approach would be the use of certain membrane processes, which may promise much lower energy needs und thus lower operation costs than mentioned

above. But corresponding technologies have to be developed first. Moreover, respective installation costs would be relatively high (Riemer 1995), thus possibly complicating investments into carbon capture technologies.

The diverse disposal options have to be evaluated especially concerning their risks for uncontrolled carbon re-mobilisation. Double burdens of the future from carbon-emitting technology as well as from leakages of artificial carbon sinks seem hardly acceptable.

- **Sub-marine disposal** is an option controversially discussed. Its concept relies on the idea, that controlled submarine CO_2 dumping will make use of natural processes of water carbonation by simply enhancing corresponding exchange rates between atmosphere and the hydrosphere. The concept foresees disposing of CO_2 in stable, low-circulation regimes below the oceanic thermocline (> 700 – 1000 m) in order to impede its re-mobilisation. Diverse conceptions to submerge carbon dioxide in different aggregate states exist with different consequences for transportation and disposal efforts as well as for the environment. Generally, submarine disposal of CO_2 seems to be attractive concerning the exceptionally *high capacity* of the oceans as dumps for this gas. Numerous questions may lead to the suspicion that disadvantages might predominate the benefits of this concept: Possible problems might result from carbonic acidification of the surrounding water containment and related adverse ecological effects. Climate-dependent warming of ocean waters may reduce the above mentioned sequestration capacity, at least in the long run (Prinn 1999). Furthermore, significant amounts of *leakage* and re-mobilisation of CO_2 seem to be unavoidable, as diffusion and circulation is not completely off-set in deep sea areas. Only liquid deposition of CO_2 at the bottom of the oceans would probably sustain longer (Herzog et al. 2000). Additionally, threats from spontaneous upwelling of large amounts of stored CO_2 are conceivable due to oversaturation effects. Similar fatal eruptions of natural CO_2 are known from Lake Nyos desaster and others.[57] Other problems are probably high *total costs* of sequestration if the necessary steps of carbon capture and transportation are considered.[58] Besides, most sequestration processes need development and verification of their *feasibility* (Hendricks/Turkenburg 1997). Last but not least, access to appropriate marine regions might be a severe problem for inland countries.

[57] See http://perso.wanadoo.fr/mhalb/nyos/index.htm

[58] Disposal itself seems to be relatively cheap except for the dry-ice option (Herzog et al. 2000).

- Another, possibly more advantageous option may be the **underground storage** of compressed carbon dioxide in saline aquifers or in depleted oil, gas or coal reservoirs. Their total capacity is lower than the above mentioned marine capacities but stored CO_2 would remain *more stable* here, which seems to be a crucial benefit. Other characteristics (costs, development needs) are quite similar to the case of marine sequestration (Herzog et al 2000). Anyhow, some early and promising *experience* has been gained from the Sleipner gas field practise, which enables storage of 3% of Norwegian emissions, after all (Kaiser/Schmidt 1998). Further beneficial experience stems from CO_2 pumping for residual gas production.
- Alternatively, fixation of carbon in useful **chemical products** or in bio-fuels might be also imaginable. Nevertheless, storing in corresponding products would be not permanent, considering their fate after usage. Consequently, low net benefits have to be expected by this option (Riemer 1995).

2.2.2 GHG-removal from sinks

The stabilization of atmospheric GHG-concentrations may be supported by enhancement of natural sinks for CO_2. It remains questionable if this would also allow for prolonged use of *existing industrial or energy infrastructures* and conventional processes (Hoffert et al 2002).

2.2.2.1 Land-use changes

Prominent concepts rely on changes of *land-use patterns*, in order to influence the natural carbon cycle by creating larger sink capacities for organic carbon (see also Rayner/Malone 1998).

- CO_2 assimilation by plants is an ongoing natural process, which may be utilised by adequate **afforestation or reforestation** measures and protection of existing forests. It may be questioned if immobilisation of CO_2 would be effective and sustainable under certain forestation conceptions. Actually, the assimilation/dissimilation balance is relevant here, which worsens with growing age of forests. That means either, to protect existing woods and their huge stored carbon masses but without further storage options or to *grow plantations* which have to be de- and reforestated regularly for allowing continuous carbon storage. The latter would probably conflict with the aims of the Convention on Biodiversity which has been ratified by many of the Parties to the FCCC. Another problem of this approach is that resulting wood products have to

be disclosed from the carbon-cycle, which seems to be difficult to realise on longer time-scales, despite some promising concepts (Schmidt 1998). "Slash-and-grow" procedures exclude their use in the tropics because of the adverse deforestation effects on tropical soils, thus having to leave the rain forests as they are, with their typically small net CO_2-uptake. General problems of these approaches are the run-out of fertilizers as well expected adverse impacts on plant ecology in a future CO_2-enriched and warming environment, thus leading to reduced net primary productivities (Tangley 2001; Shaw et al. 2002; Percy et al. 2002; Schimel 1998). But even singular events like wildfires or endemic forest diseases might disable desired carbon balances (Schimel/Baker 2002). Even worse, adverse albedo-effects of boreal afforestations may counteract their aims (Claussen/Ganopolski 1999). A main disadvantage of the afforestation concept is that huge plots of land are needed, which might be limited at least in certain regions. Resulting market effects might be adverse for consumers of local agricultural goods (Steger 2002) as well as for forestry and wood trade (Schäfer 2002). This would possibly also tackle the claims for food production as well as for sustainable economic development of art. 2 FCCC, at least with regard to its regional dimension. Finally, total biospherical sink capacities are relatively low, compared with other sequestration options (Riemer 1995). A best case evaluation of a biological carbon sink management might come to the overall result that (partial) offsets of GHG-increases would be only possible temporarily and on *time-scales of decades* (IGBP 1998). Existing but limited potentials for build-up of corresponding carbon pools and their trading (McDowell 2002) should be therefore only used as complementary measure to others (Metz et al. 2001).

- Another possibility to influence carbon uptake/release relations by land-use changes would be the application of appropriate **soil treatment strategies** (Mosier 1998). The goal of respective soil management concepts would be the enrichment of stable soil organic matter. The so-called "Terra Preta" phenomenon in tropical agriculture may add *black carbon* to the soil, which is expected to persist over centuries, thus acting as a stable carbon sink (Glaser et al. 2001). Nevertheless, consequences of extended agricultural practise in the tropics might become ecologically questionable. Other concepts for temperate zones propose a meta-stable fixation of organic carbon, which may be achieved by fertilisation rather with manure and compost than with artificial

fertilizers[59] as well as by reduced ploughing depths or by conversion of arable land to grassland, thus promoting build-up as well as reducing decomposition of *humus* soil components. Anyhow these procedures might be accompanied by reduced harvest potentials which may again conflict with constraints of art. 2 FCCC. Concluding from empirical evidence, saturation of carbon fixation will take place in most climates, thus limiting respective carbon-fixation capacities of soils. Moreover, warming and/or enhanced precipitation will affect the stability of humus components severely, thus probably leading to (re-)mobilizing of climate gases CO_2 or CH_4. Changing climates may therefore even question the limited potentials of soil carbon management, at least on longer time-scales. Compared to the afforestration option, the success of soil treatment measures seems to be even more difficult to monitor and to control.

One may conclude that terrestrial carbon management should rather concentrate on the protection of stocks of organic matter (wood, humus) than on the development of related but uncertain and questionable extra-capacities for continuous carbon-immobilisation.

2.2.2.2 Marine carbon-fixation

The above described problems of intentional land-use changes as well as considerations on the non-terrestrial part of global CO_2-uptake for primary production of organic carbon lead to the question if marine carbon fixation could be a considerable option. The concept foresees *iron fertilisation* of pelagic regions as they are depleted in this element, which is necessary for algal growth. Corresponding Fe – algae responses have been proved experimentally as well as from the geological record. But it remains highly questionable if desirable dose-effects can be achieved and controlled in the exceptionally mobile upper strata of the oceans (Hachtel 1997).[60] Especially the diffusion of fertilizers below solar exposed zones would cutoff any enhanced carbon-uptake, thus limiting the effectiveness of this concept. A much bigger problem would be the long-term fate and storage of any produced excess biomass. The relatively small natural marine carbon stocks may reflect this problem (Metz et al. 2001). Probably, large amounts of them will be decomposed subsequently, e.g., by microbial processes, thus releasing CO_2 back into the environment in the longer run.[61] Moreover, impacts on marine ecosystems might be expected by application of this method. Respective

[59] Giving up artificial fertilisation would also prevent so-called "grey emissions" from the exceptionally energy-demanding agro-chemistry.

[60] Apart from possibly adverse ecological consequences

[61] Enhanced di-methyl-sulphide emissions and related impacts on cloud formation may be the side-effects of algal fertilization, which remain to be assessed beforehand.

adverse affects would be in contradiction to the constraints of art. 2 UNFCCC. Therefore, further research would be necessary for the proof of this questionable concept and its consequences.

2.2.3 Adaptations to climate change

Mitigation of emissions and sequestration measures are directed towards stabilization of GHG. Nevertheless, some dangerous interference with the climate system may be still expected as the stabilization goal will not be achievable instantly: Even ambitious emission reduction paths might be accompanied by adverse climate change effects – at least in their transitional phases - due to the inertia of the climate system. Recall that several vulnerable regions and sectors seem to be already affected by recent climate change (IPCC 2001). Adaptive measures should thus improve the resilience of those endangered systems, which will not be within reach of mitigation policies in time, especially on regional levels. As a result, adaptation and mitigation are both directed towards the ultimate goal of UNFCCC by dealing with the different aspects of the same claim. They complement each other on different time scales as well as spatial dimensions.

Adaptation measures themselves aim at different time horizons, either in response to gradual trends of climate change or by resisting to threats from singular extreme events with growing probability.

- **Adaptation to gradual climate** change will encompass measures against long-term trends of warming and changes of precipitation patterns. Corresponding responses may foresee regionally quite different adjustments of urban planning as well as agricultural management and forest planning, like water-saving soil treatment, breeding and cultivation of climate tolerant crops and reforestrations with appropriate tree species, among others.[62] The defence against vector deseases is also often mentioned in this context. Related causes are nevertheless also of social nature, which might disclose corresponding strategies to the actors.

  Dyke-building projects may serve as effective means for coastal defence against sea-level rise[63] but they may be also appropriate for

[62] Moreover, non-technological options like enhancement of trade may cover some adverse climate effects on subsistence economies (see section D1).

[63] The Netherlands' experience demonstrates their potential. Nevertheless, additional efforts will have to control adverse consequences to local groundwater characteristics (surface discharge, salination).

- **adaptation to extreme events** on short time-scales, like river flooding and its defence. Re-creation of flooding space as well as adjustment of urban setting and architecture may respond to the same threats as well as for the latter to dangers of heat waves and severe storms. New reservoir capacity and other appropriate engineering options might bridge water supply gaps caused by enhanced probabilities of droughts in certain regions.

These examples for adaptation represent - together with mitigation options - *precautionary measures* which are seen as relevant with respect to the wording of art. 2: to "prevent dangerous … interference with the climate system". They might be classified as "proactive" according to the different notions of adaptation (IPCC 2001). Therefore and in contrast to this, aftercare solutions like monetary funds, insurances and tradable derivates – although generally reasonable - are not considered as relevant here because they will not address potential *dangers* of climate change.[64] They may only react and pay for already happened damages or losses of climate change, which have to be avoided according to art. 2.

2.3 Outlook: prospects of technological options

The diverse technological options could be realized on different time-scales. Their combined realization offer continuous and increasing improvements towards prevention of dangerous human interference with the climate system. A favourable set of options may be characterised as follows:

Utilization of existing energy saving potentials and efficiency improvements of the whole energy system as well as appropriate fuel switching might be valuable emission reduction options in the short-term. They should be accompanied by conservation of natural carbon stocks by means of adequate land cover and land use measures. Adaptation measures against extreme events might help the most vulnerable regions at the same time.

In the longer run, the rise of renewables (wind, biomass, solar) might enlarge their share among energy technologies significantly. Appropriate complementary energy conversion and transmission technologies (fuel cells, hydrogen carriers, decentralized infrastructures) have to be "on the shelf" in parallel. Additionally, adequate carbon capture and storage technologies (membrane technology/underground storage) may be implemented in a transitional phase towards overall decarbonisation of the energy system. In parallel, adaptation to gradual trends of climate change from past emissions seems to be necessary.

[64] Moreover, they cannot be seen as *technological* options.

Innovation and implementation of corresponding energy technologies will have to be initiated in time, regarding their necessity and availability.

E. Ethical analysis

1 Introduction

1.1 The setting of the Convention's ultimate goal

Atmospheric GHG-concentrations and not GHG-emissions cause global warming. Ultimately, what matters in regard to increased global mean temperatures is the *stock* of GHG in the atmosphere and not the *flow* of emissions. Art. 2 FCCC is addressing this stock in search for a "safe" level. The ultimate goal of the FCCC including all protocols the COP might ratify in the future is to stabilize atmospheric GHG-concentrations „at a level that would prevent dangerous anthropogenic interference with climate system". The term „dangerous" has no scientific meaning but is inherently related to normative questions. Thus, no interpretation of Art. 2 can avoid to address ethical questions (Toman 2001, p. 1).

The ultimate goal is related to three other broadly defined objectives (food production, ecosystem adaptation, economic development) which have been analysed in the previous chapter (D.) of this study. As we argue, these objectives are constraints (requirements) of the ultimate goal that can be interpreted differently.[65] Such interpretations also rest on ethical grounds. Thus, there are norms and values all the way down in any serious interpretation of Art. 2.

WG III argues that it is "impossible to establish a globally accepted level of stabilized GHG-concentration today" (TAR, WG III, p. 673). This impossibility-claim will be questioned and may be even falsified.

1.2 Different scopes for specification

Art. 2 often has been seen in conjunction with the five other principles of Art. 3. FCCC states that these principles ("common, but differentiated responsibility", "leadership of developed countries", "precautionary principle", "cost effectiveness", "sustainable development") are also guidelines for orientation which shall be followed in order to reach the ultimate goal of FCCC. First, we wish to distinguish four different scopes of interpretation and specification:

- Specification of dangerous levels of GHG only (*scope 1*)

[65] We entertain the hypothesis that the relationships which hold in between the ultimate objective and the three constraints can be made more explicit without reference to a „time frame". One may assume the time frame away still allowing its reintegration in the final step of interpretation.

- Specification of relationships in between the ultimate goal and constraints (*scope 2*)
- Specification in regard to other articles of FCCC (*scope 3*)
- Specification in regard to other UN-treaty regimes (*scope 4*)

It seems more promising to begin with scope 1 and 2, and to enlarge analysis towards more comprehensive scopes. Any attempt to proceed in the opposite direction will be bound to fail due to an increasing multitude of competing interpretations. Certainly, the network of larger scopes are the horizon of Art. 2. But this horizon is almost inexhaustible. Therefore, we concentrate on the first two scopes.

2 "Dangerous interference", question 1 of the TAR-Synthesis Report and the moral point of view

2.1 Openess of the term "dangerous"

FCCC has not specified any dangerous level of GHG-concentrations. There might have been good political reasons not to specify ultimate goals at the origins of FCCC. Originally, it has been more important to influence GHG-emissions by reaching towards a convention and, then, towards the Kyoto-Protocol (KP).[66] Meanwhile, a lot of authors argue that the missing specification should be added. A well justified specification of Art. 2 could contribute to the further development of the Kyoto Protocol, seen as a possible learning process in which a multitude of stakeholders is involved. *IPCC should address a specification of Art. 2 in the Fourth Assessment Report (FAR) of IPCC in close detail.*

TAR/WG III argues that the term "dangerous" is open to interpretation by the parties of FCCC (p. 609).[67] The enterprise of ethical interpretation rests on the presupposition that a commonly shared interpretation is within reach despite deep divergence of interests in COP.

In the humanities, interpretation is a rigid discipline. In the sciences, interpretation is looked upon differently: Interpretations seem to be "subjective" and arbitrary, compared to empirical research, controlled experiments, or inferential reasoning. We claim that interpretation should be a systematic enterprise according to epistemic standards. We suppose that not all interpretations are equally valid or "good". This assumption allows to oppose relativism

[66] The Kyoto-Protocol has been analysed by, among others, Oberthür & Ott (1999).

[67] The parties are self-interested national states (or groups of such states). The conflicting patterns of interests of EU, G77, CIS, AOSIS, JUCANZ, and OPEC have been analysed in several articles. How, then, might COP find an agreement on an interpretation of Art. 2 in the face of deep divergence of interests?

although there is strong evidence that our age seems to be rapidly heading toward cultural and moral relativism. Therefore, our approach clearly opposes relativism and scepticism, assuming that any long-term learning process in climate change policies has to rely upon some commonly shared ground. There is no long-term learning process without common ground. This common ground is common ground "for the time being".

2.2 Rational evaluation of "dangerous interference"?

Comments on Art. 2 are often very brief. Oberthür & Ott (1999, S. 33f) mention that the non-specific nature of this objective allows for different interpretations "while acknowledging the need for adaptation to and mitigation of climate change". Few interpretations go beyond such (trivial) statements.[68]

The first question of the IPCC Synthesis Report (2001, TAR/SR) asks: "What can scientific, technical, and socio-economic analyses contribute to the determination of what constitutes dangerous anthropogenic interference with the climate system as referred to in Article 2 of the Framework Convention on Climate Change?" (IPCC, SR, p. 2). The answer is poor. It sounds like a truism. IPCC argues that science can provide essential information which is needed for political decisions. It is emphasised that decisions "on what constitutes 'dangerous anthropogenic interference' with the climate systems" will be "value judgments determined through socio-political processes" (TAR, *Synthesis Report*, p. 38). There is a divide between the question and the answer because the question asks for the possible *contribution* of scientific, technical, and socio-economic information while the answer is about the *necessity* to make value-judgements. In TAR, scientific information including the all-prevailing uncertainties and confidence levels on the one side, and value judgements on the other side seem to be separated by a deep gap. We face the old Weberian conceptual dichotomy between facts and values. It is true that value-judgements cannot be derived from facts ("naturalistic fallacy") but there are many reasonable ways to support specific value judgements by *both* factual information and ethical principles. It seems as if TAR remains deeply sceptical about the inter-subjectively valid justification of (moral) value judgements. Moreover, TAR is silent about the nature of political processes by which value-judgements are determined. It remains doubtful whether the concept of political process entails any normative content.

WG II states on this general line of reasoning that no stabilization level will be suggested in TAR because science should not make value judgements. „This report does not make any

[68] The wording of Art. 2 is completely silent about adaptation.

judgements about what level of concentrations is ‚dangerous' because that is not a question of science *per se*, but a value judgement about relative risks and trade-offs" (WG II, p.77). Well informed policymakers „may" judge what levels of risks are acceptable. WG II has specified several serious threats to food security, ecosystem (and species) loss and sustainability but also wishes to be silent on the desirability on certain stabilization levels. The term "desirable" which has been used in several IPCC-statements in regard to stabilization-levels seems to suggest that value judgements are a matter of preferences. This suggestion (if there is any) would be misleading because stabilization of GHG-concentrations is a matter of intergenerational justice and, therefore, obligations.

Nevertheless, TAR mentions some criteria which might enable persons to argue for a reasonable value judgement:

- changes in extreme climate events
- possible abrupt and irreversible changes in ocean circulation and major ice sheets
- risks to unique and threatened systems
- risks associated with extreme weather events
- the distribution of impacts
- risks of large-scale, high impact events.

Obviously, such criteria are not "physical", but are related to normative questions of how to value possible extreme events, loss of natural systems, and other kinds of risks. *"Physical" criteria are intrinsically related towards ethical principles of risk assessment.*

There are two interpretations of the phrase "value judgments determined through socio-political processes" (TAR):

Interpretation 1: *Values* are preferences only. Judgements about values include trade-offs. They can't be universalised. Rationality is about personal utility maximization. States are to be seen as rational agents ("players"). Altruistic attitudes are unusual in international politics. A value *judgement* is an aggregation of weighed interests that includes assumptions about how to address risks and how to cooperate with other rational agents. Political processes are nothing but bargaining processes between rational stake-holders (states, companies, NGO etc.). The outcomes of bargaining can be explained and (to some degree) forecasted by game theory.

Interpretation 2: *The concept of value* must be distinguished into different categories. Any ethical theory must rest on a categorical framework which is much richer than the concept of

preferences (or interests) allows for. Some, but not all values are preferences. Some, but not all political processes are bargaining processes. Sometimes, it seems possible to identify commonly shared interests from the perspective of (global) citizens. Long-term environmental problems are paradigmatic examples. "Global citizenship" is not a contradiction in terms but of growing importance in our age of globalisation. Fair negotiations are ruled not only by interests but also by some ethically justified *focal points*. Some moral principles can be justified. It can be presumed that COP which have to address a common concern of mankind are to be seen as emerging moral communities which strive for a "moral law".

The first interpretation is "*realistic*", the second sounds" *idealistic*". There are as many interpretations in between both interpretations as there are political philosophies. Any agents which are involved in debates about Art. 2 should, at least, make their interpretation of phrases as "determined by political processes" or "must be settled politically" explicit and, by doing so, clarify positions in political theory.

TAR does not provide a convincing interpretation of Art. 2. On the one hand, it refuses to make a value-judgement, while, on the other hand, it mentions several high-risk criteria by which some degree of precaution seems to be recommended implicitly. It supposes an ill-defined concept of political process

A similar statement has been made by Schneider & Azar (2001, p. 1): "Precise statements of what is 'dangerous' are not possible, since (a) the degree of harm from any level of climate change is subject to a variety of uncertainties and (b) the extent to which any level of risk is 'acceptable' or 'dangerous' is a value judgement." The impossibility of precise specification is directly related to the unavoidability of making a value judgement. The crucial, but ambiguous term seems to be "precise". No argument is given why uncertainties and the necessity to make a value-judgement shall make any specification of Art. 2 impossible. A sharp contradiction between preciseness on the one hand and uncertainties and value-judgements on the other hand seems to be supposed by the authors. (Specification of norms and principles is quite common in deontic logic and applied ethics.) The authors argue that specification of dangerous level must be "settled in the political arena" but they are silent about any proceeding which might result in such settlement. As in TAR, no concept of policy-making is made explicit in this statement.

2.3 From description to prescription

IPCC argues about possible specification of Art. 2 in the following way: "The basis for determining what constitutes 'dangerous anthropogenic interference' will vary among regions, depending both on the local nature and consequences of climate change impacts, and also on the adaptive capacity available to cope with. It also depends on mitigation capacity" (SR, p. 38). It is far from clear whether SR only makes a *prediction* ("will vary") or whether it also *recommends* a "bottom-up"-approach of how specification of dangerous levels should be done. In such bottom-up approach any single national state seems free to consider from its point of view whether it (probably) would benefit ("winner") or not ("loser") by a certain level of GHG-stabilization and by emission reductions. If so, interpretation of Art. 2 will be deeply biased by such expectations and by assumptions of one's own capacities to adapt. This approach is a "centred" one because any agent assesses predictions according to his particular position. This weakens the prospects to reach a commonly shared specification of Art. 2 since prospects differ. Ethical theory, especially the concept of the moral point of view, defends a different approach which is "de-centred" since it forces anyone "to take the role of the other". A de-centred perspective ("universal role taking") seems a necessary condition for a commonly shared interpretation of Art. 2. If so, TAR is missing the ethical point.

2.4 The case for ethics

Ethics presumes to reflect on global, long-term, contested, high-stake issues *from the moral point of view* in order to provide *focal points* to future climate negotiations.[69] It does not deny scientific uncertainties and conflicting interests of parties but it looks upon them from the moral point of view. If the moral point of view is regarded as being *de-centred*, *universal* and *impartial (*and in some way *egalitarian),* one is not permitted to restrict impact analysis to one's own country. Therefore, it seems misleading if impact assessment will be directed by the question of whether one's own national state (or economy) will be among the "winners" or among the "losers" of climate change.[70] The moral point of views requires universal role taking and, thus, equal consideration of interests. A de-centred perspective can give special concern to the weak and the poor. In a de-centred perspective, other agents are perceived as equal fellows facing a common problem which affects different fellows differently.

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[69] The „focal point approach" (see Wiegandt 2001) can be traced back to Aristotle's „topoi".

[70] This perspective would be morally sound only if the moral point of view would be shaped in a strictly communitarian ("parochial") fashion. Thus, basic perspectives of impact assessment are linked to ethical considerations about the very possibility to specify Art. 2 from the moral point of view.

3 Sceptical arguments against a commonly shared meaning of Art. 2

Any attempt to specify and interpret Art. 2 seems to be bound to fail for several reasons which sceptics have pointed at. Sceptical arguments have political impacts. We claim that scepticism is never value-free. Few people are "radical" sceptics; and there are good reasons why radical scepticism is not a viable option for human beings. Scepticism is determined by implicit criteria which govern modes of both trust *and* distrust. Thus, one is entitled to ask for reasons for deep scepticism. If so, it seems fair to suppose that sometimes there might be a *hidden political agenda* behind sceptical arguments.

Whoever affirms the general prescriptive commitment of Art. 2 as "right" or "good" cannot defend radical scepticism any more. If so, scepticism must rest on reasons which are specific to the problem of specification. Thus, scepticism deserves a closer look.

3.1 The "no-knowledge" claim

The following statement given by J. L. Connaughton, Chairman of the White House Council on Environmental Quality, is paradigmatic for a sceptical attitude towards any interpretation of Art. 2 (http://commerce.senate.gov/hearings/hearings0202.htm):

> "The President has reaffirmed America's commitment to the goal of stabilizing atmospheric greenhouse gas concentration at a level that will prevent dangerous interference with the climate. At the same time, the President noted that given current scientific uncertainties, no one knows what that level is. This underscores the importance of the President's focus on science and technology."

President G.W. Bush has repeated this position: "No one can say with any certainty what constitutes a dangerous level of warming" (11/6/2001, quoted in O'Neill & Oppenheimer 2002, p. 1971). Thus, the commitment embedded in Art. 2 is both affirmed and made pointless by the President of the United States. It is argued that scientific uncertainties do not allow for any specification of a dangerous level (DL). "No one knows" says that there is no agent which has any knowledge about DL. We call this pattern of argumentation the "*no-knowledge*"-claim.[71] The "*no-knowledge*"-claim in conjunction with a "*wait-and-see*"-strategy will have the consequence that low stabilization targets (450-500 ppmv CO_2) will be out of reach in a couple of years even if progress in scientific research may provide better

[71] No reference to the precautionary approach of Art. 3 is made in this "*no-one-knows*"-statement.

reasons for them. It is clearly a moral decision to decide for "*wait-and-see*"-strategies in the case of scientific uncertainties.

Therefore, it seems fair to ask whether the problem of uncertainties has been addressed rightly.[72] It can be argued that many costly political decisions have to be made under conditions of uncertainty (for instance, war). What, one should ask, is so special about the case of climate change justifying the point of view that uncertainties should serve as a rationale for delay? Why is prevention (precaution) unjustified in the case of climate change but not in the case of war against dictators or terrorism?

At a first look, the notions of uncertainty and knowledge contradict each other. Uncertainties seems to imply the denial of "true" knowledge. Thus, the "*no-knowledge*"-claim could be simply derived from the matter that uncertainties are pervasive. This inference is true only if nothing but empirical knowledge is supposed and if probable knowledge does not count as "true" knowledge. If other sources of knowledge, especially moral (or ethical) knowledge, are taken into account, and if there is knowledge in the field of probabilities, the inference from empirical uncertainties to the "*no-knowledge*"-claim is not justified. To make the inference valid one has to exclude other sources of knowledge either by definition or by meta-ethical positions which deny that there can be moral knowledge. Sceptics have to make explicit the notion of knowledge on which their claim ultimately rests. (If the following statement is reasonable the opposition of knowledge and uncertainties is flawed: "I know that I should be cautious to go swimming in an unknown lake".)

One cannot combine coherently a sceptical emphasis of pervasive scientific uncertainties about the possibility of moral knowledge with a general optimism about technological progress and adaptive capacities, saying: "There are so many uncertainties and there is no such thing as moral knowledge but a few things we know almost for certain: Human inventiveness will always find viable adaptive solutions." If there is overwhelming trust about adaptation combined with deep scepticism about uncertainties and ethical justification, it seems fair to ask, according to which criteria trust and scepticism have been arranged this way.

3.2 Claims for "objective" thresholds

Another sceptical argument is presented as an inference here:

[72] Moreover, supporters of this claim should consider economic analyses which argue that uncertainties justify more stringent emission reductions (Pizer 1999).

1. Reasonable specification of Art. 2 must be the result of some empirical observation and measurement.
2. Observation or measurement of safe stabilization levels is not possible.
3. Reasonable specification of stabilization levels is not possible.
4. Art. 2 must remain unspecified.

Premise 1 is misleading. In some environmental cases, thresholds can be measured "objectively" if objectives are supposed (e.g., if plant-species a should be conserved in this area acidification of soil should not trespass level x), but in other cases thresholds are, by themselves, objectives or standards which have been set. It seems misleading to argue that a "safe" stabilization level must be observable empirically as a natural threshold. Economist Schmalensee (1998, p. 150) seems to suppose that such a threshold must exist "objectively out there" and must be measurable scientifically. From this (false) assumption it is easy to argue that such level doesn't exist in the climate system and, therefore, thresholds are "imaginary" (Schmalensee). Therefore, Schmalensee argues, decision-making should rely on cost-benefit analysis. Reasonable specification of Art. 2 is not committed to such "existence"-presumption. The possibility to make a well considered moral judgement on a threshold which has to be set ("*thesei*"), not to be found in nature ("*physei*") can't be ruled out by this argument.

3.3 The arbitrariness argument

It might be argued that in the end any specification must remain *arbitrary*. If any specification remains arbitrary, and since arbitrary choices can never justify obligations, no obligation to reduce GHG-emissions in order to stabilize GHG-concentrations has to be accepted. We call this pattern of argument the "*arbitrariness*"-claim. It can be combined with the *"no-knowledge"* claim as follows: Choices which are not based on "true" knowledge are purely arbitrary. Obligations can never be established by arbitrary choices.

Implicitly, a dichotomy is made between valid proofs and arbitrariness. This dichotomy should be refused. *Well considered and balanced judgements are a third possibility between proof and arbitrariness.*

Does the arbitrariness-claim means that all possible attempts to specify levels or quantify objectives are *equally arbitrary*? Such claim would be rather strong since it implies that to

choose, say, a stabilization level of 850 ppmv CO_2 is *equally arbitrary* to the choice of 500 ppmv. Only few experts would be glad with this consequence of the arbitrariness-claim.

We entertain the hypothesis that there are strategies of *arbitrariness-reduction in determining Art 2 at different scopes of interpretation*. Arbitrariness is not ruled by an "either-or"-code but can be reduced gradually. *Arbitrariness comes and goes in degree*. The hypothetical structure of all arguments cannot be equated with arbitrariness (see 3.4). If so, some interpretations of Art. 2 are less arbitrary than others. If so, COP should try to reduce arbitrariness as far as possible. In the end, some leeway for choice might remain but this will not support scepticism any more.

Consider, for instance, cases of specification as age limits which obviously are not "proven" but have been set by legal authorities. It would be strange to ask for an "ultimate scientific proof" that only persons of a certain age are permitted to marry, to drive a car, or to vote at elections. Such quantified standards and limits are – at least on the average and in the long run - advantageous to almost all persons being affected. In many realms of environmental policy-making objectives have not been proven either. The same holds true for standard in food safety or in drug administration. In a similar way, the determination of dangerous levels might be reasonable.

Obviously, there are ranges of reasonable disagreements. Rational and moral persons might disagree about a speed limit of 20 or 25 miles per hour inside towns but they would not take a person serious who votes for 65 mph. Physicists may disagree on a tolerable exposure x to some toxic substance but they would not accept if expositions are ten times as high as x. This might be similar in specifying dangerous levels of GHG-concentrations. If so, there is a "reasonable range of GHG-numbers" related to the specification of Art. 2. This range is determined by expert judgements (Tables C.1-C.3).

3.4 The hypothetical nature of specification

Any interpretation of Art 2 has to be related to assumptions about the crucial factor of climate sensitivity, about adaptation, technological options, vulnerabilities, non-linear damages, and the like. It is true that any specification will necessarily "depend" on some other assumptions (WBGU 2003b) and, therefore, must be *hypothetical*. Thus, it seems crucial to clarify the meaning of "hypothetical". The meaning of "*hypothetical*" we wish to rely on is close to the notion of "how to reach a conclusion". Any conclusion is hypothetical since it rests on premises. There must be an inferential structure which holds between premises and

conclusion.[73] If so, the hypothetical nature of any specification does not give credit to sceptical positions.

Conclusions should be distinguished into the sub-classes of *inferences* and *judgements*. Both inferences and judgements are hypothetical. The realm of normative inferences is deontic logic. The conclusion of a deontic inference can be a prescriptive statement (which entails a deontic operator) if this operator will be entailed in at least one premise. Thus, the conclusion has categorical force upon agents *and* has been reached hypothetically („given the premises"). Thus, it is a confusion to deny the categorical force of moral arguments by pointing at the hypothetical structure of inferences.

A judgement is a proposition whose relation to premises is reasonable (plausible) but not logically strict. The specification of Art. 2 will be a judgement, not an inference. It is not reasonable to ask for an inference or for a proof if the matter at stake only allows for an „all-things-considered" judgement (Aristotle). Judgements about stabilization levels must be hypothetical but can be reasonable.

3.5 Paralysis from ethical/moral pluralism?

Sceptical claims are supported by the argument that we are facing both *moral and ethical pluralism*. Value judgements may depend on a particular value-system which not all members of COP support. This, in a nutshell, is the *"plurality-of-moral-and-ethical-doctrines"*-argument. Moral pluralism is to be defined as the existence of several competing comprehensive moral doctrines. Ethical pluralism is defined as the existence of competing ethical theories (section E.8.1). The sceptical argument goes beyond the fact that there is such plurality. The decisive question is about the possibility to reach common moral judgement in the face of such pluralism. This possibility is not ruled out because similar judgements can be derived from different sets of premises. *Scepticism falsely presupposes that different moral doctrines and ethical theories are always leading towards diverging conclusions. We wish to argue, first, that there is broad convergence in the case of climate change and, second, that convergence counts.*

Consider the following case: A sceptical person S argues rightly that there are different moral doctrines and ethical theories. An ethicists E demonstrates that these broadly converge to very

[73] According to a famous definition, any reasoning which rests on problematic premises is hypothetical. Rescher: „A hypothetical inference, is, of course, an inference made from a ‚hypothesis', that is, from a proposition whose truth status is doubtful or undetermined, or from a proposition known or believed to be false" (N. Rescher, *Hypothetical Reasoning*, Amsterdam, 1964, p. 1).

similar judgement in the case of how to understand Art. 2. If so, it seems fair to ask S how her statement should be understood in the light of such convergence. S now faces a dilemma: She accepts that such convergence counts as a strong argument of how we should act (*first lemma*). If so, her scepticism has been denied. S can deny that convergence counts (*second lemma*). If so, scepticism becomes more fundamental.

According to both relativists and communitarians, there is no universal idea of justice since all intuitions about justice, equity, and equality are tied to basic cultural patterns of shaping interpersonal relations ("solidarity"). This argument which has been made by Rayner et al. (1999) had made impacts onto TAR (IPCC 2001, WG III, p. 670f). Therefore, we take a closer look.

It is argued that the demand for fairness arises from communities, and there are different cultural perceptions of what is equitable and fair. Taken as ethical argument it would turn out to be *communitarian*. Communitarian approaches suppose a basic relation of "I-we" and see individuals embedded in cultural world-views and practices. They always remain relativistic.

At a second look, it remains unclear which position has been favoured by Rayner, Malone, and Thompson (1999, p. 37ff) and how and to which extent this position has been adopted by TAR. Quoting two articles, TAR says: "It is very difficult to achieve a worldwide consensus on just on justice principle. (...) In summary, manifold equity principles (...) exist; these might be best applied as a combination to respect more than one equity position and thus enhance political feasibility" (WG, III, p. 670). TAR adds that there is a strong bias towards efficiency and, thus, for a principle which is based on neoclassical economics and indirectly on some sort of utilitarianism. The position of WG III is hard to accept. First, WG III argues in a communitarian fashion, emphasising cultural and moral plurality. Second, a "strong bias towards the principle of efficiency" is mentioned (p. 670). Where does this bias stem from? Is efficiency a moral principle at all? Is efficiency to be identified with the utilitarian principle to maximize happiness or with the idea to maximize the net present value? Why should efficiency be accepted worldwide as supreme principle? WG III gives no answer on p. 670 but on p. 672 it is argued that the notion of pareto-optimality is a broadly accepted efficiency principle.

Pareto-improvement is, indeed, clearly defined while the notions of justice, fairness, and equity are not. There seems to be a supposition in TAR that we better should take clearly defined concepts as guidelines for action. But this suggestion is misleading because *clarity of definition does not imply importance of matter*. In many cases, vaguely defined values as, for

instance, "freedom", "self-esteem", "joy", or "love" are of paramount importance in human life.[74] If there is a choice between a) a well-defined economic criterion (as "potential Pareto improvement" that is morally hard to accept, and, b) a badly defined criterion (as "mercy" or "loving understanding") it is not unreasonable to adopt b) as a guideline for action.

Summing up, TAR/WG III combines relativistic communitarianism with economic efficiency. It follows the bias it has mentioned. "In a rational world, the ultimate level of climate and thus GHG-concentrations would emerge from a political process in which the global community would weigh mitigation costs and the averted damages associated with different levels of stabilization" (p. 673). As an outcome of a relativistic approach on equity we are left with the economic idea of the "optimal climate path", presented in some political semantics. On the same page, the impossibility-claim is made with reference to Art. 2. *In TAR, ethical relativism terminates into the dominance of economical thinking. We strongly recommend that the COP should not adopt this position.*

Another version of this "plurality"-argument says that a given problem can be differently framed. Different *framings* determine the way of how the problem will be recognized by different agents. The problem will be seen through different lenses. Arguments count different according to different framings. If so, one can never identify which arguments are "objectively" better than others. The politics of climate change can, for instance, be framed as being a "burden sharing"-problem or as a "resource allocation"-problem. *But different framings are still addressing the same basic problem.*[75]

There is no "deep divide" in the perception of the climate change, as Müller (2002) argues. It is not true that the "North" perceives climate change from an "ecological view" while the South perceives it as a welfare problem. Also "Northern" environmentalists are perceiving the moral dimension of climate change as a problem of victimization (see section E.9.1), while "Southern" climate change experts do not ignore the ecological dimension of climate change (see contributions in Markandya & Halsnaes 2002). If so, there is no unbridgeable gap between different frames but a moral problem of how to take the role of the other. Thus, we oppose the "myth of the framework".

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[74] GDP can be exactly defined (and measured), but it is less easy to define "well-being" or "welfare" but it is reasonable to argue that well-being is more important than growth of GDP.

[75] There are no framings as such but there are distinctive framings of certain real-world problems – as there are different linguistic world-views but one common physical reality.

The *plurality-of-moral-doctrines*-argument should be addressed as follows: Traditional moral doctrines entail moral principles (as the "Golden Rule") which should govern interpersonal face-to-face-relations (family members, neighbours, poor people, strangers, widows and minorities, and the like) or principles to guide the relationship between man and God.[76]

Most traditional moral doctrines are unable to cope with the specific features of contemporary global and long-term environmental problems. Moral and religious doctrines whose origins stem from the "Achsenzeit" (Karl Jaspers) must be essentially incomplete in our age. Religious doctrines, on the other hand, have intrinsic capacities to perceive contemporary moral problems. Therefore, it seems possible to adjust moral doctrines to contemporary problems. This has to be done "from inside". *Therefore, one should not point at the diversity of doctrines as such but should take a closer look on statements addressing climate change which really have been made from, say, Christian or Buddhist traditions.*

The second aspect of the sceptical argument is about the *plurality of ethical theories*. There is such plurality but this does not imply that different ethical theories must come to different conclusions in every case. It is also possible that similar or even identical conclusions can be drawn from different ethical theories. *Sceptics underestimate options for convergent judgement.* Thus, an overlapping reasonable consensus about the meaning of Art 2 including a stabilization-"number" remains possible despite ethical divides. Such a consensus would be an agreement "at the surface". *If so, one should take into close account the very possibility of reaching ethical convergences in the climate change debate*.

3.6 Subjective assessments of trade-offs

One may wish to argue that there will be huge overlap in the probable consequences of different stabilization levels but the economic costs of more stringent stabilization levels will raise steeply if, say, 450 ppmv CO_2 will be chosen. This being so, there must be *trade-offs* between stabilization levels and opportunity costs. Costs associated with stabilization levels are also uncertain. Is misleading to argue that consequences of climate change are highly uncertain but costs will be certainly "prohibitively high", "enormous", "unbearable" etc. Nevertheless, low stabilization levels come at a price. Any serious choice entails trade-offs. Trade-offs are related to many factors like different interests, degrees of risk-aversion,

[76] The most general principle which has been found in different religious doctrines is the "Golden Rule". The "Golden Rule" is not specific to the Jewish-Christian tradition. The moral principles of the Kantian tradition in ethics presume to be improvements of the Golden Rule. If so, there is some convergence between religious moral doctrines and deontological conceptions in ethics, at least at the layer of general principles.

expectations about the impacts of climate change to one's own welfare-function, level of wealth, assumption about vulnerability, meaning of environmental quality in relation to other social goods, assumptions about capacities to adapt. These many trade-offs will be balanced by different rational actors differently and this will make an common agreement about the very meaning of Art. 2 (almost) impossible. We will call this argument the "*different-trade-offs*"-claim.

3.7 Perceived facts: resignation as conception?

It might be argued that political agreements on "what constitutes dangerous levels" should not be expected. Ethical efforts are politically irrelevant. We call this pattern of argumentation the "*no-agreement-possible*"-claim. It assumes that climate policy is "political" in the sense that what really counts are state-interests and power. This argument is empirically true but conceptually unsound. It confuses the search for common moral ground with the distribution of power and with the factual inequalities in bargaining power. The argument ignores that fair procedures as well as ethical arguments are often designed to overcome conditions of unequal political, social and economic power. Many "grand arguments" in the history of moral and legal thinking have been made under political circumstances of that kind: "But the mighty X will never agree on this proposal!" (freedom of faith, end of slavery and torture, democracy, citizen's rights, rights for women, "one man, one vote" etc.). Many political institutions are results of "sunk" ethical debates. Political scientists underestimate the long-term impacts of ethics. Even in short-term analyses the relationship between state's interests and their roles in climate politics differ. Neo-realistic approaches are at some pain to explain why some countries continue to take a pioneering role in climate policy which is not in their prudent interest. *The ongoing process of environmental regime formation at large doesn't support sceptical claims.*

3.8 The new position of WBGU on Art. 2

In a recent report (WBGU 2003b), the following statement is to be found: "Because of pervasive uncertainties it would be too early to determine tolerable level of [GHG]-concentrations. WBGU recommends to act upon low and, thereby, ambitious concentration levels (below 450 ppmv)" (our translation). The decisive argument WBGU gives for his recommendation has been made in a similar wording in Schröder et al. (2002, p. 178). There seems to be an incoherence between the denial of determination and the recommendation itself. This position is repeated on p. 77: "WBGU recommends not to determine a final

concentration level in the negotiations as a "safe" level according to Art. 2. WBGU recommends a different strategy ("Absicherungsstrategie"): First, concentration levels below 450 ppmv should be targeted at." (our translation). If the distinction between final concentration levels and low levels "for the time being" is emphasized there might be no contradiction. Implicitly, *WBGU favours a determination "for the time being"*. There is no need for an "eternal" determination. (It is an unfortunate way to put this truism in a wording which seems to be a self-contradiction.)

3.9. Conclusion

We now can combine these sceptical claims to the following statement: "There can be no empirical knowledge of stabilization levels. Specifications of dangerous levels entail necessarily value judgements. They must remain arbitrary. Interpretation probably won't come to an end. There is moral and ethical plurality. Calculations of trade-offs will almost certainly lead to different results. Setting standards by agreement will not be successful. Procedures will not result in an agreement. Mighty states might refuse any proposal which is not in accordance with their interests." This statement seems to be impressive at a first look, but not on a second, more closer look. This statement purports a peculiar policy suggestion: In climate negotiation we should not concentrate onto Art. 2 or Art. 3, but should better address more concrete topics of instruments as JI, CDM, adaptation funds, emission trading, sinks, and the like. This political suggestion ignores the problem which level of GHG-concentrations will be the final result of such "muddling-through"-strategy. Without final ends, climate-policy will be pursued in a sequence of *ad-hoc*-solutions. The portfolio of instruments will change according to circumstances of all kind.

Clearly, emission reductions under the Kyoto Protocol make sense even in the absence of a specification of Art 2 but the outcomes of "muddling-through" policies will be as least as arbitrary as a considered judgement.[77] If the Kyoto-Protocol will not be developed to more stringent commitment periods and if no "backstop"-technology will diffuse in 2040 or 2050 globally, as Lomborg hopes, the atmospheric GHG-concentrations might be well above 700 ppmv CO_2-equivalents at the end of this century**.** This is more than the "2xCO_2-world" and much higher than almost any levels proposed in the literature. *"Muddling-through"-strategies also have to face the problem of arbitrariness. Thus, it seems unsound to be highly critical*

[77] Without any comprehensive long-term strategy there is a threat that COP and IPCC could just perform their own "business as usual" in the years to come. COP could become a „show that must go on".

about the "arbitrariness" of any specification of Art. 2 made by a considered judgements and to accept uncritically the outcomes of "muddling through".

Interpretation of Art. 2 cannot rest on the claim only that sceptical arguments are far from being convincing. Interpretation must rest on substantial ethical arguments which have not been made yet.

4 The structural inter-relationship between ultimate goal and constraints

4.1 Avoidance, precaution and consequences of their moral persuasion

The ultimate objective of Art 2 is about a goal to avoid some state of affair (dangerous GHG-concentrations). Such upper limits (caps) are not ideals which should be reached.[78] Consider the case of a speed limit. If there are additional circumstances (rain, fog, darkness) it might be better not to drive as fast as the speed limit allows for. But there are no circumstances (except for cases of emergency) which permit to drive faster. If one is legally entitled to pollute a river to some degree, it doesn't follow that it is good to do so.

We hold, that humans have no experience with global climate change at all. The risk is unique. Thus, it seems obvious that the *precautionary principle* has some force upon the interpretation of the ultimate objective. The precautionary principle should not be confused with personal degrees of risk aversion. The more moral requirements are entailed in the precautionary principle, the lower the stabilization level must be chosen. This is to ask how many precaution we owe to members of future generations.

The three constraints are in some sense more „ultimate" than the stabilization level itself. Even if there were no danger of climate change at all, it would be a) obligatory to secure food production on different scales, b) important to protect ecosystems and biodiversity, and c) right to make economic development to proceed in a sustainable manner. These three objectives remain to be valid objectives even if all threats from climate change are assumed away. Thus, we face four objectives. Three of them are requirements of the fourth objective which is the ultimate one in the context of climate policies only.[79] The different

[78] To say that we should not tolerate a level of pollution higher than x does not mean that it is good to reach x exactly. It will be better to reach $y < x$.

[79] A remark on terminology: Economists prefer to speak in terms of *constraints* while ethicist speak of *requirements* that must be met. For convenience, we use both terms as synonyms.

interpretations of these requirements are relevant to the meaning of the ultimate objective. The general structure of Art 2 is this: *Three basic requirements (constraints) must be obeyed simultaneously in the overall course of action which is devoted to reach specific non-dangerous GHG-levels.*

There is a structural relationship which holds between requirements and ultimate objective: *The more moral requirements are entailed in the three constraints the more stringent and pressing the postulate to reach low stabilization levels will be, if the prospects for adaptation are rather bleak.* The opposite relationship also holds true: If the moral requirements embedded in the three constraints are weakened it will be permitted to reach higher stabilization levels. The more environmental values are entailed in the "ecosystem-adaptation"-constraint, and the more "food security for vulnerable social strata" is entailed in the "food-production"-constraint, and the more "non declining natural capital rules" are to be entailed in the "sustainable development"-constraint, the more cautious the approach towards stabilization levels *must be.* If we should keep all ecosystems in good shape in their spatial niche, we have to opt for very low CO_2-stabilization levels (WBGU 2003b).

If there are such structural relations one always has take a moral position. If so, the relationships as such are morally inescapable.

The wording of Art. 2 places the phrase „time frame sufficient to" in between the ultimate objective and the three objectives. Most experts argue that the 21. century will be decisive. Politicians and experts are now entering debates about investment strategies in the energy sector (coal, natural gas, renewables) which will determine the GHG-emission until 2050. There are many possible pathways of how to (re)structure energy supply systems. High GHG-concentrations at the end of the century will trigger climate change for hundreds of years. Therefore, the time frame encompasses only a few decades.

4.2 Possibility, necessity and limits of adaptation

On the layer of general strategies, Art. 2 seems (at a first look) to focus on mitigation and on emission reduction, not on adaptation. On a second look, however, adaptation could also prevent that certain GHG-levels will become dangerous to humans. The wording of Art. 2 does not exclude the option to prevent dangerous levels by means of adaptation.

As all experts agree, *some* adaptation must occur since some impacts from climate change seem already unavoidable. Success of adaptation measures relies deeply on the amount and on the speed of climate change. Efforts to adapt will be more successful if climate change will be

smooth. Adaptation strategies can either rely on ecological, societal or on technical adaptation measures. The literature is not very explicit on the different modes of adaptation (spontaneous or politically induced), on trade-offs between mitigation and adaptation, on the different costs of both strategies, about the cultural dimension of adaptation, and on the details of complementarity. Research on adaptation is in its origins. A conceptual anatomy of adaptation has been given by Smit et al. (2000).

Sometimes, there seems to be a hidden socio-biological approach in the background of adaptationism: If the world changes, human systems must learn to cope with changing environmental conditions. If they succeed in doing so, the are „fit". If not – so sorry. One should not ignore that the concept of adaptation has its roots in evolutionary biology. The interpretation of Art 2 should be free from suggestions which stem from a socio-biological approach. At least, such suggestions should be made explicit.

4.3 The uncertainty-lemma of adaptation

Some argue that the global society in 2100 will be much richer than today's society and therefore be better equipped economically and technically to adapt to climate change.[80] It is argued that economic growth will improve the overall adaptive capacity of almost every country in the longer run. Thus, one should better invest scarce resources in future adaptive capacities than in mitigation measures today. This argument is relevant to the specification of the „time frame" mentioned in Art 2 because some economists favour a „first-get-rich!"-strategy that implies delay of mitigation.

Climate change will not occur in a future world which will be different. But this does not imply that adaptation might be an easy task to future societies. „Many ‚adaptationists' see no need to study adaptation in any special way, simply trusting the invisible hand of either natural selection or market forces to encourage adaptation (Kates 2000, p. 6). They simply take it for granted that adaptation will be a success story.

Mitigation could be one of the most important requirements under which adaptation strategies might be successfully performed.[81] Recent empirical studies (Eakin 2000, Kates 2000) strongly suggest that the economic and social costs of adaptation should not be underestimated. Adaptationists should consider the many problems, risks and side-effects of

[80] Mendelsohn (2001, p. 168): „Developed countries can substitute technological innovation and capital for climate".

[81] It shall be kept in mind from the beginning that adaptation might be costly, and that adaptation requires institutional and cultural capabilities. See the contributions in Kane & Yohe (2000).

technological, societal, and ecological adaptation more carefully than they have done so far. There are many uncertainties related to adaptation. The following questions are unresolved yet:

- Which general epistemic approach should be adopted in order to assess adaptation capacities?
- What, if the capacities for adaptation are not sufficient to avoid serious damages even at rather low stabilization-levels (550 ppmv CO_2)?
- How can costs of mitigation and adaptation be compared?
- How important are cultural barriers?

It seems inadequate to restrict adaptation to simple cases as dike-walls. *Adaptation should be addressed by more interdisciplinary research.. Economists have no special competencies to assess the details of specific adaptation strategies.*

5 Obligations to future generations

5.1 Introduction

Any interpretation of Art. 2 presupposes some assumptions about obligations towards future generations. On the other hand, climate change is a paradigm case of how to apply such obligations. Nevertheless, as Partridge (1990, p. 40) has rightly noted, a „future ethics“ (a justified doctrine of which principles, criteria and standards should govern contemporary actions in regard of posterity) is full of sophisticated puzzles which are due to the non-actuality of posterity. Besides some problems of defining terms, any future ethics can be organized around the following topics (Krebs 2002):

- Are there any obligations to future generations at all?
- Should the ethical approach toward future generations be egalitarian or not?
- How should risk and uncertainty be addressed?
- What kind of and which amount of certain goods belongs to a fair intergenerational bequest package?

5.2 No-obligation arguments

There are some so-called „no-obligation“-arguments which deny obligations towards future persons. They have been analysed at length in recent literature (Schröder et al. 2002, p. 153ff). According to this analysis, none of the „no-obligation“-arguments deserves much

ethical credit.[82] For the time being, we are entitled to believe that obligations to future generations have to be recognized. *Future generations have moral claims upon us in regard to climate change.*

5.3 Moral standards in future ethics

It is often simply taken for granted that, on the average, future persons should find living conditions and life prospects which are „at least as good" as the prospects we contemporaries have had. Following Krebs (2000), we shall define any approach in future ethics which adopts such „*at-least-as-good-as*"-standards as being „comparative" and "egalitarian". Opposed to egalitarian and comparative standards are „absolute" standards which only oblige us to bequeath the basic conditions of a decent human life. Comparative standards imply more stringent obligations than „absolute".

To non-egalitarians, equality as such has no intrinsic moral value (Frankfurt 1997). Anti-egalitarians argue that there is no moral problem of the very difference between the rich and the poor as long the average life prospects of the poorer persons are quite well. This holds true between generations also. If all generations have decent life-prospects there is nothing wrong if some generations have better ones. If "absolute" standards are combined with some optimism about adaptation, stabilization levels must not be low. *If "comparative" standards are to be combined with the precautionary principle, only low stabilization levels (< 450 ppmv CO2) can be justified.*

5.4 The egalitarian perspective

The underlying debate is about the *intrinsic value of equality*. In some realms of practical reasoning we accept egalitarian standards, as equal treatment of persons at court, as an equal freedom for any person to live autonomously, as negative duty not to discriminate persons because of of their race, sex, religious beliefs, and the like, as equal access to positions and offices. Every person has a strong moral claim to be treated with the same respect as any other person (principle of impartiality). In other cases we accept a *presumption in favour of equality* which implies a burden of proof for those who wish to distribute certain goods unequally.

The ethical problem of how to relate *equality and equity* also is of paramount relevance for the distribution of emission entitlements. Egalitarian principles might have some implications for the fair distribution of scarce goods in general or for common pool goods in particular as it

[82] The many shortcomings of „no-obligation"-arguments does not allow for an inference that there *must* be obligations to future persons since the possibility of a convincing „no-obligation"-argument is not ruled out.

has been suggested by Hinsch (2001). WBGU (2003b, p. 27) argues that egalitarian principles with regard to emission entitlements can be derived from the human right of equal treatment but makes no attempt to explicate this derivation. According to ethical standards of justification, the argument offered by WBGU is poor. If so, the WBGU's justification of "Contraction & Convergence" is, at best, a *non sequitur*.

A "non sequitur" can be healed by adding the missing premises. Gosepath (2001, p. 422) has argued that a presumption in favour of an equal distribution of goods can be derived from formal principles of justice in conjunction with an obligation to justify any pattern of distribution morally, and with a burden of proof. If this derivation will be found acceptable, there will be a strong argument for an equal distribution of common pool goods and, thus, for a *per-capita*-allocation of GHG-emission entitlements („convergence"). Some ethical and conceptual support for such derivation is given by Ott (2003b, p. 188-193). We will not deepen this topic here, since we deal more with contraction than with convergence.

5.5 Can discounting justify high stabilization levels?

Nothing influences long-term assessments and cost-benefit-analyses more than the *rate of discounting*. This has been exemplified at the case of global climate change and the calculations of Nordhaus' DICE-model. If the rate of discounting is chosen equivalently to the rate of interest the remote future will be neglected almost completely. There are many expressions of uneasiness with discounting (see the contributions in Hampicke & Ott 2003).

Discounting is part of an instruction of how to calculate the *present net value*. Discounting future events is often being shaped economically as a rational choice between two „normal" investment projects. The problems of mitigation are treated as investment decisions.[83] This commercial shaping is misleading and inappropriate for problem-solving with respect to long-term decision-making (Randall 2002, Ott 2003a).

5.5.1 Discounting why?

The following reasons are made in order to provide a rationale for discounting:

1. impatience and myopia
2. economic and technological progress

[83] Lind & Schuler claim that global warming is not „a typical investment decision that can be analysed entirely using discounted cash flow methods" (1998, p. 63). Cooper in his reply to Lind & Schuler continues to treat mitigation actions as typical investment decisions (with far too low rates of return). Cooper argues that a rate of discount of about 10% (!) should be applied to climate change.

3. diminishing marginal utility
4. the phenomenon of interest
5. risk and uncertainty
6. environmental benefits of discounting

Analyses of such justification are to be found in Hampicke & Ott (2003). We just wish to reflect upon the argument about growing *abundance*. Take the following two propositions.

1. If we assume that future generations will be better off, we are permitted to discount.
2. If we assume that future generations will be better off in some respects, but worse off in some other respects we are permitted to discount all the former respects but not the latter.

The first proposition can be warranted by optimistic assumptions about progress. But the argument is very general. The second proposition supposes that complex and shifting patterns of growing scarcity *and* growing abundance in different parts of the world will be more likely to occur than an overwhelming pattern of diminishing scarcity in all respects which are relevant to the quality of human life. The second position fits better into the best-available future scenarios (freshwater, urbanization, migration, population growth, desertification, deforestation, and the like). Moreover, it is misleading to treat environmental goods whose scarcity is growing as commercial goods whose scarcity is diminishing. If natural capital is getting more scarce in the future we are not permitted to discount matters which we regard as being components of (critical) natural capital. *Unmodified discounting implies severe accounting errors.*

5.5.2 Reasonable procedures addressing long-term problems

If the simple logic of ordinary discounting is rejected one has to make room for adjustments. Price proposes that discounting should be undertaken „at rates specific to products, income groups and time periods, according to predicted scarcity relative to present scarcity“ (1993, p. 325). Parfit (1983, p. 36) argued that the reasons given in favour of discounting should „be judged separately, on their merits. To bundle them together in a social discount rate is to blind our moral sensibilities“. A proposal of how debates about discounting are to be structured, has been made by Ott (2003a), p. 18). In all such proposals, the rate of discounting becomes *dependent on a set on contested assumptions*. If so, the *calculation technique* of discounting should be replaced by *reasonable discourse-oriented procedures* of addressing long-term

problems (see Hiedanpää & Bromley 2002, Ott 2003c). *Dialogical considerations of how to interpret Art 2 should not become biased by references to discounting.*

6 "Physical criteria" for interpretation

Often, the "2xCO_2"-case has been adopted as upper limit of GHG-concentrations. This adoption turns an assumption which has been chosen for convenience in modelling into an general objective. If no moral reasons for choosing a „2xCO_2"-limit are given we face an *epistemic fallacy*. „Tolerable windows" which only rely on long-term ranges of global mean temperatures face the problem of a *naturalistic fallacy*.

If it is supposed that the increase of the global mean temperature should be restricted to 2-2.5°C compared to pre-industrial levels and some assumptions about climate sensitivity are made, one can infer roughly that the GHG-concentrations should not exceed 550 ppmv CO_2 (low climate sensitivity) or should not exceed 400-450 ppmv (climate sensitivity medium or high).[84] By such derivation, the problem of „dangerous levels" has been shifted from a stabilization level to a warming threshold. One can calculate hypothetically from warming per decade (< 0.2° C) , increase in global mean temperature (< 2° C until 2100), and stabilization levels (< 450 ppmv).

There are some approaches to interpret Art. 2 by relying on so-called *physical criteria*. O'Neill & Oppenheimer (2002) mention three kinds natural systems:

- Coral reefs as endangered and unique („charismatic") ecosystems with high economic value (tourism) and high degrees of biodiversity.[85]
- Disruptive outcomes as the disintegration of the West Antarctic Ice Sheet (WAIS).
- Decline of thermo-haline circulation (THC).

The authors attribute increase in global mean temperature that (with some certainty) would prevent damages to these systems: „A long term target of 1° C above 1990 global temperature would prevent severe damages to some reef systems. Taking a precautionary approach (...), a limit of 2° C above 1990 global average temperature is justified to protect WAIS. To avert shutdown of the THC, we define a limit at 3° C warming over 100 years" (O'Neill & Oppenheimer, 2002, p. 1972). The authors assume that the full protection of coral reefs is

[84] The decisive factor in this (loose) inference clearly is the assumed climate sensitivity.

[85] As it seems, there are two perspectives on coral reefs: Coral reefs are seen as unique systems and as indicators for other sensitive systems.

already out of reach but some could (probably) survive if low stabilization levels could be reached. In a next step, GHG-stabilization levels are related to different ranges of how global mean temperature (GMT) may increase due to the uncertainty in regard to climate sensitivity:

- 450 ppmv CO_2 ≈ 1.2 - 2.3° C GMT
- 550 ppmv CO_2 ≈ 1.5 - 2.9° C GMT
- 650 ppmv CO_2 ≈ 1.7 - 3.2° C GMT

Whoever puts a high existence value, bequest value, or (as physiocentrics do), intrinsic moral value on coral reefs, must be (ceteris paribus) willing to favour an upper limit 450 ppmv CO_2. Whoever has a high degree of risk aversion in regard to WAIS and THC must opt for 550 ppmv CO_2. The opposite line of reasoning and criticism is also valid: Whoever wishes to defend 650 ppmv CO_2 must be willing to defend, *first*, the certain loss of the coral reefs and many other species and ecosystems, and, *second*, willing to accept the risks related to WAIS and THR. Nevertheless, it is remarkable that in the public sphere of reasoning no one seems willing to defend, say, 750 ppmv CO_2-eq as being not (too) dangerous.[86] O'Neill & Oppenheimer favour stabilization concentrations as close as possible to 450 ppm CO_2. They argue that a delay in substantial emission reduction risks foreclosing the option of a stabilization at 450 ppmv CO_2. The same position has been adopted by the WBGU in its special report on Kyoto, supposing a criterion of maximum warming per decade (< 0.2° C) which is justified by assumptions about probable damages in the realms of food production and ecological adaptation (WBGU 2003b).

7 Aristotelian solution and salience-criterion

Let us consider proposals of how to find a reasonable interpretation at *scope 1*. We start with two strategies: a) *Aristotelian* and b) *salience-oriented* strategies.

[86] An exception is Thomas Schelling who argues as follows: „A huge uncertainty that will make any lasting regime impossible for many decades to come, however, is how much carbon dioxide can safely emitted over the coming century. A reading of the evidence – including climate sensitivity, regional climate change, likely severity of impact, and the effectiveness of adaptation – suggest that the highest ceiling for carbon dioxide concentrations, beyond which damage would be unacceptable, is probably between 600 und 1.200 parts per million." This is a rather extreme position not because of the 600 ppmv CO_2 which are slightly above the „2xCO_2" but because of the paramount difference in between 600 pmmv and its doubling (1200 ppmv equals roughly 1400 ppmv CO_2-eq).

7.1 Who knows best?

In chapter A.6 we presented an overview of which stabilization levels have been proposed in the literature. If one would be permitted to specify a stabilization level just by „*adding-and-dividing*" the numbers being proposed one would easily get a number. This could be regarded as being be a reasonable „common-sense-of-experts"-solution. Supporters of an Aristotelian ethics could argue for this „*experts'-mean*"-solution, saying that different groups of scholars which have reflected the topic of GHG-levels won't make recommendations which are completely unreasonable. *Experts are regarded as being experienced on the matter at stake and, therefore, are entitled to propose judgements since a definite proof cannot be given*.[87] A solution which would be in the middle of such reasonable recommendations deserves some moral credit. One should compare „*experts'-mean*"-results with results of a Rawlsian „*veil-of-ignorance*"-argument in order to see whether both approaches converge.

A majority of experts is sympathetic with 450-500 CO_2. Aristotelian philosophers might agree on this number "for the time being". The remaining problem is whether prudent Aristotelians should better treat feasibility as being an external barrier (obstacles) to the realization of a moral judgement or as being an internal aspect of the value-judgement itself. *Since the judgement is about "dangerous interference", feasibility is, in principle, exogenous.*

It might be replied that the history of science is full of examples which strongly indicate that a huge majority of scholars had been completely wrong. Thus, the trust in experts may commit a „*conventionalistic*" fallacy. The argument about errors of scientific communities takes it's paradigm examples from pre-modern science and, thus, must be supplemented by more specific arguments about the contemporary climate change debate. Analogies between the „Galileo case" and IPCC are superficial. If there have been errors of scientific communities, it doesn't follow that we face an error here. No inference can be drawn from the sceptical argument to a conclusion that the minority of "climate sceptics" are on the right track (see Rahmstorf 2003 for a critique of climate sceptics).

7.2 The salience criterion

A proposal which relies on a „*salience" criterion* has been made by Schüßler (2002). It shares a feature with Aristotelian approaches: Parties should take a commonly shared interest to find a reasonable meeting point under circumstances which do not allow for a scientific proof. Schüßler argues as follows: If the range of stabilization should be in between the natural

[87] The capacity of making judgements is the result of deliberation; "prudence" is inter-subjectively shaped.

variability of climate change (from 9.9 to 16.6 °C), and if only the upper half of that range still can be reached, reasonable persons which are unable to communicate with each other but are knowing that each party searches for a meeting point will decide to choose this „meeting point“ exactly in the middle of the upper half of the range. This meeting point will be „salient“ because it allows actors to prevent from overstepping the “forbidden” value of 16.6 °C in advance, considering the inertia of climate warming. Given the “salience”-criterion, the middle of the upper half of the range of natural variability should not be trespassed without obligations to act. This would imply a concrete result, if applying the values of Petschel-Held et al. on which Schüßler relies. The difference between 9.9°C and 16.6 °C is 6.7 °C. The meeting point c will be roughly 15°C. This value is below present global mean temperature. *Schüßler's proposal would imply that we are already obliged to act in advance against warming beyond the forbidden margin (16.6 °C)*. According to the “salience”-criterion we are forced to act now. The “salience”-approach seems to converge with the results of Aristotleanism. Aristotleans and supporters of the salience-criterion can find a solution without entering theoretical ethical debates. The Aristotelian solution remains *pre*-theoretical because it denies that there are „theories“ in ethics. The „salience“-solution is (in some sense) *post*-theoretical since it presupposes that ethical debate will not reach a final consensus. We, therefore, turn to theoretical approaches now.

8 Consequentialism

8.1 Overview

All four objectives of Art. 2 can be addressed by prescriptive disciplines as economics and ethics. If so, general conceptual approaches both in ethics and in economics can be used in order to specify the four objectives of Art 2. There are several competing ethical theories. A distinction should be drawn between deontology (e.g., Kantianism), contractianism and consequentialism (f.i., utilitarianism). There are similarities between ethical consequentialism and economic theory. In this section, we focus on ethical theories but we also take economic approaches into account briefly.

Utilitarianism and deontology both wish to avoid metaphysical or theological justifications. They both claim that, *first*, moral obligations are “overriding” and that, *second*, that the moral point is opposed to egoism; it is instead: universal, impartial, and, in some sense, egalitarian. The moral point of view should not be confused with the many moral belief-systems. It is essentially a perspective of impartial benevolent consideration and of (universal) role-taking.

8.2 Consequentialism

The core idea of *consequentialism* is the idea to *maximize* something which is „good in itself". To specify what can be said to be „good in itself" is the task of consequentialist axiology. Normally, the axiology of consequentialism is about mental states, as pleasure and pain (classical utilitarianism) or (dis)satisfaction of preferences. Consequentialism implies an orientation at different possible future states of the world (SW), since states of the world are seen as „locations of good". A state of the world in which a higher amount of goodness („utility", „pleasure", „satisfaction of preferences") can be reached is *morally* better that any other state with a lower amount of goodness. States of the world must be compared to the different amount of goodness they bring about. Thus, consequentialism relies deeply on predictions and forecasts.

8.3 Neoclassical economics and other programmes of maximisation

We will distinguish between *three kinds of maximizing ethical theories*. The first is the ethical theory which *might* be presupposed in *neoclassical economics*. The second theory is *classical utilitarianism*. It has been applied to climate change by John Broome (1992). The third might be labelled „*welfarism*". An welfarist approach has been recently applied to climate change (Lumer 2002, see below). Utilitarianism and welfarism ask which *hedonic changes* to certain locations of good climate change may bring about.

8.3.1 Neoclassical economics

There is a crucial bifurcation. Either neoclassical economics entails an ethics or it does not. If a) economics is seen as a model-theory with some axioms, proofs, and a formal apparatus it can be denied that economics can be contribute to moral questions. Economics, then, is nothing more than a set of models which are useful to investigate market behaviour at different scales. If b) economics is understood as a theory about how to maximizing net present social welfare or a theory about rational behaviour, there will be some prescriptive elements at the core of the theory. After debate, we decided to hold that economics does not entail any ethics.[88]

[88] The problem of an „ethics inside of economics" has been investigated in some detail in the contributions to Bromley & Paavola 2002.

8.3.2 Cost-benefit analysis

To deny that there is such an „ethics of economics“ implies that cost-benefit-analyses never should be decisive in affairs of moral weight (Randall 2002). The ongoing debates on cost-benefit-analysis (CBA) have led to the result that cost-benefit-analysis either tries a) to encompass *all* factors which are related to welfare in monetary terms (*comprehensive CBA*) or b) restricts itself to factors which can be measured by a „money-measure“ (*restricted CBA*). If possible damages are ignored, it doesn't follow that such damages are to be valued zero. *Restricted* CBA can, at best, be one piece of information in policy-making.

Comprehensive CBA is devoted to the idea of an "optimal path". This idea has been often applied to climate change, most prominently by Nordhaus. As it has been argued by many authors the ideal of an "optimal path in climate policy" implies an impressive "to-do-list" of how to monetarize the following factors:

- aggregation of different impacts
- discounting (social rate of discount)
- composition of the damage-function in order to address non-linear behavior of eco-systems
- costs of non-linear damages and of catastrophic surprises
- costs of possible socio-political consequences (migration, riots, political instability)
- comparison between costs of prevention and adaptation
- social consequences of adaptation
- estimation of adaptive capacities (capacity building)
- monetarization of endangered ecologic services and loss of biodiversity
- costs of possible damage by migratory species
- costs of real compensation
- links between adaptation and other economic trends
- estimation of future marginal costs
- costs of diseases and prevention on health risks (malaria)
- impacts on environmental assets (water, soil)
- estimation of ancillary benefit of mitigation policies
- costs of insurances
- monetarization of human life (VOSL-problem)
- economic evaluation of distribution effects which make the poor worse-off

- economic evaluation of a turn from a meager livelihood to no livelihood at all
- equity factors in cost-benefit-analysis

Therefore it is misleading to argue that Nordhaus' modelling attempts (DICE- and RICE-calculations) have found the "optimal solution" and should be taken as a clear normative standard (Lomborg 2001, p. 307). It is false that all other modellers have produced "more or less the same results" as Nordhaus (ibid.).The opposite is true: It has been demonstrated that modifications in the basic assumptions made in the DICE-model (damage function, rate of discount) can prove almost any climate-policy "optimal". Furthermore, it is misleading to argue that the costs of catastrophic events are included in the RICE/DICE-models, as Lomborg does. It is true that "Nordhaus attempted to consider extreme events by assuming that global economic damage from climate change is proportional to the temperature change raised to the power of twelve" (Schneider & Azar 2001, p. 25). This increased the optimal abatement level from 9 to 17 %.

Since, *first*, there is no „ethics of economics" and, *second*, the „to-do"-list embedded in the very idea of a comprehensive CBA is really impressive, and, *third*, Lomborg's prescriptive interpretation of Nordhaus' results does not deserve any scientific credit, we feel entitled to rule out the option to find an economic optimal path in climate policy (see also Schröder et al. 2002, ch. 3.2; SRZ 2002, Tz 527).

The wording of Art. 2 seems closer to standard-price-approaches. If so, the safe stabilization level would provide the prescriptive standard. Economists, then, should conceptualise bundles of means (JI, CDM, emission trading) by which this standard can be reached at lowest possible costs. This *should* be the meaning of "cost effectiveness" in Art. 3.3 FCCC.

CBA should be replaced by more discourse-oriented approaches. Several authors have argued along this line (O'Riordan 1997, Hiedanpäa & Bromley 2002, Ott 2003). Such approaches fit coherently into a discourse-based ethical framework (section 8). Cost-Benefit-Analyses are not well designed for cases of uncertainty and ignorance. Hanley & Shogren (2002) argue, that in the case of climate change we do not even know the shape of the damage curve. The authors recommend to find ways of combining participatory settings (as citizen juries) and best-available concepts of environmental evaluation. Randall (2002, p. 60) argues that CBA should be decisive for such issues only where „no overriding moral concerns are threatened." Climate change obviously falls into the class of issues which touch moral concerns.

8.4. Classical utilitarianism

To *classical utilitarianism* the moral point of view is seen as a calculation which course of action might result in the greatest possible difference between pleasure (satisfaction of preferences) and pain (dissatisfaction of preferences). Since moral rightness is directly related to the amount of goodness which can be realized, it is assumed that there is a prima facie moral duty to realize the state of the world with the highest amount of goodness and the lowest amount of badness. Utilitarians have to ask which interpretation of the four objectives of Art. 2 probably will maximize the overall difference in between pleasure (satisfaction) and pain (dissatisfaction). Utilitarianism does not permit discounting of utility. Any unit of utility counts the same irrespectively of its location. In principle, suffering of animals must be integrated in the overall utility-function.

As an ethical theory, utilitarianism faces two dilemmas:

1. Either its maximizing-principle will be constrained by deontological principles or it will not be constrained.
2. Either preferences will be constrained by some assumptions about „immoral“ or „anti-social“ preferences or preferences will be qualified only by their intensity.

8.4.1 Arguments against unconstrained utilitarism

Several arguments against unconstrained utilitarianism which are supported by much literature are outlined here:

1. The utilitarian protection of individuals rests on uncertain grounds. Individuals can, in principle, be sacrificed in order to maximize the overall sum of utility. In unconstrained utilitarianism the so-called „utilitarian sacrifice“ (Frey 1984, p. 8f) will have no limits except utilitarian ones.
2. Utilitarianism might destroy the identity of individual persons since it may imply a „disuniting metaphysics of personhood“ (according to Broome 1991, chapter 11). It must be supposed that a person „is in some way made up of temporal stages“ (Broome 1991, p. 231).
3. Utilitarianism implies a „double standard“ in morals since only a small group of utilitarians (Hare’s „archangels“) will be devoted to the „true“ ethical theory while most ordinary persons should believe in some ordinary Kantianism. Hare’s „split-level-view“ is close to such „double standard“.

4. Individuals are locations of units of utility only.
5. If speech acts are to be seen as quite normal acts among other types of acts, the maximizing-good-principle would have to be applied to speech acts. This would imply a duty to perform only speech acts which maximize the good. This would be incompatible with the idea of truth.
6. Utilitarianism is over-demanding in other respects. Normally, all persons are acting morally wrong since they could almost always perform a „better" course of action.
7. Utilitarianism implies a „*repugnant conclusion*" in regard to global human population since it would be morally right to enhance the human population as long as the sum of utility can be maximized by adding more people.

In sum, unconstrained utilitarianism can not be defended as a sound ethical theory. Nevertheless, utilitarians can contribute to the ethical case of climate change, as they have done (Broome 1992).

8.4.2 Towards criteria of welfare

Welfare-functions of utilitarian ethics differ from economic welfare functions. An *economic* welfare function is defined by the heroic assumption that utility is a function of consumption of commercial goods only. The utilitarian welfare-function is defined by the amount of happiness, well-being, satisfaction, and the like. Utilitarians have to assess all kinds of dissatisfaction climate change may cause. Utility-discounting is not permitted. Utilitarians have to integrate the suffering of conscious animals in the hedonic welfare-function. The "sustainable-development"-criterion is defined by a "non-declining-utility-over-time"-rule. The loss of ecosystems count morally only if this loss has any impact to hedonic changes.

Utilitarians oppose hedonic changes which bring about enduring and/or intensively felt pain. Starvation, loosing members of family, being victim of extreme events, spread of diseases, loss of property, societal disruptions, migration, and the like, affect the overall social utility-function for worse. John Broome (1992) argues that the overall pain and suffering which climate change probably will bring about cannot be outweighed by the benefits of economic growth. He argues that all utilitarian welfare functions come to the same result. *If so, there is an strong internal convergence in utilitarianism towards low stabilization levels. No utilitarian can agree upon high stabilization levels.*

8.5 Welfarism

Welfarist approaches are „non-classical“ utilitarian approaches. Damages and benefits are not simply aggregated but damages and suffering often get a special moral status. Welfarism will give some weight to justice and to equity considerations because the experience of unfairness often creates anger and, thus, is a hedonic change for the worse. Welfarism rejects the utilitarian premise that the „best“ course of action is always morally obligatory (Lumer 2002, p. viii). By doing so, the problem of utilitarian sacrifice can be resolved. Welfarists also wish to emphasize liberties, opportunities, capacities, options for access, and other dispositional “goods”.

8.5.1 Hedonic axiology

Lumer has argued that there is a moral duty „to implement the most stringent, politically feasible norms for greenhouse gas abatement“ (2001, p. ix). Lumer is right in emphasising that probable consequences of climate change like migration, social conflicts due to scarcity of resources, loss of property by natural desaster and catastrophy, fear of loosing beloved persons, overall worsened conditions of life are negative hedonic changes.[89] Lumer distinguishes the following losses in well-being:

- casualties, including casualties from migration or from deteriorated conditions of living or by economic ruin
- injuries
- diseases
- absolute poverty
- famine
- psychic suffering through catastrophes[90]
- psychic suffering through worsened social climate
- suffering by worsened conditions of life or by inconveniences of daily life
- suffering by facing threats

Lumer draws attention to other important topics like the distribution between losses which have to be borne by individuals and losses which are „socialized“ by national aid programmes (2002, p. 41). He concludes that the hedonic changes of unrestricted climate change will be

[89] Just imagine the feelings of persons who have lost their property by natural disasters (storm, flood, forest fire).

[90] As it could be noticed in the days of the great flood in Saxonia in the summer of 2002 such events cause significant hedonic changes.

mostly negative. If so, welfarists are committed to avoid negative hedonic changes. This commitment justifies low stabilization levels.

8.5.2 Abatement options

Lumer distinguishes four abatement options in regard to global emissions:

1. Business as usual
2. Stabilization of emissions at the 1990 level
3. "Strong" reduction (-25%) until 2015 compared to the 1990 benchmark
4. "Sustainable" reduction (-60%) until 2035 compared to the 1990 benchmark

Lumer argues that welfarists should favour option 4. He also argues that there is strong convergence between welfarism, Kantianism, and a "neminem-laede"-approach (2002, p. 85). Lumer sees great unanimity in ethical theories if they are applied to different climate policies (2001, p. 80). We believe that Lumer is on the right track. There is no disagreement between classical utilitarians (as Broome) and welfarists (as Lumer).

8.5.3 Problems of welfarist calculations

Lumer's argumentation rests on several empirical calculations of damages which are „best guesses".[91] He guesses that „business as usual" might result in about 100 million additional deaths in between 2050-2075 due to climate-related catastrophes (441.000), droughts and famines (37.5 millions), malnutrition due to increased prices (52.5 millions), hot spells (almost 6 millions), malaria (1.25 millions), absolute poverty due to economic ruin (roughly 60.000).[92] Four million additional deaths each year would outweigh the number of victims of wars, natural desasters, and terrorism. *Given such numbers, "business-as-usual" and "wait-and-see"-strategies are morally wrong*.

To welfarism, the hedonic welfare function of wealthy people is not much affected for worse if some possible additional gains were lost. Utilitarian, welfarist and Kantian ethicists agree that it is not over-demanding to a wealthy person to perform a non-victimizing course of action if he has to "sacrifice" only a possible additional future benefit. *A non-victimizing long-term climate policy is not over-demanding to the rich.*

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[91] Lumer is cascading conservative assumptions, does not take adaptation capacities into account, neglects the possibilities of global aid, and guesses mortalities in a highly speculative fashion.

[92] There is no need to consider Lumer's „iceberg-hypothesis" („physical injuries roughly correlate with the number of deaths, only higher", p. 32) or his calculations about losses in welfare by no-deadly damages in close detail, since 100 million additional deaths in 25 years are obviously unacceptable.

9 Deontology

9.1 Overview

Deontology can be conceptualised in different ways. In a narrow interpretation of deontology, (unintended) consequences of actions doesn't count much. Deontology, then, is equated with „Gesinnungsethik" (*sensu* Weber). A more convincing definition is to be found in Frankena (1973, p. 15): „Deontological theories deny (...) that the right, the obligatory, and the morally good are wholly, whether directly or indirectly, a function of what is non-morally good or what promotes the greatest balance of good over evil." Deontology claims that the core of morality cannot be caught by the idea of maximizing the good.

The „*Handbuch Ethik*" (Düwell et al. 2002) subsumes following ethical theories under the headline of „deontology": a) Kantianism, b) discourse ethics, c) Rawls (1971), d) Gewirth (1978) and e) contractarianism. We do not regard contractarianism as being a kind of deontology (section E.9). We wish to defend a broad understanding of deontology.

9.2 Moral claims and *prima facie* principles

Generally, deontology assumes that persons have some valid moral claims upon others (not) to be treated in certain ways. A common feature of deontological ethics is to justify moral principles which explain what we owe to each other. The moral point of view is considered as a perspective which allows („us") to identify a set of *prima facie* principles. Such set, as such, does not allow for conflict resolution. It must be supplemented by some priority-rules. An elaborated theory of moral conflict and of priority rules for conflict resolution is still missing in ethics.

9.3 Discourse ethics

To Kant, the core of deontological ethics entails the Categorical Imperative. After the so-called „linguistic turn" in philosophy, such ultimate principles are to be found in the commonly shared practice of moral reasoning itself. This idea has been worked out towards a ethical framework by so-called „discourse ethics" (Apel 1976, Habermas 1991, for overview see Gottschalk-Mazouz 2000). The core of discourse ethics which is justified by reflective arguments explains the internal relationship between moral validity and ideal or unconcerned agreement. The concept of a discourse is related to a joint effort to assess the force of a body of relevant reasons. In discourses, all consequences can be taken into account. Preferences and interests can be judged and evaluated inside debates (e.g., a difference between luxury

and basic-need-emissions (*sensu* Shue) might be proposed, or the interests of highly vulnerable groups might be found more pressing). Morality is seen as being protective to the overall identity of individual persons.

Outcomes of practical discourses are becoming part and parcel of a reasonably justified conception of morality. By moral reasoning general principles can be found as being *prima facie* in everyone's best interest (Mason 2000). Such highly general principles and norms can be used either as imperatives for action (*direct use*) or (*indirect use*) as criteria, weighing rules, and „focal points" in special debates about law, policies, societal goals, and the like. This requires a public sphere of deliberation and a civil society. Real debates are guided a) by the procedural *rules of discourses*, b) by *principles* which have been justified on higher layers of moral debate, c) by the best-available scientific *information* including uncertainties, d) by the *interests* of the parties being affected. Even if principles as such are in anyone's best interest, it does not follow that the application of principles to specific issues will result in „win-win"-situations which benefit all. This is clearly true in the case of climate change.

From the discourse-ethical perspective, there is a *primacy of arguing over bargaining*. True moral problems can't be solved by bargaining. Bargaining is related to bargaining power while arguing ideally neutralizes social power and tries to overcome private interests. Bargaining is a second-best solution. The distinction between arguing and bargaining and the ethical priority of argumentation makes room for ideas of how to resolve conflicts by, say, *fair negotiations*. Fair negotiations have to be distinguished from narrow bargaining. The idea of fair negotiations in climate policy, as it has been proposed by Henry Shue, fits quite well in the discourse-ethical framework. Fair negotiations presuppose the procedural rules of discourse and the outcomes of moral debates. Shue (1992) argued that negotiations should be constrained by ethical principles and moral considerations. *If not, leverage will be decisive – and this is unacceptable in ethics.* If, by means of argument, a certain interpretation of Art. 2 could be justified, this would be a focal point for further negotiation of the Kyoto-Protocol. *To discourse ethics, the ultimate objectives of FCCC should be set by means of argument while concrete proposals, details of instruments, and measures might be negotiated. If so, one cannot argue for high stabilization levels on moral ground.* There are hardly any *arguments* to be found except Lomborg's which is deeply flawed (Ott et. al. 2003).

9.4 Arguments against victimization

Deontology must be able to take *consequences* into account. In a broad deontological framework, consequences and side-effects of actions will be evaluated *in the light of*

principles. *There s a strong presumption against any kind of victimization in deontology.* Anthropocentric deontological environmental ethics have been often conceived as approaches which oppose environmental victimization. This presumption strongly holds in the analyses of vulnerable regions and social strata.[93] O'Neill (1997) has put the presumption against victimization into a moral principle to reject injuries. The outcome of victimization is better to be described as „injury" than as „suffering" (Williams 1997, p. 6). To O'Neill*, there is a fundamental obligation not to make injury a principle of lives and institutions*. This principle indicates a negative („perfect") duty.

Since FCCC is to be seen as an institution, the principle to reject injuries holds for COP. O'Neill distinguishes, *first*, between cases of direct injury and the more sophisticated forms of indirect environmental injuries, and, *second*, between gratuitous and systematic injury. To O'Neill, rejecting environmental injury is a matter of limiting indirect injury. CO_2-emissions which can be regarded as kinds of indirect injuries to others, are at best gratuitous and at worst systematic ones (1997, p. 137). As our knowledge about impacts of climate change grows, the kind of injury turns into a indirect but systematic injury. *High GHG-emissions are a kind of systematic indirect injury.*

This principle to reject injuries can be specified to a set of negative prima-facie-obligations which are found acceptable to most ethicists:

- respect for the life, health, personal identity, self-esteem, pursuit of happiness and property of other persons (Kant: „perfect duties")
- respect for human rights („right based morality")
- not to cause damages (*neminem-laede* principle)
- not to lie, deceive[94] or fraud
- equal respect and equal consideration for all being affected
- some commitments to reciprocity and universalization
- fulfilment of essential conditions of agency
- obligations to give aid in cases of emergency
- special concern for disadvantaged groups

[93] This presumption only supposes moral obligations. It does not suppose a individual legal right to a decent and unchanged environment.

[94] It might be argued that an obligation not to behave as a free-rider might be encapsulated in the norm not to deceive. If so, deontology could give an argument why free-riding is wrong while the free rider is behaving completely rational from the basic economic model.

Deontologists have to organize their interpretation of the four objectives of Art. 2 in the light of these principles and under the presumption against environmental victimization.

If the burden of climate change probably falls onto vulnerable groups whose members didn't contribute to the problem at stake, this „burden sharing" can be perceived as a clear and unjustified case of environmental victimization. *The principle against injury strongly supports a "polluter-pays"-approach.*

9.5 Right based ethics

For the purpose of this report, it seems acceptable to include a „right based morality" into a broad deontological framework. A system of human rights can be justified by several non-exclusive patterns of ethical reasoning (Rawls 1971, Gewirth 1978, Dworkin 1984, Habermas 1991, Nida-Rümelin 1999). Nida-Rümelin argues that five types of human rights have to be accepted in the following hierarchy (ranking):

- right to live
- basic human rights
- citizen's rights
- environmental rights
- property rights.

According to „right-based" ethics, human rights are „trumps" which can not be overridden by societal goals (Dworkin 1984). Rights are based in legitimate moral claims. It has been often argued that there are material prerequisites which must have been fulfilled if rights are to be performed. The undernourished, the sick, the illiterate, the heavily exploited persons can not really perform rights. Thus, these material prerequisites must be met. One can make a proposal that „food production" should be interpreted along this line of reasoning ("food safety") which is very close to the „basic-needs"-approach and which is also entailed in the „sustainability"-constraint (section E.14.2). A moral right to nutrition (including freshwater supply) is supposed by many UN-declarations.

A right to a safe and decent environment has been also established by many UN-declarations. This presumptive right is „soft law" but it has some impacts to the interpretation of Art. 2. Humans can not be separated from natural environments completely and have to continue metabolism with nature. It is difficult to make such a right to a decent environment a legal right at court, but it should be recognized as a „soft" universal moral claim.

A puzzling problem is about how to interpret the relationship between individual rights and collective risks. The moral problem of „statistical lives“ has not been reflected in deontology very deeply. It is well known since SAR that the “value of a statistical life” (VOSL) deeply influences the calculation of „optimal“ climate policies. From the moral point of view, any human life counts (*prima facie*) as exactly the same as any other human life (the problem of „human marginal cases“ is assumed away here). To Kantians, any *individual* human life is beyond price. It is true, however, that our practices imply that *statistical* human lives are to be valued economically (medicine, technology, traffic). This is not a logical contradiction, since individual and statistical lives are of different kind. The moral problem remains, *how safe is safe enough if individual lives are “beyond price” and statistical lives are not*. *To deontologists, there is a strong presumption for precaution entailed in the structure of the problem itself, because in the end statistical lives turn out to be individual victims (some ontological problems remain).*

9.6 Positive and negative obligations

Many ethicists may argue that it is an easy task to produce a list of values, rights, principles, and the like. Real moral problems are not about values and principles as such, but are about ranking and weighing them in cases of moral conflict. Pogge (2002) has argued that our moral convictions presuppose the following hierarchy of moral reasons:

- negative obligations not to do injustice to other persons (according to the principles mentioned above) are paramount and overriding,
- positive obligations to help (give aid, support) are imperfect obligations.

Positive obligations are permitted to be graded in relationship to *closeness* (temporal, spatial, personal) while negative obligations are not. The obligation against committing injuries is a negative obligation. One crucial bias in international affairs is the common perception that our duties to people in developing countries are positive obligations to give aid. Because of the permission to grade positive duties in relationship to closeness it seems as if our obligations to poor people in developing countries have less weight than other obligations. Things look different if poverty and misery abroad would have to be regarded as injury and victimization which is - at least partially – caused by Western institutions (as GATT and WTO). If this is the case (a big „if“, indeed), there would be strong moral claims upon Western societies

resting on negative obligations. And if so, obligations not to threaten living conditions in developing countries would have to be rather strict.[95]

10 Rawls' theory of justice and climate change

Rawls' theory of justice (1971) has been often applied on environmental matters (Singer 1988, Luper-Foy 1992, Thiero 1995) even if Rawls himself has not focused on such matters. According to Rawls, principles of justice shall be chosen in an *original position* which is fair. This position is characterized by the *veil of ignorance*. The persons behind this veil are free, rational and mutually disinterested. They are deprived from any information about their individual features, their life prospects, their social status and their concept of the good. The agents will have a general sense of fairness, and some concept of moral self-esteem.[96] Rawls argues that free and rational persons are going to choose the following basic principles:

- „First: each person is to have an equal right to the most extensive basic liberty compatible with a similar liberty for others.

- Second: social and economic inequalities are to be arranged so that they both (a) reasonably expected to be to everyone's advantage, and (b) attached to positions and offices open to all" (1971, § 11, p. 60)

The principles are *ordered lexicographically*: Rights trump equal and open access, and both principles trump the so-called „difference principle". This lexicographic order is supplemented by an interpretation of the difference-principle. Rawls argues in favour of an egalitarian interpretation. The difference-principle implies to maximize the social good at the lowest „normal" social position in a given society. Applied to risk evaluation the difference-principle becomes a „minimax"-criterion (section E.12.5). To Rawls, it seems reasonably to avoid an outcome which could place persons under horrible living conditions.

10.1 Applicability of the veil-of-ignorance method

The thickness of this Rawlsian veil can be varied according to different problems. If the veil is to cover the geographical location of birth and the period of one's life time, persons are

[95] It should be remembered that the Lockean *proviso* to leave „enough and as good" resource for others had been originally conceived as a negative duty.

[96] The problem how much morality is endorsed under the veil is contested and we can not hope to solve it here.

deprived from information to which generation they might belong. Thus, the veil of ignorance can be applied to „future ethics“.[97]

As Rawls argues, the persons in the original position are reasoning about a *just saving schedule*. In Rawls‘ theory they share some basic knowledge about how the factory of society works. From ecology they could have adopted some basic knowledge about how human societies depend upon natural endowments, including climate system. Thus, it seems in good accordance with the basic structure of Rawls’ theory to vary the veil of ignorance so as, *first*, to cover any knowledge of one’s location of birth in both space and time and, *second*, to include general knowledge about climate change. Now, one can apply the „veil-of-ignorance“-method to the specification of Art. 2.: *Which stabilization level would one like to choose if one does not know at which location and in which period of time one would have to exist. Which interpretation of the three requirements would one prefer under such conditions*?[98] We feel safe to assume that rational persons will not opt for high stabilization levels.[99]

11. Practical convergence of ethical theories

11.1 A remarkable convergence

There is a strong convergence in between the positions most experts took in the COP8-questionnaire as their own positions (annex), the Aristotelian „experts‘-mean“-solution and the outcomes of Rawlsian tests. Such convergence results in low stabilization levels (slightly below 450 ppmv CO_2). Such convergence counts, since a coherent ethical picture is about to emerge from different lines of reasoning. There is a quite remarkable convergence in between welfarists, utilitarians, deontologists, and Rawlsians to interpret Art. 2 in favour of low stabilization levels (450 ppmv CO_2). Ethical analysis has a result: The hedonic-change-approach, the principle against injury, the “veil-of-ignorance”-test, and the Aristotelian solution are converging toward a common interpretation of the ultimate objective of FCCC. The Aristotelian solution encompasses the convergence of expert’s groups. If ethics has to

[97] Originally, there was some confusion since Rawls said that the persons under the veil are „contemporaries“ which act as representatives of „family lines“. Rawls confused the idea that one can the original position can be adopted at any time with the idea that the persons under the veil are contemporaries. If this ambiguity will be resolved the Rawlsian method can be applied fairly well to „future ethics“ and to principles of climate policy.

[98] Would a rational agent, for instance, accept an interpretation of the „food-production“-constraint that addresses global yields only?

[99] Rawlsian tests which had been performed in some graduate courses in environmental ethics at the university of Greifswald always resulted in stabilization levels below 450 ppmv CO2.

speak a word in climate policy, there should be a low stabilization level. Usually, 450 ppmv CO_2 are regarded as being "low".

11.2 But what about contractarianism?

This convergence does not include contratarianism. To contractarians, the principles of morals are to be derived from bargaining between rational persons. All the duties which contractarianism recommends should to be endorsed in each individual's well-considered reason, understood as prudent egoism. It is advantageous for all agents if every single agent conforms to some moral and legal rules. Therefore it seems reasonable to enter into contracts than to live in a Hobbesian "status naturalis". The main motive to enter into contracts has been, since Hobbes, the feeling of fear. Contractarianism is an ethics of minimal decency.

Since contractarianism, *first,* has severe shortcomings as an ethical theory (Tugendhat 1994, Ott 2001, chapter 6) and, *second*, does not hold contracts between present and future persons, and, *third*, prudent egoists always wish to maximize their „take" from a common resource base, contractarianism should not be chosen as a foundation of future or of environmental ethics. Contractarians have been highly sceptical about the idea of a real contract between different generations. They deny obligations to nonhuman beings since such beings cannot enter into contracts. Only if the rich and mighty persons (or countries) have prudent reasons (fear of a rebellion) to enter into contracts with the poor, such contracts will be made.

Contractarians cannot explain well why prudent egoists should obey contracts if such obedience won't be in their interest any more. An obligation to obey contracts must be established by another contract – *ad infinitum*. Contractarianism is unable to resolve the free-rider-problem. The many problems surrounding the idea of a contract that constitutes a moral life have led to the remarkable result that contractarians have removed this idea almost completely (Stemmer 2002)..

Since the ethical convergence does not include contractarian ethics, it remains possible to defend high stabilization levels on contractarian grounds. This seems to be the only remaining ethical line of reasoning which remains open to supporters of high stabilization levels.

12 Evaluation of criteria of risk assessment

12.1 Approaches towards risk assessment

Any large-scale anthropogenic interference with the climate system will be somewhat dangerous. But identifying dangers (risks) never strictly implies the proposition that this danger is *too* risky. So, the question is not: „Is that GHG-level absolutely safe?“ but, as often, „How safe is safe enough?“ A conceptual outline of risk evaluation is given in Gorke & Ott (2003, p. 118ff). Arguing about decision-making under conditions of risks and uncertainties is not possible without ethical considerations (Skorupinski & Ott 2002). Evaluation is necessary with respect to the concept and the measure of damages.

The choice of criteria of how to evaluate collective environmental threats should be independent from one's personal degree of risk aversion and from a private risk profile. It is by no means irrational to combine a highly liberal approach to private risk profiles with a tutioristic approach towards environmental risks.

Distributions of benefits and risks onto different groups matters morally. It might be the case that the overall good prospects imply a grave danger for some groups (AOSIS, Bangla Desh). According to TAR (IPCC 2001) the impacts of climate change often will fall on poor countries whose inhabitants have not much contributed to the overall emissions. This seems, by intuition, unfair. This unfairness cannot be healed by the Potential Pareto Improvement (PPI) criterion. The PPI rests on the silent supposition that in the fabric of society any group sometimes belongs to the "losers" and sometimes to the "winners" and in the long run the overall wealth has increased while the damages have been averaged out and no group has been systematically victimized (see SRU 2002, Tz. 12). This supposition does not hold for the case of climate change for several reasons.

12.2 The precautionary principle

Several UN-declarations proclaim the precautionary principle: „In order to protect the environment, the precautionary approach shall be widely practiced by the States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental damage“. Sometimes the precautionary principle is opposed to a (murky) concept of „sound science“. This concept implies that costly actions should rest on scientific certainty. The „sound-science“-approach takes into account neither the essential features of environmental risks (wider and diffuse impacts, delayed and synergistic effects,

thresholds, threat of irreversible losses, low-probability-high-impact outcomes) nor of the situation of „post-normal“ science (see Functowicz & Ravetz 1993). It does not take into account that usual scientific standards (a high degree of certainty that a „zero-probability“-hypothesis must be rejected) should not be applied to large-scale environmental risks. Among many others, SRU (2002, Tz. 414) argues that the lack of a definite proof can't justify the delay of action. It also argues that it is unsound to ask for a "definite proof" which can't be established for several epistemic reasons.

12.3 The consequentialistic – deontological divide

The debate between consequentialism and deontology is of importance for risk assessment and risk theory. In consequentialism, risk are seen in the framework of maximization, in deontology they are seen in the framework of principles mentioned in section E.9. If maximizing ethical theories are rejected it seems inconsistent to base risk evaluation on a „maximizing-expected-utility“-criterion (utilitarianists can, of course, be highly conservative if factual preferences are strongly risk averse). Under a discourse-ethical perspective, free and informed consent is decisive for the acceptability of risks. If this criterion cannot be met (as in cases of intergenerational justice), the principles mentioned in section E.9. have to be respected: non-victimization, precaution and care for poor people who are badly informed and have no leverage and hardly any adaptation capacities. Deontologists will combine negative impacts to society (migration, social disruption, increased shortages of freshwater, extreme events, hard trade-offs) with the „rejection of injury“-principle. Thus, the framework of deontology is, in general, *tutioristic*.

According to Rehmann-Sutter (1998) a disadvantage has already occurred if the situation of a person is marked by more hazards than before. If circumstances change in such a way that one has to fear that x may happen, this count as damage even if, fortunately, x will not happen. „Imposing risks (...) is a sort of direct action towards others who are affected by a direct consequence. (...) Imposing a risk is not an introduction and acceptance of some probability of bad outcomes but a direct change for the worse of the situation“ (1998, p. 8). Rehmann-Sutter himself relies on a deontological model of risk evaluation but his argument should be accepted by welfarists since the hedonic welfare function of an individual is affected for worse by new risks. *Imposing risks as such is morally repugnant.*

12.4 Risk averse conceptions

Some ethicists, as Hans Jonas, have proposed strict deontological, highly conservative and risk-averse approaches. According to Jonas, it will be always „better safe than sorry“ if stakes are high and prospects uncertain. Jonas (1979) argues that in „big“ cases a „heuristics of fear“ should be adopted. This approach has found some support: „Given the uncertainty that exists about the effects of global warming, additional attention should be focused on potential adverse effects that are more toward the extreme end of the spectrum of scientifically credible options“ (Woodward & Bishop 1997). Theses extreme ends are at the upper end of the 1.4 to 5.8°C increase of global mean temperature which has been presented in TAR.

From a tutoristic approach the following proposal is right: If we are uncertain about climate sensitivity we should assume that climate sensitivity will be in the upper part of the scientifically credible spectrum. If so, we should act as if climate sensitivity were high. If so, we should favour low stabilization levels.

12.5 The minimax-criterion

The „*minimax*“-criterion, is based on Rawls. It says that the damage which occurs at the worst outcome should be as small as possible. Rational agents behind the veil of ignorance would be risk-averse in as far as they wish to avoid horrible living conditions at the least advantaged positions in society. They wish to avoid catastrophic outcomes because any of them could be affected for worse. This criterion meets the psychological well-known fact that risk aversion highly increases as soon as possible outcomes entail serious damages (as death).

12.6 Avoid false-positives

This criterion relies on risk aversion. It construes a four-field-matrix with different pay-offs. The matrix combines possible future states of the future world („good“, „bad“) with optimistic and pessimistic strategies of how to act. The pay-offs are „very good“ (good & optimistic), „moderate“ (good & pessimistic), „tolerable“ (bad & pessimistic) and „disastrous“ (bad & optimistic). The pay-off-matrix is presented according to Nutzinger (1999, p. 73) (Table E.1)

Table E.1: Pay-off matrix for environmental acting (from Nutzinger 1999).

real state of the world / strategy	„good“	„bad“
„optimistic“	very good (1,1)	disastrous (1,2)
„pessimistic“	moderate (2,1)	tolerable (2,2)

If we, optimistically, assume that climate change is not too big a problem and decide not to restrict our CO_2-emissions, the result can be very good, but it also can be disastrous for future generations. In order to avoid disastrous outcomes one has to choose a course of action which also precludes some opportunities. The criterion says that we should better err on the side of caution. In matters of private risk, this criterion must not be decisive in every case. But it should be considered closely in long-term environmental risks.

13 Environmental ethics: the demarcation problem and the interpretation of the „ecosystem“-constraint

13.1 General remarks about the demarcation problem

We have argued that there are moral obligations to future generations in regard to climate change. So far, the took an anthropocentric position.[100] Obligations to natural beings have not been taken into account yet. The different positions about the scope of beings who own inherent (some say: intrinsic) moral value have paramount impact to specific environmental conflicts because inherent moral values normally cannot be traded off as easily. Inherent moral values are *prima facie* „beyond price“ (Kant). If humans are to accept moral obligations to non-humans beings, they have to take the attitude of moral respect for natural beings. If inherent moral value is applied to non-human beings whose existence is threatened by environmental degradation, bargaining between human interests is no acceptable solution to such conflict any more. *The problem of inherent moral values of natural beings is of paramount importance to the „ecosystem“-constraint of Art 2.*

[100] In environmental ethics, there is a distinction between obligations „*to x*” and obligation „*in regard to x*”. The former are *direct* obligations to members of the moral community. To other parts of the natural environmental, as climate system, vegetation cover, precipitation, or the ozone layer, there might be obligations „in regard to”.

The arguments which are given in regard of inherent moral value should entail assumptions about morally relevant features (or capabilities to develop such features). To discourse ethics and to Kantians, the capacity to give and take *reasons* (for believing p or for taking a course of action a) is crucial for inherent value. But it remains possible to argue for some other features.

13.2 Sentientism

The ethical „mainstream"-position of how to resolve the demarcation-problem is pathocentrism (better: „*sentientism*"). To utilitarians the capacity of experience pleasure and suffer pain is a „fairly clear cut-off point" of moral standing. Many deontologists have committed themselves to sentientism, too. Thus, there is no disagreement between utilitarians and deontologists on the proposition that sentient creatures count morally. It is contested whether humans' and animals' interests deserve *equal consideration* or whether humans and non-human but sentient lives should *count equally*. To give equal consideration does not imply that humans and animals should be treated alike, and, most important, does not imply that lives of humans and animals are equally valuable (Ott 2003d, p. 128-132). *We hold that human beings have full inherent value and sentient animal have some moral standing.*

If so, it would be arbitrary to accept, *first*, obligations to future persons, and, *second*, to accept sentientism, and deny that future sentient being have moral standing. If so, humans have some obligations to future sentient animals in regard to their natural habitats, for instance to future ice bears or penguins in regard to their arctic environment. Ice bears are already victimized by climate change.

It might be replied that some sentient species might benefit from climate change while others might be disadvantaged. This reply is not found convincing. Analogies from the earth's history strongly indicate that major climate changes have driven many species on the way to extinction. As recent literature indicates, many natural habitats are severely endangered yet. Fingerprints of global warming on wild animals and plants have been identified with strong confidence (Root et al. 2003, Parmesan 2003).

The pressure of human settlements onto natural habitats is already large; many conservation areas are encircled by human infrastructures. The attempts to protect corridors for species' migration are far from being successful. If the needs for humans to adapt on climate change becomes more pressing, habitat preservation and conservation could in some future become a „luxury which we cannot afford any more". In hard cases, humans will favour their own

species. Thus, adaptation and species preservation might conflict. In a warming world, many efforts of conservation biology probably will be in vain. Generally, wildlife has nothing much to hope from climate change. According to sentientism, the ongoing combination of the destruction of more natural habitats and climate change can hardly be justified on moral grounds. This turns out to be a reasonable non-anthropocentric argument in favour of low stabilization levels. If obligations to sentient wildlife in regard to habitats are justified (for details see Ott 2004d), the „ecosystem"-constraint cannot be restricted to global cycles because habitats are, by definition, not global but are regional or even local.[101]

13.3 Biocentrism

Biocentrics as Taylor (1986) argue that one should take the attitude of moral respect to all living beings since one should adopt a „biocentric outlook on nature". The argument Taylor gives for adopting this biocentric outlook on nature is confused by conceptual ambiguities (concept of „community") and by circularity since the decisive condition of how to make a choice between competing world-views („reality awareness") has been already defined in terms of the „biocentric outlook on nature" itself.[102] Attfield (1999, p. 39) argues that benefits are central to morality and that all entities which have a „good of their own" are capable of being benefited. Such arguments are appealing to the commonly shared intuition that life is „something special". But these arguments have to face severe criticism (Krebs 2000). Biocentrism is, at best, highly contested. One might adopt biocentrism as part of one's personal moral identity (Wetlesen 1999). „Reverence for all life" (*sensu* Schweitzer) is not part and parcel of a well justified morality but it is a kind of „superfluous" moral myth that transcends the limits of discursive reason.

13.4 Ecocentrism

Ecocentrism has attracted many conservationists because it gives inherent moral value to biotic communities („natural wholes") as such or, in Aldo Leopolds terms, to „the land". Ecocentrism directly expresses obligations to protect species, to preserve wilderness, to restore degraded ecosystems to some „integrity", and the like. To combine ecocentricsm with the constraint of Art. 2 „allow ecosystems to adapt naturally" will result in strict moral obligations to reduce GHG-emissions and adopt very low stabilization levels. A refutation of

[101] There are only a few species, as rats, having a broad range of possible inhabitation.

[102] We will not enter into debates about types of circularity but assume that Taylor's „world-view"-argument is circular in a vicious way.

ecocentrism has been given by Ott (2003d with further references). There are no direct moral obligations toward biotic communities as such.

If one rejects such direct obligations one might quite well accept obligations *in regard to* ecosystems because of the many „life-support"-values they provide. Thus, one can accept „practical holism" while rejecting „ethical holism" (Varner 1998). Practical holism points at the interconnectedness of ecological systems with a lot of services which are underpinnings of cultural systems.

13.5 Conclusion

All approaches in environmental ethics support low stabilization levels. All approaches agree that there is an obligation to slow down global warming. An adaptive and holistic ecosystem management, the preservation of biodiversity, and the conservation of natural habitats take place on minor scales (regional, local). All ecosystems which are important habitats for wildlife have to be protected. Sentientism in conjunction with practical holism should shape the interpretation of the „ecosystem-adaptation"-constraint of Art. 2.

14 Interpretations of Art. 2-requirements

Even if there were no climate change at all, most of us would agree that we should protect the resilience of ecosystems, should ensure food production and promote a sustainable economic development. One should distinguish between the general requirement to make the three constraints more precise in terms of measurable concepts (operationalization) and the many options to do so. The following lines of how to interpret the three constraints can be distinguished. The enumeration (ecosystem, food, sustainable development) does not constitute an hierarchy between the constraints. Some emphasis should be given to the verbal structure by which Art. 2 introduces the constraints: "allow", "ensure", "enable". This verbal structure could be interpreted as to suggest that food production is most important constraint. If it is understood in terms of "fulfilment of basic needs" there will be some overlap with a SD-constraint which relies on WCED-definition of sustainable development.

14.1 "Ensure that food production is not threatened"

This constraint can be interpreted along the following lines:

1. Focus on global yields only, including cattle and fish; high substitutability for a loss in some region of the world by a gain in another region; emphasis on global trade;

optimism in regard of the development of purchase power in regions which have to face declining yields; some hope in political structures of aid. Global adaptation prospects are regarded as being quite good (genetic engineering, agriculture in Nordic areas, aquaculture). *There are several requirements for success.* For instance, global food trade requires a safe political world. The danger that food exporting countries could force food importing countries politically should not be underestimated. Purchasing power must be enhanced in regions which will rely on food imports. Economic growth must be accelerated in developing countries to improve purchase power in order to enable people to pay for imported food. This might imply more GHG-emissions and more environmental destruction. Because crop yields in the northern latitudes will be affected for worse if global warming accelerates, amount and speed of climate change must be limited in this "global-yield"-interpretation.

2. Focus on food security, especially for vulnerable groups; emphasis on the fulfilment of "basic needs"; modest optimism about self-reliance strategies; local and regional trading schemes, "bioregionalism", alternative concepts of welfare, new strategies of support and aid.

TAR provides the following information about food production (WG II, p. 84): For slight increase in temperature (1°C) there will be increased yield in northern latitudes. In the tropics and subtropics even such small increase will result in a decline of yields. "This would increase the disparity in food production between developed and developing countries" (ibid.). For temperature increase greater than 2.5° C the prospects will be overall negative. This is in good accordance with other high risks of a global warming of more than 2.5° C (WAIC, THC). Global food prices will increase according to most studies. This will conflict with the objective to eradicate poverty since the percentage of income which is needed for food may not decrease or may even increase in many regions. One should not focus on wheat, maize and rice only. The overall diet has to be addressed: Many local livestock will be under threat by higher temperatures, droughts and extreme events. Conflicts of freshwater allocation schemes will become more severe (irrigation).

WBGU (2003, p. 14-18) argues that more than 2°C increase of global mean temperature should be perceived as dangerous for food production. The assumption is reasonable that beyond a 2° or 2.5° C increase of global mean temperature the "food-production"-constraint won't be met any more. Even under optimistic assumptions food production is threatened in the North and will decrease in the South. Additional burdens are placed upon poor people.

Welfarists, Rawlsians, deontologists, and "Southern" environmentalists, would agree that this counts as a strong reason against high stabilization levels. Given a risk-averse position on climate sensitivity, the food production-constraint clearly speaks in favour of low stabilization levels. It seems fair to shift the burden of proof in this respect.

14.2 "Allow ecosystems to adapt naturally"

This constraint can be applied either to unmanaged or to all ecosystems. At a first look, it seems to be applicable to unmanaged ecosystems only. But there are limits to the adaptability of managed ecosystems, too. The crucial problem of interpretation is due to an ambivalence which is intrinsic to the concept of ecosystems itself. Ecosystems are to some degree constituted by the research design of ecologists. Nevertheless, there remain realistic suppositions in ecosystem research, assuming that there "are" such entities as biotic communities, species interactions, food chains, and the like. Because the "ecosystem"-constraint of Art 2 in its verbal formulation is problematic from a scientific point of view,[103] there is a need for reasonable objectives. *The objectives of the Convention of Biological Diversity (CBD) should be a core element of the interpretation of this constraint.* One can think of the following prima-facie objectives:

1. Minimize the overall loss of biodiversity on Earth at the different levels of genetic lines, population and species, ecosystems and landscapes!
2. Release the anthropogenic pressure on unmanaged ecosystems!
3. Develop comprehensive management schemes for an integration of ecological sustainable use and conservation ("adaptive management")!
4. Try to conserve remaining large wilderness areas!
5. Protect habitats of higher wildlife!

There is no conflict between low stabilization levels and such interpretations. The conflicts are to be seen between high stabilization levels, global food production and the objectives of the CBD. Whoever commits himself to the general objectives of CBD can't argue for high stabilization levels – and vice versa.

[103] *Strictly speaking*, the "ecosystem"-constraint is flawed since ecosystems are not the units of evolutionary adaptation because they lack any well-defined identity. Of course, species compositions of biotic assemblages will change due to climate change.

14.3 "Enable economic development to proceed in a sustainable manner"

This constraint will be contested due to the many interpretations of the meaning of sustainability and sustainable development. Regretfully, the "umbrella"-term "sustainable development" (SD) has been increasingly being used indiscriminately and arbitrarily. „To proceed in a sustainable manner" at least means that the concept of sustainable development should be regarded as a constraint on economic growth-paths.[104]

This constraint has been addressed in terms of „(basic) needs" by WCED in 1986. The notion of needs has been shaped according to the „basic-needs"-approach. The SD-constraint of Art. 2, then, would be a kind of a double constraint: *Economic improvements (which might be measured in terms of growth of GDP), should proceed only in such ways that meets the needs of the present without compromising the ability of future generations to meet their own needs*. This proposal for interpretation is based on the WCED-definition. It is not based in a more scientific theory of sustainability.

14.3.1 Spheres of the sustainability debate

If one wishes to interpret the SD-constraint in more theoretical terms, it seems helpful to distinguish some layers ("spheres") of the overall sustainable development debate. A layer-model to outline the structure of a (possible) 'sustainability science' has been proposed (Döring & Ott 2001, Ott 2003e). In this comprehensive model, special attention is given to recent debates about the diverging concepts of „weak" or „strong" sustainability (Neumayer 1999). Conceptual frameworks which try to integrate climate change in the context of SD, argue that the conceptual divergences are crucial for interpretation and measurement (Markandya et al. 2002).

Measures of the „SD"-constraint are derived from different conceptions of sustainability. A measure, then, could be a) sustained growth of GDP (*very weak sustainability*), b) genuine savings (*weak and intermediate sustainability,* see Atkinson et al.1997), c) focus on meeting basic human needs (WCED), d) focus on the equal consideration of different "pillars" ("pillar-model"), e) focus on constant natural capital rule (*strong sustainability*), f) focus on the overall resilience of man-nature-systems (*sensu* Perrings).

[104] The early economic SD-literature took SD as a constraint of an optimal growth path. As Dasgupta & Heal had argued in 1974, it is possible for an optimal path to decline towards zero over time (Markandya et al. 2002, p. 19). If such strange implications of „optimality" are to be recognized, „sustainability" has to be seen as a constraint against such implications.

14.3.2 Concepts of sustainability

„*Weak sustainability*" only requires to bequeath an unstructured bequest package. The sustainability-requirement only obliges a society to preserve the overall stock of capital constant over time. This portfolio-perspective permits the depletion of natural resources if artificial substitutes can be found and if the profits of depletion are invested in man-made capital and in knowledge rationally (so-called Hartwick-rule). *„Strong sustainability*" casts doubts on the „substitutability"-paradigm. Strong sustainability argues for the preservation of an highly *structured* bequest package. According to this approach, a society has to keep the stock of different kinds of capital intact *separately* because every stock of capital provides a stream of goods and services which can not be fully substituted by any other stock. Natural and artificial capital (including knowledge) are seen as complementary, as Daly as argued (1996). Natural capital is to be seen as a crucial part of a structured intergenerational bequest package. Multi-functionality of ecosystems in conjunction with uncertainty as well as the many aesthetic qualities and social ("biophilic") amenities of unspoiled nature provide some sound patterns of arguments against weak sustainability.

If strong sustainability will be chosen as general guideline for environmental politics,[105] one has *first*, to keep natural capital intact over time, and, *second*, to invest in natural capital as far as it already has become scarce. The notion of natural capital which is at the heart of the conception of strong sustainability comprehends natural resources as freshwater, soil, forests, fisheries, ozone layer, climate system, ecosystem services and functions, genetic material, and units of cultural significance. Notice that many single components of natural capitals cannot be substituted against each other (fish against soil, freshwater against climate). Stabilization of GHG-concentrations at low levels can be regarded as being an "investment" in natural capital. Low stabilization levels confirm to Daly's rule that human pressure on natural systems should be relieved and to the rule that sink-capacities should not be overused.[106]

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[105] In his biannual report 2002 the German Council of Environmental Advisers analysed the competing concepts of weak vs. strong sustainability in some detail. The Council argues that sustainability should be seen as an ecologically focused concept which should also take related social and economic phenomena into account. The Council proposed to adopt a slightly modified concept of strong sustainability as a basic guideline in environmental policy.

[106] Because there are issues of how to substitute non-renewables, to transform natural into cultivated natural capital, and to allow for „shadow projects" to compensate for ecological damages the issue of substitution obviously survives inside the concept of strong sustainability although substitution seems to be rejected by the concept itself. This problem has not been properly understood by the supporters of strong sustainability.

Neumayer (1999) has argued that weak sustainability is more convincing in the "source"-side of natural resources while strong sustainability is more realistic as far as the "sink"-side of natural capital is taken into account. This speaks in favour to opt for strong sustainability. *From a political point of view*, one has to ask which concept would be chosen by COP in a situation of open, well-informed and uncoerced deliberation.

14.3.3 Considerations of elevated climate sensitivities

Metz et al. (2002) have made an interesting proposal of how to interpret the SD-constraint. They argue that even the risks of low stabilization levels (450 ppmv CO_2) remain significant (2002, p. 218) if climate sensitivity will turn out to be high. They rely on the scenarios which are presented in the „*Special Report on Emissions Scenarios*" (Nakicenovic et al. 2000; SRES). At the core of the proposal is the comparison of certain SRES-scenarios with the SD-constraint. First, the authors analyse scenario "A1B" which belongs to the "A1"-family" of SRES. A1B" is a scenario in which all energy sources are balanced. "Balance" is defined as not "relying too heavily on one particular energy source" (Nakicenovic et al. 2000, p. 4). "A1B" entails high economic growth, but also assumes that de-carbonisation rates are high for developing countries. (For instance, one may think of "clean coal"-options.) Metz et al. argue that "A1B" does not reach low stabilization targets. Alternatively, scenario "B1" is to be regarded as a scenario with a strong sustainable development orientation. "We take this scenario as one possible quantification of a future in which developing countries align their development goals towards equity, efficiency and sustainability" (Metz et al. 2002, p. 223). The B1 projection is characterised by the following main features:

- demographic transition by rapid decline of fertility levels
- economic transition ("green" values, service sector, globalisation, increased R&D, diffusion of technologies)
- governance (international regime formation)
- land and food (trend away from Western style diet, biotechnology, large food trade in a safe world, bio-fuels)
- mobility and transport (rapid I&T improvement, but no expansion of traffic)
- environment and biodiversity
- lifestyles (less energy intensive)

Even the B1-scenario will not reach a 450 ppmv stabilization level without additional political efforts. Metz et al. conceive a "B1-450 ppmv-CO_2"-scenario in which reductions in both

energy intensity and carbon factor need to be accelerated (ibid., p. 226). This scenario requires that for each new investment in the energy sector, advanced technologies are chosen. The "B1-450 ppmv CO_2"-scenario is ambitious but within reach. To the authors, "limiting climate change will become more easy if the world would develop into a more sustainable direction as depicted in the SRES B1 scenario" (ibid., p. 226). It seems important to deepen this approach in order to make a reasonable choice between SRES- and Post-SRES-scenarios. *There is no argument against judging scenarios morally. The SRES-"story lines" can be made objects of ethically informed choice as WBGU has done (2003a,b).*

15 The evaluation of SRES-scenarios

In the following section, we wish to contribute to the problem of how to give priority to options in the field of public long-term climate policies. In a *first* step, we present several „rules of thumb" which are derived from deontological principles. *Second*, we address the problem of how to choose between SRES-scenarios. *Third*, we argue that the scenarios can be judged according to a concept of *moral factor analysis*.

15.1 Ethical rules for prioritising

Beside the principles given above, more concrete *priority rules* have been proposed. We mention but a few which, in part, are dependent on certain approaches in the theory of justice, the theory of intergenerational obligations, and the theory of risk. A more tutioristic approach is presupposed in such rules:

- It is better to avoid a „bad" than to create a „good", given that the amount of bads and goods are (almost) equal. („double-effect")
- One should not favour solutions which make the life prospects of the poor and of the disadvantaged more worse in the future. One should, instead, favour solutions which improve their life prospects even if this brings about some losses in the overall sum of material welfare.
- One should not favour any solution of a problem which (probably) will bring about more serious problems in times to come (D. Mieth)
- One should not favour solutions which are more feasible under contemporary power-relations but could lead to heavy social conflicts and disruptions in the future.
- Long-term-solutions should be prevail over short-term-solutions.

- One should favour solutions which (probably) bring about rather smooth than more rapid changes because smooth changes are less risky to the overall resilience of ecological and social systems.
- Solutions which keep many decent options open should prevail over solutions which endanger future capacities to solve problems.
- If adverse consequences cannot be avoided, they should be reversible.[107]
- If uncertainties are high, it will be better to slow down than to accelerate (Skorupinski 1996, p. 301).

The principles, criteria of risk assessment, and these priority rules constitute a sphere of interwoven moral claims which are like spotlights which illuminate single aspects of climate-change-scenarios (cumulative emissions, nuclear energy, deforestation, GDP, global population). Ethicists draw a distinction between *prima-facie*-obligations and *all-things-considered*-obligation (Brink 1994).[108] Brink (1994, p. 217): „To determine all-things-considered obligation we must do *moral factor addition*." We wish to apply the *model of moral factor addition* for a reasonable choice between the SRES-scenarios.[109] *After moral factor analysis, a comparative judgement could constitute a priority-relation between scenarios.*

In the SRES seven axes of the scenarios are distinguished (2000, p. 99). Different scenarios have different numerical values on every single axis. Moral factor analysis can be conducted by judging the differences among such numerical values.

15.2 SRES-emission scenarios

It is argued in SRES that scenarios are images of alternative futures. Any scenario family has a certain „logic" (p. 27). None of the scenarios includes additional climate initiatives. This exclusion has been criticized by Lomborg (2001) because it is hard to imagine future worlds which are characterised by deep concerns for the environment (scenarios B1, B2) but do not comprehend any climate mitigation activities. To judge the scenarios according to some criteria does not imply the rejection of further climate policies. The opposite is true.

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[107] This rule does not apply to desirable consequences.

[108] A person **P** has a prima-facie-obligation **O** to do **x** if there is a moral reason for **P** to do **x**. *Prima-facie*-obligations can be defeated by more superior obligations. There is an *all-things-considered*-obligation if and only if in the view of all morally relevant factors the obligation to do **x** is supported by the most strongest moral reasons (Brink 1994, p. 216). Then, the obligation to do **x** is not overridden by any stronger moral claim.

[109] The model is similar to other types of multi-factor analysis.

Therefore, an evaluation of the scenarios should not be interpreted as a principled objection against climate policy.

SRES makes the (optimistic) assumption that all future worlds will be generally more affluent than the contemporary world and that income gaps in relative terms will gradually decrease over time (SRES, p. 7) although income gaps have not been reduced in the past (ibid., p. 117). „Desaster-scenarios" have been excluded since they are „difficult to quantify with the aid of formal models" (p. 27).

The main driving forces of the scenarios are population, technology, and economic development. Emissions can be viewed as a product of population, per-capita-income and energy-intensity. Policies in these crucial realms are, therefore, implicitly climate policies.

SRES supposes that interpretations and preferences for certain scenarios will vary among stake-holders. „No judgement is offered in this report as to the preference for any of the scenarios and they are not assigned probabilities of occurrence, neither must they interpreted as policy recommendations" (ibid., p. 3). SRES does not comment on how the scenarios might be judged morally or politically. It makes no sense to maintain this reservation in an ethical analysis.[110] Taking each storyline as being a „distinctly different direction for future development" (ibid., p. 4) one has to ask from the moral point of view which direction should be favoured.

15.3 Acceptability of emission scenarios

Let's take a look at the most decisive scenario components of SRES. First, we recall the patterns of the following storylines and "families":

- *A1-storyline and family*: rapid economic growth, global population peaks in mid-century and declines thereafter, rapid introduction and diffusion of new efficient technologies, strong commitment to marked solutions, mass consumption, high saving rates and high investments, high mobility of people, decreasing income gaps across the world[111]. Environmental protection rests on active management. Per capita income ratios decrease in all groups of the A1-family. The A1-group has been constructed from an US-American and European entrepreneurial perspective. It is dominated by the hope for continued progress. Since wealth is correlated with low mortality and

[110] At the end of the „*Technical Summary*" of SRES it is repeated that no judgement of desirability of single scenarios has been made (ibid., p.46).

[111] We have to take a closer look on the assumption of SRES that income gaps will be gradually diminished.

small families, global population decreases after 2050 (Nakicenovic 2000, p. 180). Environmental policies follow the scheme of the Environmental-Kuznets-Curve (EKC) (p. 229). The EKC could bring about reductions of GHG-emissions without additional climate policies. Doubts whether GHG-emission will follow the EKC-trend are not mentioned. The A1-group has three major strains in energy supply.

- A1FI: fossil intensive
- A1B: balanced across all sources
- A1T: non-fossil energy source

A1FI has been created from A1C (coal intensive) and A1G (oil & gas intensive). A1T combines renewable energy supplies with nuclear energy, both fission and fusion. Who is inimical to atomic energy has a strong reason to reject A1T, whereas A1FI is incompatible with low stabilization targets. Lomborg (2001, p. 286) regards A1FI as unrealistic because market forces and R&D will make renewables attractive in the middle of the century. This assumptions seem to be optimistic (see Ott et al. 2003). The debates about huge coal reserves and non-standard oil-reserves should us make more cautious against the hypothesis that the probability of A1FI is low. „Re-carbonisation“ scenarios are not unrealistic. It won't be easy to implement a strong additional climate change policy to A1FI. It could be possible that societies have locked themselves in a fossil-driven economy in 2040 which, then, cannot be changed in short terms.

- *A2-storyline and family*: Heterogeneous world, less trade and more barriers to trade than in A1, local identities, continuously increasing global population, slow and fragmented economic growth, consolidation of several cultural-economic regions, inertia of social institutions, dominance of traditional cultural patterns of behaviour. Environmental protection is more local: control of local polluters and conservation of environmental amenities. A great value is put onto cultural diversity as such. Overall, environmental concerns are less important than in all other storylines. Income gaps do not narrow as much as in other scenarios (p. 180). It won't be easy to implement a strong additional global climate change policy to an A2-world since the logic of A2 is inimical to global environmental regimes. The logic of A2 speaks in favour of uncoordinated, regional adaptation strategies. There is hardly any hope that low stabilization levels will be reached by such strategies only.

  A2 is the only storyline in which CO_2 emissions from land use change, especially from loss of forest cover, will remain positive. This counts against A2 according to any

reasonable interpretation of the ecosystem-adaptation-constraint. Environmentalists would be thus averse to choose A2. WBGU (2003, p. 32) does not include A2-scenarios into account any more since A2 will not reach more ambitious objectives. *We support this rejection explicitly and exclude A2 from further analysis.*

- *B1-storylines and family:* convergent world similar to A1, but with rapid changes towards a service economy and towards its partial dematerialization. Push on decarbonisation; emphasis on global solutions, sustainability, clean technologies, quick and broad diffusion of new technologies, and improved equity. B1 is, at least in part, ecologically driven (ibid., p. 181). Environmental policies will foster corresponding markets and global diffusion in the energy sector. Technology transfer will be accelerated by political and economic measures. A conceivable B1-world without the further development of the Kyoto-process seems to be apart from the „logic" which drives B1. However, it seems possible that prudent strategies of sectoral policy integration could make a special climate policy „superfluous".
- *B2-storyline and family:* focus on regional solutions, different technological pathways, increasing population, emphasis on environmental protection and social equity. Decisive is the focus on decentralized solutions. Growth of GDP is slower in developing regions than in A1 and technological change is uneven. World population will not decrease significantly from year 2050 on. B2 may be seen as a „green communitarianist's" scenario. We will not reason about the merits and shortcomings of „green communitarianism" whose supporters idealize self-reliance, „small-is-beautiful"-solutions and „grassroots democracy". Green communitarianism has to find global solutions to global problems as climate change. The persons living in a B2-world probably will not oppose to additional mitigation policies because they share attitudes towards more environmental protection. It is far from clear whether the political capacities to enforce such policies will have been built up in a B2-world. SRES therefore simply assumes that environmental protection will be one of the few remaining international concerns (ibid., p. 183). This is *ad hoc*.

The pathways of B2 and A2 can't predicted with high confidence just because, by definition, the storylines leave much room for regional pathways. Therefore, one should be sceptical about the construction of the B2-400-scenario of WBGU (2003b).

It seems possible to identify features of single scenarios which count in favour or against them. These „counts" are part of moral factor addition. Central to this addition are the *seven*

variables of SRES: 1) population, 2) cumulative CO_2-emissions, 3) global GDP, 4) GDP growth rates, 5) primary energy per GDP, 6) total primary energy, 7) CO_2 per primary energy. In addition, we judge the prospects in the agrarian sector, in nature conservation efforts, and in a economic development that proceeds in a sustainable manner.

15.3.1 Agriculture and food production.

Very few is said about the agrarian sector in the A1-worlds. Agriculture will probably follow the internal logic of demand, efficiency, and large scale production; the agrarian sector may operate global. Given decreasing income gaps, high food security can be assumed if the impacts of climate change on global yields are low. Given increasing climate change impacts in A1FI, the overall outcome can't be predicted with high confidence. *In the A-storyline, food security probably will be best in A1T.* There is a non-zero-probability that A1FI turns into a desaster-scenario if impacts on global yields are strongly negative. There is some optimism with regard to adaptation in A1FI which is veiled by the concept of „active management".

In B1, the agrarian sector is described as follows: „Strong incentives for low-input, low-impact agriculture, along with maintenance of large areas of wilderness, contribute to high food prices with much lower levels of meat consumption than those in A1" (ibid., p. 182). It is unclear how this „high-price-low-risk"-system has to be judged under the „food-production"-constraint of Art 2. Assuming that global GDP is several times as high as today and given the equity orientation of Art. 2, high food prices may not be a big problem. We leave this point open for further debate. *The wilderness-protection is clearly positive under the „ecosystem"-constraint*.

In B2, the agrarian sector is devoted to local food security, shift in dietary patterns toward local products. Meat consumption is unevenly spread. There are no improvements of food security compared to B1.

15.3.2 Cumulative CO_2-emissions from fossil fuel burning

CO_2 emissions are most decisive to stabilization levels and to corresponding public climate policies. They average on intervals between 1990 and 2100 for the different scenarios as follows:

- A1FI ≅ 2128 Gt
- A2 ≅ 1773 Gt (*broad range*)
- A1B ≅ 1437 Gt (*broad range*)

- B2 ≅ 1160 Gt (*broad range*)
- A1T ≅ 1038 Gt
- B1 ≅ 989 Gt

The overall cumulative emissions are *lowest in B1* (lowest from fossil fuels and negative emission from land use ≅ 983 Gt), but A1T's emissions are not much higher (1068 Gt). Cumulative CO_2-emissions from land use patterns is negative in B1, low in B2 (which sounds surprising), and highest in A1FI and A1B. The reversal of deforestation is strongest in B1 and A1 because the pressure from growing populations will be relieved after 2050.[112] *Methane emissions* are highest in A2, A1FI and B2.

Given the convergence thesis and the presumption in favour of low stabilization levels (section E.11.1), A1FI must be supplemented by strong mitigation policies. „A1FI and B1 (...) define the top and bottom of the range of projected temperature changes" (IPCC 2001, WG I, p.557). An ethical justification in favour of A1FI bears a huge burden of proof. Given the Tolerable Windows Approach (TWA), A1FI exceeds the tolerable limits significantly. B2 and A1T approach the tolerable interval more closely, whereas B1 seems most desirable among all scenarios as it complies best to the provisions of the TWA. *The ultimate objective of FCCC speaks in favour of B1.*

Taking a closer look on the quality of energy supply, the share of *carbon-free technologies* will be highest in A1T (85%), followed by A1B (65%, with a broad range of uncertainty between 27% and 75%), B1 (52%, also with high uncertainty), B2 (49%, with a 27-49 % uncertainty range) and least: A2 (28%). Only the energy supply mix of scenario A1T complies to the findings of Caldeira et al. (2003) who recommend a corresponding zero-carbon supply share of 75% (optimistic) to nearly 100% (pessimistic) in the long-term and with respect of the Convention's ultimate goal.[113]

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[112] Lomborg makes one of his many mistakes (2001, p. 282), telling his readers that it is not realistic to assume that forests will grow in B1 since B1 would imply 10.4 billion people in 2100. Lomborg confuses B1 (7 billion) and B2 (10.4 billion) and he might wish to support his own position that it is doubtful whether one should prefer B1 over A1 with such poor confusion.

[113] Deduced from future fuel burning, GHG emissions and related uncertainty propagation of climate sensitivities.

15.3.3 Final energy intensity

Energy efficiency is best in A1T and B1 and poor in B2 . The share of coal is lowest in A1T (1%), A1B (4%, again with a broad range of uncertainty) and B1 (8%). The so-called „clean-coal"-option can be found an issue for intensified debate among supporters of A1T and B1.

15.3.4 Global population

World population will be much higher in A2 and B2 scenarios (15.1 billion resp. 10.4 billion in 2100) than in A1 and B1 scenarios (around 7 billion in 2100 after a peak of about 8.7. billions in 2050). The population-parameter alone clearly counts against B2 and in favour of A1 and B1. The factors that count against B2 are high population and an unclear vision about the future of democratic institutions.[114]

15.3.5 World GDP

Global GDP is slightly higher in A1T than in A1FI. All A1-storylines resemble higher GDPs than A2 and the B-family. If one makes GDP the only parameter of choice, the favourable order of options would be: A1T ≥ A1B[115] ≥ A1FI > B1 > B2. The global average income in B1 will be about 30% less than in the three A1 worlds. Notice, that this is the difference between incomes that average a manifold of today's average income. The B1-world seems to be the single world whose inhabitants - on the average - put less emphasis on material consumption. All contemporary persons which have a preference to post-materialistic lifestyles should therefore favour B1.[116] While in the A1-worlds the gains of increased GDP are invested in future economic growth, the B1-world invests more resources in the prevention of social exclusion, in means of poverty reduction, environmental protection, and dematerialization. Distribution patterns will be more equalized in B1 than in A1. Egalitarians must favour B1 over A1.

As we all know, GDP only measures products and services which are exchanged on markets and, thus, are elements of the formal part of the economy. In a B1-world, the certain other societal aspects (subsistence, childcare, informal exchange of activities) will become more important. If so, quality of life must, on the average, not necessarily be lower in B1 than in A1. It could be much higher.

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[114] If B2 coincides with low population numbers the emissions would drop very roughly towards B1-lines. „Greens" would feel sympathetic with a „low-population"-B2-world.

[115] The range of uncertainty is comparably high in the scenario.

[116] Such a preference is not part of our evaluation criteria.

15.3.6 Income ratios

If income ratios are taken into account, egalitarianists and Rawlsians would favour A1 over B1 (slightly higher) and B2 and A2 (much higher). The assumptions on shrinking income gaps (low income ratios) between world regions in 2100 are questionable for the following reason: At p. 122 (SRES), the rationale for this assumption is the convergence theorem of economic theory. At the same time SRES states, that most historical and empirical evidences speak in favour of growing income gaps „in both absolute and relative terms" (ibid., p. 117). There seems to be a tension between theoretical assumptions and empirical evidences.[117] Regretfully, the „Technical Summary" (p. 7) does not mention these caveats.

There is one implication of lower income ratios for the calculation of casualties from climate change damages. If one assumes that income ratios are (much) lower in the future, the values of a statistical life (VOSL) tend to be more equal in the future, too. Thus, if mortalities of climate change damages are calculated economically, the VOSL has to be calculated according to the projected income ratios.

From an overview on all scenarios given on pp. 190-191 of the SRES one may now structure a hypothetical choice between the scenario families. The criterion „*energy efficiency*" clearly speaks in favour of A1 and B1 as well as the criterion „*low population*", which may indirectly correspond to the food constraint of Art. 2. The criterion *GDP* (see 3rd constraint) is in favour of A1. „*Environmental protection*" addresses B1 and, perhaps, B2. The criterion „*few cumulative emissions*" favours A1T, B1 and, perhaps, B2. The desirability of „*post-material lifestyles*" speaks in favour of B1 and B2. The constraints of Art. 2 FCCC both support B1 and A1. A1B is too critical and too insecure in several respects to be chosen.

We propose to favour scenario B1. A1 and B2 might be seen as second best options. Lomborg, instead, clearly favours A1-scenarios as they „stand out as securing a more richer world" (Lomborg 2001, p. 317). According to Lomborg, there is no need to make a hard choice since with some additional revenues spent on renewables research the world is going to proceed on an A1T-route towards a solar age with continuously increasing prosperity. Thus, Lomborg rejects the Kyoto-Protocol as being inefficient. Lomborgs decisive assumption is based upon extremely optimistic decreases of solar energy costs.

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[117] The report quotes Barro who distinguishes between alpha- and beta-convergence. Alpha-convergence means that all economies may converge to similar per-capita-incomes. Alpha-convergence is rejected by most empirical studies. Beta-convergence means that single countries converge toward a "steady state". This means that there are many growth paths in equilibrium. Simply spoken: The hypothesis of a convergence of per-capita-income is very risky and contested and should be therefore treated with enough caution. SRES confirms this: "The available scenario literature takes a cautious view on economic catch up" (p. 123).

B1 entails the following advantages: few cumulative emissions, favourable under TWA and convergence-thesis, low population, enhanced globalisation which could foster a global civil society and a structure of environmental regimes; no nuclear risks, decent wealth on the average with some equity components and orientation toward distributive justice, reduction of material turnover in the economy which saves resources for further posterity as well as relief of pressure on forests and other ecosystems. Assuming that *additional* climate mitigation policies (e.g., by the ongoing FCCC-process), will be more feasible in a A1 and in a B1-world, the cumulative emissions until 2100 will be even less than the respective low values reported above. A combined „*B1 plus additional mitigation policy*"-scenario may be aimed at to put the ethical convergence towards low stabilization levels into practice. A B1-450-C&C-scenario remains realistic.

B1 can met the SD-constraint by almost all interpretations of sustainable development (section E.14.3). Only if this constraint is equated with growth of GDP (very weak sustainability), one has to opt in favour of the A1-family. But even in B1 GDP will grow continuously (SRES, p. 49). Thus, we claim that B1 does not contradict or violate the SD-constraint. Moreover, it fits the constraint best, if more stronger variants of the SD-constraints are chosen.

The following more *pragmatic argument counts in favour of B1*, too. Since A1T will not be accepted by a convinced supporter of B2 and vice versa, B1 could be as a „second-best"-position acceptable both to A1T-supporters and to B2-supporters (a similar idea has been proposed in Ott 1999). The difference between B1 and B2 is between „green" modernization and „green" communitarianism. B1 has the advantage not to face the B2-problems of „self-reliance optimism" or "small-is beautiful"-romanticism.[118]

Imagine a hypothetical debate between supporters of A1T (liberal markets, free trade, accelerated globalisation, growth of GDP, high consumption and investment, nuclear energy, dominance of Western lifestyles), B2 (decent livelihood, self-reliance, spiritual renewal, cultural identity), and B1 which tries to balance green values, SD-principles and the gains of a modern condition of life. Supporters of B1, A1T and B2 can agree on low GHG-emissions and, may be, even to additional climate change policies. A1T supporters can argue that additional mitigation policies will be easier in a more affluent A1-world than in a poorer B2 world. The logic of B2 sheds doubts on the amount of additional mitigation being possible in

[118] Self-reliance strategies – by the way - failed from China to Zimbabwe.

a less affluent, more heterogeneous, and more crowded world. On the other hand, A1T entails nuclear technology which would not comply with the provisions of the Kyoto protocol.

A1T-supporters and green communitarians could meet at a B1-point. B1 is by no means "radical". It is moderate. The potential for compromise of a B1-choice might thus enhance the feasibility of reasonable negotiations.[119]

15.4 Summarizing with respect to Art. 2

B1 can meet the ultimate goal to reach low stabilization levels with some additional mitigation policies, which seems to be compatible with the logic of this scenario. It can be modified to reach a 450 ppmv CO_2-stabilization level. B1 also meets the sustainable-development constraint as well as the food-production constraint. It complies to the idea of a long-term strategy of climate politics (Schröder et al. 2002). There are no unsurmountable barriers preventing from an „B1-plus-additional-mitigation" strategy which, thus, seems feasible - even in the political realm.

15.5 A matrix as evaluation tool

In the end, we propose a evaluation matrix which, if critically used, might or might not support a „B1+additional-mitigation" strategy over other strategies. Single consequences of each scenario can be judged according to a set of relevant principles or criteria. The first four lines entail the four objectives of Art. 2. EP asks whether certain scenario characteristics violate sound ethical principles. The CRA-rows qualify the scenarios according to conceivable severe risks. The PF-lines ask whether single scenario consequences may give an additional or prior factor on ethical weighing. Additionally, all scenarios – evaluated by the help of this matrix - could be varied according to assumptions on additional climate change politics.

The matrix can be used in different ways: a) purely hypothetical, b) partly determined, c) determined, d) completely determined. A *purely hypothetical use* of the matrix is just the following instruction: If a person adopts (prefers) certain principles, criteria, and priority rules (PCPR), he is enabled to judge single components of single scenarios (including assumed subcomponents) as being in accordance or in conflict with a set of PCPR he supports. A *partly determined use* will assume that some elements of the PCPR are valid while some others might be contested or even missing. One is permitted to add more lines. A *determined*

[119] Seven authors of the SRES report clearly favoured B1 among all scenarios, too (Kram et al. 2000).

use assumes that there is a set of valid principles, criteria, priority rules which might still be incomplete but might be completed by more principles. A *completely determined use* makes the strong assumption that the set of PCPR is both valid and complete. A hypothetical use is a drawback behind the ethical arguments being made.

With the help of this tool, a true practical discourse about the moral merits, shortcomings and disadvantages of the SRES-scenarios is within reach. Although we made some arguments in favour of a certain scenario, we do not presume that the game has been already played. On the contrary: The game has just been opened.

Table E.2: UG = Ultimate Goal (LSL = Low Stabilization Levels), C(AES) = Adaptation of Ecosystems, C(FP) = Food Production, C(SD) = Economic Development to Proceed in a Sustainable Manner, EP = Ethical Principle, PCPR= Principles, Criteria, Priority Rules, CRA= Criterion of Risk Assessment, PR= Priority Rule.

Scenario / PCPR	A1FI	A1B	A1T	A2	B1	B2
UG (LSL)						
C(AES)						
C(FP)						
C(SD)						
EP 1						
EP 2						
EP 3						
EP ... n						
CRA 1						
CRA 2						
PR 1						
PR 2						
PR ... n						

15.6 WBGU and post-SRES scenarios

So far, we have relied on SRES. In its energy report (WBGU 2003a), WBGU has taken a closer look on A1T-450. WBGU (2003a, p.134) took a A1T-450-ppmv scenario into close account. The A1T-450-ppmv scenario serves as a "proof of existence" that low stabilization levels can be reached even if demand for energy will increase. This choice does not mean that A1T is more desirable than B1. In a beyond-Kyoto report (WBGU 2003b), some new post-

SRES scenarios have been created out of the SRES-scenarios by new IASA-model-runs. The tolerable window and ambitious stabilization levels are integrated into the scenarios. There are three post-SRES-scenarios:

- A1T*-450
- B1*-400
- B2-400

There is no consideration of an A1T-400 scenario because the logic of the A1-story (traffic) does not allow for such a scenario. Moreover, it seems strange to conceive a B2*-400-scenario out of the B2-storyline. All nations would have to reject the incentives to behave as free-riders in a B2*-400 scenario. B2-400 strongly relies on the use of non-solar renewable energies and on nuclear energy which is hardly compatible with the original logic of B2 as well as with the relevant provisions of the Kyoto Protocol. It seems questionable whether B2 without coal is realistic. B1*-400 is compatible with the „tolerable window“ if climate sensitivity is critical. *As the special report has been published some time ago, no detailed comparison could be made between SRES-scenarios, their underlying logic and the new WBGU-scenarios.*

16 Results of ethical analysis

The understanding of the following statements presupposes a close reading of, at least, this chapter of the study. The statements raise validity claims. They are supported by arguments and can only be rejected by better arguments.

1. The term „dangerous“ in Art. 2 has no strict scientific meaning but is inherently related to normative questions. No interpretation of Art. 2 can avoid to address ethical questions.
2. IPCC should address specification of Art. 2 in the Fourth Assessment Report (FAR) of IPCC. There should be more serious debate about the ultimate goal in the Post-COP-9-debates.
3. There is no long-term learning process in climate policies without some common ground.
4. The concept of a *political* goal entails the requirement that it should be specified in its decisive parameters (quantity, time-frame, actors). The concept of negotiation has to

be distinguished from rational bargaining in the narrow sense. Negotiations should be constrained by ethical principles and moral considerations.

5. On a closer look, TAR does not provide a convincing interpretation of Art. 2. On the one hand, it refuses to make a value-judgement, while, on the other hand, it mentions several high-risk criteria by which some degree of precaution seems to be recommended implicitly. It supposes an ill-defined concept of political process and, in the end, ethical relativism terminates into the dominance of economical thinking ("efficiency"). COP should not adopt this position.
6. There are strategies of arbitrariness-reduction in determining Art 2 at different scopes of interpretation. Well considered and balanced judgements are a third possibility between scientific proof and arbitrariness. (It seems unsound to be highly critical about the "arbitrariness" of theoretical specifications and accept the arbitrary outcomes of "muddling through" strategies in climate policy.)
7. None of the sceptical arguments which have been made against the possibility to reach a commonly shared interpretation of Art. 2 deserves much ethical credit.
8. One can't combine coherently a sceptical emphasis of pervasive uncertainties with a general optimism about technological progress and adaptive capacities.
9. The meaning of "time frame" is this: Three requirements (constraints) must be obeyed simultaneously in the overall, time-consuming course of action which is devoted to reach specific non-dangerous GHG-levels.
10. It seems incoherent to oppose a "final determination" of stabilization level and add a political recommendation in favour of low stabilization levels (< 450ppmv CO2), as WBGU (2003b) does. The incoherence can be overcome by emphasizing that any determination is "for the time being". If so, there is a thoughtful recommendation in WGBU.
11. The wording of Art. 2 does not exclude the option to prevent a dangerous level by means of adaptation. Adaptation should be addressed by more research. Such research should encompass the cultural dimensions of adaptation but should be free from suggestions which stem from a socio-biological approach of „adaptation".
12. Interpretation of Art 2 should avoid naturalistic and epistemic fallacies. „Physical" criteria are always related to judgements about the acceptability of risks.

13. The general structure of Art 2 is this: Three basic requirements (constraints) must be obeyed simultaneously in the overall course of action which is devoted to reach specific non-dangerous GHG-levels in a certain time frame. The more moral requirements are entailed in the three constraints, the more stringent the obligation to reach low stabilization levels will be.

14. Future generations have moral claims upon us. The set of deontological principles must be applied to sets of consequences (deontological approach); the overall future hedonic changes which are involved in climate change must be taken into account fully (welfarist approach).

15. High stabilization levels can't be justified by discounting future events. Unmodified general discounting implies the possibility of severe accounting errors. Interpretations of Art 2 should not become biased by references to discounting.

16. There is an strong internal convergence in utilitarianism and welfarism towards low stabilization levels. No utilitarian can agree upon high stabilization levels.

17. To deontologists, there is a fundamental obligation to avoid injuries in actions as well as in institutions. If FCCC is to be seen as an institution, this principle to reject injuries holds prima facie for any member of COP. To deontologists, CO_2-emissions can be regarded as kinds of indirect but systematic injury to other persons. If the burden of climate change will probably fall onto vulnerable groups whose members didn't contribute much to the problem, this should be perceived as a case of environmental victimization.

18. Under a Rawlsian veil of ignorance, rational persons are to opt for low stabilization levels.

19. In cases of global environmental problems, the choice of criteria of risk evaluation should be independent from one's personal degree of risk aversion. Most ethicists agree that facing such problems society should better err on the side of caution. If so, more "tutioristic" criteria should be favoured. Tutioristic criteria speak in favour of low stabilization levels. Imposing risks as such is morally repugnant.

20. All approaches in environmental ethics converge strongly towards low stabilization levels. The ongoing combination of destruction and fragmentation of more natural habitats and climate change which puts an additional threat on natural systems is regarded morally wrong by all approaches in environmental ethics. Sentientism in

conjunction with practical holism should shape the interpretation of the „ecosystem-adaptation“-constraint of Art. 2.

21. Almost all current ethical theories (utilitarianism, welfarism, deontology, Aristotelianism, Rawlsian approaches) suggest low stabilization levels. An exception might be contractarianism. There is a strong and remarkable convergence in between the positions most experts took in the COP8-questionnaire, the Aristotelian „experts‘-mean“-solution and the outcomes of Rawlsian thought experiments.
22. Ethical convergence counts morally and politically.
23. There are different interpretations of the “sustainable-development”-constraint due to different basic approaches in the “sustainability”-spectrum (weak, intermediate, strong). The measures and indicators depend on the approach being chosen. (The author feels sympathetic with strong sustainability.)
24. There is no argument against judging scenarios morally. The SRES-“story lines” can be made objects of ethically informed choice as WBGU has done (2003a, b).
25. From the SRES report, different emission paths are conceivable. The working group addresses to the actors of climate politics to aim at scenario B1, considering the above mentioned convergence hypothesis and the objective and provisions of the Framework Convention which have to be fulfilled.

F. Conclusions

1 Messages for decision makers

1.1 Points of departure

IPCC TAR (2001) indicates that the baseline emissions of CO_2 would result in a greenhouse gas concentration ranging from 500 to 900 ppmv until 2100, but *stabilization would not yet materialize within the 21st century*. Even in case of stringent emission reductions undertaken now, past emissions lead to a pre-commitment to nearly a doubling of pre-industrial CO_2-concentrations and somewhat more than a 1 degree Celsius increase in global mean temperature as well as associated damages.

Variation in emission trajectories, climate sensitivity and other parameters together have a tendency to widen the envelope of potential impacts. In addition, there is substantial uncertainty surrounding the projected temperature increase and the climate impacts associated with these scenarios. Nevertheless, conditional probability considerations may limit some confusion on the multitude of conceivable scenarios.[120] The *challenge for decision-makers* is to choose emission trajectories that are both feasible and represent reasonably ambitious levels of stabilization.

Current legal interpretation does not restrict the array of potential solutions considered by policy-makers and does not provide specific guidance as to the rejection or acceptance of *particular solutions*. Nevertheless, the precautionary principle and the provisions of the Vienna Convention of the Treaties shall not be violated.

1.2 Basic options

The ultimate goal of the UNFCCC can be achieved by mitigation, by adaptation or both. Adaptation may be necessary due to the time-delayed impacts of historical emissions. Higher stabilization levels are not necessarily dangerous in themselves if the overall prospects for adaptation are good. As adaptation proposals are associated with many uncertainties, proponents of this strategy should be willing to shoulder the burden of its feasibility. Decision makers will have to decide *which mix of mitigation and adaptation* to pursue – keeping in

[120] An example might be the underlying assumption that sulphate emissions from burning processes will be mitigated for health reasons, which will affect the radiation balance - and thus reduce the envelope of probable emission scenarios.

mind that mitigation has largely global effects, whereas the benefits of adaptation can reaped more exclusively by those who invested into such policies.

Technological options for mitigation are of particular relevance to infrastructure awaiting retirement in the near future. Decisions between fossil and non-fossil fuel options and within such categories will often have lock-in effects for the next decades, i.e. the period most decisive for determining whether lower vs. higher stabilization trajectories can be achieved. Above all, the development and utilization of energy saving potentials in different sectors is expected – esp. in the short-term – to enable significant mitigation of fossil fuel needs and related emissions worldwide.

1.3 The challenge of the ultimate objective

Determining a level of stabilization is ultimately not only a science-based task but also a value judgment that decision-makers have to make. The goal of stabilization of concentrations of greenhouse gases at a "safe" level is augmented by *three additional constraints*. These constraints (ecosystems to be permitted to adapt naturally, secure food production, and sustainable economic development) must be fulfilled *prima facie* in any period of the process of reaching „safe"-levels of greenhouse gases.

There is a strong interrelationship between the three constrains which may lead to *trade-offs* between them. Each of these three constraints can be assessed with respect to (i) the spatial and inter-temporal scales, (ii) the uncertainties associated with each of the three constraints, (iii) the distributional effects associated with climate impacts and (iv) policies considered to limit such impacts.

Policy-makers may impose restrictions on any of these trade-offs between the three constraints as well as between the aforementioned four categories used for the assessment of the three constraints (chapter D.1); these *restrictions* limit the set of available policy options. For example, decision-makers will have to find operational ways to deal with the question which scale of regional and temporal disruptions are acceptable to them or how to bridge the distributional implications of unequal climate impacts (positive in some regions and negative in others). This may, for example, become evident concerning the question on which level food production has to be secured (local – regional - global).[121]

[121] Respective evaluations may have consequences for the role of trade for balancing of local food shortages.

1.4 Results of ethical analysis

The *concept of a political goal* entails the requirement that it should be specified in its decisive parameters (quantity, time-frame, actors). None of the sceptical arguments which have been made against the possibility to reach a commonly shared interpretation of Art. 2 deserves much ethical credit. One cannot combine coherently a sceptical emphasis on pervasive uncertainties with a general optimism about technological progress and adaptive capacities.

There is a strong ethical presumption against victimization and a moral obligation to refrain from injury – applicable to both present and future generations. Conflicting assumptions about "comparative vs. absolute" standards, about a permission to discount and about prospects for adaptation are decisive parameters for the specification of intergenerational responsibility. Facing global environmental problems, the choice of criteria of risk evaluation should be independent of one's personal degree of risk aversion. *Most ethicists agree to better err on the side of caution*. If so, more safety-oriented criteria should be favoured.

The divide between anthropocentrism and variants of eco-centrism is of minor practical relevance for specifying the ultimate goal, because all approaches in environmental ethics *converge strongly towards low stabilization levels* and clearly favour secure food supplies. The more moral requirements are entailed in the three constraints, the more the obligations tend towards low stabilization levels. Nevertheless, different approaches provide different grounds of how strict the "ecosystem adaptation"-constraint should be interpreted. There are also different reasonable interpretations of the "sustainable development"-constraint according to different basic approaches in interpreting "sustainability" (weak, intermediate, strong). The measures depend on the approach chosen.

The trade-offs between the interpretations of the three requirements are to be considered: If the first two requirements are interpreted more ambitiously (food security, nature conservation), the interpretation of the third constraint (sustainable economic development) may be weakened. From equity considerations, any weakening of conditions for sustainable economic development should call for burden sharing procedures (in favour of developing countries).

Possible *prescriptions in favour of different emission paths* are conceivable, which might be justified quite differently. Considering the SRES report, a matrix for assessment of possible future scenarios is proposed, which enables decision makers to make reasonable and transparent choices on the basis of a set of relevant criteria and principles (see E.15.5).

Concluding from this exercise, *the working group would recommend developments towards scenario B1*.[122] Nevertheless, other evaluations may be also considered.

1.5 Political feasibility

While German and European political actors are generally willing to publicly announce specific stabilization levels (either for CO_2 or all greenhouse gases), many governments outside Europe and many other political actors have not yet publicly positioned themselves on Article 2. Major developed countries (e.g., the USA) and nearly all developing countries currently eschew to specify publicly their preferred stabilization goal. Furthermore, even if political actors position themselves publicly, they restrict themselves to a stabilization goal (expressed in ppm or temperature change), but normally give *no indication how the three additional constraints of Article 2 are to be taken into account* (except for some statements on absolute and/or decadal permissible changes in temperature, which might be interpreted as a measure for ecosystem adaptability).

An exploratory questionnaire on the major aspects regarding Article 2 UNFCCC, esp. its interpretation, tradeoffs among the additional constraints, time frame, and permissible costs, indicates that the EU is perceived as the most ambitious climate policy actor and the USA (on average, but not consistently) the least ambitious actor. Russia and the G77 plus China group fall in between the EU and the USA, on average. Only on *equity issues* associated with Article 2, the G77 plus China places a higher value on its importance than the EU does. The same principal ordering (EU, Russia and G77 plus China, USA) applies to the suggested timing when to start to negotiate Art. 2 UNFCCC questions.

These preliminary findings indicate perceived substantial transatlantic differences on many aspects of Article 2 UNFCCC; in terms of global coalition building for specifying Article 2, the future *behaviour of the intermediate group* consisting of Russia as well as G77 plus China will determine whether or not a relative ambitious goal on Article 2 will be defined.

Irrespective of strategic considerations of single Parties, it seems desirable to allow for fair negotiations. Transparency, consistency, and universal validity of any argumentation put forward towards specification of Art. 2 may support its acceptability and preferably its factual long-term acceptance. Whether pursuing the long-term aspirations of Art. 2 is compatible with the often shorter-term negotiation horizon remains an open question.

[122] The B1-scenario resembles developments towards global decarbonization for sustainability and equity improvement.

2 The challenge of ethical reasoning and potentials for its improvement

The problem of global climate change and claims for adequate response are clearly a challenge to *normative efforts*. Normative orientation may be only given by *ethics* in those fields where legal frameworks are missing or not specified. This is the case for the Climate Convention because its development towards a binding instrument for effective climate protection needs further and globally *acceptable* reasoning.

Acceptability of reasoning is a prerequisite for broad and sustained acceptance of worldwide measures and subsequent compliance thereon. *Professional ethics* aims at development of universal norms and is therefore expected to be capable to formulate acceptable clues for climate precaution. Nevertheless, the issue of long-term obligations and problems of adequate dealing with the *rights of future generations* are partly evaluated with some dissent among professional ethicists. Further clarifications are needed – especially with regard to certain opposing "no-obligation claims" of the present (see also Schröder et al. 2002).

A pending problem seems to be the *dichotomy of anthropocentric ethics* with respect to its main lines of utilitarism and norm-ethics. Their different maxims and corresponding criteria are generally acceptable but may lead to quite different assessment results. Reasoning according to universally acceptable (but different) standards may not lead to uniform evaluations. International climate politics will have to deal with some plurality of ethical reasoning. This may be qualified to some extent by the observed convergence on the level of results in the climate case (section F.1).

In the *absence of a meta-ethical theory*, reasonable procedural approaches are needed. These could be developed from discourse ethics, which is expected to overcome any paralytic consequences of ethical plurality. Discourse ethics is in some way structurally analogue to the climate political arguing process and might be therefore favourable also for practical reasons. Anyhow, representatives of the future cannot be involved in discursive processes – a severe disadvantage of respective concepts. The application of Rawls' veil of ignorance method might be a possible way out of this problem.

Promising perspectives of future ethical research on reasoning of any regulatory option in question would be to *refer theories of distributive justice to theories on those collective environmental goods* which consider the climate problem (see also Schröder et al. 2002). More specifically: Evaluations of chances and risks from climate gas emission will have to

consider climate subsystems (esp. the atmosphere) as collective sinks for yet harmless dumping of greenhouse gases. Respective sinks – like the oceans - might therefore be seen as global resources with limited capacity. Assessments of the distribution of historical and present emissions and its possible future allocation will have to take into account that corresponding resource potentials might be exhausted. “Individual” access to these resources under scarcity will thus have to be reasoned according to universal moral persuasions.

X. Annex

1 Clustering and assessment of positions on Art. 2 as from an expert survey

1.1 Aims of the survey

In order to extend the empirical basis on the positioning of actors in international climate negotiations (COP-8 and beyond) with regard to Art. 2 UNFCCC, and in order to identify potential conflicts and negotiation strategies, a questionnaire was prepared and distributed among participants at COP-8 in New Delhi. It was intended as an exploratory instrument to acquire feedback from a select group of experts and actors who evaluate their own position and that of others, based on their individual judgement and interpretation. The experts' tasks were to identify their own position for each of the questions and to assign a position to each of four major actors in climate negotiations (United States, European Union, Russia, G-77 plus China). Due to the constraints at COP-8, the survey could neither be comprehensive nor representative. Since half of the experts were researchers and about half of the experts were from Europe, the survey represents these groups disproportionately. This should be kept in mind when interpreting the data. Basic information on the questionnaire can be found in the box below.

1.2 Results from the expert survey

The results of the above mentioned survey refer largely to the average values (*m*) of all experts and the respective standard variation (*sv*). By responding to the questions, the experts determined a position for themselves and for other actors in a multi-criteria space. These results may indicate specific opportunities and difficulties for constructive future negotiations on Art. 2. The most relevant results are described below.

Box X.1: Basic information on Art. 2 UNFCCC questionnaire

Each expert was asked to select a position on the following issues, with regard to his/her own personal opinion as well as with regard to the perceived opinion of actors from the USA, EU, Russia and G77/China (in brackets: acronym of the variable and its possible range).

1. Net benefit from Art. 2 objective (BENEFIT: -5: highly damaging, +5: highly beneficial);

2. Costs of reference stabilization level (550 ppmv, all GHG in CO_2 equiv.); asks for

a) share of annual global GDP (GDP-PERCENT), and

b) acceptability of costs (COST-ACCEPT: -5: prohibitively expensive, +5 negligible costs).

3. Clarity of meaning of Art. 2 (CLARITY: -5: completely unclear, +5: completely clear)

4. Consistency of constraints of Art. 2, comparing the following pairs:

a) ecological vs. economic (ECOL-ECON: -5: highly conflicting, +5: fully compatible);

b) ecological vs. food (ECOL-FOOD: -5: highly conflicting, +5: fully compatible);

c) economic vs. food (ECON-FOOD: -5: highly conflicting, +5: fully compatible).

5. Inclusion of equity considerations (EQUITY: -5: completely irrelevant, +5: highly important)

6. Agenda for Art. 2 implementation (IMPLEMENT: year to become a key negotiation issue)

7. Preferred stabilization level for GHG (STAB-LEVEL: in ppmv CO_2 equiv.)

8. Required time-frame for stabilization (TIME-FRAME: target year)

The questionnaire was distributed to about 75 individuals. 31 experts returned fully or partially completed questionnaires; among them were 23 participants of COP-8, the 5 authors of this study and 3 other researchers. Twelve experts were active members of delegations at COP-8 (even though a few preferred to be identified as researchers), 4 are assigned as NGO representatives and the remaining 15 are researchers. About one third of actual feedback originated from respondents from developing countries.

1. **Ordering of actors:** It is striking that for most variables the actors maintain a quite certain order of positions. Compared to a hypothetical actor ("optimist") who associates Art. 2 with high benefits, low and acceptable costs, high clarity and compatibility of the three conditions, high importance of equity, early implementation, low stabilization level and short time-frame, the experts put themselves in the first place, followed by ascriptions of positions of the EU, Russia, G77/China, and finally the USA at the other (more "pessimistic") end of the spectrum. The *decline/incline of most variables* from average positions of the first to the fifth (hypothetical) actor is depicted in Figures X.1 and X.2. The multi-criteria chart of Figure X.3 visualizes the distances between actor positions for key variables and the potential for conflicts and coalitions. A set of positions near the periphery represents more optimistic actors (the experts and the EU), while the position set in the inner core of negative variables represents actors critical to Art. 2 (USA).

2. **Expert positions:** Above all, it is important to learn how the experts describe their *own positions*. On average, they share the viewpoint that net benefits of accomplishing Art. 2 would be very high (m = 3.9) while costs would be low (m = 1.2% GDP loss) and acceptable (m = 2.12), but not completely negligible. Equity is seen by the experts as a key issue for the negotiations. The three conditions are perceived as largely compatible with each other. Compatibility is highest for economic and food conditions (m = 1.9), second for ecology and food conditions (m = 1.4) and lowest for economic and ecological conditions (m = 0.03). Not surprisingly, the experts assign to themselves the highest clarity on the meaning of Art. 2, but with m = 1.9 (compared to a maximum of 5) they do not think that Art. 2 is completely clear to them. The experts also set the earliest date when Art. 2 should be a negotiation issue (2005), the lowest stabilization level (483 ppm CO2-equivalent), and the shortest time-frame (until 2066). Obviously, the personal perspective of actors represents some idealism.

3. **European Union:** Compared to their own view, the experts estimate the *EU position to be only slightly different* for most variables. The positions are close for the estimated GDP percentage (almost identical), even though cost acceptability differs by one point. Positions are also similar on the compatibility of the three conditions, but the compatibility between economic and ecological conditions is even slightly negative. The widest gap between the self-assessment of experts and the ascribed position of the EU occurs on the equity issue, which - however - differs by less than two points. This can be explained by those among the experts from developing countries who have a higher preference for equity. The three stabilization variables are slightly higher (Figure X.2).

4. **United States of America**: *On the other end of the positioning space* is the USA, which represents negative net benefits (m = -1.2) according to our experts, high and unacceptable costs (m = -2.6 for both variables) and a strong aversion against inclusion of equity (m = -2.4). It is interesting to note that even though the experts on the average assume economic and ecological conditions as incompatible and conflicting from the US perspective (m = -2.7), they also see no conflict between food security and economic (m = 1.0) or ecological conditions (m = 0.6) for the USA, which is even less than for Russia or G77/China. Another deviation from the rather negative positioning of the USA is the issue of clarity where the USA is close to zero, similar to Russia and slightly higher than G77/China. The experts assume that the USA would begin implementation of Art. 2 very late (m = 2017) and would aim at a high stabilization level (on an average of 724 ppmv

GHG) within a timeframe beyond the 21st century. Concluding from most variables, in the view of experts the USA appears to be a major obstacle to further progress on Art. 2.

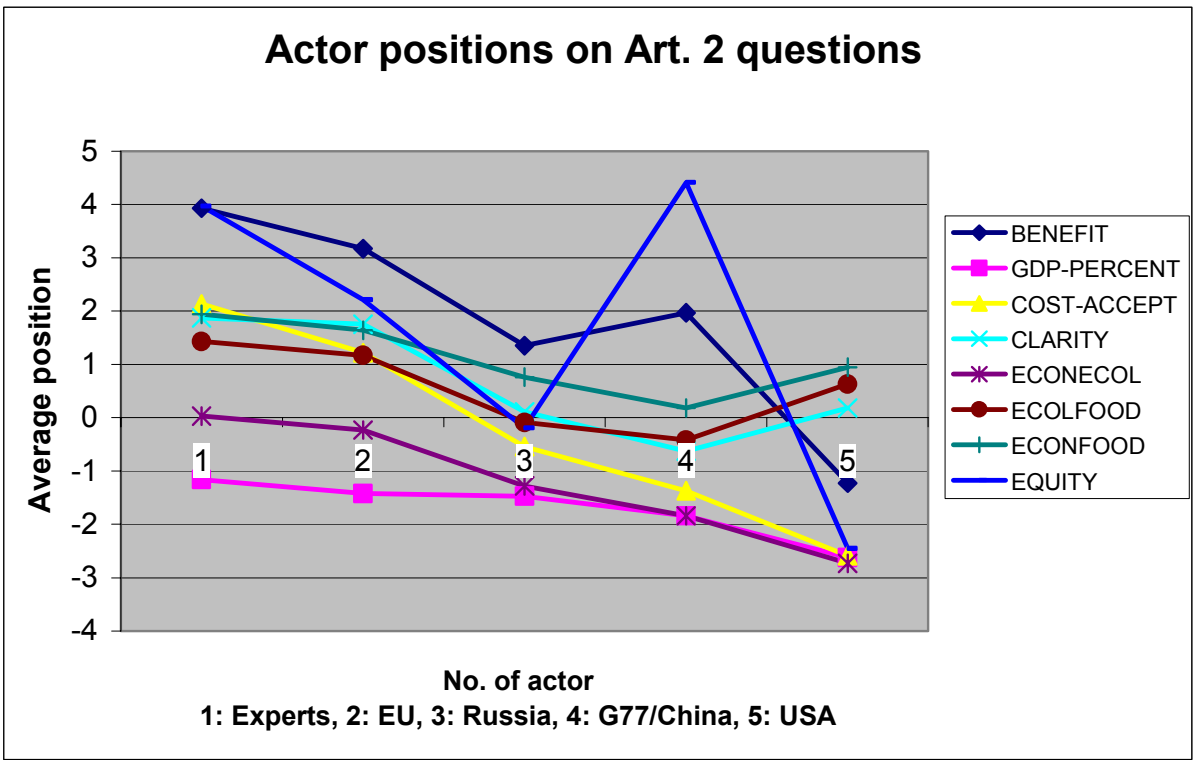

Figure X.1: Aggregated positions of actor groups on the meaning and consequences of Art. 2 (see also box X.1 for abbreviations).

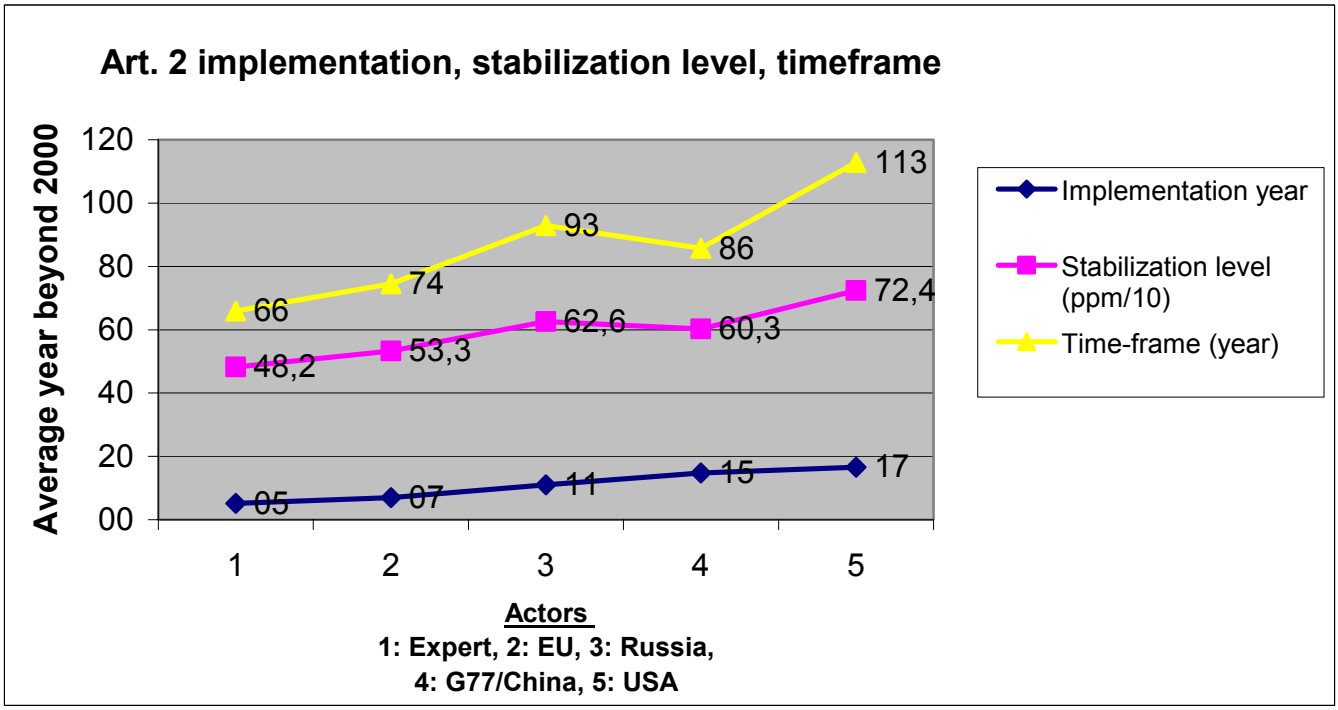

Figure X.2: Aggregated positions of actor groups on stabilization issues (numbers for years are given from 2000 on).

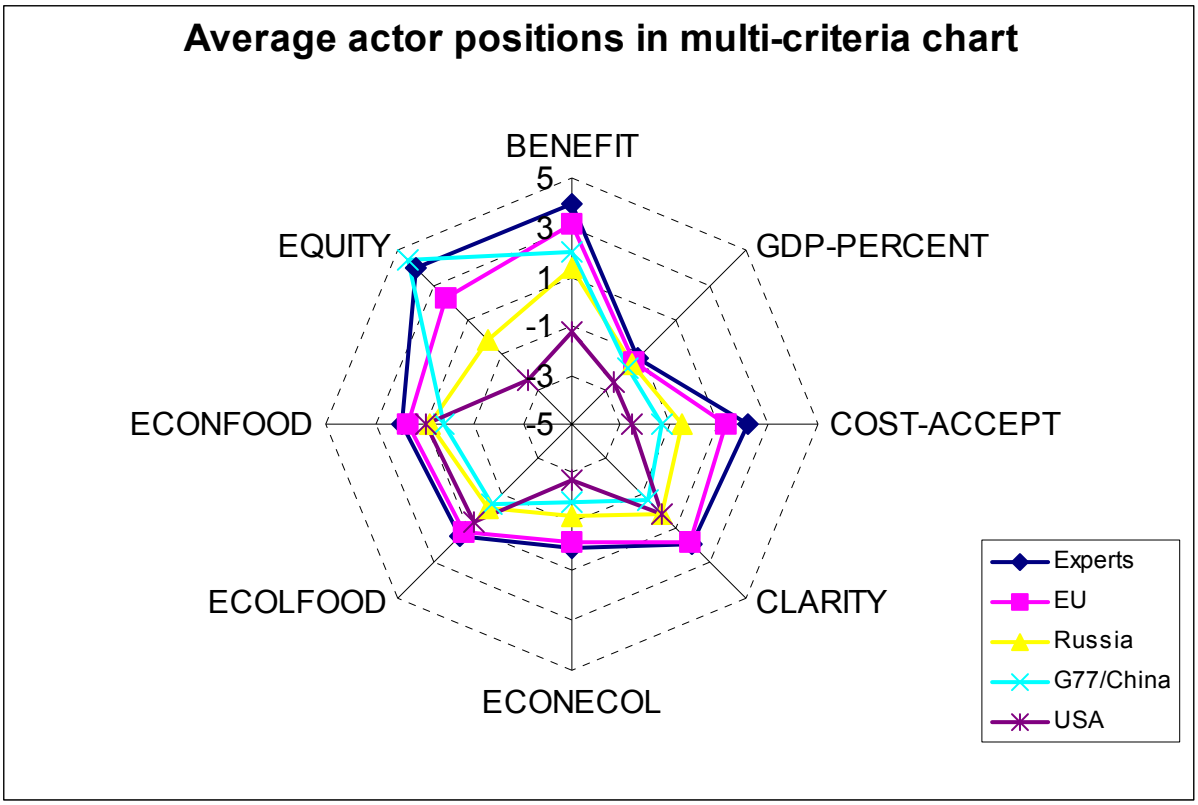

Figure X.3: Comparative patterns of average actor positions on Art. 2 issues

5. **Russia and G77/China:** The positioning of Russia and G77/China seems to be *more moderate* than that of the USA. It is noteworthy that G77/China is characterized by relatively higher net benefit (m = 2 compared to 1.4 for Russia), while – at the same time - costs are more significant (m = 1.8% GDP compared to m = 1.5% GDP for Russia) and less acceptable (m = -1.8 vs. –1.5). The experts assume a significant conflict between economic and ecological criteria (m = -1.3 for Russia, m = -1.8 for G77/China) for both actor groups but not for the other two pairs, with Russia slightly more on the positive side. Given the push of Russia for the ultimate objective at COP-8 and the resistance of G77/China to discuss the issue, it may be somewhat surprising that G77/China is assumed to aim for a slightly lower stabilization level (603 ppm compared to 626 for Russia) within a shorter time-frame (2086 for G77/China, 2093 for Russia). One possible explanation – apart from statistical error – might be the higher expected net benefit which may ultimately prevail in G77/China. Nevertheless, the implementation year is set considerably earlier for Russia (2011) than for G77/China (2015). The most striking point is the expert's assumption that equity is very important to the interpretation of Art. 2 (m = 4.1) for G77/China, thus differing a lot from Russia (m = - 0.2). Here is a remarkable

exception, where G77/China receives the highest score, even slightly more than the experts themselves (m = 4.5). This indicates the common perception that a requirement to get the G77/China involved into further progress on Art. 2 is *to include equity* in some way. This contrasts with the expected strong resistance of the USA (m = -2.4) against this point, where more than 50% of the experts assign a score of –4 or –5, assuming that the equity issue is close to completely irrelevant to the USA.

6. **Potential fields of conflict:** Among all variables, the *equity issue shows the largest diversity of opinions* (range of 6.5), indicating a major point of conflict in future climate negotiations. A second field of conflict is the perceived incompatibility between economic and ecological conditions; not so much because of the diversity of positions but rather due to the fact that - on average - all actors (incl. the EU) are found in the negative range. This implies that some *inherent conflict is expected between the condition of ecosystem adaptation and enabling of sustainable economic development*. The fact that this variable receives the lowest score for all actors means that the experts see a still unresolved issue. There is a wide range of views about *benefits and costs* (range of 3.8 for benefits, range of 4.7 for cost acceptability) which could make agreements to become more difficult to achieve. Rather high average values and a smaller range of opinions about the actor positions occur on the compatibility of ecology-food conditions (range 1.84) and economy-food conditions (range 1.75) which implies that the experts do not see it as a significant conflict potential.

7. **Implementation, stabilization and timeframe:** Negotiating the implementation of Art. 2 is preferred by the experts themselves to happen around 2005, which is about two years earlier than the EU. Other average implementation years are 2011 for Russia, 2015 for G77/China and 2017 for the USA, which however shows a maximum variation of 12 years. Experts prefer an average stabilization level of 482 ppm CO_2-equivalent, with 450 ppm as first and 550 ppm as second preference. For the EU they assign an average level of 533 ppm, with an overwhelming majority for 550 ppm. On the opposite end is the USA with an average of 724 ppm and a majority for 700 ppm. The average and majority position of G77/China is 600 ppm, while the ascriptions with regard to Russia are quite heterogeneous (with an average of 626 ppm). The experts' valuations are variable with regard to the required time-frame for stabilization. The averages are quite similar for the experts' own position (2066) and that of the EU (2074); Russia (m = 2093) and

G77/China (m = 2086) are supposed to prefer longer time-frames and show a similar distribution. The USA is an outlier with an average time-frame expanding to 2113.

8. **Potential coalitions:** The clustering of data provides some indication about potential coalitions. Not surprisingly, with regard to most variables, there is a rather high coincidence between the EU position and the experts' own viewpoints (in particular of researchers and NGOs). This coincidence which can be observed in climate negotiations is largely independent of the origins of the experts. *With regard to net benefits of Art. 2, there may be formed a grand coalition of EU, Russia, G77/China* (in line with the experts self-assessments, too). Only the USA is found in the negative benefits range. With regard to the timeframe, nearly all country groups are assumed to set stabilization targets before the year 2100, except the USA which would follow with a delay in 2113. The experts' preference for *equity is similar to G77/China and comes close enough to the EU to support a coalition*. However, the gap between the experts and the EU of 1.8 is more significant than for any other variable. The issue of the clarity index suggests that no actor appears to have full clarity of the meaning of Art. 2. The experts themselves and the EU achieve a value near +2, whereas the other actors plot near zero (USA) or reach even negative values (Russia and G77/China).

9. **Uncertainty on positions:** The previous analysis is based on the average values of the variables across all responses. The variation of viewpoints can be explored by their standard variation (*sv*), even though the Gauss distribution may not be adequate for each data sample. However, it can be used as a first approximation to represent the uncertainty of the experts in identifying the positions. The corresponding data are depicted in Figures X.4 – X.6. It is interesting to note that *sv* is largest for the group of interviewed experts themselves for most variables. This sounds reasonable since 31 different actors are involved with quite heterogeneous backgrounds. Remarkable are the following exceptions: *sv* achieves by far the lowest value near *sv* = 1 for "benefits" which clearly indicates that the experts basically agree on the significant benefits from Art. 2. The standard variation *sv* is also low for "equity". Only the variability of corresponding ascriptions on G77/China is lower, which implies that for both there is only *little uncertainty about the significance of equity*. It is somewhat surprising that *for most variables Russia receives the lowest of all uncertainties*, even lower than for the EU, while nearly all variables on the USA contain the highest variation, immediately followed by G77/China. This result seems unexpected because the USA is often treated as a

candidate with a clear position, while G77/China is supposed to have a wide range of positions. A similar tendency can be observed on "implementation", "stabilization level" and "timeframe". "Implementation" shows a steady increase in the order from experts to USA. Nevertheless, "stabilization level" shows a boost in variation of ascribed position for Russia, G77/China and the USA, achieving a standard deviation in the range of about 140 ppm. The *variability of answers are lowest among the variables "benefits" and "costs", while "clarity" gets by far the highest variation* (sv = 3.5), followed by the three compatibility variables (see Figures X.4 and X.5).

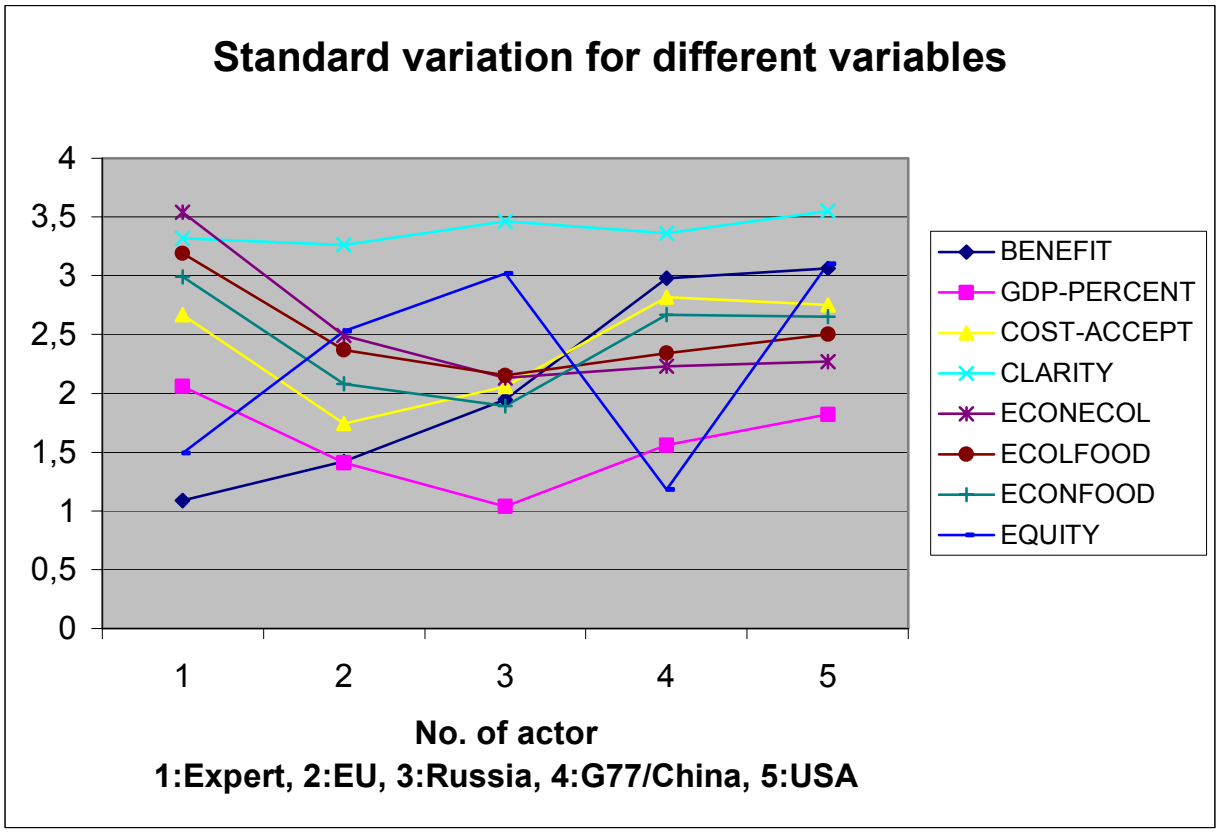

Figure X.4

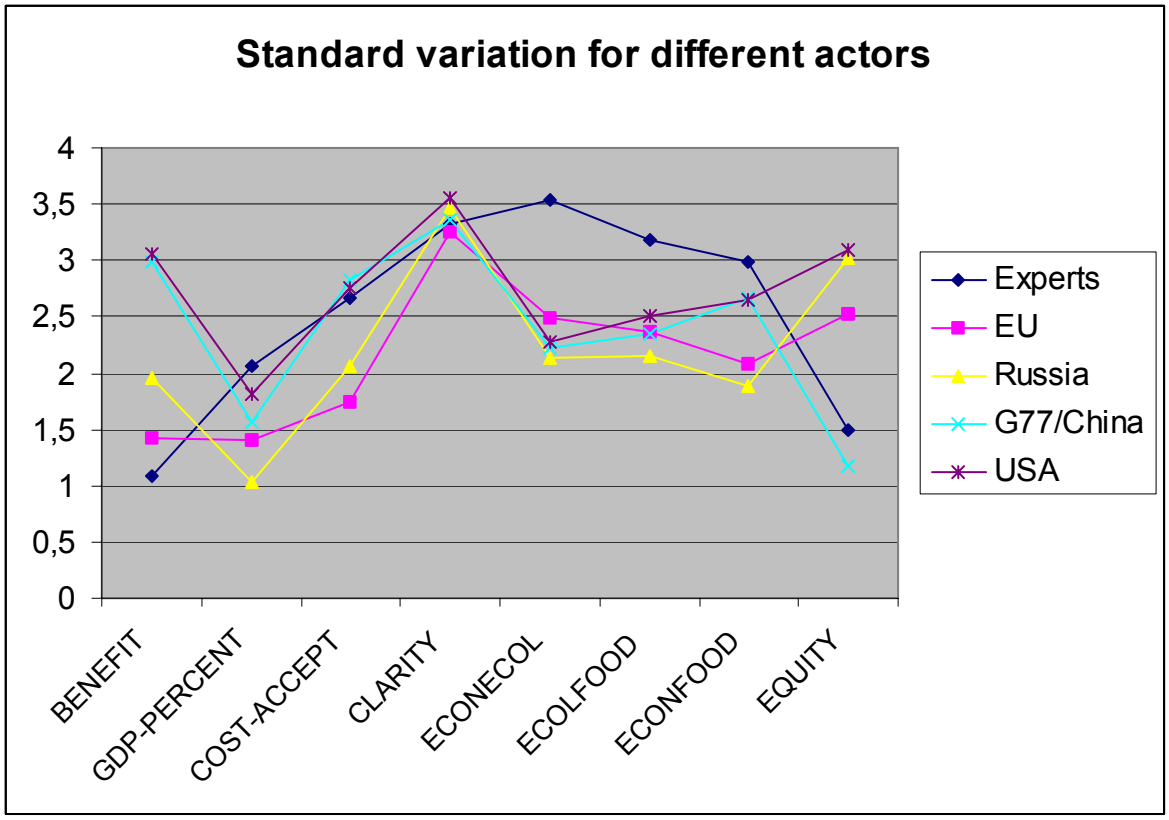
Standard variation for different actors
4
3,5
3
2,5
2
1,5
1
0,5
0
BENEFIT
GDP-PERCENT
COST-ACCEPT
CLARITY
ECONECOL
ECOLFOOD
ECONFOOD
EQUITY
Experts
EU
Russia
G77/China
USA

Figure X.5

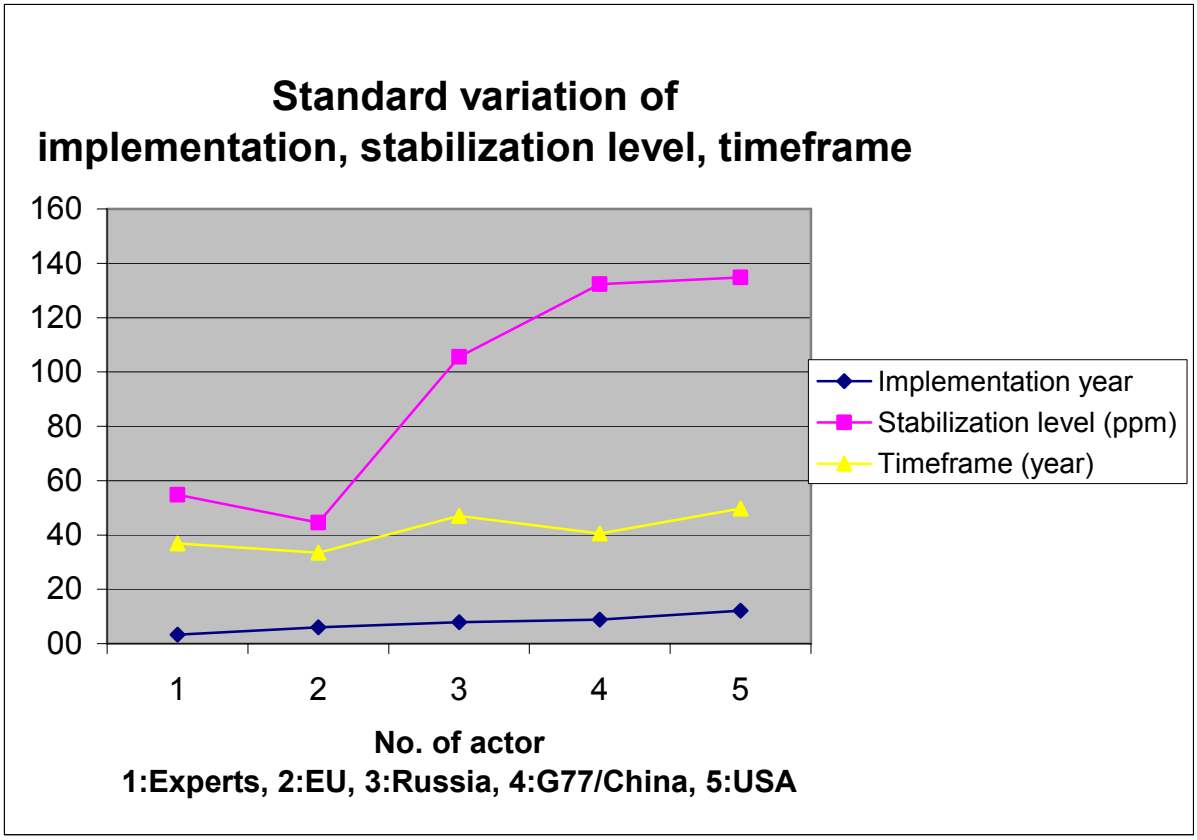
Standard variation of
implementation, stabilization level, timeframe
160
140
120
100
80
60
40
20
00
1
2
3
4
5
No. of actor
1:Experts, 2:EU, 3:Russia, 4:G77/China, 5:USA
Implementation year
Stabilization level (ppm)
Timeframe (year)

Figure X.6

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