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Executive Summary

by

Meinhard Schröder et al.

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Initial circumstances

Climate conditions and the related effects have for a long time throughout the history of mankind been accepted as given by fate; that was why only a passive role, if any at all, had been attributed to human society. This can be explained by the dynamics and complexity of climate processes, which are difficult to describe. The human role, which is becoming more and more likely to be considered an active one within the climate system, and the corresponding future climate scenarios that can be deduced from it, have led to the fact that human beings are now about to lose the ”innocence” they have claimed so far. In contrast to naturally emerging climate changes in the historic past, causes as well as reactions have built in the meantime an operative correlation, that is to be justified. The possible risk of an ultimate climate change and its meaning for mankind as a whole and for individual regions is, however, subject to highly controversial and partially emotional discussions in science and the public.

“Climate” is an abstract term, which is to be made ”visible” principally only by model ideas, whose form and complexity are different. Prognostic models are an essential instrument of climate research, but although the models get closer to reality and their formulations become stricter, they are always confronted with the problem of uncertainty. Therefore, the question of *acting under uncertainty* is a substantial core factor of the climate problem.

The decision, whether to refuse to act or carry out certain actions in the context of climate change, is to be *justified*, because these actions influence the life perspectives and risks of those, who are affected, and touch their (supposed) demands on environmental quality. But it seems to be difficult to evaluate the obligatory, desirable or appropriate measures of actual or planned climate acting in the field of politics, law or economy, in light of the global dimension of the climate problems and their long-term character: Here questions of fairness, especially in relation to the long-term inter-generation perspective, of risk evaluation and cost minimisation are among others to be distinguished as well as to be connected to each other. Additionally one has to determine who will act as the legitimate representative for possible commitments, which are due to actions

with long-distance effects and long-term consequences and, in view of the time horizons to be surveyed, which obligations correlate to which commitments. Against the background of existing dissents in the field of climate sciences and the unavoidable uncertainty of climate prognoses, this leads to the question of when and how far climate-related worries, risks or dangers seem to justify preventive climate provisions.

Another problem is that justified climate protection objectives possibly may conflict with other objectives and principles of environmental politics and/or security or development interests of individual nations or regions. It is not clear so far, if possible universal moral commitments or the formulation of standards under international law are able to help finding a generally acceptable solution to these world-wide problems. From the point of view of scientific research, this problem outline gives cause to critically review and reflect upon emerging climate problems. This is done on the grounds of a *critical stocktaking* of natural and social science knowledge on future climate development and its consequences for the society and the environment. Here it is necessary to clearly show well-known and accepted knowledge on climate and climate consequences on the one hand, and, on the other hand, to demonstrate unsolved questions and gaps, especially with regard to necessary action, in order to formulate further needs for clarification and research.

The following reflection which is based upon the above mentioned aspects, is to analyse and evaluate comparable criteria for acting in the climate context from the point of view of natural science, epistemology, ethics, jurisprudence, politics and economy. Relevant system correlations between local environmental states and climate – emerging from the participating disciplines - are to be determined and to be surveyed in relation to meaning, objectives and problems of cognitive and reflexive processes. The achievement and validity of corresponding simulations, projections and evaluations are to be particularly assessed from the point of view of *theory of science*. Additionally possible conflicts of objectives in the field of environmental protection and between climate protection and economic development are to be expounded and to be evaluated from a transdisciplinary point of view.

The questions on rationally justifiable measurements for the treatment of potential climate hazards and risks, that go beyond the modelling of possible future climate scenarios and their consequences for human beings and the environment, particularly affect the problem of applicability of the *precautionary principle*, that will be progressively implemented in the field of environmental protection.

Therefore in the process of evaluating elements of rational climate policy, it is necessary to explain which preconditions and implications are connected with the application of the precautionary principle to the climate problem. Furthermore it is to be discussed if, and to which extend climate risks are acceptable for different societies, and how the burdens can be fairly shared by taking the appropriate measures, and if *long-term commitments* imposed by the present generation exist, and if they can be realised.

Conclusions

1. Scientific research on the possible future development of greenhouse gas emissions, the development of the global climate and its effects for human beings and the environment give cause for substantial **worries**. Nevertheless in the light of incomplete scientific knowledge and scientific uncertainty about probabilities and effects of climate change, it is possible to justify controversial evaluations of possible measures and their potential consequences. Presently an unambiguous and concluding, i.e. “final” evaluation of the underlying justification structures seems to be impossible.

2. It is the aim of continuous climate and climate impact research to reduce the **incompleteness** and **uncertainty** of the knowledge base. However, due to fundamental reasons, these cannot be eliminated. Acting in the light of climate politics remains acting with uncertainty. Acting with uncertainty can and should be oriented towards normative criteria of rational risk evaluation.

3. There is a need for justification when climate-related action has been carried out or has been postponed. The action is always to refer to the present knowledge level. Here rationality and acceptability of decisions in the field of climate politics depend upon the question, if the underlying descriptive and normative grounds **are made explicit for later review**.

4. Due to the diverse scientific aspects of this topic and their great importance in relation to society and to the question of their legitimacy, it is necessary to evaluate and assess related questions by **trans-disciplinary** means. The cross-sectional character of this topic implies the co-operation and reflection between the relevant disciplines of natural sciences, social sciences and philosophy. Specific research suggestions, made from the point of view of every single discipline, as well as from the trans-disciplinary point of view, are to be defined in the appendix of the extended report.

5. The climate problems are about to have substantial **global effects** with respect to the possible confounded and responsible subjects of climate change. Therefore international programmes for climate and climate effect research, as well as international initiatives and agreements on the grounds of international law, are reasonable and necessary to jointly handle climate change-related risks.

6. In addition to the effectiveness and efficiency of the interventions in question in the field of economic processes, it is to be reviewed if these interventions are an appropriate means to achieve, that burdens which are imposed by climate effects or by protection measures (which are taken to defend or to avoid these burdens) are to be **fairly shared**. At the same time this implies a fair balance between the rights of present and future generations; their different range of affectedness on different spatial and time scales are objects of consideration. This applies also to possible capital or know-how transfers, as long as they are an appropriate means to complete the set of preventive climate provisions. Prevention obligations, which should be acceptable for individual regions, emerge from the “causation principle”, e.g. the present and historic emission profiles of the near past, as well as from the economic

capability of the participating industrialised and developing countries, and their potential in the field of research and technology.

7. Existing **principles for action** in the field of international environmental law and environmental politics (precautionary principle, intra- and intergenerational fairness, sustainability etc.) are necessary for the justification of national and international climate protection politics, but are not sufficient for the definition of an operative strategy for climate policies. These principles are to be included however, to serve as guidelines for climate protection politics. But they are subject to various interpretations and are to be put in concrete terms. The same applies to the principle of adequacy which limits precautionary measures (see below, thesis 9). The open and normative relations between precautionary motivations and appropriateness of measures cannot be unambiguously defined, but are subject to interpretation.

8. The implementation of the action principles, stated in thesis 7, does not determine specific strategies or measures to be selected. The orientation towards the precautionary principle, in particular, does not imply the decision whether to prefer preventive or adaptive strategies. Both strategies include precautionary aspects. Depending upon the realisation of either preventive or adaptive action patterns, diverse **conflicting objectives** may emerge from the relevant conditions, costs and (side-) effects.

9. In light of the discrepancy between the need for climate research information and its incompleteness, short-term and serious interventions in the economic system in favour of a massive prevention strategy do not seem to be justified. It must also be taken into consideration, that short-term massive interventions in the economic system bear **risks for the society** as well. Therefore, long-term predictable (e.g. calculable) measures, which come into effect gradually, are to be taken. In the near future they show comparatively less effects on the climate system, but if continuously applied, they stand for a long-term effect. They should be realised step by step according to the principle of adequacy.

10. A high ability to learn and a substantial level of reversibility can be implemented during such an alteration process. This refers to the setting of interim objectives, to modifications of the intended hierarchy and to the measures. Current empirical knowledge, taken from the constant monitoring of climate changes and their modelling results, is to be included as well as findings about the formulation of standards within the society and the effectiveness and side-effects of individual instruments. The idea of **flexible planning** in the field of climate protection allows experience to be gained with the operation of new instruments and allows them to be used in further planning steps. Additionally it allows climate politics to react to current scientific findings without giving up the aim of precaution. In relation to that, the post Rio process is to be considered a decision process consisting of several steps; it seems to be appropriate for the planning task as far as its *structure* is concerned – although not necessarily as far as its concrete results are concerned.

11. The appropriateness of precautionary climate policy actions can be evaluated on the grounds of different criteria, for example, economic and/or ethical **rationality** – with quite different results. Any neutral or overriding meta-perspective, that would enable to ”definitely” or ”finally” evaluate the superiority of some specific criteria or derived findings is absent. The plausibility of the appropriate argumentation patterns is to be reviewed only transversally, by critically comparing contrary patterns of justification. More specific evaluations are full of uncertainties, because, on the one hand it is hardly possible to calculate a climate path, which stands for an economic optimum, and on the other hand, the preferences, life styles and possibilities for adaptation of future persons can only be predicted within certain limits; and this makes it difficult to keep the maxims of intergenerational fairness.

12. A wide range of possible climate policy interventions are about to be discussed. Relevant options on various national, European and international levels are characterised by specific requirements for effectiveness and/or efficiency. In light of climate prevention and its presumed urgency, the short-term realisation of measurements for

flexible mechanisms and the strict exploitation of possible "No-regret" potentials seems to be reasonable, as long as these are available immediately and effectively. Furthermore, legal instruments can be involved if necessary, at different time intervals, to secure the long-term effectiveness of climate protection.

13. On the national level, it would be more substantial for the aim of long-term climate protection, if climate protection strategies were developed that go beyond the year 2005, than to achieve the set objective of reducing CO_2-emissions by more or less exactly 25%, and to amount probably to nothing more than that. It is the challenge for long-term climate politics to introduce over a period of 20 to 30 years a **re-orientation of the energy supply system**, that does not depend that heavily on carbon fuel.

14. The present outline of the **Kyoto Protocol,** whose ratification has been basically made possible due to the results of the Bonn and Marrakesh conferences in Summer and Autumn 2001, is, as many observers put it, not sufficient. Although some of its details have been criticised by the public and by scientists, it seems to be a basically appropriate means to outline the general climate protection concept. This is because the content of the Protocol, which has become less substantial due to the concessions, made *inter alia* in the field of quantified reduction units, is to be considered separately from the Protocol's high relevance in the field of international contract law. It offers the perspective to establish binding periods of time in the future, and therefore it is the only hold to introduce long-term, effective and favourable climate development by using the means of international contract law. In the future decades, the Kyoto Protocol can be adapted to the latest findings of climate research and, if necessary, be tightened within future binding periods of time. The contractual commitments established during the Bonn conference, are to be considered minimum objectives of climate politics, which do not basically exclude that individual nations or several EU states take on further pacesetting roles, as they have already taken on in other political fields. Such pacesetting roles however, must be particularly justified.

The following remarks give reasons for the recommendations mentioned above from different disciplinary points of view as well as in interdisciplinary perspective.

State of affairs

Detection and attribution of climate change

It is a basic principle that climate processes and their simulated representations, which are created by means of complex models, partially depend on chance. Consequently, the description of these processes is necessarily a statistic task. This applies as well to the detection of climate changes, that are to be proven, as to the attribution of climate signals to their anthropogenic or natural causes. The causes for climate conditions near the ground however, can be backed up by long periods of time, that have been sufficiently reviewed. Irregular patterns are characteristic of these time periods. The model for research of climate change and its proofs assumes, that these data include parts, depending on chance, as well as quasi-regular parts, overlapping each other. The latter could be caused by the increasing concentration of greenhouse gases.

To prove climatic changes, which have not been caused by natural effects, the change rates, taken through observation, have to be assessed. Here it is necessary to examine in advance, to which extent the stochastic parts influence the result. Therefore the process starts with a ”null hypothesis” which is to be analysed by a statistical test. This hypothesis is based on the theoretical assumption, that the climate variable changes only on the grounds of the natural variability, and that the change rate is zero within the statistic average. It is then related to an alternative hypothesis, which includes a different approach to the assumed climate change, for example in a way that the expected change rate has a positive value and shows a definite amount.

Basically, it should be possible now to unambiguously assign the climate data to the relevant hypotheses. As a matter of fact, one may use the factual data of the last 50 to 100 years (resembling instrumental data

record exists for that period of time) to extract change rates but – and this is a dilemma – the same data cannot be used to establish the null and/or alternative hypothesis. This is said to be due to the fact, that the observations cannot be assigned to the relevant hypotheses because the data base is not independent (which is a precondition in statistics) and cannot be used to calculate the change rate *and* to evaluate the hypotheses. Therefore, the purpose to assign observations of real climate conditions of the past to a null and/or alternative hypothesis by implying specific probabilities cannot be achieved.

But if the available period for observation – prolonged for example by including historical climate records from the pre-instrumental era – was substantially longer than the typical time range of the presumed greenhouse-gas-induced changes, one could assess the statistic features of the natural climate variability up to the middle of the 19th century by including observations, made before the industrial revolution, without coming into conflict with the independence criteria mentioned above. But corresponding extended data series, that could bear precise information, are yet lacking; they are subject to current research programmes.

Statements which do not depend on empirical data and which can be formulated through models of different complexity, offer a way out of the dilemma described above. Typical values of the internal natural variability of average world-wide temperatures can already be circumscribed by simple considerations. It seems plausible, that they are significantly shorter than the amplitude between glacial or interglacial epochs.

In addition to anthropogenic greenhouse effects, other external processes can also create signals for climate changes within comparable time ranges which interfere with the natural climate variability. This includes fluctuations in energy radiation through solar processes or volcanic aerosol. Geo-scientific findings on palaeo-climate could be assessed by stating, that heavy climate fluctuations are possible – even within time ranges of years – despite the relatively balanced climate since the end of the last glacial epoch. Therefore, additional alternative hypotheses and extended models are required in order to assign an observed signal of climate change to a specific probability.

In light of the uniqueness of climate observations, the question arises, which probabilities are to be assigned from the given empirical data to specific models with their characteristic forces (e.g. no external effects, only greenhouse gas effects, only solar-related changes and so on). Appropriate assignments can be made by means of the so-called *Bayes decision*. The Bayes perspective allows a unified interpretation of the detection and attribution problem by considering the variety of models as a statistical ensemble. At the same time the models generally do not represent a continuum, but are restricted by the numerical experiments to discrete cases. Preliminarily, they do not include any normative preferences.

Conditional probabilities can be calculated through the Bayes theorem by using the following propositions: (1) A probability statement on the frequency of a specific observation, provided by a given model prediction. This statement takes into account the natural variability of the observation parameters, the distribution of meteorological stations and measurement errors; (2) a probability statement on the prediction variability of a specific model; and (3) a quantified but subjective probability assumption of the appropriate models.

Corresponding probabilities based on logic grounds – along with the used knowledge base and along with invested prescriptions – could lead to quite different final results. It can be demonstrated, that the refusal of the null hypothesis (”observations are part of the natural variability”) with a sufficiently small significance a does not necessarily imply the other way round that a human influence on the climate with a probability of $1 - a$ is proven. It is more the subjective probability in addition to the extend of probability for climate change signals, that is part of the evaluation process of change detection. That means for example, provided there is a proof statement, that “climate sceptics” are to be confronted with higher probabilities of signals for climate change than ”model optimists”. The probabilities for the occurrence of various scenarios are part of the knowledge on model evaluation. This illustrates the emergence of diverging evaluations of ”proofs” for human-induced climate changes. It will be of interest in relation to the negotiation level and the development of sharing and burden strategies.

Climate impact research

Interactions between the climate and those systems affected by climate changes are basically to be described on global and regional scales. The ”traditional” method of climate impact research, as a pure scenario analysis, neglects the interaction between human beings and the environment and is therefore an unsuitable instrument for a complete description of *global change*.

The scenario analysis is appropriate for regional climate impact research based on the assumption that activities, which are restricted to a single region, may not affect large-scaled processes on a global scale. But this assumption can hardly be applied to industrialised countries, due to their economic integration with the international community. In addition to that, the effects of a possible climate change are difficult to assess for single delimited and relatively small regions, because the structural change in industry leads to substantial changes within a very short period of time and significantly alters the subject of the climate effect. Additionally, comparable situations in history indicate, that major changes could only be triggered off by climate changes in those societies, whose social and economic systems were destabilised before. Therefore it is always to be checked within the framework of climate impact analysis, whether the subject of analysis is in fact “determined by climate” or whether other factors have a substantially greater influence. Consequently the development of integrated regional models should be fostered. This is a new challenge for the conception of models, because regional climate models, regional climate impact models and sector-specific models are to be combined. The concept of ”vulnerability” of single regions has proved a possible and encouraging approach to regional risk analyses.

The criticism of traditional approaches towards climate impact research applies to the global dimension, too. The scenario analysis is only suitable to examine the sensitivity of the (global) climate system towards *ad hoc* disturbances. So far, different emissions of greenhouse gases or aerosols have been assumed as possible driving forces. It is suspected, that the whole range of possible disturbances have not completely been taken into consideration. For example, the influence of land-use or land-cover chan-

ges on climate – like large-scaled deforestation of tropical rain forests or boreal forests in the North of America, Europe and Asia – have been examined only roughly and only in separate model calculations. Another problem of the scenario analysis is, that the various scenarios are not and/or cannot be assigned to a certain probability of occurrence; they are being developed under the point of view of plausibility. That means for example, all scenarios which had been analysed by the *Intergovernmental Panel of Climate Change (IPCC)*, may considered equally plausible.

Finally concluding, global climate impact research is to be covered only by means of "earth system analysis" – defined here as the analysis of global interactions between natural and anthropogenic spheres. At present there are only conceptional earth system models of such earth system models, where the anthropogenic sphere remains restricted to socio-economic aspects. In the last years, considerable progress has been achieved in describing single components of the earth system, particularly in modelling the natural earth system; here the anthropogenic sphere is defined in advance as a marginal condition of the natural sphere without feedback reactions. It may be suspected, that essential progress is about to be achieved in the oncoming years in the field of integrated global climate impact research.

The political dimension of climate change

Two decades ago, the protection of the stratospheric ozone layer was the ruling issue of global environmental politics. The issue of climate protection has now become a substantially greater challenge for international politics – being confronted here with a far more diverse structure of emitting sources, that cover many different sectors (particularly energy, agriculture and traffic). Therefore a quick solution to the problem was not about to be found. As a consequence of the so-called Brundtland Report which also introduced the term "sustainable development" to the broad discussion, the international discussion on world-wide environmental and development politics, being brought together on the occasion of the UN Conference on Environment and Development in Rio de Janeiro in 1992, reached its peak for the time being. In addition to further agreements, the

United Nations Framework Convention on Climate Change was signed, which marks the end of the first phase of international climate politics, and which serves at the same time as the basis for the Kyoto Protocol of 1997.

International climate politics has come to a turning point because of the Kyoto protocol. The Framework Convention's weak formulations about emission reduction goals have been followed by precisely defined reduction plans. Compared with the demand to substantially reduce the emissions however, the regulations of the Kyoto Protocol are modest. Even if the industrialised countries reduced their greenhouse gas emissions – as it was planned at the beginning – by 2008/2012 in relation to 1990, the predicted growth of emissions in the so-called developing countries will overcompensate these figures. The Bonn and Marrakech Agreements of 2001 weakened these emission reduction objectives, but they prevented the Kyoto Protocol from being cancelled. As far as this question is concerned, the Kyoto protocol has not yet become an effective instrument of global climate politics, but it offers to be a starting point for effective climate protection in the long run.

As far as the different theories of international political science are concerned, there is a large variety of options for assessments of climate politics: Neo-realists draw their attention to the important function of super powers, whereas neo-liberal institutionalists stress the role of international regimes and organisations. Marxists emphasise the influence of asymmetric distribution of wealth on a global scale and stress the role of those industrialised countries that influence international regulations in a disproportional manner; cognitive approaches focus on the acquisition and organisation of knowledge and its functional transfer towards policymakers. None of these general theories can claim to explain more than only partial aspects of the factual situation.

As far as the formation of a moral judgement is concerned, the discussion about fair criteria to define an acceptable code for the sharing of emission rights and/or to accept emission reduction commitments, has not yet led to any agreement. Presently each participant can justify his activities by referring to a criteria of his choice. Developing countries claim

that there are historical responsibilities for greenhouse gas emissions of the near and far past and demand to equally share emission rights. Experience shows that industrialised countries in particular, acknowledge a responsibility only for emissions that have occurred since 1990. It is remarkable that there has not yet been a discussion about the question, if equal sharing of emission rights – depending on their absolute extent – includes initially the moral right to develop a country on the grounds of environmentally harmful activities which the industrialised countries have *de facto* already claimed for themselves. It is finally this topic, where political long-term ”explosives” might be suspected and which the developing countries cannot avoid in the negotiations about long-term emission paths; and this may even weaken their position for negotiations, at least in a moral sense.

The post-Kyoto sharing of emission reduction commitments implies a challenge for European climate politics in particular, although the EU as a whole follows so far a comparatively ambitious path: Whereas some EU member states will (almost) reach their goals, there are other countries that are potentially confronted with problems of complying with the contract. The clearer it gets that some member states of the EU have difficulties in translating the contract into action, the more this will effect the EU’ s leading role in global climate politics. And this could affect the actual selection of preventive or adaptive measures.

The weight of German climate politics on the international scale depends in the end on the role of the European Union as a central player within global climate and environmental politics. As such, it is the EU’ s possibility of exerting influence which allows Germany to play a substantial role in global environmental politics. At the same time the EU, with its willingness to comply with the reduction commitments, must largely rely on the implementation particularly in Germany and Great Britain.

As far as German domestic climate politics are concerned, it must be stated that they lack any conclusive climate policy; this stands in contradiction with the large degree of consensus on the importance and the matter of concern of this political issue. The emission reductions envisaged

for the year 2005, might however, be roughly reached. But further objectives and long-term political strategies for the next decades have not been formulated yet.

Climate protection from ethical points of view

Climate change as a long-term problem implies first of all the question about the moral status of future generations. “No Obligation” arguments can however be formulated, which could help to shirk possible commitments in relation to future generations. But it is a fact, that legitimacy claims of substantial “No Obligation” arguments can be weakened or qualified in relation to their moral importance. This brings us to the conclusion, that commitments in relation to future persons do exist. Suitable argumentations of ethical theories can be taken to further justify long-term commitments. Here, the attitude towards universalistic or particularistic approaches as well as the evaluation of contractualistic positions is full of consequences. According to the particularistic point of view, it is allowable to review climate change in the light of the question, if a collective is about to be among the winners or the losers. According to the universalistic point of view this is not allowable.

The preference given to universalism, has its roots in claims which are naturally inherent in moral judgements. As far as *linguistic logic* is concerned, it is superior to particularism and additionally, justifies itself *pragmatically* by showing an interest in solving conflicts on a neutral basis. Here economic globalisation might be a “vehicle”, that helps ethical universalism to be accepted in the long run; but that alone does not transport its normative substance. It is more the real discourses on global problems that undermine particularism. In discourses which are related to global problems, arguments with a clear particularistic character can hardly be referred to as a justification. The structure of global problems, as well as the implied requirement that discursive arguments and suggestions should be generalised for gaining acceptability, is directed towards universalism. So ethical universalism is based on assumptions and argumentation rules which cannot be pragmatically circumvented, and which we have to acknowledge if we want to get solutions to global problems.

In the end, favouring peaceful solutions, they can be achieved by discourse only (pre-discursive consents).

The basic moral insights mentioned above, still do not lead to unambiguous demands for action. Appropriate criteria and further principles have to be related to the climate problems: If we reject the strict preference of the bad prognosis forwarded by Jonas as being too rigid, but accept the minimisation of maximum damages and avoidance of optimistic strategies in case of an uncertain prognosis in connection with an assumption on the dimension of the climate problem, as well as – in the light of obligations in ethical considerations – with a precedence of activities that avoid damage, over those that bear advantages, we come to tutiorism in the climate context (prevention principle). This is consistent with intuitive conceptions about the conditional primacy of security and the juridicial principles of risk assessment. International declarations (e.g. UN Agenda 21) already include tutioristic standards in the form of the precautionary principle. The "Tolerable Window Approach" can be seen as another possible concrete term of tutiorism. Therefore a *moderate tutioristic, intergenerational universalism* is an ethically acceptable position. But this position always implies that rules, set to satisfy the need for justification, are being followed.

The atmosphere and its climatic characteristics can be considered as an intergenerational common good. In relation to the primary allocation of emission licences, this favours distribution criteria, directed to equality. Emission profiles which tend to be based on equality, are most likely to be justified in the long run. But it is absolutely necessary to look at an egalitarian position with some reservation, in order to avoid wrong incentives, contradictions and contra-intuitive consequences. In addition to the moral perspective, there must be a solid information base which strengthens the power of judgement. Beyond the level of justification, we have to deal therefore first of all with empirical questions.

It does not seem to be satisfying, to postulate a stability objective in an abstract manner, without defining an approximate value and to make it plausible. Furthermore as far as ethical questions are concerned, it would be dubious not to determine any upper limits and to rely on the possibili-

ty of being able to calculate and to achieve a “climate path” which is an optimum only from an economic point of view. From the point of view of the *moderate tutioristic, intergenerational universalism,* the highest concentration of climate-related trace gas must be limited. The knowledge achieved through climate research, enables us to reflect upon that despite all remaining uncertainties.

Consequently we could formulate at first a temporary approximate value of about 550 ppm of CO_2 equivalents. This value is a temporary one, because it is supposed to be subject to correction *in both directions* in light of current knowledge in climate research. This *basic* reversibility however, corresponds to a *pragmatic* asymmetry in relation to the possibilities of correction. If at first we chose a higher stabilisation level and realised, due to a better climate science data base, that this level has to be decreased, this would be perhaps far worse than to realise the opposite. Therefore a tutiorist will choose a value, which can be in fact corrected in both directions. The selected value is temporarily suitable for an orientation, but is not ”sacrosanct”.

This definition stands for a global, collective objective of avoidance. It implies a long-term planning task, a global climate regime under international law, and the use of various instruments. This objective is a normative standard of specific emission scenarios. Questions of distribution and allocation are put into concrete terms in relation to the limiting value, because it implies a statement on the expected maximum tolerable emission amount for the next century. This amount is to be distributed according to well-founded criteria. That leads to the ”ethical optimum” of a development path.

Therefore from an ethical point of view, one can outline general objectives and an approximate course and achieve, what is always required from ethics: orientation.

Economic aspects of climate politics

Climate change is being caused to a large extent by the burning of fossil fuel. At the same time this energy carrier is one of the most important

and ruling production factors of world-wide economic development. Coherent climate politics should therefore try to find a sound balance between the protection of the climate system and the aims to further increase the incomes for the continuously growing world population. Here the great imbalances of income in the different regions of the world are to be taken into consideration. Many regions are not able to break the vicious circle of poverty and underdevelopment without sustainable economic growth, and that also requires an increasing use of fossil fuel.

There are two model types, that help identify the economic implications of climate politics: On the one hand, impact models serve to analyse the allocation and distribution effects of specific climate policies in relation to their regional and sector-related structure. On the other hand, so-called optimising models help to find long-term optimum emission paths, which lead to a balance between climate change and economic development. But: optimising models work on the condition that a ”world-wide welfare function” is postulated which is to be maximised. The details of this approach contain many evaluation problems and require for example, agreement on the evaluation of regional distribution effects of climate politics. It is questionable if such a consensus of a possible ”world-wide welfare function” as a basis for the definition of an optimum path for world-wide economic growth can be taken for granted.

The monetary evaluation of climate damage also implies many problems; but experts even dispute over the costs that will be due in the next decades, only to avoid emissions. There is no consensus either on the discount rate which is to be used within the framework of an inter-temporal analysis for the discounting of future costs and effects, and which would become an integral part of a welfare function. Optimising models are therefore being calculated on a high level of aggregation and on the grounds of very simplified economic correlations.

The different models for optimum climate politics lead to comparatively low reduction rates of greenhouse gas emissions. A stabilisation of emissions, as it was proposed for example by WBGU in 1997, or even a stabilisation of the concentration of greenhouse gas in the atmosphere, would not be an optimum from the point of view of economic modelling.

This is due to the fact that current emissions cause climate damages only after several decades, but welfare is increased by consumption immediately. Therefore even with low discount rates, it is a matter of economic ratio to have a higher consumption today – that leads to short-term high effects – and to accept future damages, because being discounted, they today stand for a low loss of effect.

In contrast to optimising models, other models that deal with the impact analysis of climate politics do not claim to calculate an optimum path for economic growth in the future. They are rather based on existing economic correlations and decisions and examine the question of how specific measures in climate politics affect economic development in individual regions and in individual industries. They create information about economic effects of different climate policy strategies within a realistic and given framework of conditions in institutions and economic politics. The requirements on the data base of such models are still considerable, because their perspectives will have to be directed towards many decades in the future and therefore will have to include basic economic correlations and technical developments in its scenarios. The requirements however, are not nearly as extensive as those used for optimising models.

Impact analyses of different strategies in climate politics come to the conclusion that the economic cost of small reduction measures that are being actually discussed – as for example of the Kyoto Protocol – are overestimated by the public. There are however, different effects in individual regions, which are often not included in the discussion. But the models also allow the conclusion, that the stabilisation of greenhouse gas emissions, which is often demanded, or the stabilisation of the concentration of greenhouse gas emissions – within the framework of existing economic systems and energy technology – could not be achieved without dramatic welfare effects.

Flexible instruments – the situation in Germany

Instruments that are more oriented towards market economy have been demanded for German environmental politics since the Seventies. The mostly regulatory character of the instruments of environmental politics

gave reason for this demand. But the more the justifications for intervention in environmental politics moved from the protection against dangers to the objective of precaution, the greater the need became to make the instruments more flexible. Whereas the controversy “environmental taxes versus environmental certificates” was, to a large extent, displayed in the mainly theoretical discussion on environmental economy, a wide mixture of instruments was created in the field of practical environmental politics which was able to integrate objectives of other sector-related policies, as well.

Therefore current environmental politics are mainly characterised by regulatory arrangements; here it is the Plant Licensing Law – at least in the industrial sector – which plays a dominant role. Although there are regular hints at the objectives of environmental politics to be considered for the development of the tax system, this cannot be interpreted as if environmental politics have already been made more flexible to a large extent in the sense of market economy principles. And the discussion on a possible carbon dioxide duty and/or tax as an alternative to a competitive solution of suitable certificates did not lead to the introduction of appropriate measures, neither in German nor in European environmental politics. The political objective of reducing greenhouse gas emissions has rather been integrated within a variety of individual measures, which are partially directed towards other purposes and adapted to the specific conditions of the various sectors.

Nevertheless attempts can be recognised, that can help make German environmental politics more flexible, and whose experience could be used for the future introduction of flexible instruments – according to the Kyoto protocol. The introduction of the so-called ”compensation solution” in the field of policies to keep the air clean (BImSchG, TA-Luft) for example, can be considered an attempt to enable companies to reduce their costs for emissions reductions by balancing the emissions of several plants. Compensation solutions of this kind are however, an extension of the Plant Licensing Law. Due to the strict formulation of compensation options – this was necessary in order to avoid so-called “hot spots” of local effects of harmful pollutants – the compensation regulation has been

actually practised in only a few cases. The importance of setting a restrictive framework is becoming obvious, when it comes down to the evaluation of the compensation principle in terms of environmental politics as a local policy instrument to keep the air clean. The introduction of *global* instruments in climate politics which are part of precautionary policies, offers substantially more options – this is also due to the fact that there is no “hot spot” problem in the field of climate politics. But these options have to be integrated in a practicable way with the concrete formulation of flexible mechanisms.

Legal framework for climate protection

The legal principles for climate protection are basically laid down on the various levels of international, European and national law. In light of global climate problems reaching across the borders, the main part of politically and legally important climate protection activities takes place on an international and European level. The amount of greenhouse emissions can however, be defined for individual states, but an isolated mitigation will hardly lead to a significant reduction of the greenhouse effect, which is caused by the accumulation of climate-related trace gas emissions of all countries. Additionally there is only little room for ”solo efforts” of EU member states, because of the considerable competence of the Union in the field of environmental politics. That means, that international law is about to become a first-mover in climate protection. Consequently, the whole community of states has taken on the obligation to protect the climate on international scale according to the regulations of international law. The individual states and the regional state unions, such as the EU, are now obliged to implement, on the executive level, the climate protection measures which have been agreed upon on international level.

Current research knowledge in the field of natural sciences plays an important role in the evaluation of legal aspects of the climate protection problems as well. The vast majority of climate researchers see however, a correlation between the human-induced emission of greenhouse gas and the global rise in temperatures at the earth surface has been proven. But the reasons, correlations of effects and consequences of these risen tem-

peratures have not been comprehensively clarified. Consequently, there is the question of how environmental law can and must contribute to a solution from the point of view of precaution. But the range of the precautionary principle in climate protection has not (yet) been sufficiently examined in jurisprudence, e.g. the question to what extent the rights of third persons are allowed to be affected – due to the precautionary principle and in favour of climate protection. The jurist must rely, in this respect particularly, on further scientific knowledge about causes and effects of climate change.

The precautionary principle included in German environmental law, allows appropriate measures, i.e. precautionary measures for climate protection, that correspond to the principle of adequacy of action – seen also from the aspect of uncertainty – and is therefore particularly important for the legal authorisation of state activities for the sake of future generations (environmental protection as a state objective, art. 20a GG[1]). To avoid that a state-organised climate precaution, that necessarily goes more or less along with interventions in civil rights and liberties of the individuals affected, does not get out of hand, the precaution principle requires suitable limitations. It is to be emphasised, that it is not the precautionary principle itself, but only its qualified operative implementation, which gives the basic authorisation for formal state interventions in favour of climate protection. In cases of climate protection, the precautionary principle has generally to be dealt with more caution than in the field of traditionally risky areas like nuclear power – besides the need to refer to all sources of knowledge to a full extent and then to include possible corrections. This is because the risk threshold is, at least in the medium range, lower and the scientific foundations are comparably less sound. Otherwise there would be the risk of disproportionate limitations of basic rights.

The principle of integration which is supposed to include environmental matters in other political areas, is paradoxically an obstacle to progress in the field of a common climate protection law in Europe. There is for example, a conflict between purposes designed for the development of

[1] German constitution

the traffic infrastructure to support the domestic market and purposes to reduce mobility-related emissions.

The latest political development, the failure of the Hague conference in November 2000 in particular and the refusing attitude of the present government of the U.S. in relation to climate protection, seems to call the Kyoto protocol, whose entry into force was originally planned for 2002 ("Rio + 10"), and in which *all* Parties to the Framework Convention on Climate Change participate, very much into question. However the U.S. at least signed the protocol despite strong domestic oppositional attitudes. And there was even progress in some technical questions (e.g. the question of controlling compliance). But there was no convergence between the U.S. and the EU on the accounting of greenhouse gas sinks in relation to reduction commitments of the Kyoto Protocol which was the reason why the U.S. will not further participate for the moment. The brisk refusal of the Kyoto Protocol, stated by the present U.S. government, makes it additionally difficult to achieve a common and effective international climate protection mechanism, and forces the parties to the convention to consider a ratification of the Kyoto Protocol, even if the U.S. do not participate. The first steps in this direction were made at the climate conferences in Bonn and Marrakesh in 2001, not without losing some substantial content. But in the end, the protocol will gain legal power only if an effective system of sanctions is being implemented, that operates in case of non-compliance to agreed climate protection commitments. Appropriate measures hereto were agreed upon in November 2001 in Marrakesh.

On the whole, the legal examination of the climate protection problem shows, that law can first of all contribute to climate protection by the help of agreements, which are concluded under international law. But regarding this assumption, the possible contribution of law substantially depends on the *political* willingness of states to commit themselves to the task of climate protection.

Trans-disciplinary evaluation of climate problems

Trans-disciplinary evaluation of modelling future climates

Modelling plays a particularly important role in climate and climate impact research. But recall, that it is impossible to create any absolute definite knowledge by this means. However, it would be also groundless to principally disqualify all modelling results. And many questions in the climate context do not offer any alternative to methods that are based on modelling; that applies even to the branch of palaeo-climate research, whose empirical data base cannot be interpreted without creating models. Statements about the uncertainty of scientific knowledge seem sometimes to be characterised by resignation, when possibilities of science-related contributions to long-term social decisions are being discussed. But then, a naive belief in science would suddenly turn into an equally naive sceptical attitude. Instead, the scale of uncertainty should rather be a criteria to evaluate knowledge pools. Even if appropriate knowledge pools are also compared under the condition of uncertainty, science can and should contribute to clarify these uncertainties, that have been created by scientific research itself. Dealing offensively with the topic of uncertainty helps avoiding illusory security, without trying to run down the sciences wholesale. That means in concrete terms, that models and simulations can have a plausible meaning and ”truth” due to validations and statistical methods beyond a questionable claim for *guaranteed* knowledge.

Another critical feature of knowledge pools in the climate context is their *incompleteness*. The knowledge about processes in and between the partial climate systems (atmosphere, ocean, ice, land surface, biosphere) is full of gaps, as well as the knowledge about interrelations between anthroposphere and atmosphere. Decisions on relevance are taken in such a situation to define, which aspects are to be considered important and which are less important. The same applies to the research need; it depends upon the question of what is considered appropriate for a specific situation. Decisions on relevance necessarily include normative parts, the distinction between important/less important cannot be made therefore, simply according to inner-disciplinary standards. In case of an interest in climatologic questions, which is merely oriented towards the acquisi-

tion of knowledge, the normative parts are quite small. But they get substantially greater, as soon there is a *practical* interest, as is the case in the field of problem-oriented integrative research for climate protection. That means, that integrative climate research can *principally never be neutral* as far as underlying values are concerned. Decisions on relevance must be taken, which have not only to meet immanent scientific criteria, but also to keep societal, ethical or political relations; but that does not imply that its approach is not to be considered a scientific one.

The assumption, that value-dependent climate research – performed on the grounds of a practical interest in knowledge – is "corrupt", because it is subject to political influence and is therefore about to serve as an instrument, is a wrong conclusion. Concerning value-neutrality of research, it must be emphasised, that there is more of a continuum than a contradiction between disciplinary and problem-oriented research. Even the classical disciplines are not strictly neutral, but are based on normative preconditions. As mentioned above, it is only the weights of normative premises that vary. So neutrality in terms of values is not a constitutive element of scientific excellence. Therefore the problem-oriented character of climate research does not put a risk to its scientific quality, but leads to higher requirements on methodological transparency and excellence.

The modelling of large-scale processes in the climate system has been developed to such an extent, that the results are considered highly reliable information in the global context; that applies also to the requirements in the context of anthropogenic climate impacts and, to a limited extent, to the modelling of climate effects in specific vegetation zones or ecosystems. In contrast to that, the modelling of economic or social scenarios over the relevant periods of time offers no more than rough indications. Economic modelling, that goes beyond intra-generational periods of time, is even to be considered a speculation, because of principally unpredictable changes of human preferences and decisions. This has substantial consequences if models from the participating disciplines have to be coupled: the divergence between models of natural science and social science with respect to time periods and methodology puts a limit on the possibilities and reliability of coupled models. In extreme

cases – e.g. the modelling of long-term occurring costs for the adaptation to climate change – we will have to do without integrative models. Considerations about what to do at the present time to slow down or to avoid disastrous developments in the far future, can be made even without simulating economic aspects beyond inter-generational periods of time. Here, comparative evaluations of options of acting by using economic statements on the grounds of ”simple”, medium-range models and simulations, are to be included. It is clear, that coupled models *are not the ideal solution for every question.* They cannot either generate any decision criteria, that are ”more objective” than criteria which may emerge from, for example, ethical principles. However, linked models can give heuristic indications to critical aspects in the relationship of anthroposphere and climate.

Therefore, modelling results – the “prognoses” of the climate and its impacts – are equally to be evaluated in light of these reflective ”findings”. The question of how ”good” the prognoses must be to justify measures of a certain kind and certain extent, is yet to be answered. The plausibility and the transparence of prognostic knowledge would at least be guaranteed for appropriate rational risk evaluations. But regardless of the quality of individual prognoses, the problem of uncertainty is evident in this respect too. Developing several plausible scenarios instead of optimising individual prognoses in view of decision necessities offers an appropriate possibility to deal with the uncertainty of prognoses. So the openness of the future is integrated with the methodical approach, and that is more or less forced by the wishful formulation of the premises for the various scenarios. It also seems to be more helpful with respect to the findings and more promising to compare models in relation to their premises and preliminary decisions, than to only strive for the convergence of their results. This approach stimulates reflections on the question of how to deal with future-related problems, rather than to place them into the scope of supposedly certain prognoses. With future-related statements, based on coupled models, it is particularly important to put aside prognoses (which offer illusory securities) in favour of *scenario calculations* – which are explicitly *open for future developments*.

Preconditions for the determination of objectives in climate politics

Considerations with respect to environmental ethics and environmental politics must determine objectives or develop objective-related hierarchies. This is very important for climate protection and other environmental problems, because the selection of specific guidelines (e.g. clean-air regulations, protection of the ozone layer, mitigation of greenhouse gas emissions) can lead to absolutely different results in practice – even within the same environmental medium. This problem basically refers to the setting of limits, standards and avoidance objectives. The stabilisation of greenhouse gas concentrations on a safe level, as it is demanded by the United Nations Framework Convention on Climate Change, is also part of it.

Justified and precisely formulated medium-range goals can be considered characteristic features of modern environmental politics. They should be connected with state and non-state acting to secure their realisation potential. According to different environmental media and areas, a distinction is to be made between framework objectives and qualitative goals. It is necessary in the view of the operational level, to find concrete terms for general demands in relation to appropriate measures. For example, it is not sufficient to demand a wholesale reduction of CO_2 emissions only.

Suggestions referring to the formulation of realistic objectives are based upon scientific findings and normative premises as well as upon ideas, on what is to be considered “economically possible” and ”politically acceptable”. Natural sciences are not capable of setting an ”objective” aim by themselves, and this is due to the fact that the description of environmental conditions alone does not necessarily imply that they are inherent and ”given by nature” (naturalistic fellacy). Trans-disciplinary reflections – although necessary – seem to be more harmful than beneficial to *concrete* objectives, because objectives are always ”determinations” at the same time which could be challenged by critical reflection. Indeed, reflection virtualises the process of establishing objectives to that extent, that practice-oriented objectives are hardly to be deduced. Nevertheless, a reflective access to climate politics makes it easier and/or even possible to determine *plausible* objectives.

There are special requirements on the structure of formulations on objectives: On the one hand, objectives are to be defined through the transition of vague qualitative objectives (“clean air”, “climate stability”) into quantified objectives by assigning concrete values; and these quantified objectives are to be achieved within equally definite time intervals. This is the only way to develop so-called “Distance-to-targets” models, that offer information on the question if we get closer to the target, or if we reach or miss it within a certain period of time. This information in turn allows statements on the success or the failure of strategies and measures, as well as hypotheses about the effectiveness of operating instruments. On the other hand, the required concrete values should not be set arbitrarily and/or be ”pure invention”. The fact that appropriate values are expressed in symbolic ”round” terms (e.g. 25% reduction of CO_2 emissions), is probably to be accepted in favour of a better perception of the goals by the public.

First order objectives have a peculiar and special status. On the one hand, they are based upon commitments and are therefore obligatory, on the other hand they are conventional as far as their quantification is concerned – i.e. they are possibly not designed for a long duration. The term ”set objectives” literally expresses this conventional feature. This duality of objectives is a “tense relationship” that cannot been completely resolved by side one or the other. In this respect, morality and discernment are connected to each other.

As far as quantification is concerned, objectives – and that goes for the field of climate protection as well – can only be agreements, i.e. sensible conventions, which can and must be corrected in light of new findings. Therefore as far as their quantitative aspect is concerned, objectives are only preliminary and approximate values, designed for orientation. They cannot and do not need to claim any other obligatory status. Further expectations, such as for example their ”proof”, are not to be justified. In many technical disciplines, conventional approximate values, worked out and defined by experts, are already accepted to a large extent. That applies for example, to radiation protection, noise or water pollution prevention. Economic objectives too, are to be considered agreements (e.g. maximum

inflation rates for member candidates of the EU currency union). From this point of view, it would not be understandable if climate protection objectives would be burdened with a higher need for justification.

The quantitative dimension of the objectives includes arguments, which, inter alia, refer to "realism", feasibility and their consistency with other objectives. Within this dimension, objectives are negotiated and oriented towards other objectives. An appropriate example is the adaptation of the EU emission reduction commitments within the framework of the so-called "EU Bubble" to the planned nuclear phase-out in Germany. In this respect, operational problems must not be ignored, when it comes to the definition and formulation of objectives. Objectives that try to ignore these aspects would be "utopian". The semantics of "realistic", "possible", "matter-of-fact" or "unprejudiced" however, can bear valuations that are to be reviewed, if necessary.

As an executive authority, only the state is capable and authorised to define binding objectives for climate politics and to establish appropriate instruments for their realisation. In this respect, it is necessary to refer back to scientific expert knowledge. There could be a need for consultancy in relation to the definition of objectives, referring to the evaluation of operational conditions, knowledge conditions, coherence relationships and methodological aspects.

Elements of rational climate politics

Precautionary principle and the principle of adequacy

The precautionary principle is substantially important in the field of climate protection; on the one hand in light of the problem of scientific uncertainty, arising from the modelling and prediction of future climate conditions, on the other hand in light of the scale of predicted environmental damage and its connected potential risks for mankind. In this respect, effective measures to minimise risks seem to be necessary despite the lack of full scientific certainty, particularly from the perspective of environmental international law. Moreover, the precautionary principle

seems to be an appropriate means for the realisation of intergenerational fairness and/or for the keeping of long-term commitments, due to its intertemporal orientation towards the currently demanded avoidance of possible long-term damages. It is therefore to be the normative nucleus of the guiding principle of sustainable development in favour of future generations.

There is no dispute on the general statement that the lack of scientific certainty must not be used as a wholesale justification for the postponing of measures. But beyond that consensus, the practical application of precaution is impeded by the fact that there a common understanding about content and range of the prevention principle is lacking. On the national level – here within the framework of German environmental law in particular – scope and limits of the precautionary principle have already been outlined in the appropriate literature and in the executive, whereas on the international level most of them have not been determined yet.

Another problem occurring with the concrete formulation of climate precaution, agreed upon on the international level, is the fact that measures, to deal with climate change should be cost-efficient so as to ensure global benefits at the lowest possible cost (according to art. 3.3 of the Framework Convention on Climate Change). In addition to these economic criteria, the Framework Convention on Climate Change limits precautionary measures under scientific uncertainty to cases, where there are threats of serious or irreversible damage.

To avoid any inadequate or excessive precaution without setting a particular objective, the underlying knowledge base should meet high requirements; this already holds true for example, in the national and European interpretation of the precautionary principle. The fact that complete knowledge of the causes is not possible, must not lead to a lax handling of scientific and other appropriate sources of knowledge. Therefore it is necessary to thoroughly *examine all accessible sources of actual knowledge*. If a predicted risk potential proves to be less substantial or to have reversible effects, a new decision is to be made and, if necessary, an already operating measure is to be cancelled in order to avoid that basic and/or civil rights and choices of affected individuals become subject to limitations.

The discernable open content of the precautionary principle in international law allows the parties substantial degrees of freedom for evaluating the concrete use and formulation of precautionary measures in climate protection; and this may reduce the coherence in relation to the climate protection objective.

The prevention principle has gained acceptance and legally binding character in German and European law – i.e. the executive level for international agreements – and has therefore already advanced to an important cornerstone for national and international environmental law. There are however, several deficits in the common interpretation of the precautionary principle; but the already outlined limits of this principle offer indications how to put it into more concrete terms by national and European law. In contrast to the international level, the limiting principle of adequacy as a legal limitation of the precautionary principle yet plays an important role only in German environmental law.

The means of state precaution must be suitable and necessary to achieve the objectives and must not excessively burden the affected individual. In this respect and in view of scientific uncertainty the review of alternative options for precautionary action becomes extremely important, which would possibly put less strain on society. The plurality of conceivable and practically possible precautionary options offers the legislative body a large degree of freedom in designing its own options in the absence of urgent risks, because the field of prevention does not require spontaneous and strict action. The legislative body can make optimum use of this flexibility – as long as certain effectiveness of the measures and their alternatives can be sufficiently determined. Conversely, comprehensive bans in the field of state precaution are to be justified only by a lot of argumentation and in a situation of imminent risks. There is a general rule: The greater the distance in time between the immediate cause for a precautionary measure and the probable damage, the more likely are cautious measures to be taken for the moment.

Together with the need to use all accessible sources of knowledge and the principle of adequacy mentioned above, it is especially important *on the European level*, to confront and compare the environmental matters

which are protected by the precautionary measures, with other common EU-related objectives. That means, that environmental protection cannot be principally given priority treatment, even though environmental protection is intended to be integrated with other common EU-related policies. Otherwise the fundamental position of the basic and still existing liberties within the EU – which was originally an economic community – would be undermined. Their appropriateness – in view of possible limitations to basic liberties – is therefore to be strictly reviewed in each individual case when climate-related precautionary measures are being discussed.

In light of the open content and the indefinite scope of the prevention principle, as well as of country-specific limitations imposed by the principle of adequacy, it seems that on an international scale, precautionary measures in climate protection should only be *formulated step by step*, so that already planned measures can be adapted to new knowledge. This is a way to avoid non-acceptable limitations to economic activities, which would be especially important for developing countries.

Thus, the precautionary principle offers political decision-makers the necessary orientation, so that they – if they balance pros and cons and proceed step by step – can put the climate protection objectives of justice and inter-temporal fairness and/or sustainability into force. It is most likely to put climate precaution immediately into concrete terms on the European and/or national executive level.

Economic and ethical rationality

Economic and (normative) ethical rationality is based upon different patterns of justification which in the end lead to different opinions on rational climate action. It is possible to explain the dissents between economy and ethics by the fact, that ethicists and jurists tend to widen and to strengthen normative action frameworks, whereas economists try, wherever it is “sensible”, to solve problems within a welfare function. Corresponding dissents can also be proven within the ethical dispute on moral relevance of principle obligations to act *versus* factual consequen-

ces of action, or within the political debate on regulatory law *versus* deregulation. Solutions emerging from regulatory law are generally believed to be effective, but from an economic point of view to be often hardly efficient. Regulatory procedures are likely to be preferred, if the achievement of the objective is said to be very important or specific standards have to be complied with. Conversely the economic perspective is likely to be favoured in order to minimise economic loss. Together with the argument on appropriate action in climate politics, this controversy plays an important role in the debate on the liberalisation of the energy markets as well.

For a deeper understanding of the dissents, we have to look at the fact of how they refer to the relations of purpose to means. From a (discourse-related) ethical perspective, there is the following simplified structure: Society selects in practical discourse and/or political elections, type and scope of collective goods – such as health, environmental quality etc. Society wants to make sure that these goods are produced and maintained, and agrees upon appropriate objectives and strategies to guarantee their protection. Here, economic tasks are subordinated to the discoursive agreement on objectives in climate protection or other substantial goods. It is rather the role of economy to realise these "set" objectives as efficiently as possible without putting the objectives themselves in question. By expliciting the costs economists can, however, warn that the realisation of objectives within ambitious climate politics could possibly be very expensive. If a society however, complies with its objective in light of this information, the choice of this objective is to be accepted by economy as being "rational". To put it in economic terms, in this case the society would consider the achievement of a specific objective for environmental quality worth at least the predicted amount.

As a basic alternative, climate protection objectives can be integrated within a calculation oriented towards maximisation of utility, which can be simply characterised as a function of bundles of goods and climate conditions. The postulate of rationality is here a request to maximise as follows: Combine the consumption bundle and climate conditions in a

way, such that total benefit is maximised! An economic optimum of greenhouse gas emissions into the atmosphere would be one that maximises the total benefit. A preventive policy, whose total welfare losses are higher than the positive effect of avoiding emissions, would therefore not be rational from an economic point of view. In contrast to the first perspective, the efficiency criteria would play a more important role here, because the question – if the loss of goods (welfare, benefits, consumption etc.), possibly resulting from emission reduction proves any large-scale climate protection objectives to be at all rational or not – is answered *within* an economic calculation.

If it seems to be too much of an effort to achieve a specific, desirable climate protection objective, after reviewing the effects of all "trade-offs", the objective is abandoned because it is not "worth" the calculated consumption loss. Here the efficiency criteria does not refer to a relation of means to purpose, but to the total amount of benefit. The terms efficiency, optimum character and rationality can be deduced from one another here. Due to the dual meaning of the term efficiency, which has been proven in many debates, it is critical to use it as a criteria of rationality, because it can also be referred to the function of benefit (optimum) as to the most cost-effective way to achieve an objective (effectiveness). Efficiency can either be an optimum in a purely economic sense or only part of an effectiveness strategy.

For those who stick to the model structure of optimum climate politics on the level of economic theory, externally set objectives are to be justified separately. Therefore, objectives of climate politics have to be justified within democratic processes as components of an ethically and legally normative framework and also as being pragmatic. These components can then be added to the optimum path as more or less obligatory frame conditions (for example, similar to the fact that the moral status of basic human rights is indisputably superior to the maximisation of the total amount of utility).

In summary one can say, that precautionary climate action can be assessed quite differently. The assessment depends on the selection of either economically *or* ethically rational criteria, because there is no meta-per-

spective that would allow a more or less finally binding evaluation of the superiority of one specific concept of rationality and corresponding criteria. In certain cases, it may be possible to critically examine the respective argumentation patterns with regard to their plausibility, in order to determine the authorisation of contrary approaches to act which are relevant to climate development.

Strategies for coherent climate politics

Climate politics require highly substantial conceptions and operational conditions, because it is an extraordinary long way from abstract long-term objectives to concrete regulations which is overloaded with a lot of ambiguous meanings and decision necessities. Strategies are an interim step on the conceptional way from general objectives to concrete measures on the executive level along with their specific instruments. Climate policy strategies preliminarily structure the future by selecting specific individual options or bundles of options from a variety of possibilities and by putting them on the short list. They direct climate-related developments (e.g. emissions) towards specific paths to get closer to the set objective. Appropriate preventive or adaptive strategies allow “medium-range” definitions, so that long-term orientations can be put into concrete terms without determining the discussion of measures. Thus, this may result in a dissent on the level of measures, even in case of a consensus on the level of objectives.

Long-term needs are to be additionally looked at, with respect to the anthropogenic causes of climate change, in view of its impacts and the required duration of climate protection measures. These requirements have to be taken into account in climate politics, and in the connected strategic orientations for appropriate processes of setting goals and further planning. But these requirements, however, are not at all easy to meet: Due to the fact that knowledge is (generally) uncertain or incomplete, it must be possible to define priorities, strategies and measures in climate politics in a *flexible* way, thus enabling that new knowledge can easily be included into re-considerations. They must be provisional with respect to their premises and evaluations as well as with their set objectives, whose

normative force can be assessed differently over time. So it is a specific feature of strategy development in climate politics, that perspectives from thinking in long-term categories have to be foreseen in the area of necessary short-term decisions, but to allow at the same time, that the need for modifications and flexibility, which emerges from the temporary character of knowledge, can be complied with.

Climate can in this way be subject to discussion in the form of a permanent societal, political, scientific and public discourse on nature, environment and the future of society. This discourse includes large-scale benefits, emerging from the possibility to gain knowledge on various levels. Observation, modelling, simulation and evaluation of technical development as well as measures of political operation, control and modifying decisions are to be permanently integrated within strategies of climate politics. Such action within the framework of climate politics, being considered a ”flexible planning”, is an example for the approach of a “purpose-related incrementalism” which is also suitable to cope with other long-term problems. The only means to search for ”coherent” solutions is to take part in a permanent process of knowledge acquisition, in which descriptive as well as normative parts are subject to permanent development. Every single step towards further knowledge can and should be the incentive for further detailed steps of action – this however, should be done within set long-term objectives, which can be justified for example, by environmental protection principles, paradigms of sustainability and their ethical reflection.

Against this background, it seems to be ecologically reasonable as well as economically rational to develop and to realise first of all strategies for the exploitation of “no regret” potentials – if necessary, in the form of a solo national effort. This would comply with the precautionary principle, which is limited by the demand to weigh up predicted advantages and unavoidable implications, but which offers justifiable possibilities for action. Both principles would be taken into consideration by referring to “No Regret” options. A climate strategy which is explicitly oriented towards the exploitation and use of these potentials, would probably be easy to impart and to realise. If economic implications were

taken into account, an increase of efficiency would be possible, which would also meet the question of effectiveness as far as realisation is concerned. Such a strategy would also take into account the uncertainties mentioned above, which continue to characterise the climate problem and which in any case suggest, that it would be reasonable to operate step by step and/or to have sufficient reversibility as far as the measures are concerned. Other purely incremental approaches should be avoided, because they are considered to be not systematic, arbitrary and hardly target-oriented.

But these recommendations depend upon the premise, that “no regret” measures can be instantly realised without substantial interventions into the economic system. This would lead at first only to changes of marginal economic data. In the long run however, the course of climate politics could be gradually altered; “no regret” measures would be necessary buffers in time, then. During this time period, insights from the acquisition of actual knowledge on the climate system, on its interference with the anthroposphere and on experiences of newly implemented measures can be included, and used to draw up concepts for and to realise then due substantial interventions on a considerably better basis of knowledge than today. This would be also an economically consistent kick-off for long-term climate politics; interventions in the economic system, which are too fast and too massive and which are based on insufficient knowledge, would be therefore avoided in favour of later benefits from future research.

A coherent climate strategy will have to send reliable signals for the planning of private and industrial decisions. In view of the outlined uncertainties, such preliminary decisions can be bindingly determined to some extent however only for a medium-range time horizon of not more than two or three decades. Beyond this period, climate politics can only set indicative standards; the explicit possibility of regular monitoring and reversibility must then be integrated with the politics, so that it is possible to react to further scientific progress and alterations of other framing conditions. The implementation of sufficient possibilities to acquire knowledge or experience, the explicit consideration of the global charac-

ter of the climate problem by selection of appropriate instruments, and the optimisation of the chronological order of strategy elements in the long-term perspective are therefore cornerstones of a coherent climate strategy.

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2 Carl Friedrich Gethmann, Umweltprobleme und globaler Wandel als Thema der Ethik in Deutschland, 9/96, 2. Aufl. 10/98

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