

FEBRUARY 2000

ECN-C--00-010  
CICERO WP 1999: 12

## **PROJECT DEFINITION AND INTRODUCTION TO SOME KEY CONCEPTS AND ISSUES**

**The joint CICERO-ECN project on sharing  
the burden of greenhouse gas reduction among countries**

J.R. Ybema  
J.C. Jansen  
F.T. Ormel

**CICERO**

Center for International Climate and Environmental Research – Oslo

---

Senter for klimaforskning

## Acknowledgement

This report is the first Working Paper of the Burden Sharing study project that aims *to identify the most promising rules applicable for differentiation of greenhouse gas emission reduction burden among countries*. The project is carried out jointly by CICERO (Oslo, Norway) and ECN (Petten, the Netherlands) under ECN project number 7.7170. The project has started in October 1998 and will be completed by mid-2000. ISSN number: 0804-452X.

The Burden Sharing study project is financed by the Dutch National Research Programme on Global Air Pollution and Climate Change and by own contributions from CICERO and ECN respectively.

## Abstract

This Working Paper gives a general introduction to the project. It presents an outline of the set-up of the project. In addition, it explains some key concepts and issues on negotiating the distribution of the burden of greenhouse gas mitigation among the signatory countries and regions of the Framework Convention on Climate Change in the post-First-Budget-Period specified by the Kyoto Protocol (2008-2012).

## CONTENTS

SUMMARY	5
1. INTRODUCTION	7
1.1 International climate negotiations and differentiation	7
1.2 The differentiation problem	7
1.3 Focus and phasing of the Burden Sharing study project	8
1.4 Introduction to Phase I	10
1.5 Report outline	11
2. PRELIMINARY REVIEW OF RELEVANT CONCEPTS	12
2.1 Introduction	12
2.2 Basic notions of Burden Sharing	12
2.3 Regional scope	13
2.4 Conclusions	15
REFERENCES	16



## SUMMARY

This report gives an outline of the set-up of the present Burden Sharing study project. Moreover, it gives a first introduction to some key concepts and issues at stake. The project is aimed at *identifying the most promising rules applicable for differentiation of greenhouse gas emission reduction burden among countries.*

The project set-up can be outlined schematically as follows:

Phases	Activities
Phase 1: Basic analysis	a. definitions, concepts and data collection. b. analysis of existing international burden sharing agreements. c. analysis of equity principles. d. analysis of earlier differentiation proposals. e. set-up of a database on emission indicators.
Phase 2: Design of burden sharing rules	a. specification of evaluation criteria of burden sharing rules. b. development of burden sharing rules.
Phase 3: Consequences and evaluation of rules	a. selection of burden sharing rules for further analysis based on results of activity 2a. b. estimation of costs and economic consequences of applying selected burden sharing rules (no-Kyoto-instruments scenario). c. ditto, but assuming implementation of emission trading, JI and CDM.
Phase 4: Dissemination	a. workshop with scientists at the beginning of phase 3. b. development of computer model M-SHARE. c. workshop with policy makers.

According to many scientists a substantial reduction in global GHG emissions, compared to present-day global emission levels, is necessary to effectively address the issue of preventing human-induced climate change. Yet global GHG emission reduction implies a burden in terms of a major environmental constraint to global economic development and, consequently, in terms of worldwide (net) costs to meet the GHG emission constraint. The *burden sharing issue* addressed in the present project refers to the issue of how to elaborate on international agreements (FCCC, Kyoto Protocol) regarding the sharing among nations of agreed global GHG emission ceilings and/or emission reductions and the implied net costs thereof.

The following policy considerations may play a role in burden sharing negotiations:

- *Equity*: costs and benefits are to be distributed 'fairly'.
- *Effectiveness*: burden-sharing rules should be effective in reaching their objective.
- *Efficiency*: the goal should be reached at the lowest resource costs possible.

A major issue is *the regional scope* of burden sharing. Should burden sharing arrangements be defined by a universal global set of rules or does the application of a distinct set of rules for each, limited number of country groupings enhance the chance of successful global burden sharing negotiations? The former approach should be underpinned by principles of equity in the broadest sense (including full compensation for low-income parties), while in the latter case national burdens would be determined groupwise with justification by distinct mixtures of equality, equity, and exemption principles.

# 1. INTRODUCTION

## 1.1 International climate negotiations and differentiation

In December 1997, the Kyoto Protocol was adopted. The Kyoto Protocol includes legally binding commitments for Annex I countries (OECD, Eastern Europe) to limit or reduce greenhouse gas emissions. The commitments refer to a period of five years around the year 2010 (2008-2012, which is the so-called first budget period) and the commitments are differentiated per country<sup>1</sup>.

The Kyoto Protocol was adopted after a long period of intensive negotiations. It was no surprise that negotiations were difficult and that they took a long time: the commitments of countries to reduce their greenhouse gas emissions can have very significant impacts and the national circumstances of countries differ considerably.

As agreed at earlier Conferences of the Parties, only the Annex I countries took commitments in Kyoto. The non-Annex I countries, which mainly consist of a group of developing countries, have no commitments as yet. This is in line with Article 2.3 of the Framework Convention on Climate Change (FCCC) stating that:

‘The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but *differentiated* responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.’

Currently, the negotiations under the FCCC are largely dealing with the organisation, structure and conditions of the Kyoto mechanisms. However, it is expected that at some stage the negotiations will focus on new commitments for time periods beyond 2012 and this will likely include a larger or smaller part of the non-Annex I countries. In line with the Kyoto Protocol it is expected that such new commitments will also be differentiated.

## 1.2 The differentiation problem

The differentiation scheme that came out of the Kyoto Protocol was not founded on a specific method, but rather based on negotiations given the various interests and national circumstances of the parties. Yet a more systematic approach to differentiation may well facilitate negotiations on future commitments. In order to have good prospects to be used in the climate negotiations, burden sharing rules need to meet several criteria. These criteria are addressing relevant differences between countries and refer to principles such as equity, cost-effectiveness and transparency.

Several attempts have been made to design indicator based burden sharing rules (Torvanger, 1999). Some proposals for burden sharing mainly used aggregated indicators, such as greenhouse gas emission per GDP or per capita. Other proposals used more disaggregated, sectoral

---

<sup>1</sup> Another important characteristic of the Kyoto Protocol is that it includes different greenhouse gases in a basket approach and some kinds of carbon sinks that result from land use. Moreover, it includes the rough features of the so-called Kyoto mechanisms: Joint Implementation, Emission Trade and Clean Development Mechanism. These characteristics have been important conditions to achieve an agreement in Kyoto.

indicators. It is noted that one of these latter attempts (Blok et al., 1997) has facilitated importantly the achievement of agreement on internal EU differentiation of commitments.

The simple guide-lines or ethical principles on which such burden differentiation rules are based, such as, for example, emissions per capita, emission per unit of GDP, cumulative emissions etc., have been extensively researched, both in political science, economics and ethics (see, for example, Ringius 1999; Ringius, Torvanger and Holtmark 1998; Rose 1992). However, less attention has been paid to identifying those fairness and equity principles, which have played a significant role in the analysis of international environmental negotiations, and to the question why these principles mattered.

Information is available, although to a varying extent, on the differences between countries that might play a role in formulating burden sharing formulas, such as sectoral energy use, industrial structure, economic development, potential for emission reduction and abatement costs. However, this information is not necessarily available at the level of detail, quality and comparability needed for defining burden sharing formulas that are useful as a basis for negotiating climate agreements. Moreover, the available information focuses almost exclusively on CO<sub>2</sub> emissions from energy use. Data on emissions of other greenhouse gases (GHGs) and on land use changes - both being items that are covered by the Kyoto protocol - are much less available.

### 1.3 Focus and phasing of the Burden Sharing study project

The NRP<sup>2</sup> Burden Sharing study project aims *to identify the most promising rules applicable for differentiation of greenhouse gas emission reduction burdens among countries*. The project is carried out jointly by CICERO (Oslo, Norway) and ECN (Petten, the Netherlands). The project has started in October 1998 and will be completed by mid-2000.

Burden sharing rules will be designed with the purpose to facilitate future international climate change negotiations, especially negotiations in the FCCC framework on the second and subsequent budget periods. Differentiation of burdens should be based on relevant differences between countries. These differences may well relate, for example, to differences among nations in the existing energy supply and demand structure and in the level and structure of economic development. Burden sharing arrangements emanating from application of alternative burden sharing rules with a wide appeal among negotiators can assist in starting up successful international burden sharing negotiations. Evidently, the full responsibility for the final negotiation outcomes rests fully with the official negotiators and may well deviate from the burden sharing rule (BSR) arrangements on the negotiation table at the outset of the negotiations

The project comprises *four phases*:

- Phase 1: basic analysis. In this phase elements, rules, and considerations relevant for the design of burden sharing rules are reviewed and structured. Besides, data are collected that may be used in actual burden sharing rules.
- Phase 2: design of burden sharing rules. Based on the structured considerations of phase 1, several burden sharing rules will be designed which are expected to hold out fair chances of being used in upcoming negotiations. Criteria for the evaluation of burden sharing rules will be considered explicitly.
- Phase 3: consequences and evaluation of rules. In this phase the emission targets per country that result from the burden sharing rules will be calculated and the cost consequences will be estimated.
- Phase 4: dissemination. The developed burden sharing rules will be presented in two workshops to experts and to policy makers inviting comments to select and further improve the burden sharing rules.

---

<sup>2</sup> NRP stands for Dutch National Research Programme on Global Air Pollution and Climate Change.

The project set-up can be outlined schematically as follows:

---

Phases	Activities
Phase 1: Basic analysis	<ol style="list-style-type: none"><li>a. definitions, concepts and data collection.</li><li>b. analysis of existing international burden sharing agreements.</li><li>c. analysis of equity principles.</li><li>d. analysis of earlier differentiation proposals.</li><li>e. set-up of a database on emission indicators.</li></ol>
Phase 2: Design of burden sharing rules	<ol style="list-style-type: none"><li>a. specification of evaluation criteria of burden sharing rules.</li><li>b. development of burden sharing rules.</li></ol>
Phase 3: Consequences and evaluation of rules	<ol style="list-style-type: none"><li>a. selection of burden sharing rules for further analysis based on results of activity 2a.</li><li>b. estimation of costs and economic consequences of applying selected burden sharing rules (no-Kyoto-instruments scenario).</li><li>c. ditto, but assuming implementation of emission trading, JI and CDM..</li></ol>
Phase 4: Dissemination	<ol style="list-style-type: none"><li>a. workshop with scientists at the beginning of phase 3.</li><li>b. development of computer model M-SHARE.</li><li>c. workshop with policy makers.</li></ol>

---

The different elements of the study and the general line of the research project are depicted by Figure 1.1 below.

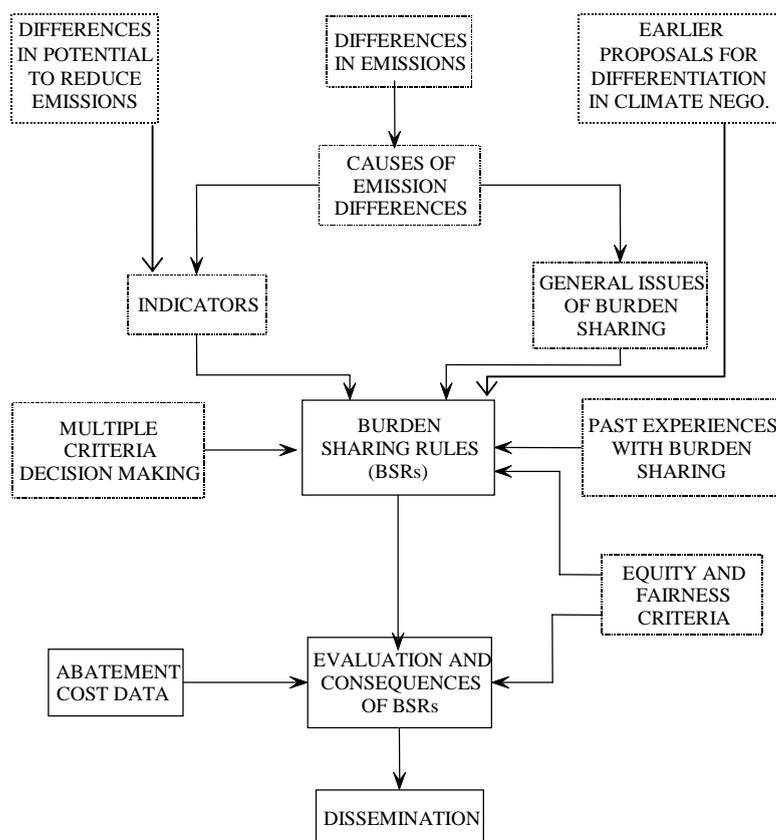


Figure 1.1 *Different elements and the general line of the NRP Burden Sharing project. The elements that are covered in the first phase are presented with dashed lines.*

#### 1.4 Introduction to Phase I

Phase I of the Burden Sharing study project includes several activities:

- a) an overview of emission and cost indicators that may be included in burden sharing rules,
- b) an analysis of equity principles,
- c) an analysis of other international agreements with differentiation elements,
- d) an analysis of different ways to combine indicators,
- e) an analysis of earlier proposals for differentiation in the international climate negotiations,
- f) set-up of a database on emission indicators and country specific data.

The Phase I activities a through e will be reported upon in Working Papers numbers 2 and 3. The insights gained from these activities will be embedded into the design of new burden sharing rules. Activity f is a supporting activity that allows quantifying emission targets based on the burden sharing rules.

The primary aim of Phase I is *to collect, and to perform a preliminary analysis of, information on indicators that are likely to have relevance for the design of burden sharing rules*. The indicators considered relate to emission figures per country, per gas, per source, data on energy efficiency, allowance factors for differences in emission levels, and information on the cost to reduce emissions of greenhouse gases. The kind of questions that will be addressed in Phase I are:

- Which principles of fairness do matter for negotiating burden sharing?
- What are the main elements of burden sharing proposals launched during the Kyoto Protocol negotiations?
- What indicators and allowance factors have been suggested in earlier differentiation proposals? What are the most important greenhouse gases?
- Which greenhouse gases have large uncertainty ranges in emission figures?
- What are the primary driving forces of emissions of greenhouse gases?
- What kind of information sources of emission figures is available? Which information sources are preferable to be used?
- At what level of detail should emission figures be explained?
- What is the value of aggregate emission indicators such as emissions per capita and emissions per GDP?
- For which indicators are emission data available?
- Can greenhouse gas abatement cost indicators be considered in burden sharing rules?
- Can the potential to abate emissions be included in burden sharing rules?
- What are key aspects of promising burden sharing rules?

## 1.5 Report outline

This report presents the outline of the present Burden Sharing study project, especially on Phase I (Chapter 1). Further information on this study and an introduction to some relevant concepts and definitions are presented in Chapter 2.

## 2. PRELIMINARY REVIEW OF RELEVANT CONCEPTS

### 2.1 Introduction

This chapter gives an introductory and preliminary overview of some major concepts and principles relevant to this study. Some definitions of *burden sharing* found in the literature are summarised and their appropriateness for the purposes of the present study are discussed in Section 2.2. Issues of *regional scope* are discussed in Section 2.3. Section 2.4 presents the main findings. A more rigorous treatment of principles of fairness and justice will be presented in Project Working Paper no. 2.

### 2.2 Basic notions of Burden Sharing

In the literature several connotations of the concept 'burden sharing' can be found. Burden sharing can refer to *the way in which a group of countries benefiting from a collective good agree to share the costs of providing the collective good* (Ringius, 1996). It is noted that this definition explicitly refers to the cost implications of providing a collective good, notably in the present context: a global climate that is not substantially altered by anthropogenic activities. We refer with burden sharing to the way a group of countries agrees to share the emission targets. Cost will result to the respective countries resulting from the latter burden sharing and they matter. However, other consideration matter as well for our burden sharing rule, such as the need to emit to be able to perform all kinds of activities, the relative contribution of countries to causing the problem and earlier attempts to combat emissions.

It is important to be clear about what the object of burden sharing analysis is (Rose, 1992). Some authors restrict the burden sharing issue to global GHG reduction as such. For example Ridgley defines the burden sharing issue as the issue for what share of the desired global GHG reduction should each nation or region be accountable (Ridgley, 1996). The predilection for the former definition in the present study relates to the view that a broad international agreement on GHG mitigation commitments can only be reached if due consideration is given to the cost implications of such an agreement in a way that is acceptable to all the signatory nations. Hence, both the limit of total GHG emissions and the total emission reductions to be agreed upon among the signatory nations as well as the cost implications of reaching the agreed limit form the basis for burden sharing.

The time frame does also matter. Collier makes a distinction between *short term and long term goals* (Collier, undated). For example, theoretical ideals of equity can only serve as an allocation mechanism in the long term. In the short term, emissions have to be reduced - at least to some extent - within the existing infrastructures, as otherwise prohibitive costs would have to be borne.

The idea of introducing burden sharing in negotiations on trans-national environmental issues is usually justified by referring to one or more of the three following policy considerations:

- *Equity principles*  
Refer to 'the quality of being fair or impartial' (Flexner as cited by Banuri et al, 1996, p. 85). Equity refers to a normative evaluation, or value judgement, of the social desirability of economic and non-economic disbursements, both positive and negative. Several allusions to equity are made in the Framework Convention on Climate Change. E.g. the Convention's financial mechanism should 'have an equitable and balanced representation of all Parties within a transparent system of governance' (Article 11.2). Burden sharing rules that seek to

build on equity principles can be *allocation based* and *outcome based*. Allocation based rules are defined in terms of initial allocation of emission rights and are directly related to the distribution of emission rights or to the distribution of the direct (gross) abatement costs. Outcome based rules take into account the incidence of net welfare changes due to global warming policy as projected by models with macro-economic feedback mechanisms (general equilibrium models). Outcome based rules relate e.g. - on a per capita basis - the net welfare change to national income levels. Modelling outcome-based rules tends to be a complex exercise, while the results are highly sensitive to rather sweeping assumptions.

- *Effectiveness*

Burden sharing rules should be effective in reaching the goal the rule is meant to achieve. This goal can be defined in terms of limiting the total amount of global emission to a level that will prevent dangerous anthropogenic interference with the climate system (Kawashima, 1996). This maximum allowable global emission level should be provided by scientific findings on the projection of climate change. However, this goal would severely curtail the room for burden sharing arrangements as it is not clear if the goal suggested by Kawashima lies within the solution space set by the boundary conditions (such as for instance politically feasibility). In this study effectiveness will be defined as achieving a particular, well-defined goal. This goal can be e.g. an overall percentage reduction for the whole group of nations included in a burden-sharing rule. At any rate, for evaluating the effectiveness of the burden-sharing rule the goal to be achieved has to be clearly set. Preferably the goal determination is to be complemented with an indication of why the goal concerned is chosen. At any rate, any burden-sharing rule should make at least some contribution towards meeting the ultimate objective of the FCCC, i.e. the prevention of dangerous anthropogenic interference with the climate system.

- *Efficiency*

Achieving a goal at the lowest resource costs possible. This notion is also referred to in a more narrow connotation as *cost-effectiveness*.

There is no fundamental conflict between the policy goals of effectivity and efficiency on the one hand and most concepts of equity on the other. But the application of economic concepts may give rise to differences in opinions based on diverging ideas and, explicit or implicit, assumptions on how individual utility functions should be defined compared and aggregated (Banuri et al. 1996). Therefore, the link between costs and equity will have to be treated cautiously in this study. There should be clarity about how these principles are treated and when one prevails over another one. Likewise, Ridgley (1996), referring to a seminal book on policy design (Tinbergen, 1952), points out that in burden sharing rules effectiveness, equity and efficiency should be treated separately by distinct indicators and/or policy instruments.

## 2.3 Regional scope

An important issue in making a burden-sharing rule is how to deal with different *regional scopes*. The FCCC recognises the principle that poor countries can ill-afford to bear serious cost consequences of GHG emission limitations. On the other hand, in some countries per capita income is rapidly rising towards a level commonly found in OECD countries. This brings up the issue of *graduation*, i.e. the question how to specify under which conditions nations should become contributors to the cost of global GHG emission limitation. It is, therefore, relevant to design burden sharing rules (BSRs) that will allow for entrance of new countries into the group of nations that accept a negotiated contribution to the agreed total GHG emission limitation. Whenever a BSR is in place a number of countries will fall under the jurisdiction of such rule, while others may choose not to participate (yet). Hence, a BSR should be designed in a flexible way, providing a clear key to the determination of rights and obligations for countries that wish to join a burden sharing agreement after its implementation has already started.

Two alternative approaches present themselves to include countries with widely varying economic conditions and welfare levels. One approach is to design one universal BSR that makes due allowance for the daunting gaps in welfare levels and economic orientations between the world family of nations. A second, alternative approach would be to design specific BSRs for specific groupings of countries with more or less homogeneous among-group economic conditions. The first approach defines the countries included in this study as a *concentric set*, the second defines them as members of *disjunct sets* (see graph below).

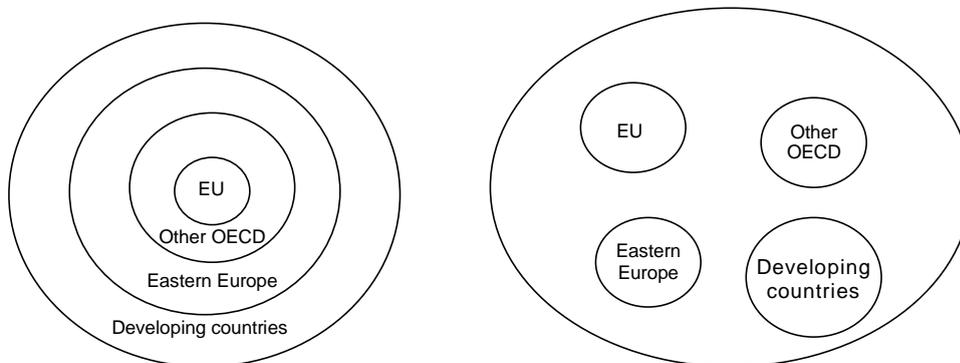


Figure 2.1 *Schematical representation of the 'universal approach' and the 'regional diversity approach'*

Turning to the second approach, for each of the groups of countries there should ultimately be one burden-sharing rule. Moreover, there should be an additional BSR that distributes the global burden between groups. The within-group BSRs could be a reflection of the country share in the group burden concerned, while the second between-groups BSR may indicate absolute burden figures. An advantage of the second approach over the first one is that each within-group BSR might well be simpler than a universal BSR for all (participating) countries. On the other hand, appealing features of a universal approach are:

- a. Unequal treatment of countries in different groups with similar welfare levels are avoided.
- b. It is appealing as such that all (participating) countries would be judged by exactly the same standards for determining their net (positive or for poor countries possibly negative) burden.
- c. Avoidance of difficult post-treaty graduation negotiations with regard to developing countries that will achieve high post-treaty standards of living for its population as a result of rapid economic development.

Evidently geographic location is only one criterion for defining different groups of countries. Other criteria could be e.g. the national resource base with respect to hydrocarbon fuels. The OPEC versus non-OPEC countries would provide a very crude indication to make the second criterion operational. National welfare would be an obvious alternative criterion. E.g. a very crude way to operationalize the third criterion might be the groups of 'affluent' OECD versus 'poor' non-OECD countries. Even within the OECD it might be considered to define more homogeneous subgroups of affluent countries. A priori, it would seem that the upshot of grouping of nations for BSRs has to be:

- Not too many groups, say no more than 4 or 5.
- A major part of the overall variance in scores on the discriminate variable(s) used for splitting up the nations of the world can be statistically explained by between-group differences, while within-group variances should be moderate.

## 2.4 Conclusions

According to many scientists a substantial reduction in global GHG emissions, compared to present-day global emission levels, is necessary to effectively address the issue of preventing human-induced climate change. Yet global GHG emission reduction implies a burden in terms of a major environmental constraint to global economic development and, consequently, in terms of world-wide (net) costs to meet the GHG emission constraint. The *burden sharing issue* addressed in the present project refers to the issue of how to elaborate on international agreements (FCCC, Kyoto Protocol) regarding the sharing among nations of agreed global GHG emission ceilings and/or emission reductions and the implied net costs thereof.

The following policy considerations may play a role in burden sharing negotiations:

- *Equity*: costs and benefits are to be distributed 'fairly'.
- *Effectiveness*: burden-sharing rules should be effective in reaching their objective.
- *Efficiency*: the goal should be reached at the lowest resource costs possible.

A major issue is *the regional scope* of burden sharing. Should burden sharing arrangements be defined by a universal global set of rules or does the application of a distinct set of rules for each, limited number of country groupings enhance the chance of successful global burden sharing negotiations? The former approach should be underpinned by principles of equity in the broadest sense (including full compensation for low-income parties), while in the latter case national burdens would be determined groupwise with justification by distinct mixtures of equality, equity, and exemption principles. As both approaches have their pros and cons, this issue will be further investigated in the next stages of the present study.

## REFERENCES

- Banuri, T. et al. (1996): *'Equity and Social Considerations'*. In: Bruce, J.P., Lee, H. and Haites, E.F., eds., *Climate Change 1995: Economic and Social Dimensions of Climate Change*, Cambridge University Press, New York/Melbourne, 1996.
- Blok, K., G.J.M. Phylipsen and J. W. Bode, (1997). *'The Triptique Approach: Burden Differentiation of CO<sub>2</sub> Emission Reduction Among European Union Member States'*. Department of Science, Technology and Society, Utrecht University, Utrecht, the Netherlands, 1997.
- Collier, U. (undated). *Allocating emission reduction targets in the European Union*. Unpublished paper.
- Kawashima, Y. (1996): *Possibility of Differentiating Targets - Indices and indexing proposals for equity*. Paper submitted at a workshop of the Royal Institute of International Affairs, London. 6-7 June, 1996.
- Ridgley, M.A. (1996): *'Fair sharing of greenhouse gas burdens'*. *Energy Policy*, Vol. 24, No. 6, pp. 517-529, 1996.
- Ringius, L., A. Torvanger and B. Holtsmark (1998): *'Can multi-criteria rules fairly distribute climate burdens - OECD results from three burden sharing rules'*. *Energy Policy*, Vol. 26, No. 10, pp. 777-93, 1998.
- Ringius, L. (1999): *'Differentiation, Leaders, and Fairness: Negotiating Climate Commitments in the European Community'*. *International Negotiation* 4 (2) (Summer 1999): pp. 133-166, 1999.
- Rose, A. (1992): *Equity Considerations of Tradable Carbon Emission Entitlements*. In: *Combating Global Warming*. Geneva, UNCTAD, 1992.
- Rose, A., B. Stevens, J. Edmonds and M. Wise (1998): *International Equity and Differentiation in Global Warming Policy*. *Environmental and Resource Economics*, Vol. 12, No. 1, pp. 25-51, 1998.
- Tinbergen, J. (1952): *On the Theory of Economic Policy*. Amsterdam, 1952.
- Torvanger, A. and O. Godal (1999): *A Survey of Differentiation Methods for National Greenhouse Gas Reduction Targets*. Forthcoming as 'Temanord Report', Nordic Council of Ministers, Copenhagen, and as *CICERO Report*, Oslo, 1999.
- Ybema, J. R. (1997): *'Differentiation of CO<sub>2</sub> targets for the OECD countries based on the Triptych approach'*. Draft ECN publication. Petten, Netherlands, 1997.