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INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



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F. Gurnea (IPCC)

MEMORANDUM

TO: All WG III Lead Authors
FROM: Erik Haites *Erik*
RE: Dates, Outline, and Format
DATE: December 11, 1993

Dates

Working Groups I and II have adopted 2020, 2050, and 2100 as the time horizons they will use for their analyses. If you are reporting results for particular time periods it would you could use these same dates.

Outline

Attached is my edited version of the report outline based on the latest information I have on the chapter outlines. I suspect many of the writing teams have modified their outlines. If you have changed your chapter outline, please send me your latest version.

Format

The Technical Support Unit will have to integrate all of the draft chapters. To facilitate this integration we would appreciate receiving one paper copy and one electronic copy of the draft chapter from each writing team. **The electronic copy should be in WordPerfect 5.1 or a compatible ASCII file.**

To make the integration easier, please observe the IPCC style guidelines for headings and references (provided below) and keep all other formatting to a minimum.

IPCC guidelines for headings:

1st level heading	Bold with initial capital i.e., B.1 Carbon Dioxide
2nd level heading	Bold and italic with initial capitals i.e., <i>B.1.1. Atmospheric Abundances and Trends</i>
3rd level heading	Italic with initial capitals (not bold) i.e., <i>B.1.1.1. Land Use Changes</i>
4th level heading	Italic normal text (not bold or initial capitals) i.e., <i>B.1.1.1.1 Recent estimates of deforestation rates</i>

No space/lines between titles/headings and the text following it.

Space between end of text/paragraph and the next title.

If 2 titles follow directly together, no space between them.

IPCC guidelines for references:

References in the text should take the form: parentheses, author, comma, publication date; for example: (Haites, et al., 1993).

Bibliographic references should be in the following form:

Surname of author, initials, year of publication: title of publication. Publisher. Reference to page numbers.

The reference should all be listed at the end of the text, either numbered as they appear in the text, or by alphabetical order of the authors' names. Titles of books and periodicals should not be underlined. For periodicals in particular, effort must be made to include all relevant information in the bibliographic reference.

IPCC WORKING GROUP III PRELIMINARY REPORT OUTLINE

1. SCOPE OF THE ASSESSMENT (Writing Team 1)

1.1. Overview of the Climate Change Issues

1.1.1. Regional Changes and Sources

1.1.2. Relation to Consumption and Development

1.1.3. Disparity in Consumption in the North/South, Development/Survival in the South

1.1.4. Awareness of Issues

1.2. Sustainable Development

1.2.1. Basic Concept and Implications for Limiting climate Change

1.2.2. Equity and Social Aspects with Respect to Development

1.2.3. Distribution Effects from Chapter III

1.2.4. Special Role of LDCs in Climate Change

1.2.5. What can Developed Countries Do?

1.2.6. Special Policy Instruments for Mitigating and Adapting

1.2.7. Is Fossil Fuel Usage Consistent with Sustainable Development?

1.2.8. Forestry

1.2.9. Implications for Climate Change for Sustainable Development

1.2.10. Discounting Problems and Others

1.2.11. Distribution effects

1.2.12. Importance of International Agreements on Sharing Environmentally Sound Technologies, with Appropriate Incentives for Innovation

1.3. The Basic Taxonomy

1.3.1. What are the Interactions Between Economic/Social Changes and Climate Change?

1.3.2. What are the Links in These Relations and the Basic Scientific Sources of our Uncertainty About Those Links

1.3.3. Importance of Extreme Values Versus Mean/Medians

1.3.4. Timing and Magnitude of Responses

1.3.5. Weighing Costs and Benefits

1.3.6. Non-Pecuniary Aspects (Environment)

1.3.7. Importance of Having a Rational Response (Cost-Effective, Taking Into Account Relative Risk and Opportunity Cost of Funds Associated with Climate Change Mitigation)

1.3.8. Concept of an "Optimal Sequential Decision Making Strategy" (optimal trajectories)

1.3.9. The importance of integrated assessments

1.3.10. The Extent to Which Capital Growth and New Technology Can Offset Climate Degradation

1.4. Focusing on Intermediate Steps in the Process of Limiting Climate Change

1.4.1. *The Climate Change Convention and the National Action Plans*

1.4.2. *Year 2000 Only as an Intermediate Step*

1.4.3. *Comprehensive List of Greenhouse Gases*

1.4.4. *Net Emissions: The Importance of Sinks*

1.4.5. *The Baseline Problem*

1.5. The Need and Scope for Governmental Action on a Global Scale

1.5.1. *Inducing Markets to Take Into Account Externalities*

1.5.2. *Positive Steps: Mitigation as a By-Product of Addressing Local Climate issues (Smog), Fossil Fuel Emissions Reductions Have Other Economic and Environmental Benefits (Acid Rain, Toxics)*

1.5.3. *Government Actions Which Exacerbate the Problem*

1.5.4. *Remedying the Market Distortion Reduces Emission, Generates Direct and Indirect Benefits*

1.5.5. *Imposing Carbon Taxes Reduces Emissions and Reduces Need for Other Forms of Distortionary Taxes*

1.5.6. *Making Markets Work Better in Ways Which Have Emission Benefits*

1.6. Introduction of Improved Technology

1.6.1. *Moving to the Frontier: The Puzzle of why Firms and Individuals do not use Cost Effective Energy Efficient Technology*

1.6.2. *Inducing Innovation*

1.6.3. *The Scope for Moving to More Energy Efficient Societies*

1.6.4. *The Scope for Moving to More Emission Efficient Energy Sources*

1.6.5. *The Sources of Opposition*

1.7. Measuring and Climate Influences and Change

1.7.1. *Green GDP and Benefit/Cost Analysis*

1.7.2. *Special Aspects Related to Limiting Climate Change*

1.7.3. *How do the Differences in Uncertainties (Including Monitoring Uncertainty) Associated With Different Gases/Option Affect Policy*

1.8. International Aspects

1.8.1. *Geographic Distribution of Sources, Sinks, Impacts, Capacities to Respond*

1.8.2. *Joint Implementation*

1.8.3. *International Trade*

1.9. Developing National Action Plans

2. APPLICABILITY OF COST-BENEFIT ANALYSIS TO CLIMATE CHANGE (Writing Team 3)

2.1. Cost-Benefit Analysis: Introduction

- *How Can Cost Benefit Analysis Help Decision-Making to Achieve GHG Emission Reductions*
- *Limits of Traditional Approaches*
- *Applying Cost Benefit Analysis and Investment Programs to Policies Rather Than Isolated Projects*
- *Cost Benefit Analysis as a Component of Decision Analysis: Risk and Uncertainty, Irreversibility and Discount Rate*
- *New Developments in Multi-Criteria Analysis (MCA)*
- *a Proposed Framework for Application of Cost Benefit Analysis and MCA to Climate Change Issues*

2.2. Literature Review: Application of Cost Benefit Analysis to Climate Change

- *Principal Sources: Work of Nordhaus; Manne-Richels; ABARE (Australia); Japan (Institute of Energy Economics); Good Summary of Recent Asia Work in ESCAP Reports; OECD/IEA; ILASA*

2.3. Valuation

- *Valuation of Impacts (Discussion of Issues and Techniques Relevant to Each Major Impact Category)*
- *Costing of Mitigation Measures*
- *Approaches for Dealing With Difficulties in Valuation; Multi-Criteria Analysis*

2.4. Policy Formulation and Project Design

- *How Can Cost Benefit Analysis and MCA be Used to Help identify, evaluate, and Prioritize Policies and Projects*
- *Relevance of Strategic Planning Approaches (e.g. Integrated Planning by Electric Utilities)*

2.5. Treatment of Risk, Uncertainty, and Irreversibility

- *Identifying Robust Strategies; Dealing with the Timing Of Policies*
- *Formal Bodies of Decision Analysis*
- *Relevance of Approaches Long Established in Private Industry to Deal With Significant Uncertainties (e.g. Oil Exploration) Options, Hedging and Insurance Value of Information Models*

2.6. Discount Rate

- *Major Conceptual Issues and Their Resolution*
- *Robustness of Results*

2.7. Evaluating Implementation Strategies

- *How Does One Evaluate the Effectiveness of Alternative Implementing Strategies With Particular Emphasis on Transfer Mechanism and trading off Equity vs. Efficiency*
- *Tradable Emission Permits*
- *Grants and GEF-Type Mechanisms*

3. SOCIAL COSTS OF GLOBAL CLIMATE CHANGE (Writing Team 5)

3.1. Overarching Issues

- *Benefit as Damage Reduction*
- *Time Discounting*
- *Valuation of Non-Market (e.g. Ecological) Effects*
- *Nonlinearity*
- *GDP Scaling*
- *Risk Treatment: Upper - and Lower-Bound Warming & Damages*
- *Consumer Surplus*
- *Transient vs Equilibrium Warming Damage (e.g. Sea-Level Rise)*
- *Timing & Predictability (Increased Damage for Faster Warming)*

3.2. Damage Estimates for 2xCO₂ Equilibrium Warming

- *Market Sector*
- *Agriculture*
- *Sea Level Rise*
- *Forests*
- *Water Supply*
- *Health*
- *Pollution: Air*
- *Pollution: Water*
- *Net Heating/Cooling Requirements*
- *Tropical Cyclones - Floods, Droughts*
- *Migration*
- *Construction*
- *Leisure Activities*
- *Urban Infrastructure*
- *Non-Market Sector*
- *Biodiversity*
- *Human amenity*

3.3. Translation of Baseline Damages to Policy Scenario Abatement Benefits

- *Warming Avoidance Potential as a Function of Policy*

3.4. Secondary Costs of Carbon Dioxide Abatement

- *Reduce Air Pollution*

- 3.5. Damage Estimates for Very-Long-Term Warming**
- 3.6. Regional Differences**
 - *Damages at Other Levels of CO2 Concentrations Due to Policies/Scenarios*
- 3.7. Differential Impact on Developing Countries**
 - *Physical Impact*
 - *Valuation: Discounting Differences, e.g.*
- 3.8. Catastrophic Risk**
- 3.9. Impact of technological Change on Prospective Damages**
- 3.10. Abatement versus Adaptation**
- 3.11. Comparison of Policy Response Benefits with Abatement/Adaptation Costs**
 - *Discrete Scenario Analysis*
 - *Optimization Models*
- 4. COSTS OF MITIGATION OF GHGs (Writing Team 6 & 7)**
 - 4.1. How do we Measure Costs (Direct and Indirect)**
 - *Welfare Measures*
 - *General vs Partial Equilibrium Approaches*
 - *Treatment of Uncertainty (Hedging Behaviour)*
 - 4.2. Importance of Patterns of Development and Technological Change**
 - 4.3. What do Costs Depend Upon**
 - Baseline*
 - Goal (Emissions, Concentrations, Timing)*
 - Assumptions:*
 - *Market Structure (Regional and International Level)*
 - *Demand-side parameters*
 - Economic Growth*
 - Price and Non-Price Mechanisms*
 - *Supply Side Parameters*
 - Technology Cost and Availability*
 - *Resource Base*
 - *Time Horizon*
 - 4.4. Bottom-Up vs Top-Down Approach**

4.5. Short Term. Review of Existing Studies (Global and Regional)

- *Why do Studies Differ*
- *Methodologies*
- *Inputs*
- *Range of Uncertainty*

4.6. Long Term. Review of Existing Studies (same issues)

4.7. Key Insights and Direction for Research.

4.8 Studies on Developed Countries

4.8.1. *Short to Intermediate Term (The Transition Period to a Slow Carbon World; period of Natural Rate of Capital Stock Turnover; Roughly Next 40 Years)*

4.8.2. *Long Term (40 years and beyond)*

4.9 Economies in Transition

4.10. Developing Countries

4.11 Globe as a Whole

4.12 Bottom Lines (The Following is Meant to be *Illustrative*)

4.13 Needs for Additional Research

5. EQUITY AND SOCIAL CONSIDERATIONS (Writing Team 4)

5.1. Introduction: The Contribution of Science to Understanding Equity Issues

- *Discuss the Contribution That Science can Make to the Consideration of Equity and Sociological Issues.*
- *Discuss the Concepts of Equity.*
- *Make the Point that While Science can Illuminate Issues and Describe possible Choices and Analyze Their Likely Consequences, it can not prescribe the choices that should be made.*
- *Prescriptions are Based on Values, and Thus Prescriptions are the realm of Political Action not Science.*
- *Making Choices is the Province of National and International Officials.*
- *Science can Contribute to Making Choices, but Choices Themselves are Based on Values.*

5.2. Equity Within Countries

- *Consider the Differential Impact of Climate Change and Efforts to Mitigate and Adapt to it on Various Regions, Economic Sectors, and Social Groups Within Countries*

5.3. Equity Among Countries

- *Discuss the Differential Impact of Climate Change and Efforts to Mitigate and Adapt to it on Different World Regions.*
- *Discuss the Carrying Contributions of Various Regions to Past, current, and Future Emissions of Greenhouse Gases*
- *Discuss the Consequences of Climate Change for Various Regions*
- *Discuss how the Costs of Efforts to Mitigate and Adapt to Climate Change Would Affect Different Regions.*

5.4 Intergenerational Equity

- *Discuss the Differential Impact of Climate Change and Efforts to mitigate and Adapt to it on Successive Generations.*
- *Discussion of the Use of Discount Rates for Evaluating Costs and Benefits and Efforts to Find Alternative Ways of Evaluating Costs and Benefits.*

6. DECISION-MAKING FRAMEWORK (Writing Team 2)

6.1. Background & Scope

How do we take into Account Factors Associated to Climate Change when Making Decision?

- *Uncertainty*
- *Irreversibility*
- *Risk*
- *Frequency of Extreme Events*
- *Value of Information*
- *Short/Long Term Factors*
- *Opportunity Costs*
- *Economic Factors Affected Through Climate Change (GDP, Fractions of GDP, Population, Technological Progress, Utility)*

6.2 Paradigms & Attitudes Toward Risk

- *Responses (and Perceptions) to Risk*
- *Anthropocentric vs Ecocentric Attitudes*
- *Taking Action & Free-Riding*
- *Sovereignty or Global Governance*

6.3. What Methods can be Used for Making Decisions With Respect to Climate Change

- *Portfolio Diversification*
- *Sequential/Hedging Decision-Making*
- *B/C Analysis (Beyond Conventional Cost Benefit Analysis)*
- *Insurance Analysis*

6.4. What are the Risk-Related Trade-Offs When Facing Climate Change

- *Risks of Inaction vs Action*
- *Short Term vs Long Term Decision-Making*
- *Uncertainties – a Taxonomy*
- *Value of Information, Option Value*
- *Technical Progress/Energy Substitution and Other Substitutions*
- *Discounting Issue*
- *Opportunity Costs & Other Costs*

6.5. Risk Assessment of Climate Change

- *A Parallel to Nuclear Risk Analyses*
- *Catastrophic Scenarios*
- *Time Dimension (timing)*
- *Insurance Mechanisms*

6.6. About the Linkages Between the Natural Sciences and Socio-Economics

- *Attitudes*
- *Sensitivity of Socio-Economic Parameters*
- *Regional Differences*
- *Sensitivity of Socio-Economic Groups*
- *Research Needed to Make Society Able to Confront Uncertainty/to Save Time to Adapt.*

7. GENERIC ASSESSMENT OF RESPONSE OPTIONS (Writing Team 9)

7.1. Cost Effective Efficiency Improvements

7.1.1 Energy Use

- *Buildings*
- *Transport*
- *Industry*

7.1.2 Irrigation in Agriculture

7.2. Alternative Energy Supply Strategies

7.2.1. Fuel Switching Among Fossil Fuels

7.2.2. Nuclear Fission

7.2.3. Renewable Energy Systems

7.2.4. Geothermal & Other Non-Fossil Systems

7.3. Carbon Sequestration in Biomass

7.3.1. Deforestation, Reforestation, and Afforestation

7.3.2. Soil Conservation

7.3.3. Ocean Pollution and Marine Primary Productivity

7.4. Greenhouse Gas Removal and Storage/Destruction

7.4.1. Stack-Gas Cleaning

7.4.2. Other Gas Removal Options

7.5. Other Response Strategies

8. THE POLICY INSTRUMENTS (Writing Team #8)

8.1 Introduction

- Feasible Instrument Set

8.2 Aim

- to Assess the Optimal Policy Mix for the Control of Greenhouse Gas Emissions (Including CH₄, Oxides of Nitrogen, etc)**
- Characteristics Against Which Instruments Will be Assessed (Using a Combination of Stavins/Bohm List)**
- Is the Instrument Cost-Effective, ie. Is it Least cost in Terms of Achieving Greenhouse Targets?**
- What are the Monitoring and Enforcement Costs if Any?**
- What are the Incentives for Individuals or Governments to cheat?**
- What is the Level of Certainty With Which a Particular target is Achieved Using the Instrument?**
- What is its Coverage - All GHGs or Only a Subset?**
- Does the Instrument Have a Particular Technology bias (eg. energy Saving); is it Neutral/Not Neutral with Respect to technological change? Would its Use "lock-in" Particular Patterns of Trade or Industry Location?**
- Is the Instrument Broadly Understandable to the General Public?**
- What is The Nature of Any Changes in Income Distribution (Between/ Within Countries) Arising From the Use of the Instruments and Will Such Changes Impede the Adoption of the Instruments? Is the use of the Instrument "Feasible" in a Political Sense?**
- How is the Instrument Affected by Non-Participation by Some Agents (Domestic/International); How Many/What Proportion of GHGs have to be Covered to Make the Instrument Effective?**

- *Likely Interaction (Positive/Negative) With Other Instruments/Policies*
- *How Will the Instrument Perform in a Range of Economic/Institutional/Political Environment? Is it Robust in an Environment of High/Low Inflation, High/Low Economic Growth, External Imbalance, Fixed/Flexible Exchange rates?*

8.3 Description and Categories of Instruments

8.3.1 International

- *Carbon Taxes*
- *Tradeable Permits*
- *Joint Implementation*
- *Tradeable Absorption Rights (Probably Should be Considered in the Permits Section)*
- *Negotiated Standards/Phase-Out of Given Practices*

8.3.2. Domestic

- *Carbon Taxes*
- *Tradeable Permits*
- *Subsidies*
- *Investment Credits/Taxation Policy*
- *Deposit Refund Schemes?*
- *"No Regrets" Policies Such as Information Provisions/Education*
- *Regulation*
- *Implementation of User Charges/Deregulation of Energy Utilities*

8.4 Review of the Use of Each Instrument

- *Is It Feasible/Is It Cost Effective?*
- *Does the Instrument Encourage Agreement and Adaptation?*
- *Is the Instrument Effective For All Greenhouse Gases or Only Some?*
- *Does the Instrument Encourage/Discourage Further Technological Change?*
- *How Does the Instrument Perform in Different Economic Environments?*
 - *In High Growth/Low Growth Economies?*
 - *In Economies With High/Low Inflation?*
- *Carbon Taxes*
- *Permits*
- *Joint Implementation*
- *Tradeable Absorption Rights*
- *Subsidies*
- *Investment Credits/Taxation Policy*
- *Provision of Education/Information*
- *Regulation*
- *User Charges/Deregulation*

- 8.5 Consequences of Using a Portfolio of Instruments**
- *Free Riding*
 - *Leakage*
 - *International Tax Incidence*
 - *Interaction Between Instruments/Optional Policy Mix*
 - *Costs of the Wrong Choice*
 - *Effectiveness of Instruments in the Short vs. Long Run*
 - *Problems Not Easily Addressed by the Policy Instruments*
 - *Further Work That Needs to be Done on the Instruments*
- 8.6 Impact of Other Policies on GHG Emissions and on the Effectiveness of GH Policy**
- *Trade Policy*
 - *Agricultural Policy*
- 8.7 The Optimal Portfolio of GH Policy Instruments**
- *Policy Design*
 - *Effectiveness of a Continuation of Instruments*
 - *The "Best" Policy Mix in Industrial/Developing Countries*
 - *Leakage*
 - *Gas Coverage*
 - *Problems in Poor Countries - Wood and Dung Burning, etc.*
 - *A Table Providing an Assessment of the Relative Performance of Each Instrument*
- 8.8 Concluding Remarks and an Assessment of Further Research That Need so to be Completed on the Instruments**
- *Summary of Ranking*
 - *Legal Issues With Respect to International Treaties, Enforcement, etc.*

9. EMISSION SCENARIOS (Writing Team 10)

9.1 Background and Scope

[In this section we explain that we will emphasize the evaluation of IS92 scenarios and present the criteria for this evaluation.]

9.2 IS92 Emission Scenarios

9.2.1 Modeling Framework

9.2.2 Underlying Assumptions

9.2.3 Results

9.2.3 Criteria for Evaluation in This Report

- *Comparison to Other Literature*
- *Comparison to Relevant Processes*

9.3 Comparison of IS92 Scenarios with Other Emission Scenarios

[In this section we compare results of the IS92 scenarios with other scenarios in order to assess whether the IS92 scenarios are consistent or not with other estimates. We then try to explain the similarity or differences by examining the input assumptions and structures of the different models.]

9.3.1 Comparison of Results

CO2 Emission Scenarios Related to Energy and Industry

CO2 Emission Scenarios Related to Land Use/Agriculture

Other GHG Emission Scenarios Related to Energy and Industry

Other GHG Emission Scenarios Related to Land Use/Agriculture

CFC (and Substitutes) Emission Scenarios

9.3.2 Explaining the Difference Between Scenarios

Comparison of Input Assumptions of Different

Comparison of Model Structures/Parameters [Includes review of literature on sensitivity analysis of existing models]

9.4 Uncertainty and Sensitivity of IS92 Emission Scenarios

[In this section we focus on a sensitivity analysis of the model used to generate the IS92 scenarios].

9.4.1. Sensitivity to model input assumptions (e.g. population, GNP)

9.4.2. Range of estimates of key model inputs from literature and other sources (e.g. population, GNP)

9.4.3. Uncertainty due to model structure/parameters (e.g. emission coefficients)

9.5 Evaluation and Recommendations

9.5.1 Uncertainties

Qualitative Ranking of Sources of Uncertainty [e.g. certain, confident, uncertain, unknown]

Research needed to Reduce Uncertainties

9.5.2 Strengths and Weaknesses of IS92 Scenarios

Science applications

Policy applications

9.5.3 Recommendations for Developing Consistent Scenarios

Usage of IS92 scenarios

Recommendations regarding new scenarios

PROGRESS REPORTS

- Writing Team 1: An almost-complete draft has been prepared, incorporating material from various lead authors. Draft includes all sections of outline proposed by J. Stiglitz at September meeting in Seoul, emphasizing framework for analysis, and describing how economists and other social scientists structure the analysis of climate change. Flow of the argument has required some reordering of the material from the outline. Convening lead author, Goldemberg expects to circulate draft to other lead authors in early January, then to convening authors of other chapters by late January.
- Writing Team 2: We have distributed the work and within a month each one of us will have circulated their own portion with another. Mr. Zag Pillet is holding a workshop in the first week of March in Switzerland. We have already contacted the contributing authors and would like to contact a few more. During discussions at Stanford, we also felt the need to get inputs from Working Group II.
- Writing Team 3: The tentative timetable is as follows:
- Circulate chapter outline, October 20, 1993
 - Finalize outline and assign topics/sections for short reports, November 20, 1993
 - Receive topic/section reports, January 10, 1994
 - Circulate (zero) draft of chapter, mid-February 1994
 - Convening lead authors meeting in Washington, early March 1994
 - Circulate penultimate draft of chapter, early April, 1994
 - submit final version of chapter to WGIII, early June 1994
- Writing Team 4: Writing Team 4 has launched its work. We have completed a preliminary version of the outline for our contribution and are refining it. We have begun to identify contributing authors and are in correspondence with some of them. We will circulate the draft outline to them for comment early next year. We are starting to work on bibliography. We are thinking about the agenda for the July meeting in Mombassa, Kenya. The lead authors will meet in January or February.
- Writing Team 5: We have drafted a lot of material on benefits. This covers sectoral impact; impacts by world region, especially LCDs as

requested; and treatment of uncertainties where there are ranges of estimates. This leaves treatment of the "surprises" and discounting and its effects on benefits. We propose a small 1-1 1/2 days seminar probably in Washington in January. Between now and January, the drafts have to be circulated within our group -- we hope to do this before Christmas.

Writing Team 6 & 7: Our writing team has prepared guidelines for the following sections:

- the comparative survey of existing studies;
 - the section on development patterns and technological change;
 - distribution of comparative surveys on to geographic basis.
- These surveys will be used by Richard Richels and Thomas Johansson in their analysis of both top-down and bottom-up models.
- additional contributors and lead authors
 - some decisions about meetings of the lead authors

On January 26 in Washington, we will discuss a detailed outline of the chapter and allocate the pages. That meeting will also ensure that we will be able to cover all the existing materials and that the geographic distribution of our experts is balanced enough to avoid the risks of underestimating the specifics of developing countries.

Another meeting is planned for the first week of March in Paris or near Geneva specifically devoted to the bottom-up/top-down debate.

Writing Team 8: We have distributed and agreed on an outline of our chapter and a framework for assessing the various policy instruments. Authors and contributors have commenced their writing tasks and some drafts have been exchanged between team members. The policy instruments workshop has been organized for January 17-20, 1994 in Tokyo, Japan. An edited proceedings of the workshop will be produced which will become input for our chapter. As many team members as possible will meet at the workshop to exchange drafts and progress writing tasks. ABARE has established a coordination team to assist in the preparation of the final report of Writing Team 8.

Writing Team 9: Writing team 9 of Working group III that will report on "Generic Assessment of Response Options" has used its time up

till the end of 1993 to discuss in more detail the major outline and setup of Chapter 9, the ensuing division of tasks among the lead authors, and the time schedule to follow.

A first survey of potentially relevant literature has been distributed among the lead authors also suggestions and information about the conferences and workshops, (e.g Tsukuba, Japan, January 16-20, 1994; Groningen, the Netherlands, June 1-3, 1994, and Nairobi, Kenya, July 18-23, 1994) have been exchanged. The intention has been expressed to organize a writing team 9 workshop in the Spring of 1994, most likely in Zimbabwe. By that time, the various draft texts will be thoroughly discussed. By the end of January hopefully some first results will be ready.

Writing Team 10: In October, J. Alcamo circulated a revised chapter outline with assignments. In October and November, members of the writing team compiled information for their written contributions. In november, new researchers were recruited so that the writing team can meet its very difficult schedule; A. Grubler (IIASA, Austria) has agreed to write a contribution on regional-scale energy-related emissions, and A. Bouwman (RIVM, Netherlands) has agreed to assist Aca Sugandhy with global and regional-scale land use/agriculture-related emissions. J. Wasson and W. Pepper (both of ISC Corporation, U.S.A.) have been asked to provide contributions on CFC scenarios, and the IS92 scenarios, respectively.

J. Alcamo, A. Bouwman, J. Edmonds, A. Grubler, and T. Morita met in Amsterdam, December 8-9. The meeting was a great success in clarifying the chapter's objectives, goals, themes, and format and in discussing its tentative conclusions and recommendations. These are some specific results of the meeting:

- We defined four main purposes of emission scenarios, and for each of these, agreed upon a set of "mandatory" and "desirable" characteristics. These characteristics will serve as a benchmark for evaluating the IPCC and other scenarios.
- Regarding our comparison of scenario inputs and results, we decided to focus on global calculation and country/regional-scale calculations for Africa, China, India/South Asia, the former Soviet Union, and USA. We also agreed upon a common format for this comparison.

- tentative conclusions and recommendations were discussed at length. We believe that these points will bring to focus the best ways to use the IS92 scenarios, as well help to make clear the requirements of the next generation of scenarios.

The writing team members who attended the Amsterdam meeting agreed to bring their completed contributions to the Tsukuba meeting of the writing team, now scheduled for January 14-15. At this meeting all contributions will be discussed and approved, including the chapter's conclusions and recommendations. According to Dr. Morita, the members of the writing team who did not attend the Amsterdam meeting (Dadi, Reddy, and Sugandhy) have been invited and are expected to attend the Tsukuba meeting on Economic Instruments that takes place January 17-20. He is asking them to come a few days earlier to Tsukuba to attend the writing team 10 meeting.

Following the Tsukuba meeting, J. Alcamo will synthesize all contributions into a complete draft chapter, which will then be sent for informal comment to the IPCC WG III bureau. comments of the Bureau will be discussed at a meeting of the writing team planned for mid-March at IIASA. Shortly thereafter, the chapter should be ready for outside peer-review.



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



IPCC Working Group III
First session
Montreal, 3-7 May 1993

WGIII/1st/INF. 2
(12.II.1993)
ENGLISH ONLY

SUGGESTED FORMAT AND DESIGN LAYOUT FOR IPCC REPORTS

(Prepared by the IPCC Secretariat)

These draft proposals are being forwarded to the Working Group
and Subgroup Co-chairs for comments before finalization.

A document on the subject will be submitted
to the ninth session of the IPCC
(Geneva, 29-30 June 1993).

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INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

CLIMATE CHANGE

The IPCC Scientific Assessment

Report Prepared for IPCC by Working Group 1

Edited by J.T.Houghton, G.J.Jenkins and J.J.Ephraums
(Meteorological Office, Bracknell, United Kingdom)



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ANNEX B

1

Greenhouse Gases and Aerosols

R.T. WATSON, H. RODHE, H. OESCHGER, U. SIEGENTHALER

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EXECUTIVE SUMMARY

The Earth's climate is dependent upon the radiative balance of the atmosphere, which in turn depends upon the input of solar radiation and the atmospheric abundances of radiatively active trace gases (i.e., greenhouse gases), clouds and aerosols.

Since the industrial revolution the atmospheric concentrations of several greenhouse gases, i.e., carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs), nitrous oxide (N_2O), and tropospheric ozone (O_3), have been increasing, primarily due to human activities. Several of these greenhouse gases have long atmospheric lifetimes, decades to centuries, which means that their atmospheric concentrations respond slowly to changes in emission rates. In addition, there is evidence that the concentrations of tropospheric aerosols have increased at least regionally.

Carbon Dioxide

The atmospheric CO_2 concentration, at 353 ppmv in 1990, is now about 25% greater than the pre-industrial (1750-1800) value of about 280 ppmv, and higher than at any time in at least the last 160,000 years. Carbon dioxide is currently rising at about 1.8 ppmv (0.5%) per year due to anthropogenic emissions. Anthropogenic emissions of CO_2 are estimated to be 5.7 ± 0.5 Gt C (in 1987) due to fossil fuel burning, plus 0.6 - 2.5 Gt C (in 1980) due to deforestation. The atmospheric increase during the past decade corresponds to $(48 \pm 8)\%$ of the total emissions during the same period with the remainder being taken up by the oceans and land. Indirect evidence suggests that the land and oceans sequester CO_2 in roughly equal proportions, though the mechanisms are not all well understood. The time taken for atmospheric CO_2 to adjust to changes in sources or sinks is of order 50-200 years, determined mainly by the slow exchange of carbon between surface waters and deeper layers of the ocean. Consequently, CO_2 emitted into the atmosphere today will influence the atmospheric concentration of CO_2 for centuries into the future. Three models have been used to estimate that even if anthropogenic emissions of CO_2 could be kept constant at present day rates, atmospheric CO_2 would increase to 415 - 480 ppmv by the year 2050, and to 460 - 560 ppmv by the year 2100. In order to stabilize concentrations at present day levels, an immediate reduction in global anthropogenic emissions by 60-80 percent would be necessary.

Methane

Current atmospheric CH_4 concentration, at 1.72 ppmv, is now more than double the pre-industrial (1750-1800) value of about

0.8 ppmv, and is increasing at a rate of about 0.015 ppmv (0.9%) per year. The major sink for CH_4 , reaction with hydroxyl (OH) radicals in the troposphere, results in a relatively short atmospheric lifetime of about 10 years. Human activities such as rice cultivation, domestic ruminant rearing, biomass burning, coal mining, and natural gas venting have increased the input of CH_4 into the atmosphere, which combined with a possible decrease in the concentration of tropospheric OH, yields the observed rise in global CH_4 . However, the quantitative importance of each of the factors contributing to the observed increase is not well known at present. In order to stabilize concentrations at present day levels, an immediate reduction in global anthropogenic emissions by 15-20 percent would be necessary.

Chlorofluorocarbons

The current atmospheric concentrations of the anthropogenically produced halocarbons, CCl_3F (CFC-11), CCl_2F_2 (CFC-12), $\text{C}_2\text{Cl}_3\text{F}_3$ (CFC-113) and CCl_4 (carbon tetrachloride) are about 280 pptv, 484 pptv, 60 pptv, and 146 pptv, respectively. Over the past few decades their concentrations, except for CCl_4 , have increased more rapidly (on a percentage basis) than the other greenhouse gases, currently at rates of at least 4% per year. The fully halogenated CFCs and CCl_4 are primarily removed by photolysis in the stratosphere, and have atmospheric lifetimes in excess of 50 years. Future emissions will, most likely, be eliminated or significantly lower than today's because of current international negotiations to strengthen regulations on chlorofluorocarbons. However, the atmospheric concentrations of CFCs 11, 12 and 113 will still be significant (30 - 40% of current) for at least the next century because of their long atmospheric lifetimes.

Nitrous Oxide

The current atmospheric N_2O concentration, at 310 ppbv, is now about 8% greater than in the pre-industrial era, and is increasing at a rate of about 0.8 ppbv (0.25%) per year. The major sink for N_2O , photolysis in the stratosphere, results in a relatively long atmospheric lifetime of about 150 years. It is difficult to quantitatively account for the source of the current increase in the atmospheric concentration of N_2O but it is thought to be due to human activities. Recent data suggest that the total annual flux of N_2O from combustion and biomass burning is much less than previously believed. Agricultural practices may stimulate emissions of N_2O from soils and play a major role. In order to stabilize concentrations at present day levels, an immediate

1.1 Introduction

The Earth's climate is dependent upon the radiative balance of the atmosphere, which in turn depends upon the input of solar radiation and the atmospheric abundances of radiatively active trace gases (i.e., greenhouse gases), clouds and aerosols. Consequently, it is essential to gain an understanding of how each of these climate "forcing agents" varies naturally, and how some of them might be influenced by human activities.

The chemical composition of the Earth's atmosphere is changing, largely due to human activities (Table 1.1). Air trapped in Antarctic and Greenland ice shows that there have been major increases in the concentrations of radiatively active gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) since the beginning of the industrial revolution. In addition, industrially-produced chlorofluorocarbons (CFCs) are now present in the atmosphere in significant concentrations, and there is evidence that the concentrations of tropospheric O_3 and aerosols have increased at least regionally.

Atmospheric measurements indicate that in many cases the rates of change have increased in recent decades. Many of the greenhouse gases have long atmospheric life-times, decades to centuries, which implies that their atmospheric concentrations respond slowly to changes in emission rates.

The effectiveness of a greenhouse gas in influencing the Earth's radiative budget is dependent upon its atmospheric concentration and its ability to absorb outgoing long-wave terrestrial radiation. Tropospheric water vapour is the single most important greenhouse gas, but its atmospheric concentration is not significantly influenced by direct anthropogenic emissions. Of the greenhouse gases that are directly affected by human activities, CO_2 has the largest radiative effect, followed by the CFCs, CH_4 , tropospheric O_3 , and N_2O . Although the present rate of increase in the atmospheric concentration of CO_2 is about a factor of 70,000 times greater than that of CCl_3F (CFC-11) and CCl_2F_2 (CFC-12) combined, and a factor of about 120 times greater than that of CH_4 , its contribution to changes in the radiative forcing during the decade of the 1980s was

Table 1.1 Summary of Key Greenhouse Gases Influenced by Human Activities¹

Parameter	CO_2	CH_4	CFC-11	CFC-12	N_2O
Pre-industrial atmospheric concentration (1750-1800)	280 ppmv ²	0.8 ppmv	0	0	288 ppbv ²
Current atmospheric concentration (1990) ³	353 ppmv	1.72 ppmv	280 pptv ²	484 pptv	310 ppbv
Current rate of annual atmospheric accumulation	1.8 ppmv (0.5%)	0.015 ppmv (0.9%)	9.5 pptv (4%)	17 pptv (4%)	0.8 ppbv (0.25%)
Atmospheric lifetime ⁴ (years)	(50-200)	10	65	130	150

1 Ozone has not been included in the table because of lack of precise data.

2 ppmv = parts per million by volume; ppbv = parts per billion by volume; pptv = parts per trillion by volume.

3 The current (1990) concentrations have been estimated based upon an extrapolation of measurements reported for earlier years, assuming that the recent trends remained approximately constant.

4 For each gas in the table, except CO_2 , the "lifetime" is defined here as the ratio of the atmospheric content to the total rate of removal. This time scale also characterizes the rate of adjustment of the atmospheric concentrations if the emission rates are changed abruptly. CO_2 is a special case since it has no real sinks, but is merely circulated between various reservoirs (atmosphere, ocean, biota). The "lifetime" of CO_2 given in the table is a rough indication of the time it would take for the CO_2 concentration to adjust to changes in the emissions (see section 1.2.1 for further details).

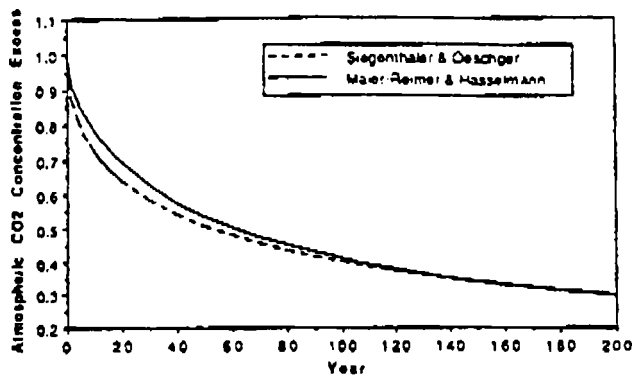


Figure 1.2: Atmospheric CO₂ concentration excess after a pulse input at time 0 (initially doubling the atmospheric CO₂ concentration), as calculated with two ocean-atmosphere models. Solid line: 3-dimensional ocean-circulation model of Maier-Reimer and Hasselmann (1987), dashed line: 1-dimensional box-diffusion model of Siegenthaler and Oeschger (1987). The adjustment towards a new equilibrium does not follow an exponential curve; it is very fast during the first decade, then slows down more and more. The concentration excess does not go to zero; after a long time, a new equilibrium partitioning between atmosphere and ocean will be reached, with about 15 percent of the input residing in the atmosphere.

1.2.1.1 The role of the atmosphere

The mean annual concentration of CO₂ is relatively homogeneous throughout the troposphere because the troposphere is mixed on a time scale of about 1 year. The pre-industrial atmospheric CO₂ concentration was about 280 ppmv, as reconstructed from ice core analyses (c.f. Section 1.2.4.1), corresponding to an atmospheric amount of 594 Gigatonnes of carbon (GtC: 1 Gt = 10⁹t = 10¹⁵g; 1 ppmv CO₂ of the global atmosphere equals 2.12 GtC and 7.8 Gt CO₂); today, the level is about 353 ppmv (Figures 1.3 and 1.4). The atmospheric increase has been monitored since 1958 at a growing number of stations (Keeling and Heimann, 1986; Keeling et al., 1989a; Beardsmore and Pearman, 1987; Conway et al., 1988).

1.2.1.2 The role of the ocean

On time scales of decades or more, the CO₂ concentration of the unperturbed atmosphere is mainly controlled by the exchange with the oceans, since this is the largest of the carbon reservoirs. There is a continuous exchange of CO₂ in both directions between the atmosphere and oceans. The net flux into (or out of) the ocean is driven by the difference between the atmospheric partial pressure of CO₂ and the equilibrium partial pressure of CO₂ (pCO₂) in surface waters.

The exchange of carbon between the surface and deeper layers is accomplished mainly through transport by water

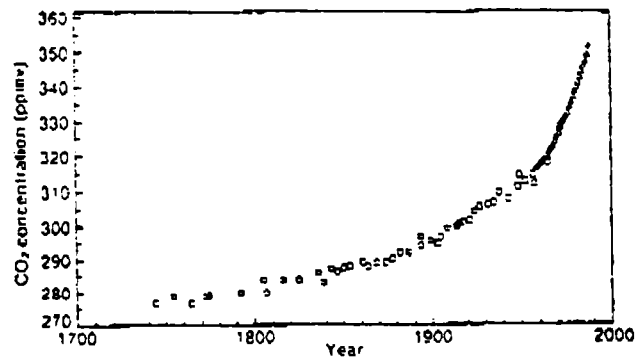


Figure 1.3: Atmospheric CO₂ increase in the past 250 years, as indicated by measurements on air trapped in ice from Siple Station, Antarctica (squares; Neftel et al., 1985a; Friedli et al., 1986) and by direct atmospheric measurements at Mauna Loa, Hawaii (triangles; Keeling et al., 1989a).

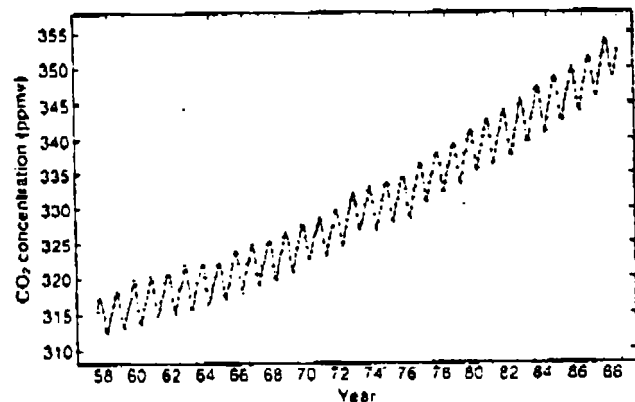


Figure 1.4: Monthly average CO₂ concentration in parts per million of dry air, observed continuously at Mauna Loa, Hawaii (Keeling et al., 1989a). The seasonal variations are due primarily to the withdrawal and production of CO₂ by the terrestrial biota.

motions. Ventilation of the thermocline (approximately the uppermost km of the ocean) is particularly important for the downward transport of anthropogenic CO₂. The deep circulation is effective on time scales of 100-1000 years.

The natural carbon cycle in the ocean and in particular pCO₂ in surface ocean water are strongly influenced also by biological processes. The marine biota serve as a "biological pump", transporting organic carbon from surface waters to deeper layers as a rain of detritus at a rate of about 4 GtC per year (Eppley and Peterson, 1979), which is balanced by an equal upward transport of carbon by deeper water richer in CO₂ than surface water. This "biological pump" has the effect of reducing surface pCO₂

about 55%, compared to 17% for CFCs (11 and 12), and 15% for CH₄ (see Section 2). Other CFCs and N₂O accounted for about 8%, and 5%, respectively, of the changes in the radiative forcing. While the contribution from tropospheric O₃ may be important, it has not been quantified because the observational data is inadequate to determine its trend. This pattern arises because of differences in the efficiencies of the gases to absorb terrestrial radiation.

Aerosol particles play an important role in the climate system because of their direct interaction (absorption and scattering) with solar and terrestrial radiation, as well as through their influence on cloud processes and thereby, indirectly, on radiative fluxes.

There is a clear need to document the historical record of the atmospheric concentrations of greenhouse gases and aerosols, as well as to understand the physical, chemical, geological, biological and social processes responsible for the observed changes. A quantitative understanding of the atmospheric concentrations of these gases requires knowledge of: the cycling and distribution of carbon, nitrogen and other key nutrients within and between the atmosphere, terrestrial ecosystems, oceans and sediments; and the influence of human actions on these cycles. Without knowledge of the processes responsible for the observed past and present changes in the atmospheric concentrations of greenhouse gases and aerosols it will not be possible to predict with confidence future changes in atmospheric composition, nor therefore the resulting changes in the radiative forcing of the atmosphere.

1.2 Carbon Dioxide

1.2.1 The Cycle of Carbon in Nature

Carbon in the form of CO₂, carbonates, organic compounds, etc. is cycled between various reservoirs, atmosphere, oceans, land biota and marine biota, and, on geological time scales, also sediments and rocks (Figure 1.1; for more detailed reviews see Sundquist, 1985; Bolin, 1981, 1986; Trabalka, 1985; Siegenthaler, 1986). The largest natural exchange fluxes occur between the atmosphere and the terrestrial biota and between the atmosphere and the surface water of the oceans. By comparison, the net inputs into the atmosphere from fossil fuel combustion and deforestation are much smaller, but are large enough to modify the natural balance.

The turnover time of CO₂ in the atmosphere, measured as the ratio of the content to the fluxes through it, is about 4 years. This means that on average it takes only a few years before a CO₂ molecule in the atmosphere is taken up by plants or dissolved in the ocean. This short time scale must not be confused with the time it takes for the atmospheric CO₂ level to adjust to a new equilibrium if sources or sinks change. This adjustment time, corresponding to the lifetime

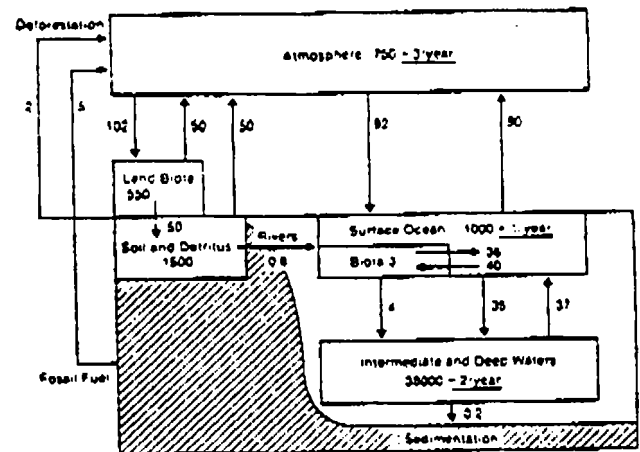


Figure 1.1: Global carbon reservoirs and fluxes. The numbers apply for the present-day situation and represent typical literature values. Fluxes, e.g. between atmosphere and surface ocean, are gross annual exchanges. Numbers underlined indicate net annual CO₂ accumulation due to human action. Units are gigatons of carbon (GtC; 1Gt = 10⁹ metric tons = 10¹²kg) for reservoir sizes and GtC yr⁻¹ for fluxes. More details and discussions are found in several reviews (Sundquist, 1985; Trabalka, 1985; Bolin, 1986; Siegenthaler, 1986).

in Table 1.1, is of the order of 50 - 200 years, determined mainly by the slow exchange of carbon between surface waters and the deep ocean. The adjustment time is important for the discussions on global warming potential, cf. Section 2.2.7.

Because of its complex cycle, the decay of excess CO₂ in the atmosphere does not follow a simple exponential curve, and therefore a single time scale cannot be given to characterize the whole adjustment process toward a new equilibrium. The two curves in Figure 1.2, which represent simulations of a pulse input of CO₂ into the atmosphere using atmosphere-ocean models (a box model and a General Circulation Model (GCM)), clearly show that the initial response (governed mainly by the uptake of CO₂ by ocean surface waters) is much more rapid than the later response (influenced by the slow exchange between surface waters and deeper layers of the oceans). For example, the first reduction by 50 percent occurs within some 50 years, whereas the reduction by another 50 percent (to 25 percent of the initial value) requires approximately another 250 years. The concentration will actually never return to its original value, but reach a new equilibrium level; about 15 percent of the total amount of CO₂ emitted will remain in the atmosphere.

F +

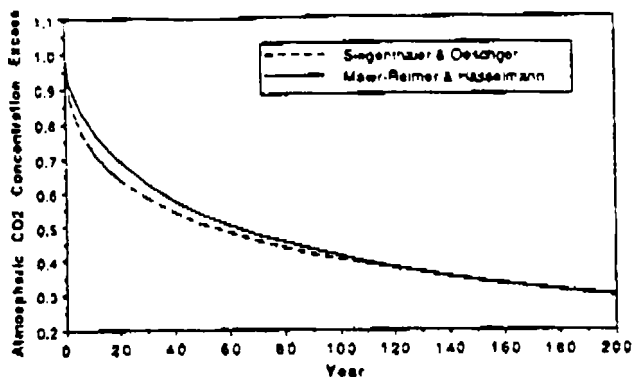


Figure 1.2: Atmospheric CO₂ concentration excess after a pulse input at time 0 (initially doubling the atmospheric CO₂ concentration), as calculated with two ocean-atmosphere models. Solid line: 3-dimensional ocean-circulation model of Maier-Reimer and Hasselmann (1987). dashed line: 1-dimensional box-diffusion model of Siegenthaler and Oeschger (1987). The adjustment towards a new equilibrium does not follow an exponential curve: it is very fast during the first decade, then slows down more and more. The concentration excess does not go to zero; after a long time, a new equilibrium partitioning between atmosphere and ocean will be reached, with about 15 percent of the input residing in the atmosphere.

1.2.1.1 The role of the atmosphere

The mean annual concentration of CO₂ is relatively homogeneous throughout the troposphere because the troposphere is mixed on a time scale of about 1 year. The pre-industrial atmospheric CO₂ concentration was about 280 ppmv, as reconstructed from ice core analyses (c.f. Section 1.2.4.1), corresponding to an atmospheric amount of 594 Gigatonnes of carbon (GtC: 1 Gt = 10⁹t = 10¹⁵g; 1 ppmv CO₂ of the global atmosphere equals 2.12 GtC and 7.8 Gt CO₂); today, the level is about 353 ppmv (Figures 1.3 and 1.4). The atmospheric increase has been monitored since 1958 at a growing number of stations (Keeling and Heimann, 1986; Keeling et al., 1989a; Beardsmore and Pearman, 1987; Conway et al., 1988).

1.2.1.2 The role of the ocean

On time scales of decades or more, the CO₂ concentration of the unperturbed atmosphere is mainly controlled by the exchange with the oceans, since this is the largest of the carbon reservoirs. There is a continuous exchange of CO₂ in both directions between the atmosphere and oceans. The net flux into (or out of) the ocean is driven by the difference between the atmospheric partial pressure of CO₂ and the equilibrium partial pressure of CO₂ (pCO₂) in surface waters.

The exchange of carbon between the surface and deeper layers is accomplished mainly through transport by water

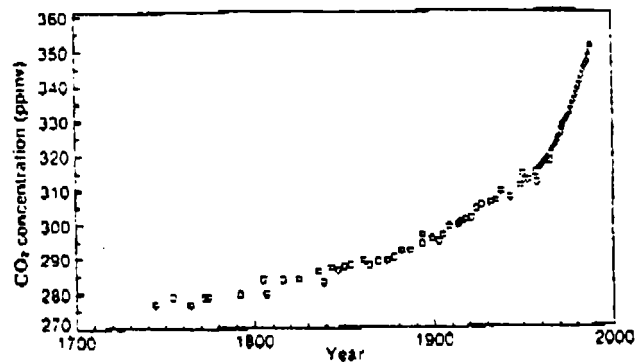


Figure 1.3: Atmospheric CO₂ increase in the past 250 years, as indicated by measurements on air trapped in ice from Siple Station, Antarctica (squares: Nestel et al., 1985a; Friedli et al., 1986) and by direct atmospheric measurements at Mauna Loa, Hawaii (triangles; Keeling et al., 1989a).

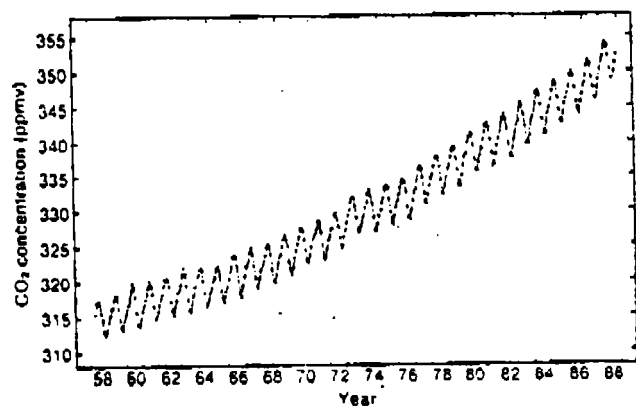


Figure 1.4: Monthly average CO₂ concentration in parts per million of dry air, observed continuously at Mauna Loa, Hawaii (Keeling et al., 1989a). The seasonal variations are due primarily to the withdrawal and production of CO₂ by the terrestrial biota.

motions. Ventilation of the thermocline (approximately the uppermost km of the ocean) is particularly important for the downward transport of anthropogenic CO₂. The deep circulation is effective on time scales of 100-1000 years.

The natural carbon cycle in the ocean and in particular pCO₂ in surface ocean water are strongly influenced also by biological processes. The marine biota serve as a "biological pump", transporting organic carbon from surface waters to deeper layers as a rain of detritus at a rate of about 4 GtC per year (Eppley and Peterson, 1979), which is balanced by an equal upward transport of carbon by deeper water richer in CO₂ than surface water. This "biological pump" has the effect of reducing surface pCO₂

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INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



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MEMORANDUM

TO: All WG III Lead Authors
FROM: Erik Haites *Erik*
RE: Literature Summary
DATE: December 22, 1993

Attached is a literature summary provided by Robert Stavins.

An updated list of workshops is also attached.

**READINGS IN THE FIELD
OF
NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS**

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PREFACE

This document combines an outline of the field of natural resource and environmental economics with a bibliography of approximately 600 references. The Table of Contents provides an overview and outline; the Reading List identifies specific references under each of the outline headings; and the Reference List contains a bibliography.

We thank the following persons for their help: Peter Berck, Richard Bishop, Glen Blomquist, John Braden, David Brookshire, Gardner Brown, Ilana Cohen, Parzival Copes, Maureen Cropper, Donald Dewees, Diane DuPont, Roderick Eggert, Anthony Fisher, Rick Freeman, Charles Howe, Randall Kramer, Jeffrey Krautkraemer, Eric Lichtenberg, Robert Mendelsohn, Raymond Mikesell, Gordon Munro, Philip Neher, George Parsons, Steve Polasky, Giulio Pontecorvo, Robert Porter, Alan Randall, Bruce Rettig, Steve Salant, Kathleen Segerson, Joseph Seneca, V. Kerry Smith, Tom Tietenberg, and David Zilberman.

We welcome suggestions of ways to improve this document, including additions and other changes to the outline and reading list.

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- Kamien and Schwartz (1991), pp. 1-120

B. Optimal Control--Maximum Principle

- Kamien and Schwartz (1991), pp. 218-221
- Clark (1990), Chap. 4, pp. 88-121
- Conrad and Clark (1987), pp. 25-31
- Dorfman (1969)
- Pontryagin et al. (1962)

C. Deterministic Dynamic Programming

- Kamien and Schwartz (1991), pp. 259-263
- Stokey and Lucas (1989)
- Williams (1989)
- Conrad and Clark (1987), pp. 22-24
- Beckmann (1968)
- Bellman and Dreyfus (1962)
- Bellman (1957)

D. Analytical Solutions

1. Phase Diagrams

- Kamien and Schwartz (1991), pp. 102-111, 174-184
- Clark (1990), pp. 97-102
- Conrad and Clark (1987), pp. 158-159

2. Computational and Numerical Techniques

- Chapman (1987)
- Conrad and Clark (1987), pp. 40-56

E. Constraint Qualification

- Seierstadt and Sydsaeter (1987), p. 83

F. Sufficiency

- Kamien and Schwartz (1991), pp. 41-46, 133-135, 221-226
- Seierstadt and Sydsaeter (1977)
- Arrow and Kurz (1970)
- Mangasarian (1966)

G. Free Horizon

- Kamien and Schwartz (1991), pp. 57-64
- Hotelling (1931)

H. Infinite Horizon

- Kamien and Schwartz (1991), pp. 95-96, 174-184
- Seierstadt and Sydsaeter (1987), pp. 379-385
- Michel (1982)

I. Special Topics

1. **Commitment and Time Consistency**
 - Laibson (1991)
 - Cohen and Michel (1988)
 - Kahn (1986)
 - Kahn (1982)
 - Reinganum and Stokey (1985)
 - Bulow (1982)
 - Coase (1972)
 - Pollack (1968)
 - Strotz (1956)
2. **Bang-Bang Control**
 - Kamien and Schwartz (1991), pp. 202-208
3. **Most Rapid Approach Paths**
 - Kamien and Schwartz (1991), pp. 209-217
 - Clark, Clarke and Munro (1979)
 - Spence and Starrett (1975)

J. Stochastic Dynamic Optimization

1. **Metric Spaces**
 - Malliaris and Brock (1982)
2. **Stochastic Calculus**
 - Malliaris and Brock (1982), Chap. 2, pp. 65-140
3. **Blackwell's Theorem**
 - Sargent (1987), pp. 339-363
4. **Stochastic Dynamic Programming**
 - Clark (1990), Chap. 11, pp. 343-364
 - Bertsekas (1987)
 - Conrad and Clark (1987), pp. 176-223
 - Mangel (1985)
 - Cropper (1976)
 - Dasgupta and Heal (1974)
5. **Stochastic Optimal Control**
 - Kamien and Schwartz (1991), pp. 264-271
 - Sargent (1987), pp. 29-40
 - Malliaris and Brock (1982), pp. 108-117
6. **Bounded and Unbounded Payoffs**
 - Bertsekas (1987)

II. NATURAL RESOURCE ECONOMICS

A. Nonrenewable Resources

1. **Overview**
 - Hartwick (1989), Chap. 1-5
 - Conrad and Clark (1987), Chap. 3, pp. 117-145

- Neary and van Wijnbergen (1986)
- Johansson and Löfgren (1985), Chap. 2, 3
- Fisher (1981), Chap. 2
- Dasgupta and Heal (1979), Chap. 6-10
- Peterson and Fisher (1977)

2. Resource Accounting

a. National Income Accounts

- Mäler (1991)
- Devarajan and Weiner (1990)
- Repetto et al. (1989)
- Stauffer (1985)

b. Growth Accounting

- Hartwick (1988)
- Weitzman (1976)

c. Valuing Resource Holdings

- Boskin et al. (1985)

3. Resource Scarcity

a. Theory

- Dale (1984)
- Devarajan and Fisher (1982)
- Solow (1974a)
- Barnett and Morse (1963)
- Stiglitz (1974a)
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b. Measuring Scarcity

- Norgaard (1990)
- Halvorsen and Smith (1984)
- Harris and Skinner (1982)
- Smith (1980)
- Brown and Field (1979)
- Fisher (1979)

4. Sustainability

- Heijman (1991), Chap. 6
- Norgaard and Howarth (1991)
- Solow (1991)
- Barbier and Markandya (1990)
- Howarth and Norgaard (1990)
- Batie (1989)
- Pezzey (1989)
- Dasgupta and Heal (1979), Chap. 16
- Eagan (1987)

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List of Workshops

WORKING GROUP III WORKSHOPS (Attendance by invitation only)

- | | |
|--|---|
| January 17-20, 1994
Japan | Policy Instruments and their Implications
A workshop on policy instruments and their implications, Tsubuka, Japan. |
| March 3-6, 1994
Switzerland | Decision-making Under Uncertainty & CC Risk Economics
Topical workshop dedicated to decision making under uncertainty as it applies to climate change, Montreua, Switzerland. |
| April 7-8 , 1994
Brazil | Greenhouse Gas Emissions Scenarios
A workshop on the review of current emissions scenarios, Fortaleza, Brazil. |
| April 27-29, 1994
Italy | Top-Down and Bottom-Up Modelling: What Can We Learn from Each Approach?
A workshop on top-down and bottom-up modelling and what we can learn from each approach, Milan, Italy. |
| July 18-22, 1994
Kenya | Equity and Social Considerations: What is Science? What are Values?
A workshop on equity and social issues related to climate change, Nairobi, Kenya. |
| August 1994?? | Sustainable Development, Cost-Benefit Analysis and Decision Making Related to Global Warming
Saudi Arabia has indicated that it might be interested in hosting a workshop for WG III. |

IPCC WORKSHOPS OF INTEREST TO WORKING GROUP III

The IPCC has been specifically requested to provide advice to the first Conference of the Parties (COP) to the Framework Convention on Climate Change (FCCC) on Article 2 of the Convention. This advice is expected to be based on the results of two workshops.

- | | |
|---|---|
| April 11-14, 1994
Brazil | First Workshop on Article 2 of the FCCC
The first workshop will deal with emissions scenarios, stabilization of atmospheric concentrations, regional climate change scenarios, and implications for impact assessments. This workshop which will be held in Fortaleza, Brazil, April 11 - 14. |
|---|---|

August, 1994
Zimbabwe

Workshop on Desertification

WG II is organizing a workshop on desertification to be held in Harare, Zimbabwe in August, 1994. It is expected that adaptation, mitigation, and socio-economic impacts will be important issues for this workshop.

January, 1995

Second Workshop on Article 2 of the FCCC

The second workshop will be held in January, 1995.

NON-IPCC WORKSHOPS OF POTENTIAL INTEREST TO WG III

June 1 - 3, 1994
Groningen, Netherlands

International Conference on Joint Implementation

Organized by the Foundation International Development Economics in cooperation with the Netherlands' Ministry of Housing, Physical Planning, and the Environment.

June 6 - 8, 1994
Denmark

Conference on Abatement Costing

Organized by RISO.

GLOBAL COMMONS INSTITUTE

17/12/93

Dr Joseph Stiglitz
Council of Economic Advisors
White House
Washington DC
United States of America

Dear Dr Stiglitz

IPCC WORKING GROUP THREE (IPCC WG3)

GCI is a participating organisation in the IPCC Working Group Three.

We refer to; -

- (a) the letter (dated 7 October 1993) from the IPCC WG3 bureau to the Director of the Global Commons Institute asking GCI to send relevant research materials to lead authors, and
- (b) the letter (dated 29 November 1993) from the IPCC WG3 bureau to all the lead authors working on the IPCC WG3 contribution to the IPCC Second Assessment Report, drawing to your attention the compilation by the Bureau, ourselves and others of a basic bibliography of key publications relevant to the concerns raised in the letter.

Apropos (a), we provide here for your consideration a recent GCI technical paper on "*Global Benefit*" and who provides it.

Apropos (b), for the moment we refer you to the publication "*If Women Counted*" by Marilyn Waring published by McMillan in 1989 (ISBN 0-3333-49262-5), and inform you that a list of key publications will be provided to you in due course as requested.

Also apropos (b) we attach overleaf a copy of GCI's reply to the bureau's letter to you.

Yours sincerely



Aubrey Meyer
Director

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Com & Sally
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F Enquiry
(IPCC)

GLOBAL COMMONS INSTITUTE

2 12 93

James P Bruce
Chairman IPCC WG3
1815 Juno Avenue
Ottawa
Ontario K1H 6S6
Canada

Dear Mr Bruce

We acknowledge receipt of your letter to us faxed here on the 27th of November. We also confirm receipt of a copy of the letter (29th November) which you mentioned, was being written by the bureau to lead authors.

We are pleased that the general tenor of our concerns is reflected in your letter to the lead authors. However, we remain concerned. On the 11th of November you and Aubrey Meyer had a lengthy phone conversation. During this you agreed that the issue of *"global benefit"* and who and what provides it, must be dealt with in the Second Assessment Report. I wrote you a follow-up letter on the 12th confirming this understanding between us, with copies to Prof Bolin and Dr Sundararaman. An initial bibliography was then supplied by us.

In paragraph two of your letter to the lead authors you make - in the critical area - the following formulation. *"In particular, we must ensure that publications on some key issues of importance to developing countries are adequately addressed. These issues include; recognition of the regional social, environmental and economic benefits of existing ecosystems and ways of life that are threatened by climate change and sea-level rise."* This is the nearest your letter comes to articulating the point we have been making to you. But your formulation is still inaccurate and confirms wrong analysis and augurs the technical assessment of wrong analysis.

What your formulation should read is as follows; *" recognition of the global social, environmental and economic benefits of existing ecosystems and ways of life."* Moreover, the caveat you attached to your formulation, viz. *"that are threatened by climate change and sea-level rise"*, further compromises the accuracy of your formulation. Your caveat turns the whole concept into a, *"sympathy for victims"* formulation. This is wrong. It is not a formulation which invites an understanding of the fact that people who already live sustainably (ie at low-impact levels) provide benefit to everyone globally, not just to themselves or just *"regionally"*. They in fact provide *"global benefit"*. Whereas people who live unsustainably provide *"global disbenefit"*.

If *"we"* - western industrialised countries - are only concerned about *"them"* because they are potential victims [indeed *our* potential victims] who are simply in danger of losing their capacity to appreciate themselves, we are critically failing to grasp the exemplary importance - for us with our globally unsustainable lifestyles - of people whose "ways of life" are already globally sustainable by virtue of their low impact and high efficiency values (see enclosed material).

The implications of this for the SAR are considerable. I urge you and Dr Haites to keep this theme clearly represented in the choice of literature and key publications to which you refer.

We enclose a recent GCI paper on this theme. It is a selective summary technical assessment drawn from GCI's extensive datasets for cross-cutting socio-economic global systems analysis. It also forms part of a significant GCI contribution to the Global Climate Change Conference in Phoenix Arizona next April, at which time the work will be formally presented and published in full. The accepted abstract is enclosed here for your information in the meantime.

Yours sincerely

Anandi Sharan (Ms)
Director

copies to; -
Prof Bolin, Dr Hoesung Lee, Dr Sundararaman,
Dr Haites and other relevant parties.

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GLOBAL COMMONS INSTITUTE

EQUITY AND SURVIVAL

**Who provides global benefit; who causes global disbenefit?
A basis for the reform of global institutional arrangements.**

By Anandi Sharan and Aubrey Meyer

The following ideas emerged over the last two years as part of GCI's research project on "*Equity and Survival*". The ideas were developed through interaction with many delegates [especially from developing countries] to the International Negotiating Committee for a Framework Convention on Climate Change (INC_FCCC). This paper is written partly as a recommendation to the Intergovernmental Panel on Climate Change Working Group Three (IPCC_WG3) on "*Economic and other Cross-Cutting Issues*". The Panel will produce its Second Assessment Report by 1995.

1. Impact, Income and Population; Per Capita Impact, Per Capita Income and Efficiency; 1950 - 1990.

Regional (a) *CO² Impact*, (b) *Income* [measured in PPP\$s**] and (c) *Population* *** are the three basic factors observed. The ratios between each, viz (d) *CO² Impact per capita*, (e) *PPP Income per capita* and (f) *Efficiency***** [as Unit of Income per unit of Impact], are assessed. The relative strengths of these are then compared between different parties as proportions of global totals. These comparisons are the beginning of an assessment of the extent of "*global benefit*" or "*global disbenefit*" caused by any party.

* The CO² data are from the CDIAC database of the US Energy Department.

** The Income data used are "*Purchasing power Parity*" (PPP) figures taken from the Penn World Tables 5.5. These tables delink national currencies from their exchange rates with the US dollar, and value them for their domestic purchasing power.

*** The population data are from the UN Statistics Department.

**** Efficiency is the ratio between PPP\$s and the amount of industrial CO² (measured in metric tonnes of carbon) emitted to generate the PPP\$s. CO² from fossil fuel burning is the principal source of greenhouse gas impact. Global formal sector income is 90% linked to the burning of fossil fuels and the resultant CO² emissions.

2. Charts and Tables - efficiency trends 1950 - 1990.

Overleaf, four regions of the World are projected: - *OECD, Latin America, Asia (less Gulf States), Africa (less South Africa)* with the six indicators mentioned. The indicators are expressed regionally across the period 1950 - 1990 as proportions of global totals for the same indicators. 1990 global values for each are equal to the value of "1.00".

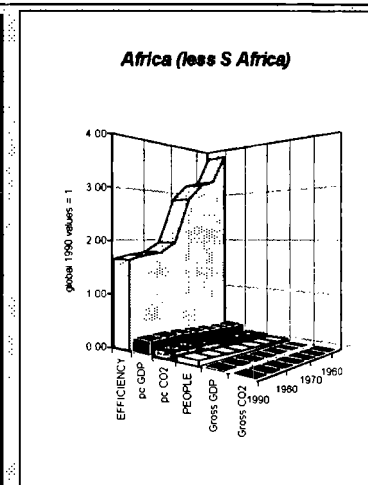
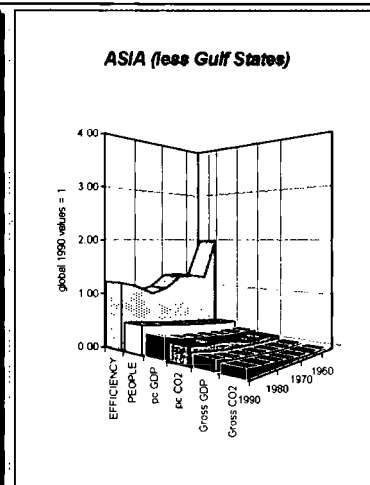
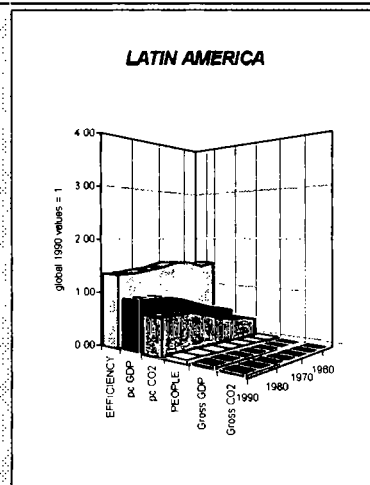
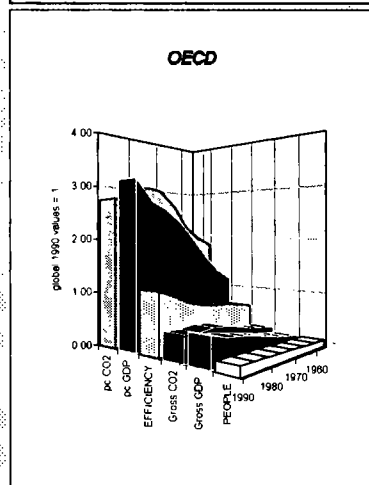
There is a clear trend. High income - both per capita and gross - is accompanied by high impact and low efficiency values. Conversely low income - both per capita and gross - is accompanied by low impact and high efficiency values. The evidence is that there is an inverse relationship between impact/income on the one hand and efficiency on the other.

TREND SHARES of GLOBAL INDUSTRIAL CO2-IMPACT, GDP-INCOME (purchasing power parity \$s), CO2:GDP EFFICIENCY, PEOPLE [1950 - 1990; Global 1990 values = 1] LAND & IMF VOTES [1993 only; Global values = 1].

	OECD						LATIN AMERICA						ASIA (less Gulf States)						AFRICA (less S Africa)					
Global 1990 values = 1	Gross CO2 Impact	Gross GDP Income	EFFICIENCY	PEOPLE	Per Cap CO2 Impact	Per Cap GDP Income	Gross CO2 Impact	Gross GDP Income	EFFICIENCY	PEOPLE	Per Cap CO2 Impact	Per Cap GDP Income	Gross CO2 Impact	Gross GDP Income	EFFICIENCY	PEOPLE	Per Cap CO2 Impact	Per Cap GDP Income	Gross CO2 Impact	Gross GDP Income	EFFICIENCY	PEOPLE	Per Cap CO2 Impact	Per Cap GDP Income
1990	0.48	0.53	1.12	0.17	2.73	3.06	0.05	0.07	1.35	0.08	0.69	0.96	0.18	0.21	1.22	0.52	0.33	0.41	0.02	0.03	1.65	0.11	0.15	0.25
1980	0.45	0.45	1.00	0.17	2.68	2.67	0.05	0.07	1.35	0.07	0.69	0.94	0.14	0.16	1.14	0.48	0.29	0.33	0.01	0.02	1.73	0.09	0.15	0.26
1970	0.48	0.41	0.85	0.16	2.98	2.53	0.04	0.06	1.39	0.06	0.69	0.93	0.12	0.12	0.98	0.43	0.27	0.27	0.01	0.02	1.76	0.08	0.15	0.27
1960	0.46	0.35	0.78	0.15	2.94	2.29	0.03	0.05	1.44	0.05	0.60	0.86	0.09	0.09	1.05	0.39	0.23	0.24	0.01	0.02	1.96	0.07	0.13	0.25
1950	0.39	0.29	0.74	0.15	2.65	1.95	0.02	0.04	1.51	0.05	0.49	0.74	0.06	0.07	1.25	0.35	0.16	0.20	0.00	0.01	2.84	0.06	0.08	0.24
	0.31	0.22	0.72	0.14	2.23	1.59	0.02	0.03	1.50	0.04	0.43	0.64	0.04	0.05	1.26	0.31	0.14	0.18	0.00	0.01	3.16	0.05	0.07	0.22
	0.26	0.18	0.66	0.13	2.00	1.33	0.01	0.02	1.39	0.04	0.41	0.57	0.04	0.04	1.19	0.28	0.15	0.16	0.00	0.01	3.26	0.04	0.07	0.21
	0.23	0.14	0.61	0.12	1.87	1.14	0.01	0.02	1.46	0.03	0.34	0.49	0.02	0.04	1.97	0.25	0.08	0.16	0.00	0.01	3.85	0.04	0.06	0.22
	0.24						0.15						0.24						0.20					
	0.62						0.07						0.09						0.05					

Highest Per Capita Impact-Income

Lowest Per Capita Impact-Income



Lowest GDP:CO2 efficiency

Highest GDP:CO2 efficiency

For example, of the regions selected OECD was responsible for nearly 50% of gross global CO² impact in 1990. From this it derived nearly 60% of gross global income. This impact/income was caused by around 17% of global population. Thus per capita impact and per capita income in the OECD were at around three times the global 1990 values for these two indicators. OECD efficiency levels on the other hand, while they rose across the period in question, rose from a low starting point (0.61 of the 1950/55 average global efficiency level) to a higher level (1.12 of the 1985/90 average global efficiency level) at the end of the period.

Conversely Africa was responsible for nearly 2% of gross global CO² impact in 1990. From this it derived nearly 3% of gross global income. This impact/income was caused by around 11% of global population. Thus per capita impact and per capita income in Africa were at around one sixth and one quarter respectively of the global 1990 values for these two indicators. African efficiency levels on the other hand, while they declined across the period in question, fell from a very high starting point (3.85 of the 1950/55 average global efficiency level) to a lower level (1.65 of the 1985/90 average global efficiency level) at the end of the period.

3. Global Benefit and Global Disbenefit

The term "*Global Benefit*" is used in a number of ways in the current literature on the economics of global climate change. Its use emanates predominantly from the industrial countries. Partly because it has been developed by bankers interested in lending or granting money, the term has been used in the context of assessing "*monetary costs*" and so-called "*incremental costs*" of greenhouse gas abatement measures.

(a) The GEF's Programme for Measuring the Incremental Costs of Protecting the Global Environment (PRINCE) for example says, "*Since only the global benefits represent the objective of financing, the global community would want to release the new domestic benefits. One way is to sell them (at a price equal to the value, appropriately discounted for time and risk) back to the host country.*" Thus the attempt is made to make global benefit net of domestic benefit. Whilst this is clearly contentious, there is no parallel attempt to make domestic benefit net of global disbenefit. The GEF use of the term global benefit is inaccurate and highly provocative.

(b) The term "*global benefit*" also occurs in Article 3 (Principles), paragraph three of the Climate Change Convention. Article 3 paragraph 3, states that "*the parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost effective so as to ensure global benefits at the lowest possible cost.*"

The term "*global benefit*" is thus central, and captures all the themes of politics and economics arising out of global climate change. On the basis of distribution of impact, income and efficiency (as shown in the tables and charts), we can say that (a) there are parties which provide global benefit whilst suffering sub-global disbenefit and that (b) there are parties which derive sub-global benefit whilst causing global disbenefit.

Since (a) everyone's interests are subsumed within the unfolding behaviour of the global efficiency trajectory and (b) this level is itself going to be the result of the net effect of the levels of global benefit and global disbenefit provision and (c) this net global benefit/disbenefit provision is inseparable from the net levels of global CO² impact and (d) this net global impact is on current trends not significantly separable from the inefficiency of global formal sector fossil fuel income generation;

We can say that (a) the global formal sector income is not in reality a private resource, it is a global common property resource, and (b) that therefore it must be used in a globally accountable way for the provision and sustenance of global common benefit and not for the provision and sustenance of sub-global private benefit, and (c) that also therefore by definition it must also be used for the diminution of and the cessation of the provision of global common disbenefit and must not be used for the provision of or the sustenance of sub-global private or common disbenefit especially by institutional means.

4. The inequitable and unsustainable global economic order

We know that today over 90% of formal income globally is derived from the burning of fossil fuels. Calculations by GCI show that (a) 93% of this income goes to less than one third of the world's population, generated above a sustainable equitable income/impact level* and that (b) the remaining 7% of this income goes to two thirds of the world's population, generated below a sustainable equitable income/impact level.*

This has been occurring over time and has been and remains an increasing divergence between the growth of money-less people on the one hand and the growth of people-less money on the other. The former provide global benefit by consuming resources efficiently at sustainable global levels, and the latter is an expression of the inefficient and unsustainable exploitation of resources and represents the provision of global disbenefit. This growing inequity is an expression of growing net disbenefit or declining global survival prospects.

5. Institutional reform and equity.

In the regional tables, each region's share of their voting power at the International Monetary Fund (IMF) is shown at 1993 levels. The IMF is an example of an institution which operates on the basis of allocating rights by income. OECD for example, with over fifty per cent of gross global income has over 60 per cent of IMF voting power. However, as the data also shows, this is synonymous with allocating rights by impact. Moreover, those who are least efficient are determining global economic policy. Present institutional arrangements, are thus incompatible with sustainable, equitable outcomes.

Conversely, a global common property arrangement - such as the Climate Convention - allocates voting rights equally on the basis of one party one vote. This is an acknowledgement of the fact that the climate system belongs to everyone equally and indivisibly. The Climate Convention states that; the threat of climate change is "*a common concern of humankind*" and that parties to the Convention should, "*protect the global climate system for the benefit of present and future generations of humankind on the basis of equity.*" Thus there is a direct contradiction between the principles of the Convention and voting practice at the IMF. The IMF voting procedures are merely symptomatic of the broad panoply of inequitable and unsustainable global economic practices which are still in the ascendant at this time. Reform is inevitable.

Feedback

Please contact: Global Commons Institute, 42 Windsor Road, London NW2 5DS.
Ph 081 451 0778, Fx 081 830 2366, e-mail gn:saveforests.

With any suggestions on how to these arguments can be used and improved.

* * * * *

* A global per capita equitable and sustainable fossil fuel income/impact threshold for 1990 is calculated as follows: global (\$/CO₂)

2.5⁽¹⁾ - equivalent to a 60% fossil fuel cut, as per IPCC 1st Assessment Report)

F. Ennema (1 PCC)
W63

PRELIMINARY REPORT OUTLINE

Writing Team 1: SCOPE OF THE ASSESSMENT

I. Over view of the climate change issues

- Regional changes and sources
- Relation to consumption and development
- Disparity in consumption in the North/South, development/survival in the South
- Awareness of issues

II. Sustainable development

- Basic concept and implications for limiting climate change
- Equity and social aspects with respect to development
- Distribution effects from chapter III

Special role of LDCs in climate change

- Expected population change
- Fuel efficiency
- Reliance on fossil fuels
- Rapid changes in output per capita

What can developed countries do to reduce first three?

- Need and scope for joint actions (public good problem)
- Role of joint implementation

Special policy instruments for mitigating and adapting

- Is fossil fuel usage consistent with sustainable development?
- Forestry

Implications for climate change for sustainable development

- Disasters
- Drought frequency

- Too much rain
- Global warming models may yield local cooling

✓ Discounting problems and others 2 types 7 moneys
Distribution effects

- Across generations
- Within countries
- Across regions and countries

- Special problems of island nations and low

Large Island
hydro electric

Different perspectives

- (1) Sustainable develop
- (2) C-B
- (3) Clean technology

Measuring inequality, aspects of inequality
lying nations

Importance of international agreements on sharing environmentally
sound technologies, with appropriate incentives for innovation

III. The basic taxonomy

What are the interactions between economic/social changes and
climate change?

How does economic activity affect climate?

The relative role of human activity in climate change.

How will changes in the climate affect economic activity?

What kinds of actions can be taken to mitigate the climate
changes?

What kinds of actions can be taken to respond to the climate
changes that do occur?

What are the links in these relations and the basic scientific
sources of our uncertainty about those links

Link between emission rates and ambient states

Link between ambient states and climate

(various aspects of climate: precipitation)

Link between climate and sea level

Link between policy actions and emission levels

Link between policy actions and adaptation responses

Importance of extreme values versus mean/medians
consequences of changes in seasonality patterns
diurnal variations
evidence of change

Timing and magnitude of responses

Lags (including stock effects)

Surprises

Non-linearities

Rational responses to these choice questions

Weighting Costs and Benefits

✓ Discounting the future

Weighting risks for small probability events (catastrophes)

Relative risk analysis

Lessons from other examples (nuclear, earthquake)

Risk aversion

- C. Net emissions: the importance of sinks
 - Scope
 - Non-emission benefits
 - Biomass fuels
- D. The baseline problem
 - Scenario "simplification"
 - North-South controversy
 - Why are baseline scenarios important
 - Do baselines grandfather high energy users
 - final performance measurers

✓ V. The need and scope for governmental action on a global scale

- Carbon*
- A. Inducing markets to take into account externalities
 - Taxes and regulations
 - Energy efficient houses (see "moving to the frontier" below.)

- Non-climate Benefits of Climate Remediation*
- B. Positive steps: mitigation as a by-product of addressing local climate issues (smog)
fossil fuel emissions reductions have other economic and environmental benefits (acid rain, toxics)

- C. Government actions which exacerbate the problem
 - Pricing energy too low (subsidizing)
 - Pricing water too low (rice)(subsidizing water, rice. market gardening, subsidizing cows; more generally ag subsidies)
 - Other examples

Remedying the market distortion reduces emission, generates direct and indirect benefits

- ✓ CC. The public good problem (free rider problem) *difficulties of translating*

- D. Imposing carbon taxes reduces emissions and reduces need for other forms of distortionary taxes

- E. Making markets work better in ways which have emission benefits
 - charging for parking
 - pay at the pump insurance
 - peak load pricing (airplanes, cars, electricity)
 - recycling

*Policy before pollution
Not to do with*

Self-interest (China) // GEF to

Responding to uncertainty

portfolios (attention to correlations, both across response strategies and between actions and environmental uncertainties)

mix of mitigation and adaptation

response times (importance of lags; both economics and physics)

what decisions is it important to make in the short run

(a) foreclosing options

(b) high costs of actions in the future

{cost benefit analysis of delay, no regret policies}

✓ Non-pecuniary aspects (environment)

Importance of having a rational response (cost- effectiveness, taking into account relative risk and opportunity cost of funds associated with climate change mitigation)

Concept of an "optimal sequential decision making strategy"

(optimal trajectories)

Timing: Costs and benefits of delay

Value of information

Responding to new information

Portfolio of actions

The importance of integrated assessments

interactions between various actions

interactions between actions and GDP and hence climate

The extent to which capital growth and new technology can offset climate degradation

IV. Focusing on Intermediate Steps in the process of limiting climate change

The climate change convention and the national action plans

A. Year 2000 only as an intermediate step

Conflicts between the "2000 goal" and cost efficient long run climate stabilization

B. Comprehensive list of greenhouse gases

Inappropriateness of gas by gas list

Methane

The problem of the "Montreal gases": the scientific response the CFC's

Views towards sulfates and other offsetting actions

VI. Introduction of improved technology

A. Moving to the frontier: the puzzle of why firms and individuals do not use cost effective energy efficient technology

- information

- returns to scale

- risk

- irrationalities

- cost and availability of capital (capital market inefficiencies)

 - (social versus private return to capital)

 - (cost versus availability of capital)

 - (role of multinationals making loans for energy purposes)

 - (would country be better off first growing, then investing in energy efficient technology)

Alternative explanation: incorrect assessment of virtues of alternative technologies

1. wrong private discount rate

2. incomplete estimate of costs

→ (The top down versus bottom up controversy)
AA. Transfer of Technology from VIII

B. Inducing innovation

- Incentives

- Threats

 - Coffee standards

 - credible threats

- Government encouraged and sponsored research

 - international cooperation (see below)

 - tax credits

C. The scope for moving to more energy efficient societies

- Land use

- Fuel efficient cars

- Efficiency of industry

- Architectural practice (housing)

- Appliances

D. The scope for moving to more emission efficient energy sources

- Magnitudes of supply (natural gas, hydro-electric, bio-mass)

- Magnitudes of gains

E. The sources of opposition

- The Human dimension: dislocated workers

- Dislocated firms: compensating for old capital?

*Reduced for
Poly & PTs*

Special interests

International dimension (oil producers versus users)

VII. Measuring and Climate influences and change

Helps to focus on the true social cost of emissions/climate change and monitor performance

Green GDP and benefit/cost analysis

Special aspects related to limiting climate change

How do the differences in uncertainties (including monitoring uncertainty) associated with different gases/options affect policy

VIII. International Aspects

1. Geographic distribution of sources, sinks, impacts, capacities to respond

Climate change global problem; needs to be approached globally

Required to achieve cost effective reductions

Alternative goals and mechanisms for responding globally

2. Joint implementation

Dividing the credit

Relevance of concept

Market mechanisms

Alternatives

Monitoring

Mechanisms

Distributional consequences

3. International Trade

Impact of climate changes on patterns of international trade and terms of trade

Potential scope of emission regulations as a barrier to trade

IX. Developing National Action Plans

For Developed Countries

For Less developed countries - emphasis on public awareness and adaptation

The need for coordination national action plans

regional

international

scope for regional, international cooperation

The basic taxonomies of emissions

Help to identify sources of emission growths and control

1. Emission/energy relation

$$\text{Emissions} = \frac{\text{Emissions}}{\text{unit energy}} \frac{\text{energy}}{\text{GDP}} \frac{\text{GDP}}{\text{Population}} \frac{\text{Population}}{\text{Pop}}$$

2. Additional environmental and economic benefits of fossil fuel emission reductions

3. Other sources of emissions

Rice farmings

Land fills

Writing Team 2: DECISION-MAKING FRAMEWORK

1 Background & Scope

How do we take into account factors associated to CC when making decision?

- uncertainty
- irreversibility
- risk
- frequency of extreme events
- value of information
- short/long term factors
- opportunity costs
- economic factors affected through CC
(GDP, fractions of GDP, population, technological progress, utility)

2 Paradigms & attitudes toward risk

- responses (and perceptions) to risk
- anthropocentric vs ecocentric attitudes
- taking action & free-riding
- sovereignty or global governance

3 What methods can be used for making decisions with respect to CC

- portfolio diversification
- sequential/hedging decision-making
- B/C analysis (beyond conventional CBA)
- insurance analysis

- 4 What are the risk-related trade-offs when facing CC
 - risks of inaction vs action
 - short term vs long term decision-making
 - uncertainties -- a taxonomy
 - value of information, option value
 - technical progress/energy substitution and other substitutions
 - discounting issue
 - opportunity costs & other costs
- 5 Risk assessment of CC
 - a parallel to nuclear risk analyses
 - catastrophic scenarios
 - time dimension (timing)
 - insurance mechanisms
- 6 About the linkages between the natural sciences and socio-economics
 - attitudes
 - sensitivity of socio-economic parameters
 - regional differences
 - sensitivity of socio-economic groups
 - research needed to make society able to confront uncertainty/to save time to adapt.

Timetable

- coordination, contributors
 - outline of each section
- Nov. 30, 1993

Writing Team 3: To come

Writing Team 4: To come

Writing Team 5: SOCIAL COSTS TO GLOBAL CLIMATE CHANGE

1. Overarching Issues
 - o Benefit as damage reduction
 - o Time discounting
 - o Valuation of non-market (e.g. ecological) effects
 - o Nonlinearity

- o GDP scaling
- o Risk treatment : upper - and lower-bound warming & damages
- o Consumer surplus
- o Transient versus equilibrium warming damage (e.g. sea-level rise)
- o Timing & predictability (increased damage for faster warming)

2. Damage Estimates for 2xCO₂ Equilibrium Warming

- o Market sector
 - o Agriculture
 - o Sea level rise
 - o Forests
 - o Water Supply
 - o Health
 - o Pollution : air
 - o Pollution : water
 - o Net Heating/cooling requirements
 - o Tropical cyclones - floods, droughts
 - o Migration
 - o Construction
 - o Leisure activities
 - o Urban infrastructure
- o Non - market sector
 - o Biodiversity
 - o Human amenity

3. Translation of Baseline Damages to Policy Scenario Abatement Benefits

- o Warming avoidance potential as a function of policy

4. Secondary costs of carbon dioxide abatement

- o Reduce air pollution

5. Damage Estimates for Very-Long-Term Warming

6. Regional Differences

Damages at other levels of CO₂ concentrations due to policies/scenarios

7. Differential Impact on Developing Countries

- o Physical impact
- o Valuation : discounting differences, e.g.

8. Catastrophic Risk

9. Impact of technological Change on Prospective Damages

10. Abatement versus Adaptation

- ## 11. Comparison of Policy Response Benefits with Abatement/Adaptation Costs
- o Discrete scenario analysis
 - o Optimization models

Writing team 6&7 : COSTS OF MITIGATION OF GHGs

1. How do we measure costs (direct and indirect)
 - welfare measures
 - general vs partial equilibrium approaches
 - treatment of uncertainty (hedging behaviour)
2. Importance of patterns of development and technological change
3. What do costs depend upon
 - Baseline
 - Goal (emissions, concentrations, timing)
 - Assumptions:
 - Market structure (regional and international level)
 - Demand-side parameters
 - economic growth
 - price and non price mechanisms
 - Supply side parameters
 - technology cost and availability
 - Resource base
 - Time horizon
4. Bottom-up vs top-down approach
5. Short term. Review of existing studies (global and regional)
 - why do studies differ
 - methodologies
 - inputs
 - range of uncertainty
6. Long term. Review of existing studies (same issues)
7. Key insights and direction for research.

TIME SCHEDULE

September 30th	Names of lead authors
October 31st	Names of contributors and outline on section 5 (Richels)
December 31st	Outline of each section and preliminary list of references
March 1st	First draft
End of March/April	Writing team meeting
May 31st	Second draft
July 31st	Final draft

Writing Team #8: THE POLICY INSTRUMENTS

The Policy instruments to be considered were categorized as follows :

- o International
- o Domestic
 - economic
 - regulation
 - land use planning
- o information provision

These instruments were further divided as follows :

- o economic instruments
 - taxes
 - tradable permits and joint implementation
 - tradeable absorption arrangement
 - energy subsidies
 - other incentives
 - user charges for services
 - deposit fund schemes
 - trade policies
 - environment policies
- o Domestic regulation
 - technology based
 - performance based
- o Land use planning and other policies with indirect implications for climate change

It is proposed that the policy instruments chapter would have the following structure :

- o Introduction
 - feasible instrument set

- o Description and categories of instruments
- o Review of the use of each instrument
 - is it feasible/is it cost effective?
 - does the instrument encourage agreement and adaptation?
 - is the instrument effective for all greenhouse gases or only some?
 - does the instrument encourage/discourage further technological change?
 - how does the instrument perform in different economic environments?
 - . in high growth/ low growth economies?
 - . in economies with high/low inflation?
- o Consequences of using a portfolio of instruments
 - free riding
 - leakage
 - international tax incidence
 - interaction between instruments/optional policy mix
 - costs of the wrong choice
 - effectiveness of instruments in the short vs. long run
- o problems not easily addressed by the policy instruments
- o further work that needs to be done on the instruments

Timetable

Dec. 1993	first stage exchange of drafts between team members
Jan. 17-19 1994	Workshop - Japan
May. 16 1994	Drafts available for internal review and distribution to other teams
July 14 1994	Provision of draft to Bureau

Writing Team #9: GENERIC ASSESSMENT OF RESPONSE OPTIONS

CHAPTER OUTLINE - SEPT. 07, 1993

1. A Taxonomy of Response Options
 - a. Adaptation and Mitigation Response Options
 - b. Response Options and the Institutional Frameworks
 - c. Response Options and Political Feasibility
 - d. Unilateral and Multilateral Responses
2. Various Methods of Assessing Costs and Benefits of Various Response Options - A Survey
 - a. Various options and their feasibility
 - b. Methodologies in assessing the options
 - c. Survey other Main Empirical Results With Respect to Costs and Benefits of Response Options

- d. Integrated Response Options
- 3. Response Actions and Cost Functions in relation
 - a. The Scale of Application
 - b. The Region of Application
 - c. The Timing of Application
 - d. Unilateral Vs. Multilateral Action
 - e. Response Options, Net Costs and Acceptability
- 4. Criteria for the Assessment of Response Options
 - a. Cost effectiveness
 - b. Distributional Impacts
 - c. Feasibility, Applicability and Acceptability
 - d. Comprehensiveness
 - e. Enforcement, Data Limitations
- 5. Response Options and the Distributional Aspects
 - a. Distributional Impacts Among Economic/Social Sectors and Industry Groups
 - b. Distributional Impacts Among Energy Exporters and Importers
 - c. Distributional Impacts Within Countries: Income and Interest Groups
 - d. Response Options and International Competitiveness
 - e. Carbon Leakage
- 6. Response Options and the Special Circumstances of Developing Countries.
 - a. Response Options and their Applicability and Consequences on Developing Countries: a Literature Survey
 - b. Energy Policies in Developing Countries: some Special Distributional Aspects.
 - c. Various Options for Special Consideration
 - energy efficiency
 - market imperfections
 - technology transfer
 - afforestation
 - land-use patterns

Writing Team 10: EMISSION SCENARIOS

5.1 Background and Scope

[In this section we explain that we will emphasize the evaluation of IS92 scenarios and present the criteria for this evaluation.]

5.2 IS92 Emission Scenarios

- 5.2.1 Modeling Framework
- 5.2.2 Underlying Assumptions
- 5.2.3 Results
- 5.2.3 Criteria for Evaluation in This Report
 - Comparison to other literature
 - Comparison to relevant processes

5.3 Comparison of IS92 Scenarios with Other Emission Scenarios

[In this section we compare results of the IS92 scenarios with other scenarios in order to assess whether the IS92 scenarios are consistent or not with other estimates. We then try to explain the similarity or differences by examining the input assumptions and structures of the different models.]

5.3.1 Comparison of Results

a. CO2 Emission Scenarios Related to Energy and Industry

- Global
- Regional

b. CO2 Emission Scenarios Related to Land Use/Agriculture

- Global
- Regional

c. Other GHG Emission Scenarios Related to Energy and Industry

- Global
- Regional

d. Other GHG Emission Scenarios Related to Land Use/Agriculture

- Global
- Regional

e. CFC (and Substitutes) Emission Scenarios

- Global
- Regional

5.3.2 Explaining the Difference Between Scenarios

- a. Comparison of Input Assumptions of Different
- b. Comparison of Model Structures/Parameters [Includes review of literature on sensitivity analysis of existing models]

5.4 Uncertainty and Sensitivity of IS92 Emission Scenarios

[In this section we focus on a sensitivity analysis of the model used to generate the IS92 scenarios].

5.4.1. Sensitivity to model input assumptions (e.g. population, GNP)

5.4.2. Range of estimates of key model inputs from literature and other sources (e.g. population, GNP)

5.4.3. Uncertainty due to model structure/parameters (e.g. emission coefficients)

5.5 Evaluation and Recommendations

5.5.1 Uncertainties

-- Qualitative Ranking of Sources of Uncertainty [e.g. certain, confident, uncertain, unknown]

-- Research needed to Reduce Uncertainties

5.5.2 Strengths and Weaknesses of IS92 Scenarios

-- Science applications

-- Policy applications

5.5.3 Recommendations for Developing Consistent Scenarios

-- Usage of IS92 scenarios

-- Recommendations regarding new scenarios



MEMBER

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL OF ECONOMIC ADVISERS
WASHINGTON, D.C. 20500

F
Environ
(IPCC)

December 23, 1993

Dear Jose:

Here at long last is the preliminary draft of the SCOPE chapter of the IPCC WG3 report. We are very interested in your views and suggestions. This version is still preliminary. A few sections have yet to be completed to our satisfaction. I would very much appreciate your reaction to the spirit of the chapter and the general approach. We are especially interested in any developing country examples of strategies being considered that we have not noted. We view this draft as substantive and reflective of the approach that we would like to see used.

Fully recognizing the joint nature of the writing team responsibility, we are more than happy to accommodate any changes you would like to see made. We would like to work together and improve the next version, before sending it out to the other international co-authors.

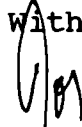
Please note that we took as much as possible from our international co-authors. We have used material directly from Professor Amano and Mrs. Saha. We have not been able to use the language from Shaoziong's contribution but learned from his comments. His statements on the importance of economic growth as a determinant of future improvements in environmental protection and standards of living are hopefully reflected in the text. We could certainly benefit from his thoughts on national action plans, alternate goals, and sustainable development.

We are seeking copies of national action plans for different countries to enrich the last section of the chapter. We have copies from Germany, Netherlands, Japan, Canada, and the U.S. Each is at a different stage of implementation and level of detail. Do you know of any from developing countries?

Here are the changes we envision for the next version of the chapter. The sections on the national action plans, joint implementation, discounting and adaptation strategies will be completed. The section 1.3 (costs) will have additional sophistication in presentation of the arguments and will use more recent articles and reports. We will continue to emulate the style and level of presentation found in the assessment reports from WGI of the IPCC.

I look forward to talking with you about the chapter and the progress being made by our working group. Sally Kane will continue to work on improving the chapter and will be calling you shortly.

With warm regards,



Joseph E. Stiglitz

Professor Jose Goldemberg
Centre for Energy and Environment Studies
Princeton University
Engineering Quad
Princeton, New Jersey 08544-5263



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



145 King Street West, Suite 1002, Toronto, Ontario M5H 3X6 CANADA
Tel: (416) 369-0900 Fax: (416) 369-0922

November 23, 1993

Dear Colleague:

Working Group III of the Intergovernmental Panel on Climate Change (IPCC) will issue a report on its assessment of the state of economic science on climate change in 1995. Part of that report will include a review of published studies on the economic costs of mitigating greenhouse gas emissions. The section will review country-specific, regional and global studies; distinguish between short-run and long-run cost estimates; summarize both "bottom-up" and "top-down" analyses; and attempt to provide some understanding as to why cost projections differ to the extent that they do.

We are anxious that the survey be as comprehensive as possible. To this end, we are writing to you for suggestions of peer reviewed research in this area. We would particularly appreciate reprints of any research that you or your colleagues have undertaken. Both original studies or reviews of existing work would be most welcomed.

Please forward such material to either:

Professor Thomas Johansson
Department of Environment and Energy Systems Analysis
Lund University
Gerdagatan 13
S-223 62 Lund Sweden

Dr. Richard Richels
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, CA 94303 U.S.A.

Your timely response to this request would be much appreciated.

Sincerely yours,

Erik F. Haites
Head, Technical Support Unit,
Working Group III, IPCC

Canadian Embassy



Ambassade du Canada

501 Pennsylvania Avenue, N.W.
Washington, D.C. 20001

June 10, 1993

Mr. Joe Stiglitz
Member-designate
Council of Economic Advisors
Old Executive Office Building
Washington, D.C. 20501

Facsimile no. (202) 395-6947

Dear Mr. Stiglitz,

Doug Russell (Director, International Issues Branch) and Alex Mansen (Director, Domestic Issues Branch) of Environment Canada's Atmospheric Environment Service will be visiting Washington D.C. on Friday, June 25, to discuss the development of the U.S. Climate Change Action Plan. I would be grateful if you and your colleague, Raymond Squitieri (to whom I am writing separately), would agree to meet with them that day to discuss the Council of Economic Advisors' work on the Climate Change Mitigation Group.

As you may know, Messrs Russell and Mansen have been centrally involved in climate change issues over the past few years, Russell as Director of the Climate Change Convention Negotiations Office at Environment Canada and Mansen as Director of the Climate Response Strategies Branch. No doubt the meeting would mutually profitable.

Please let me know, on (202) 682-1740, if I can provide additional information. All good wishes in the meantime.

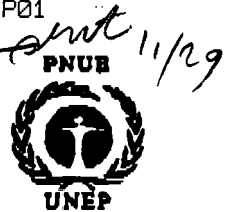
Yours sincerely,

A handwritten signature in dark ink, appearing to read "David J.R. Angell".

David J.R. Angell
Second Secretary



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



145 King Street West, Suite 1002, Toronto, Ontario M5H 3X6 CANADA

Tel: (416) 369-0900 Fax: (416) 369-0922

Copy to Ray, Sally sent 11/29
File @ (IPCC) 11/29

November 17, 1993

Professor John Byrne
 Director
 Center for Energy and Environmental Policy
 College of Urban Affairs and Public Policy
 Graham Hall
 University of Delaware
 Newark, Delaware 19716
 U.S.A.

Post-It™ brand fax transmittal memo 7671		# of pages	2
To	Dr. Joseph Stiglitz	From	Erik Haites
Co.		Co.	
Dept.		Phone #	
Fax #	(202) 395-6947	Fax #	

Dear Professor Byrne:

It has recently come to my attention that Dr. Hoesung Lee wrote to you early this year inviting your active participation in Working Group III of the IPCC of which he is a Co-Chair. I apologize for the lack of communication in the interim. Unfortunately, it appears that copies of some correspondence were not transferred to the Technical Support Unit for Working Group III when it was created in June of this year.

The procedure established by the Intergovernmental Panel on Climate Change is to invite governments and participating organizations to nominate potential lead authors. The Bureau of each Working Group (the Co-Chairs and Vice Co-Chairs) then selects its lead authors from among the nominees, taking into account the credentials of the experts nominated, the need to ensure that the diversity of scientific views is represented, and the commitment to increase the involvement of developing country scientists. The United States has an abundance of highly qualified experts on issues related to the economics of climate change and nominated approximately 40 experts for topics to be addressed by Working Group III. Obviously, only a fraction of the American nominees could be accepted as lead authors. A list of the Lead Authors selected by Working Group III is attached together with a list of their addresses and other contact information.

You can contribute in two ways; as a contributing author and as a reviewer. The lead authors select the contributing authors. You are free to contact any of the lead authors to discuss the topics they are addressing and then identify areas where you are able to contribute. You need only come to a mutually satisfactory arrangement concerning the scope and timing of your contribution. Your publications on demand-side management and alternative energy technologies fall within the scope of writing team 9. I will send a copy of your abbreviated

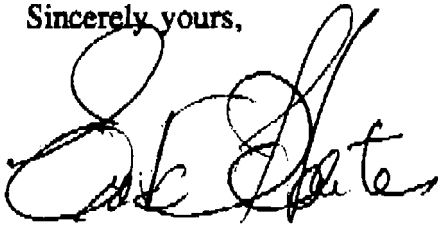
Professor John Byrne
November 17, 1993
Page 2

curriculum vitae to Dr. Catrinus Jepma, the convening lead author for writing team 9. If you wish to serve as a contributing author, you should contact Dr. Jepma or any of the other lead authors.

Given other demands on your time, you may wish only to serve as a reviewer. If that is the case you need only wait until next fall when a draft of the Working Group III report will be available for review. At that time you will be contacted and asked whether you wish to review some or all of the report. You can be both a contributing author and a reviewer.

If you have any questions concerning Working Group III, please do not hesitate to contact me at the above address. Again I apologize for the lack of communication since January, I can assure you that it won't happen again.

Sincerely yours,



Erik F. Haites
Head, Technical Support Unit
Working Group III, IPCC

attachments: List of lead authors by writing team
 Addresses of lead authors

- cc. letter only
 Mr. Paul Kerkhoven, Office of Senator William V. Roth, Jr.
 Dr. Joseph Stiglitz, Council of Economic Advisors
 Mr. Daniel Reifsnyder, State Department
 Ms. Florence Ormond, Technical Support Unit, Working Group II
- cc. letter and abbreviated curriculum vitae
 Dr. Catrinus Jepma, Convening Lead Author, Writing Team 9

Risk assessment including, inter alia, discussion of the following questions:

- What methods can be used to assess risk?
- What are the perceptions of and responses to risk?
- What are possible response measures?
- What are the risks of inaction, of undertaking economically attractive response measures and of taking more far-reaching response measures? (This section should take into account sequential decision-making, portfolio analysis, and benefits and costs of taking action early versus late.)

Methods and applications of cost-benefit analysis including, inter alia:

Concepts such as opportunity costs, trade-offs, marginal costs and marginal benefits and the value and importance of non-market factors such as biodiversity, long-term discounting, public perceptions, thresholds and irreversibilities.

Equity considerations including, inter alia:

Varying responsibilities among countries for past emissions, the "free rider" problem, inter-generational equity and the question of the time lags between the incurring of costs and the accruing of benefits.

The value of information including, inter alia, discussion of the following:

Significant efforts are being undertaken every year on global climate research in the area of natural sciences. Where are the highest potential payoffs for likely future decisions? What are the most critical uncertainties, including scientific uncertainties? How can research resolve them? What is the value of this scientific research in terms of its ability to describe the linkages between the natural sciences and socio-economics?

Sociological considerations

EVALUATING THE NET BENEFITS OF LIMITING CLIMATE CHANGE

Key Question: What methods exist for assessing the economic and social benefits of action and inaction? The issues addressed under this theme will include, inter alia:

Methods for estimating benefits through damage-avoided by adaptation

What would be the socio-economic impacts in the absence of any action to deal with the problem of increasing concentrations in the atmosphere of GHGs and aerosols? Different degrees and timing of action to limit climate change?

- Methods based on market impacts - for example, adaptation through trade, market agents, migration of population and economic activity.
- Methods based on non-market impacts such as ecological and social impacts.

Murasinghe, M.
Zhou...
Kononov...
Cline

C. Rosengweig
[Schengen, Kame]
Jim Broadie Woods Hole
Margaret Stadel (CAN) (Chap 2)

Peter Rogers
Karlheinz Neller

Draft for consideration by the Working Group III Plenary

Fisher
Kuhneman

Methods for estimating benefits: Potential valuation of avoided impacts

IPCC Workshop on Agricultural Impacts and Adaptation
February 17, 1993

Sponsors: U.S. Environmental Protection Agency, U.S. Department of Agriculture,
and the Farm Foundation

Le...
(IPCC)

- 8:00 - 8:15am Continental Breakfast
- 8:15 - 8:30am Welcome; Workshop Objectives
- SESSION I** Chair, Dr. John A. Miranowski, Director, Resources and Technology Division
- 8:30 - 9:00am Introduction - IPCC Objectives and Perspectives from Working Group III, Dr. Joseph Stiglitz, US Council of Economic Advisors
- 9:00 - 9:30am Dr. W. Sombroek, Food and Agricultural Organization, Rome, Italy--
Baseline Agricultural Conditions Without Climate Change
- 9:30- 10:30am **Agronomic, Soil, Pest, Trace Gas and Climate Interactions**
- Dr. S.C. van de Geijn, Research Institute for Agrobiolgy and Soil Fertility (AB-DLO)--Biophysical Response of Plants to Climate, Carbon Dioxide and Other Stresses
- Dr. J. Rogasik, Institut fur agrarrelevante Klimaforschung Munchenberg, Deutschland--Climatic Effects on Water Balance and Soils
- 10:30-10:45am Break
- 10:45-11:15am **Agronomic, Soil, Pest, Trace Gas and Climate Interactions (cont.)**
- Dr. David Patterson, USDA/ARS--Weeds in a Changing Climate
- Dr. John Westbrook, USDA/ARS--Climate and Pest Interactions (*unable to attend*)
- SESSION II** Chair, Dr. Carol S. Kramer, Associate Director, Resources and Technology Division
- 11:15-12:00pm **Agriculture and Climate Change--Regional Issues**
- Dr. Lin Erda, Chinese Academy of Sciences/People's Republic of China--
Impact and Adaptation in China and East Asia
- Dr. S.K. Sinha, Indian Agricultural Research Institute, India--Impact and
Adaptation in India and South Asia (*unable to attend*)
- Dr. F.E. Chege, Ministry of Research, Technical Training and Technology (MRTT)-Kenya--Impacts and Adaptation in Africa
- 12:00-1:00pm Lunch - Conference Room 525

1:00 - 2:00pm

Agriculture and Climate Change--Regional Issues (cont.)

Dr. Walter Baethgen, International Fertilizer Development Center/UNDP-
Uruguay--Impacts and Adaptation in Latin America

Dr. Cynthia Rosenzweig, Goddard Institute for Space Studies (GISS)--
Impacts and Adaptations in Developed Countries

SESSION III

Chair, Dr. Betsey Kuhn, Chief, Land & Global Resources Branch,
Resources and Technology Division

2:00 - 3:00pm

Global and Socio-Economic Issues

Dr. David Schimmelpfennig, USDA/ERS--Variability and Socioeconomic
Adaptation

Drs. Cynthia Rosenzweig, GISS and John M. Reilly, USDA/ERS--Results
of Recent Global Studies

3:00-3:30pm

Writing period. Each non-author participant is requested to write down
the 5 most important topics/results to highlight. Identify key tables or
graphics to include in the final report. Working together is encouraged.

3:30-3:45pm

Break

3:45-5:00pm

Non-author Panel - Dr. Balu Bumb, International Fertilizer Development
Center; Dr. Donald Mitchell, The World Bank; Dr. Carlos Pomareda,
Inter-American Institute for Cooperation on Agriculture; Dr. Susan Offut,
National Research Council--Comments and Recommendations

5:00-5:30pm

Dr. Robert Watson, U.S. Office of Science Technology and Policy, Co-
leader, Working Group II, IPCC--Synthesizing Results from WG-II

5:30-5:35pm

Dr. John M. Reilly, Deputy Director for Technology, Resources and
Technology Division--Closing Remarks