

Modeling in the context of the impact of the implementation of response measures

UNFCCC expert meeting on response measures
23 and 24 November 2005
Montréal, Canada

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SUBSIDIARY BODY FOR IMPLEMENTATION

Seventeenth session

New Delhi, 23–29 October 2002

Item 7 (a) of the provisional agenda

FCCC/SBI/2002/9

**IMPLEMENTATION OF ARTICLE 4, PARAGRAPHS 8 AND 9, OF THE
CONVENTION PROGRESS ON THE IMPLEMENTATION OF ACTIVITIES
UNDER DECISION 5/CP.7**

**Report of the workshop on the status of modelling activities to assess
the adverse effects of climate change and the impact of implemented
response measures**

**Bonn, Germany, 16–18 May
2002,**

Model and Policy Comparisons

36. The greatest benefit of economic modelling is that it provides a structured framework for organizing data and ideas, but there is substantial uncertainty associated with the results of such modelling exercises as a result of data gaps, model structure inadequacies and the incomplete analytical framework for evaluating the impacts of response measures. These uncertainties raise serious questions about the appropriate use of models. They further limit the value of the absolute quantitative outcomes of models and the significance of individual quantitative calculations. **However, all participants viewed comparison of policy approaches as a fruitful use of modelled data.**

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Source for Model Comparison: Barnett, J., S. Dessai, and M Webber. 2004. “Will OPEC Lose From the Kyoto Protocol?” *Energy Policy* : 32(18): 2077-2088.

Difficulties in Comparing Modeling Results (Barnett *et al* 2004)

- The reference or **Business as Usual** scenario of future developments from which the cost of deviations due to the Kyoto Protocol are estimated. The higher the baseline, the greater the estimated cost of reducing emissions;
- **Assumptions about substitution** among fossil fuels, between fossil fuels and non-fossil fuels, between energy and other factors of production, and substitution among products of differing energy intensities;
- Assumptions about the **international policy regime** to be pursued, including the amount of emissions trading, the use of flexibility mechanisms, and the use of sinks of CO₂;
- Assumptions about the extent to which **energy intensive industries may relocate**. Some of this relocation may favour oil exporting economies;
- Whether the models account for **cartel action by oil producers** to control the price of oil (few do, as equilibrium models assume perfectly competitive markets). Cartel action may counteract possible impacts of response measures on oil revenue;
- Whether the model accounts for reductions of **other greenhouses gases** besides CO₂;
- Assumptions about **future availability of conventional** (cheap to access) **oil reserves**;

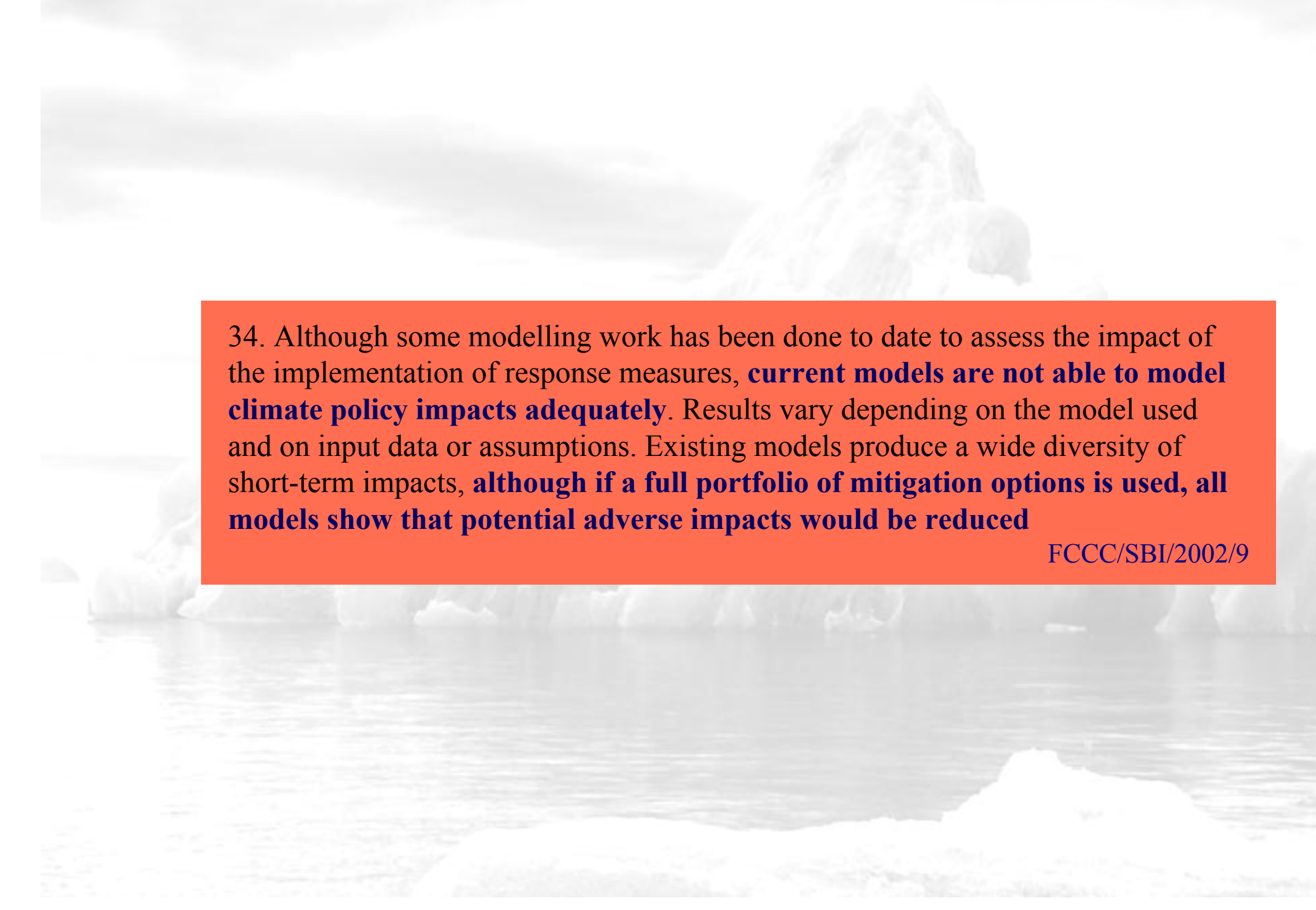
Model Comparison

Model Types

GTEM	Computable General Equilibrium (CGE), dynamic	
MS-MRT	Computable General Equilibrium (CGE), dynamic	
GREEN	Computable General Equilibrium (CGE), recursive	
OWEM	Macro-economic	
CLIMOX	Computable General Equilibrium (CGE), recursive .	Endogenous Oil Price
G-Cubed	Computable General Equilibrium (CGE), dynamic.	Financial Sector

Impact of the Kyoto Protocol on Oil Exporting Countries

GTEM	0.2% decline in real GNP at 2010 with trading among Annex B Parties.	Polidano <i>et al.</i> (2000)
MS-MRT	1.15% decline in welfare in 2010 in Mexico and OPEC countries (0.45% decline in GDP) with trading among Annex B Parties.	Bernstein <i>et al.</i> (1999)
GREEN	3% loss in real income in a situation of no permit trading	Pershing (2000)
OWEM	9.8% reduction in BAU annual oil revenue with trading among Annex B Parties and assuming that oil prices remain at BAU levels.	Ghanem <i>et al.</i> (1999)
CLIMOX	10% decline in oil revenue in 2010 from BAU with 'some' trading among Annex B Parties.	Bartsch and Müller (2000)
G-Cubed	13% decline in oil export revenue in 2010 from BAU with trading among Annex B Parties.	McKibbin <i>et al.</i> (1999)

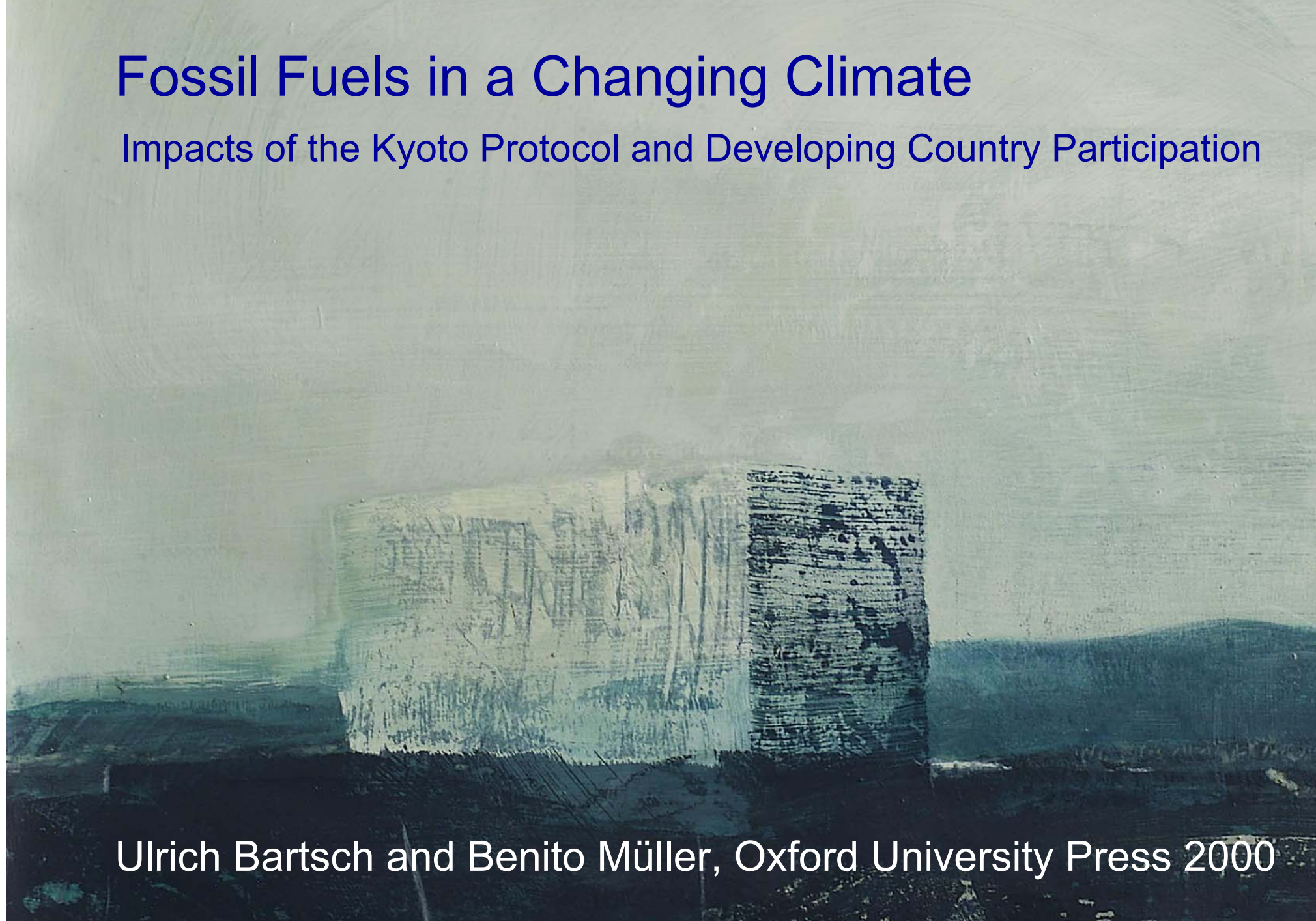
A background image of a large iceberg floating in the ocean under a cloudy sky. The iceberg has a prominent peak and several smaller chunks are visible in the water.

34. Although some modelling work has been done to date to assess the impact of the implementation of response measures, **current models are not able to model climate policy impacts adequately**. Results vary depending on the model used and on input data or assumptions. Existing models produce a wide diversity of short-term impacts, **although if a full portfolio of mitigation options is used, all models show that potential adverse impacts would be reduced**

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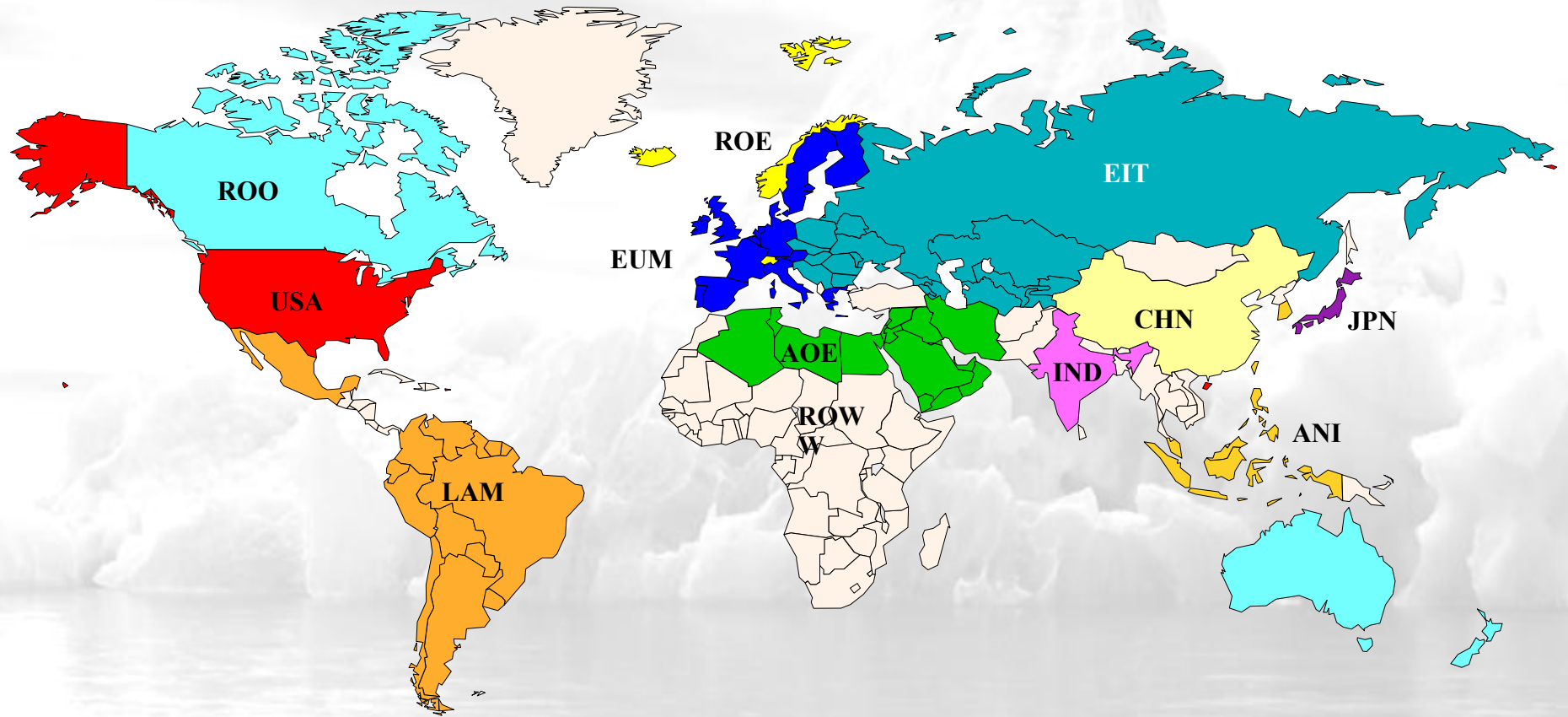
Fossil Fuels in a Changing Climate

Impacts of the Kyoto Protocol and Developing Country Participation

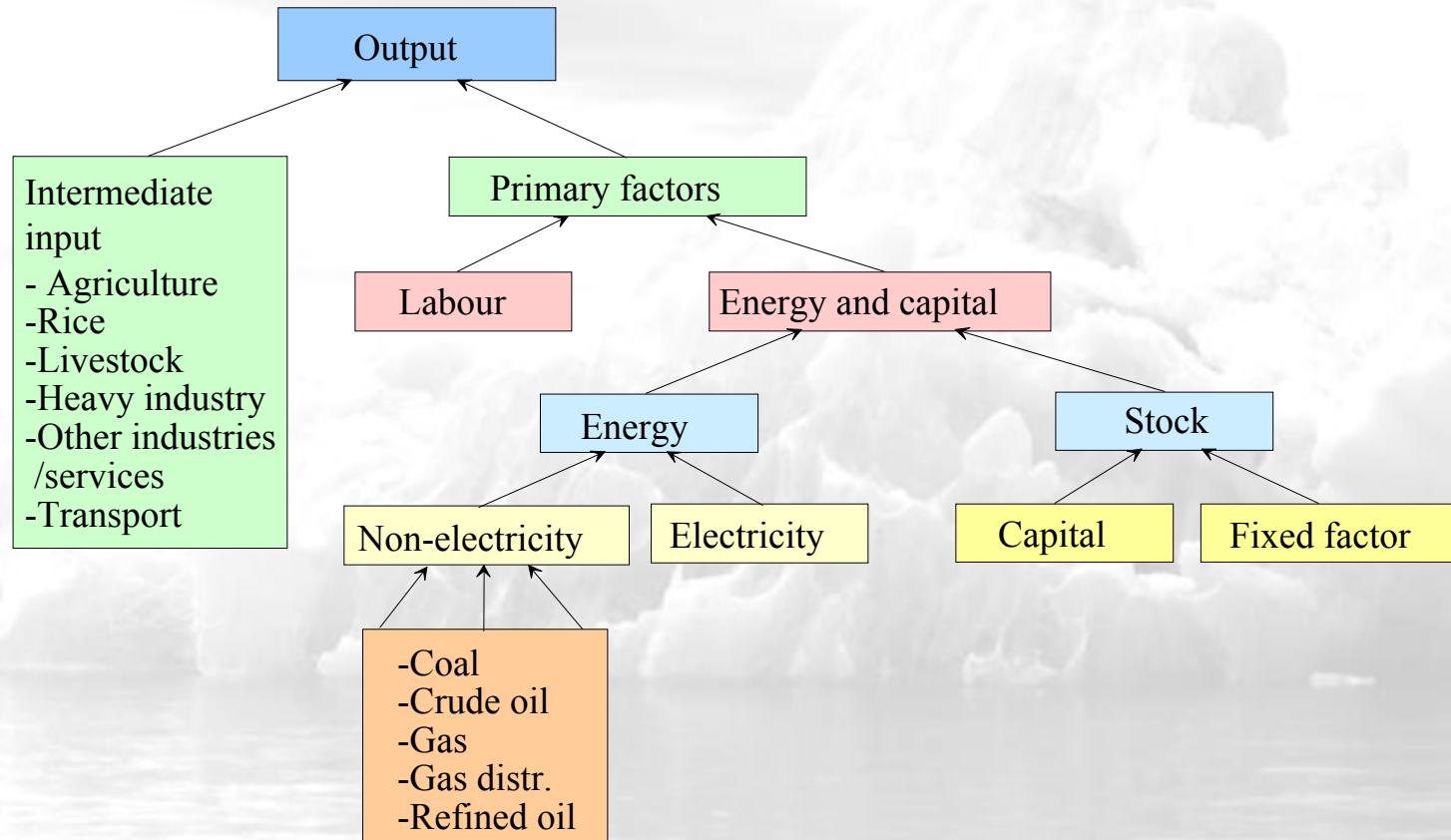


Ulrich Bartsch and Benito Müller, Oxford University Press 2000

The OIES Model for Climate Policy Analysis (CLIMOX)

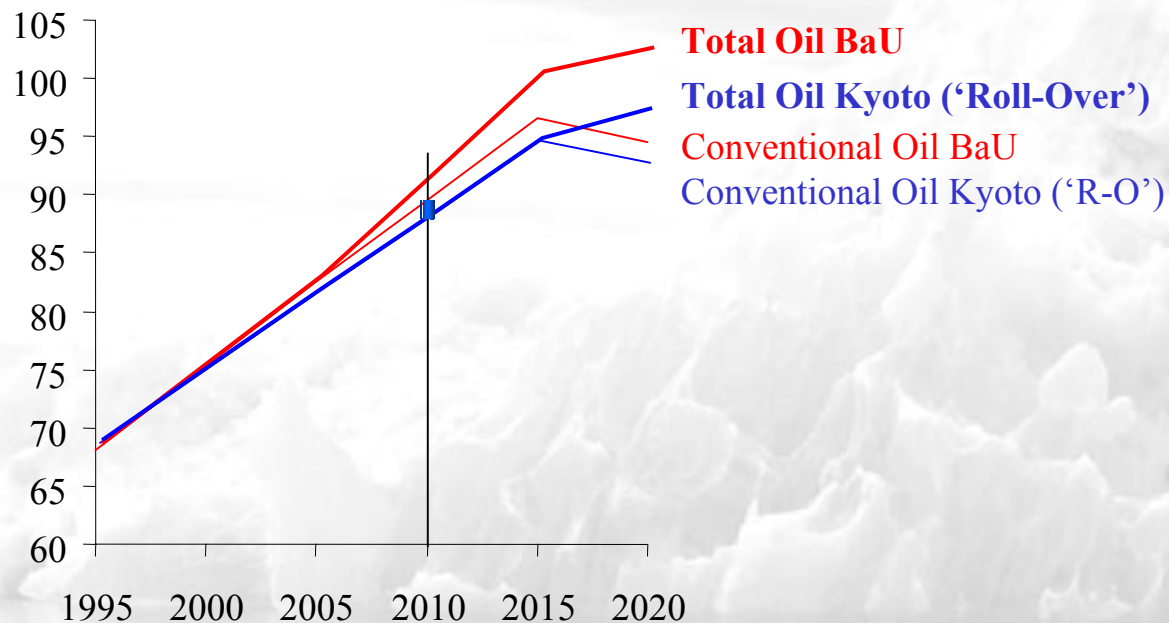


CLIMOX production structure

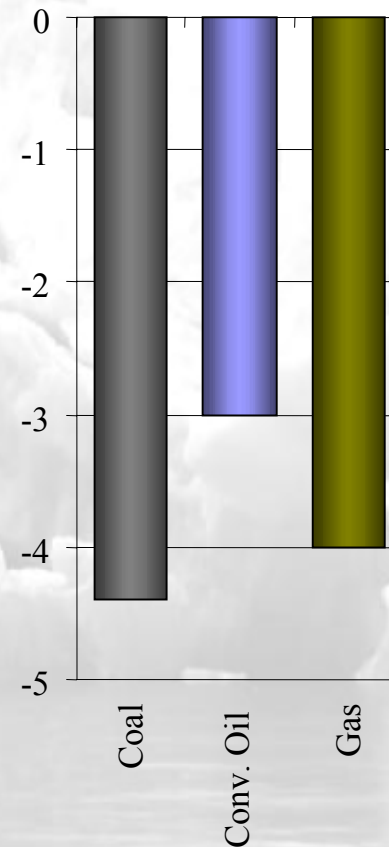


CLIMOX Results

Global Oil Production million barrels of oil equivalent/day



Impact of Kyoto (2010)



OWEM (OPEC World Energy Markets)



Source: Ghanem, Shokri., Lounnas, Rezki., Brennand, Garry, 1999.

‘The impact of emissions trading on OPEC’, *OPEC Review* June, 23 (2), 79–112

Table 7: Kyoto Protocol scenarios. Selected results for 2010

	<i>BaU</i> (2000)	<i>Baud</i> (2010)	<i>No</i> <i>Trading</i>	<i>OECD</i> <i>alone</i>	<i>Trading</i> <i>Annex I</i>	<i>Annex I</i> <i>+ CDM</i>
Annualised cumulative discounted (5%/yr) OPEC revenue 1998 \$ bn		144.2	120.9	121.1	130	132.5
Change from BaU			-16.2%	-16.0%	-10%	-8%
World oil demand m bl/day	76.2	87.9	80.6	80.4	84	84.4
Change from BaU		0%	-8%	-9%	-4%	-4%
OPEC production m bl/d	29.8	39.6	32.7	32.4	35.9	36.3
Change from BaU			-17%	-18%	-9%	-8%

“Allowing trade in carbon emissions has a less negative impact upon OPEC export revenue.”
[Ghanem *et al.* 1999:99]

Table 11. The effect of alternative oil price developments accompanying Kyoto targets

<i>Stabilisation criterion</i>	BaU (2000)	BaU (2010)	OPEC alone			Non- OECD
			High Price <i>Revenue</i>	BaU price <i>Price</i>	Low price <i>Production</i>	
Real basket price 1998 \$/barrel	\$17.00	\$19.40	\$22.70	\$18.80	\$11.20	\$21.20
Change from BaU			17%	-3%	-42%	9%
Annualised cumulative discounted OPEC revenue 1998 \$ bn (discount rate 5% p.a.)		144.2	144.2	120.9	81.2	141.1
Change from BaU			0%	-16%	-44%	-2%
World oil demand m bl/day	76.2	87.9	79	80.6	84.2	n/a
Change from BaU			-10%	-8%	-4%	
OPEC production m bl/d	29.8	39.6	29.1	32.7	39.8	n/a
Change from BaU			-27%	-17%	0.5%	

“In this context, **soft oil prices can, therefore, be regarded as a more potent threat to revenue flows than climate change mitigation measures**”[Ghanem *et al.* 1999:104]

“**Joint management of a relatively buoyant oil price with non-OPEC oil-exporting countries** offers the most feasible route to mitigating the severity of losses incurred, together with a **full global trading system** that is unrestricted by capping”[Ghanem *et al.* 1999:107]

Methodological Issues

2010 OPEC Revenues Changes from BaU



- Monetary figures of response measure impacts are inevitably hypothetical, derived from models with necessarily **hypothetical Business-as-Usual assumptions**
- Methodologically the best – and possibly the only – use of such figures is to evaluate (rank) policies **under different BaU assumptions**, to make **robust policy choices**

All scenarios based on OWEM 'Kyoto alone' (no trading) scenario



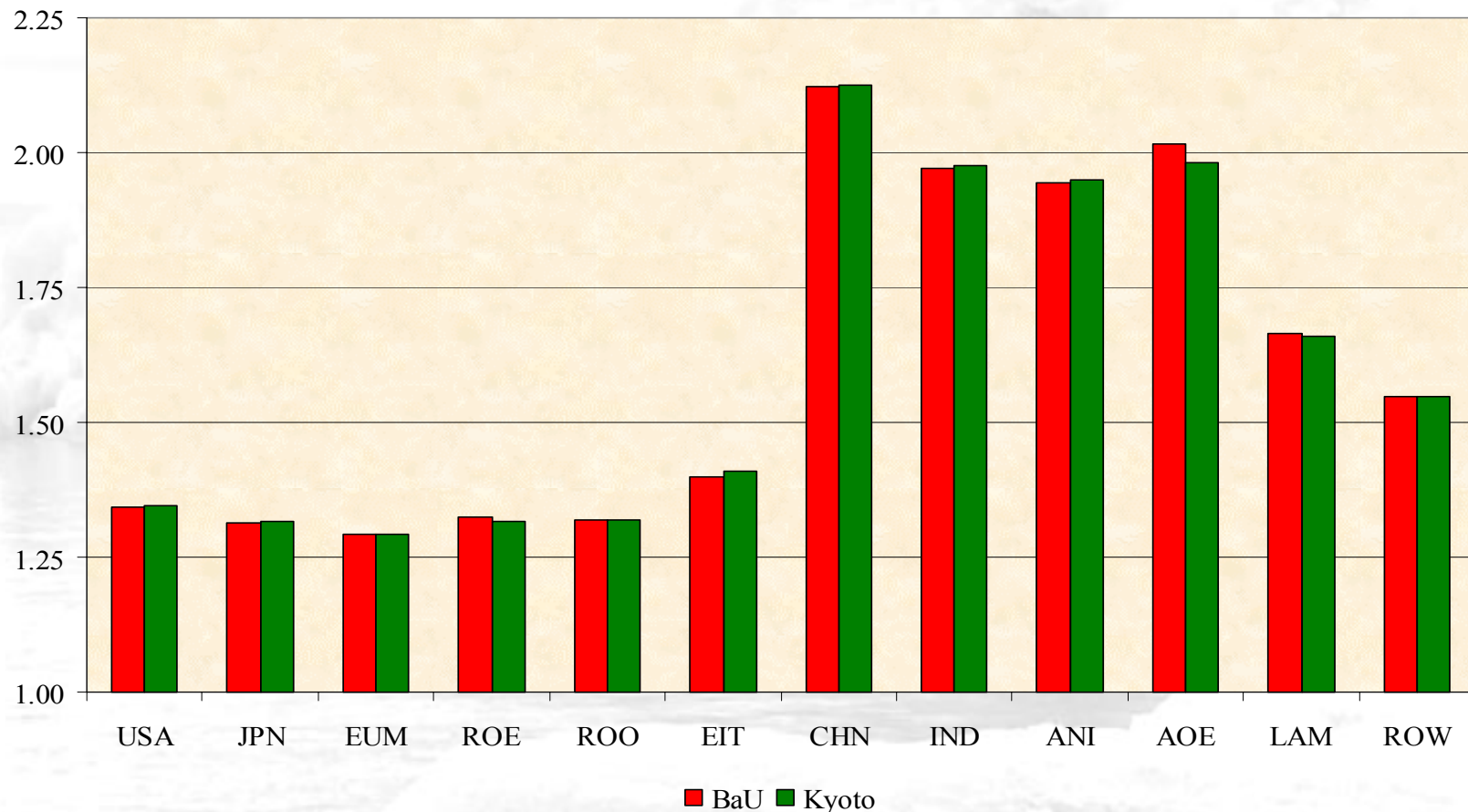
UNFCCC and the Kyoto Protocol

- “however, it is **difficult to predict with a high degree of accuracy a drop in oil demand due to the implementation of the protocol**. Forecasts show that demand in developing countries will rise as they strive to implement development programs that enhance their peoples’ living conditions. At the same time, demand growth rates are predicted to fall compared to the situation if the Protocol is not implemented. The [OIES] **CLIMOX model** shows that OPEC revenues will grow 65% between 1995 and 2010 in the base scenario, while the growth rate drops to 49% if the Kyoto Protocol is implemented”
- “studies show that OPEC countries’ **revenue loss will be less if emissions trading is employed,**”
- “the loss of OPEC countries ‘will be reduced considerably if the **clean development mechanism** is implemented, which OAPEC member countries are allowed to employ in several areas related to oil projects, such as curbing flared gas, cutting emissions and pollution from various branches of the oil industry, using clean technology, producing clean fuel, and conserving energy and rationalizing consumption in energy consuming industries.”

44. In the light of these constraints it was proposed that more modelling efforts, which would provide a **detailed examination of welfare, terms of trade** and **socio-economic impacts** on individual developing countries, be undertaken.

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CLIMOX: 2010 Real Income (Paasche) Indices. 1995 = 1

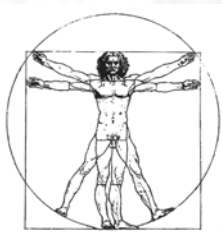


V. ISSUES FOR FURTHER CONSIDERATION

50. Participants mentioned the following key issues as possible areas for further consideration: [...]

- Making available detailed **information on the logic and data needs of individual models, and compiling and disseminating information on generic modelling methods and tools.** [...]
- Providing **capacity-building to developing country experts for constructing and strengthening data sets, improving the quality of analytical tools,** and disseminating results of these efforts in sectors that can contribute to climate change impact analysis, and for the development of models to assess impacts of response measures.

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european capacity building initiative

- Project Proposal for a web-based Economic Model Inventory, as part of the ECBI Policy Analysis Programme, submitted to the German Ministry of Environment
- Technical Modelling Project for ADCs (Mexico, Turkey)

Zentrum für Europäische
Wirtschaftsforschung **ZEW** Centre for European
Economic Research

A large, jagged iceberg floats in the ocean under a cloudy sky. The iceberg has a prominent, sharp peak. The water is dark and calm, reflecting the sky. The text "Thank You!" is centered over the iceberg in a dark blue, serif font.

Thank You!