Adverse Effects of Climate Change Mitigation Policies: Gaps and Limits in the Modelling

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to Assess the Adverse Effects of Climate Change and
the Impact of Implemented Response Measures
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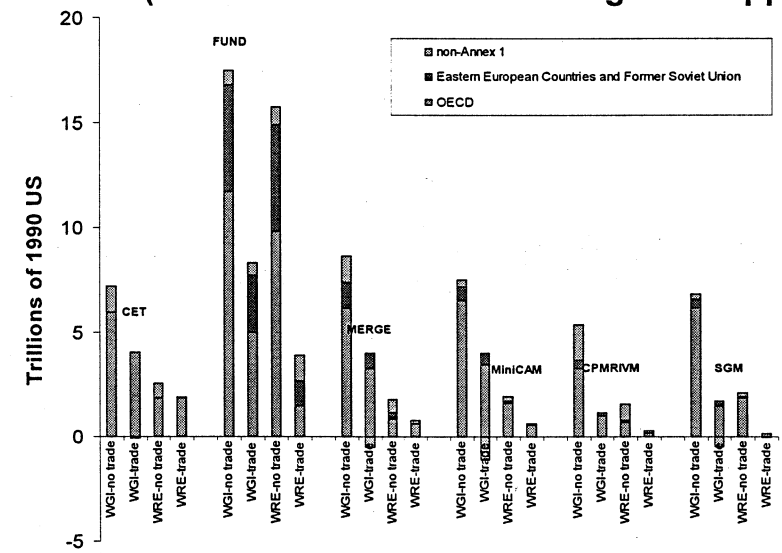
Models do not give a single story

(Modelled costs of stabilising at 550 ppm)



Model results suggest negative impacts on fossil fuel producers and exporters…

- Policy inspired reduced demand for fossil fuels in OECD
  - Limited offset on total demand from developing country demand increase
- Reduced price (from declining demand)
- Terms of trade losses
- Development of alternative fuels (which compete with oil and lead to additional revenue decline)

Model Estimates

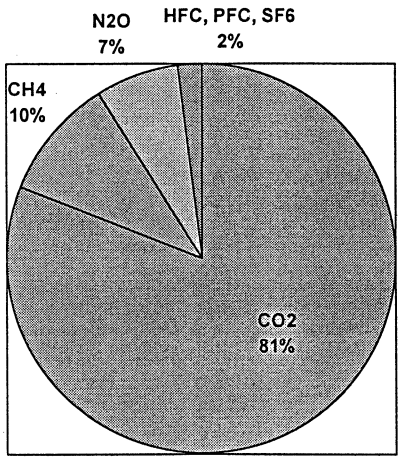
Selected Models	Losses to Oil Exporting Countries from Reference Case		
	Without trading	With Annex-I Trading	With "Global Trading"/CDM
G-Cubed	25% oil revenue decline	13% oil revenue decline	7% oil revenue decline
GREEN	3% real income loss	"substantially reduced loss"	n/a
GTEM	0.2% decline in GDP	GDP decline < 0.05%	n/a
MS-MRT	1.39% welfare loss	1.15% welfare loss	0.36% welfare loss
OPEC Model	17% revenue decline	10% revenue decline	8% revenue decline

SOURCE: IPCC TAR

. . . but each model uses different assumptions:

- Non-CO2 greenhouse gas offsets
- Sinks (both LULUCF and geologic storage)
- U.S. "out" of picture
- Prospective policy choices in climate mitigation often not [fully] included:
  - Use of Kyoto mechanisms
  - Choice of sectoral policies (e.g., transport vs. power generation);
  - Deferment of non-conventional fossil-fuel investment
- Technology breakthroughs

GHG Emissions in OECD Countries (CO_{2eq})

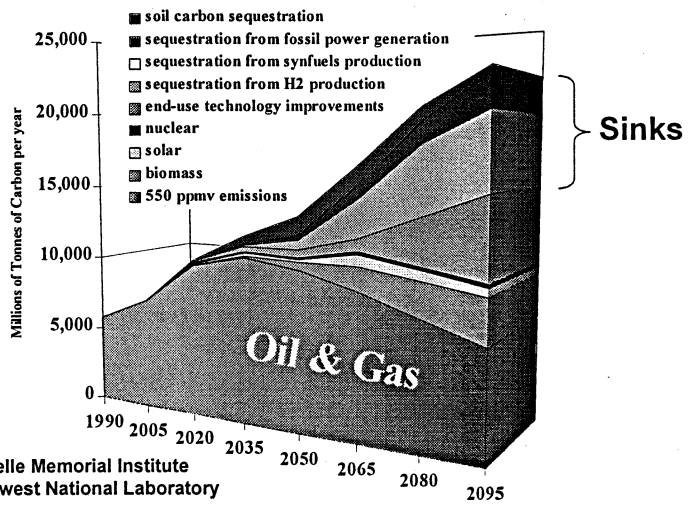


Source: UNFCCC 2000

Few models consider all GHGs:

- IPCC TAR reviews only one case (Reilly *et al*, 1999)
- Model suggests that with multi-gas targets and controls, price can be reduced by 25%
- Cost reductions in non-CO_2 gases reduces impact on fossil fuels

21st Century Energy Scenario: Sinks Play a Major Role



Source: Battelle Memorial Institute
Pacific Northwest National Laboratory

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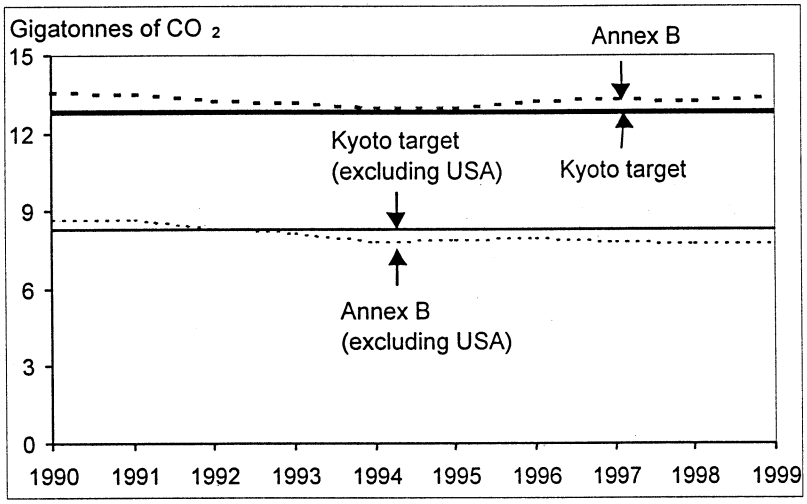
Annex B CO_2 Emissions & Target

(With and without the United States)



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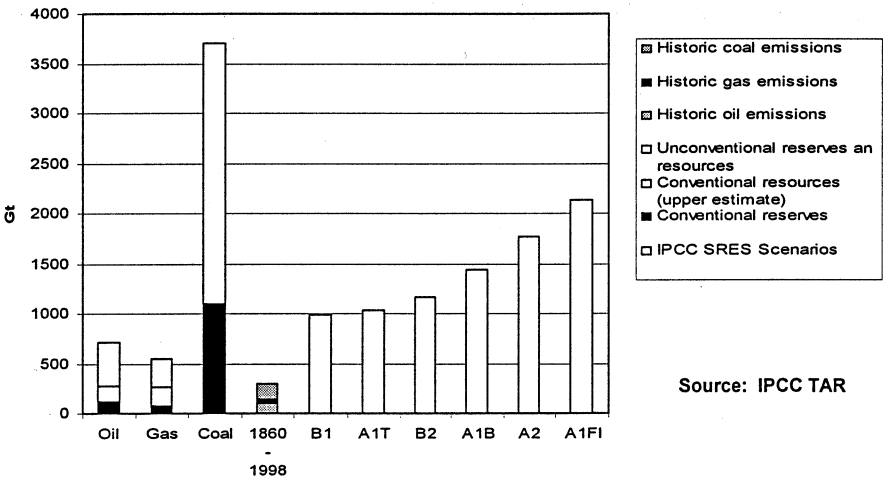
Model results: projections of compliance costs without the United States

Price of traded tonnes ($/tC)	MIT-EPPA (all GHG)	ABARE – GTEM (all GHG)
Kyoto	160.7	60.7
Kyoto w/o US	87.5	3.4
Kyoto w/o US and w/o "hot air"	94.9	32.0

Policy Choices Matter

- Which gas is the focus?
- Which fuel is the focus?
- Which sector is the focus?
- Which policies are used – and when do they take effect?
- How are policies modelled?

The story on fuels...



Source: IPCC TAR

Sectoral Contributions

OECD Total Final Consumption of Energy (mtoe, % fuel in sector)

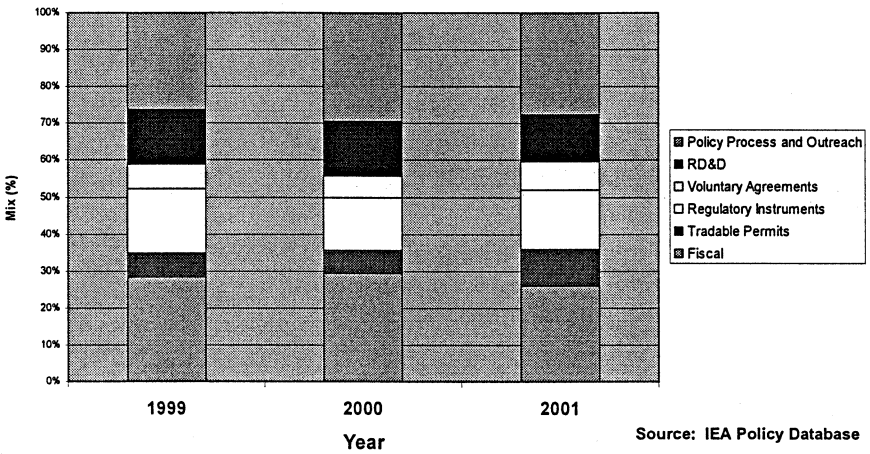
Fuel	Coal		Oil		Gas		TOTAL
Sector							
Industry	119	16%	345	46%	284	38%	748
Transport	0	0%	1,113	98%	24	2%	1,137
Comm/Res	24	5%	216	43%	261	52%	501
Electricty/heat	821	68%	133	11%	260	21%	1,215
TOTAL	964	27%	1,807	50%	829	23%	3,600

Source: IEA Data

What *ARE* the Policies?

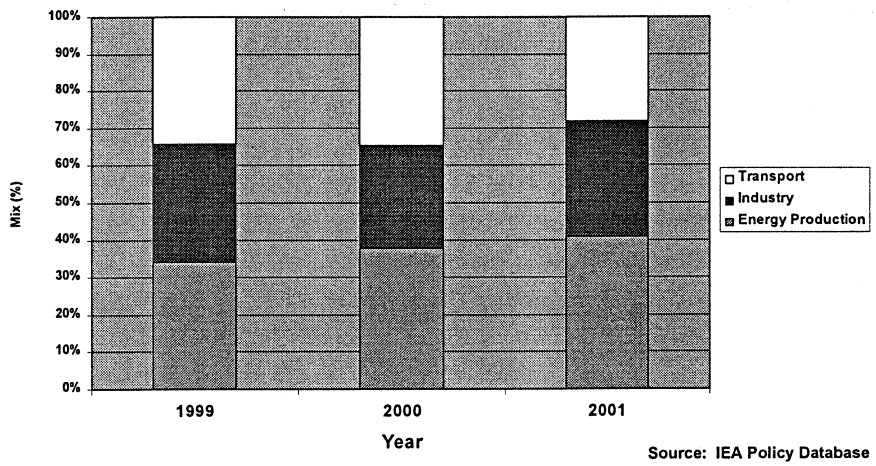
- Policies cover all gases and all sectors -- but emissions are not evenly divided among these
  - Energy and CO_2 are key
  - Disaggregating emissions useful for policy analysis
- Policy actions include:
  - Market approaches (taxes, subsidies, cap-and-trade)
  - Regulations
  - R&D
  - Processes/outreach

Countries continue to choose portfolio of policies. . .



Source: IEA Policy Database

...covering all sectors



Source: IEA Policy Database

How models incorporate policies

(Adapted from IPCC TAR)

	Market Policies	Technology Policies	Voluntary Policies
Macro-econ (I/O, CGE)	*Models all instruments; hard to model transactions costs*	*Mostly exogenous, some LBD*	*Qualitative assumptions*
Sectoral (Partial equilibrium, technology optimisation)	*All instruments, usually through changes in capital stock*	*Changes in capital stock; exogenous assumptions on stds and LBD*	*Exogenous, with some investments reflecting future expectation*
Project Assessment (C-B, C-E)	*All instruments*	*Exogenous data*	*Exogenous*

How do models treat policies?

- Depends on the model!
  - Top-down vs bottom-up, CGE vs I/O vs. macro-economic
- Market policies:
  - Often stylised representations only
  - Market imperfections not well represented (if at all)
- Technology policies
  - Most models require exogenous assumptions on behaviour and preference
  - Models are seldom able to account for new technology, or to accurately estimate the geographic diffusion of existing technologies; they also do not always account for learning by doing
- Models do not distinguish *WHY* a policy was taken

Ancillary Policy Rationale

- Reduced reliance on foreign supplies (energy security issue)
- Lower costs, e.g.,
  - Reduced costs of vehicle operation
  - Energy efficiency in power plants
- Improved local/regional air quality
  - Equivalent percent reduction in emissions of SO_x, NO_x and particulates
- Share of fuel efficiency reduction driven by these benefits : ??

Conclusions (1)

- Models are useful – but imperfect tools
- Results vary, depends on model used and on input / assumptions
  - Range of models produce wide diversity of near-term impacts, although if full portfolio of mitigation options are used, all models show impacts are reduced
  - In the longer term (post 2020), with more aggressive reductions, impacts may be greater – although this depends on policy choices
- Incomplete data and inadequate understanding
  - Lack specific policy information and methods to parameterise them properly
  - Do not fully understand interactions between multiple policies – either within or across countries
  - Inadequate assessment of technology development
  - Few models have been tested against present day

Conclusions (2)

- Difficult to model climate policy impacts
  - Separating climate policy consequences from consequences of other policies (e.g., energy, environment, social) is difficult if not impossible
- Models are inherently open to interpretation
  - Decisions on action are political; they may be informed by models but cannot be decided by them
  - Models should only be part of portfolio of policy tools to determine actions
  - Training needed for proper interpretation
- Models can and should be further improved