Carbon Leakage Effects of Climate Policies

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Overview (1)

- ETP: value added of a global model
- Carbon leakage
- The EMP project models
- Results: leakage and trade effects
- Conclusions

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ETP prospects

- Global model with regional detail
- Less detail than national MARKAL models (end use, regional detail)
- Value added: Global technology potential, supply security, CO2 permit trade, global learning, global commodity trade/leakage effects (energy, materials, food)
- 1st bottom-up model within IEA
- Linked to established IEA products (WEO)

Carbon Leakage

- Increase of emissions outside the policy area
- Two channels:
  - Resource (energy) price
  - Production location choice (Industry/Agriculture)
- Top-down econometric estimates: 20-30% leakage; energy channel dominates

The EMP project

- Energy and Materials Policy design
- National Institute for Environmental Studies NIES, Japan
- November 2000 - February 2002
- http://www.resourcemodels.org

The EMP project models I

- November 2000-February 2002
- Philosophy: impossible to build one single comprehensive global model (MATTER experience)
- Instead global regionalised sector/commodity models
- Combination physical flows and economics is essential

The EMP project models II

- GAMS/CPLEX LP/MIP models
- Energy & Material commodity flows "from cradle to grave "
- Global regionalised with commodity trade
- Each problem requires unique approach: modular GAMS code design

The EMP project models III

- Allow input calculations (Excel)
- Input + code accessible to 3rd parties (Excel/Internet)
- Data organization different
- Minimize data (technology once)
- Choice early starting year/late end year to allow validation, avoid resid's and salvaging
- Flexible reporting (Excel)

The EMP models IV

- More economics
  - Monopolies/oligopolies
  - Trade tariffs
  - Interregional transportation cost
  - Region-specific investment cost, fixom
  - Demand elasticities
  - Interregional CO2 permit & commodity trade
- Higher rigidity: all processes upper bounds, no lower bounds

The EMP project models V

- FREAK: Petrochemicals (Gielen & Yagita, 2001)
- STEAP: Iron and Steel (Gielen & Moriguchi 2002)
- BEAP: Agriculture and forestry products + whole global energy system (Gielen, Fujino, Hashimoto, & Moriguchi, 2002)

Model characteristics

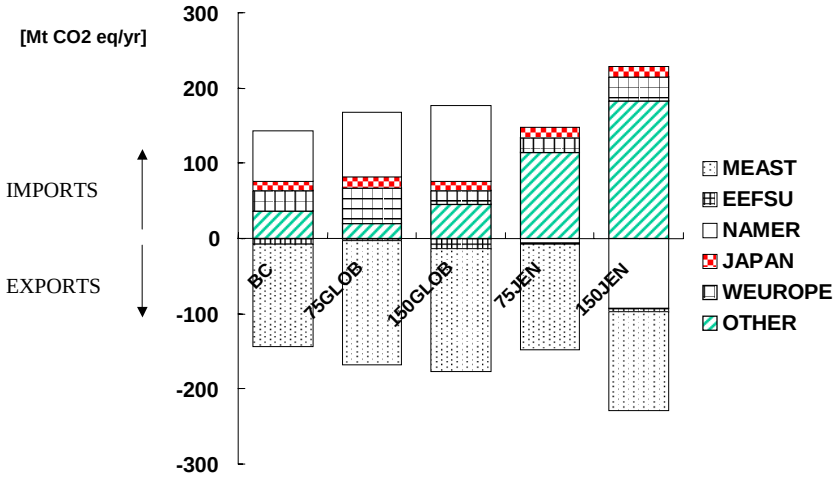
	BEAP	FREAK	STEAP
Scope	Global (12 regions)	Global (7 regions)	Global (11 regions)
Time span	1965-2040 (5 yrp)	1995-2035 (10 yrp)	1965-2040 (5 yrp)
Number of processes	176	100	74
Number of commodities	83	50	33
Matrix size	500,000*600,000	40,000*55,000	200,000*200,000
Permit trade	Yes	No	No
Objective function	Consumer/producer surplus	System cost	Consumer/producer surplus

Results

- BC = Base Case (no new policy)
- E = Europe
- GLOB = Global
- J = Japan
- N = North America

- Various penalty levels, code indicates penalty (EUR/t CO2eq + policy region)

Results II: FREAK (Petrochemicals 2020)



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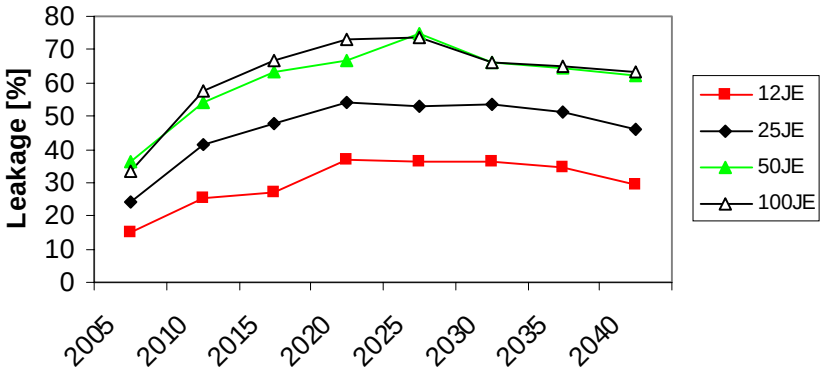
Results III: STEAP (I&S) CO2 Leakage



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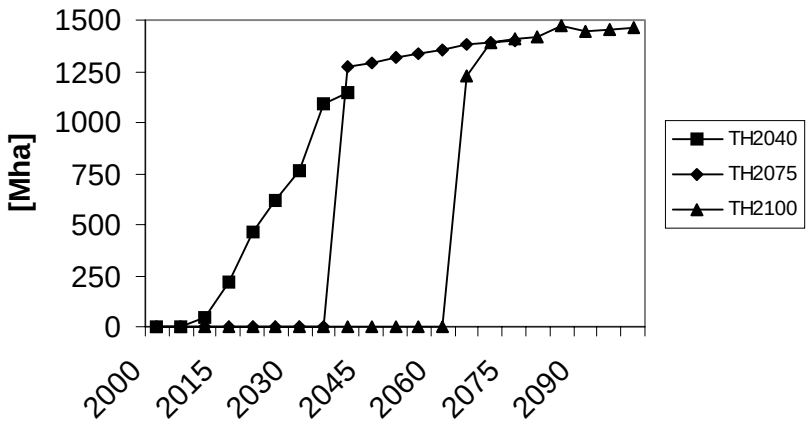
Results IV Impact import tariffs on leakage [%] Tax 25 EUR/t CO2

Tariff	No tariff	25 EUR/t steel	50 EUR/t steel	100 EUR/t steel
2015	47	10	-13	-17
2020	55	7	-11	0
2025	52	-48	-113	-110

Results V: BEAP

	Leakage [%]	Permit trade [Gt/yr]	Meat [Mt/yr]	Cereals [Gt/yr]
BC	0	0	48.3	1.88
12JENO	21	1.9	46.4	1.80
25JENO	19	4.3	43.2	1.77
50JENO	8	5.8	38.8	1.73
100JENO	9	6.2	32.7	1.72

Results VI: impact model time horizon on afforestation



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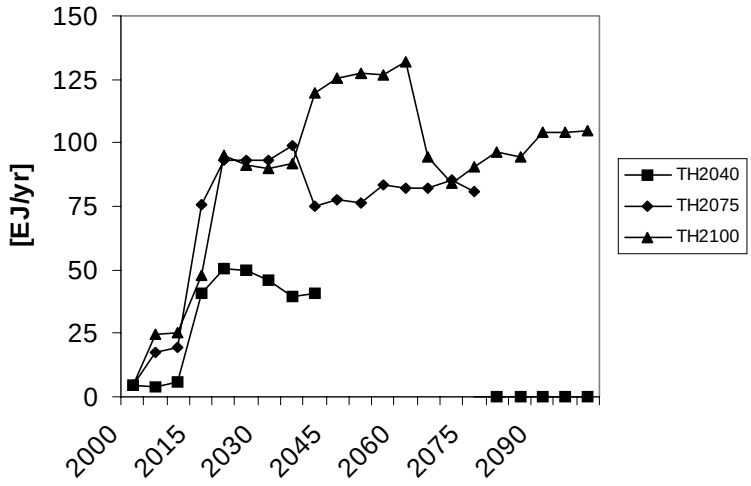
Results VII: impact model time horizon on bioenergy



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Conclusions

- 20% leakage in continued Kyoto: same result as econometric models
- 9% leakage in case of LULUCF trade
- Sector impacts significant
  - Iron and Steel 50-75%
  - Petrochemicals 40-50%
  - Food commodities <20%
- Sensitive for trade barriers

Suggestions for ETP

- Not one model, but a modelling toolbox
- Add inter-regional physical material/agricultural product flows ?
- Speed up current ETP model?
- Time horizon 2100 + starting year ?
- More detail industry
- Add land use module
- MIP investment decisions

Suggestions for ETSAP

- Expand to more specific global regionalized models - sub-tasks?
- Involve trade modellers (eg GTAP)
- How to distribute burdens and credits among partners?