

# **Alternative designs for tariffs on embodied carbon – a global cost-effectiveness analysis**

by

Christoph Böhringer, Brita Bye, Taran Fæhn,  
and Knut Einar Rosendahl

# Research questions:

- **How much can be gained in terms of cost-effectiveness through careful design of the system?**
  - quantified in a global, static CGE model
  
- **Is careful design costly in other senses (administrative, legal, political, distributional)?**
  - information is mostly qualitative, but
  - the CGE analysis measures the maximum acceptable costs (administrative, legal, political) of moving to a less feasible regime for the sake of effectiveness.

# Optimal carbon tariffs

- Hoel (1996): Optimal *unilateral carbon policy*
  - $t$  (unilateral carbon tax) = marginal utility of avoiding emissions domestically
  - $s_i$  (carbon tariff on good  $i$ ) = marginal utility of reducing net imports
    - Includes utility of terms-of-trade effects and emission reductions abroad
- Globally optimal carbon tariff (Gros, 2009):
  - Carbon tax in the coalition =  $t$
  - terms-of-trade effects offset each other
  - $s_i$  (carbon tariff) =  $t \frac{de}{dm_i}$  = tax the marginal carbon content of net imports, i.e. the increase in emissions abroad ( $e$ ) caused by the last unit imported ( $m_i$ ). The change in emissions follows from *all* price- and quantity adjustments

# How to operationalise carbon content?

## IN THEORY (MAX. EFFECTIVENESS):

- Include all emission changes in the wake of changed import
- Make it firm-specific and dynamic (responsive to behavioural adjustments)
- Cover all import and export goods

## IN PRACTICE (PRACTICABILITY CONSIDERATIONS) :

1. TECHNOLOGY BASIS; Industry- and country-specific or based on average carbon content (foreign or domestic)?
2. EMBODIMENT: Direct emissions, only, or including electricity-induced or all input-output effects?
3. COVERAGE: Only the most energy-intensive or all?

## OUR HYPOTHESIS:

**The closer to theory, the more effective – even in a realistic, imperfect world (CGE-modelled)**

## OUR QUESTION:

**Are there important trade-offs between efficiency and feasibility?**

# Feasibility of carbon import tariffs

## Legality:

- Consistent with WTO/GATT's non-discrimination principles (Article I and III)?
  - Discriminates equal products - only production processes vary (foreign vs domestic)
  - Bureaucracy on border is trade barrier
- Two GATT clauses can allow for border measures for environmental reasons, but strict!
  - at odds with other concerns? necessary? other alternatives tried?

## Practicability

- Administration & compliance costs likely increase with cost-effectiveness
- All designs can be based on official data -> avoid (rel. high) compliance costs of firms

## Political/distributional concerns

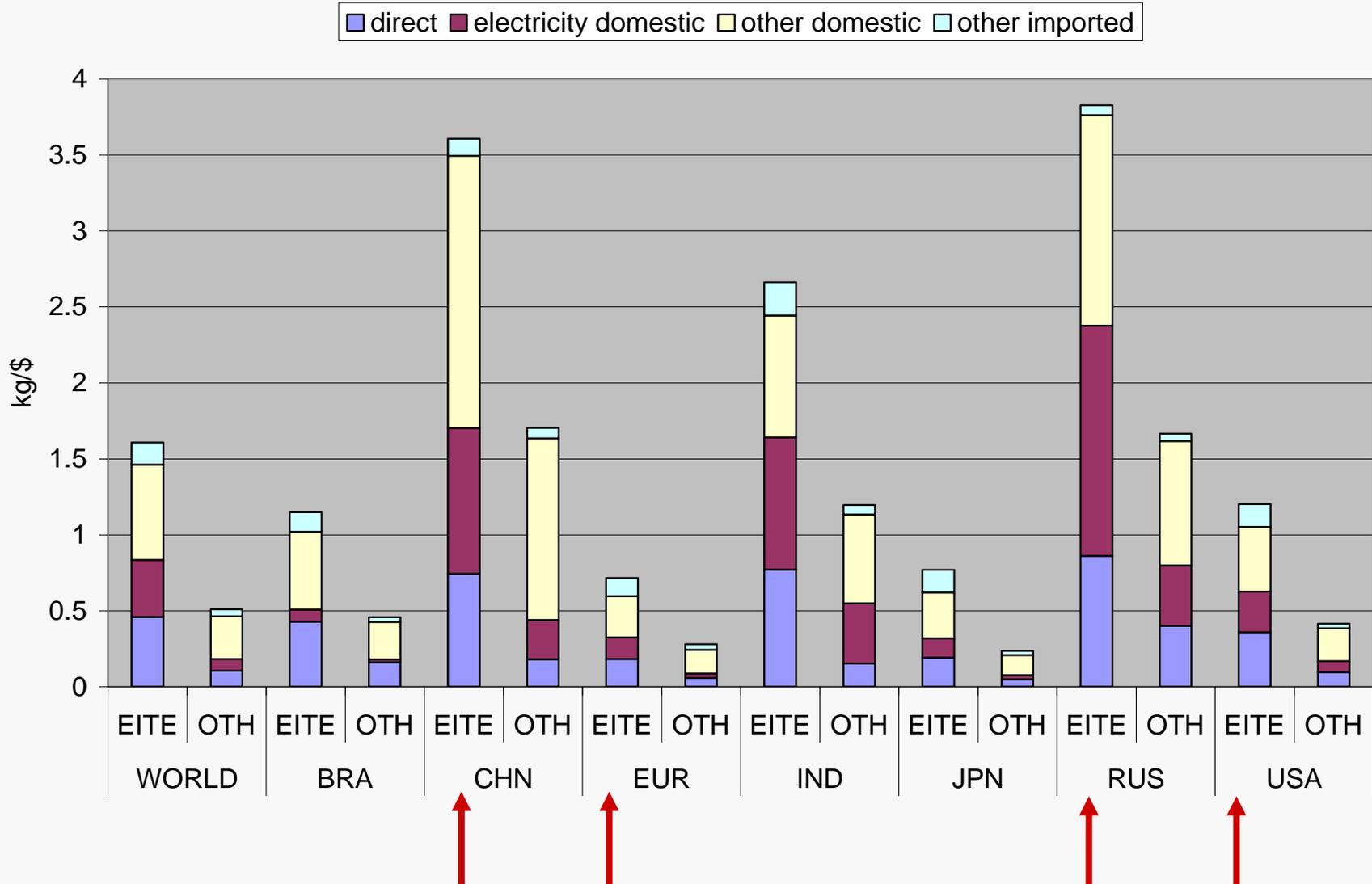
- Strong EITE lobbyists in regulated countries
- Import tariffs may increase countries' incentives to join coalition
- North-south distributional perspective (also in WTO)
- Risk trade wars or harm climate negotiations

# 54 scenarios for import tariff design

- compared to a reference with emission pricing, only (permit trade), cap 20%

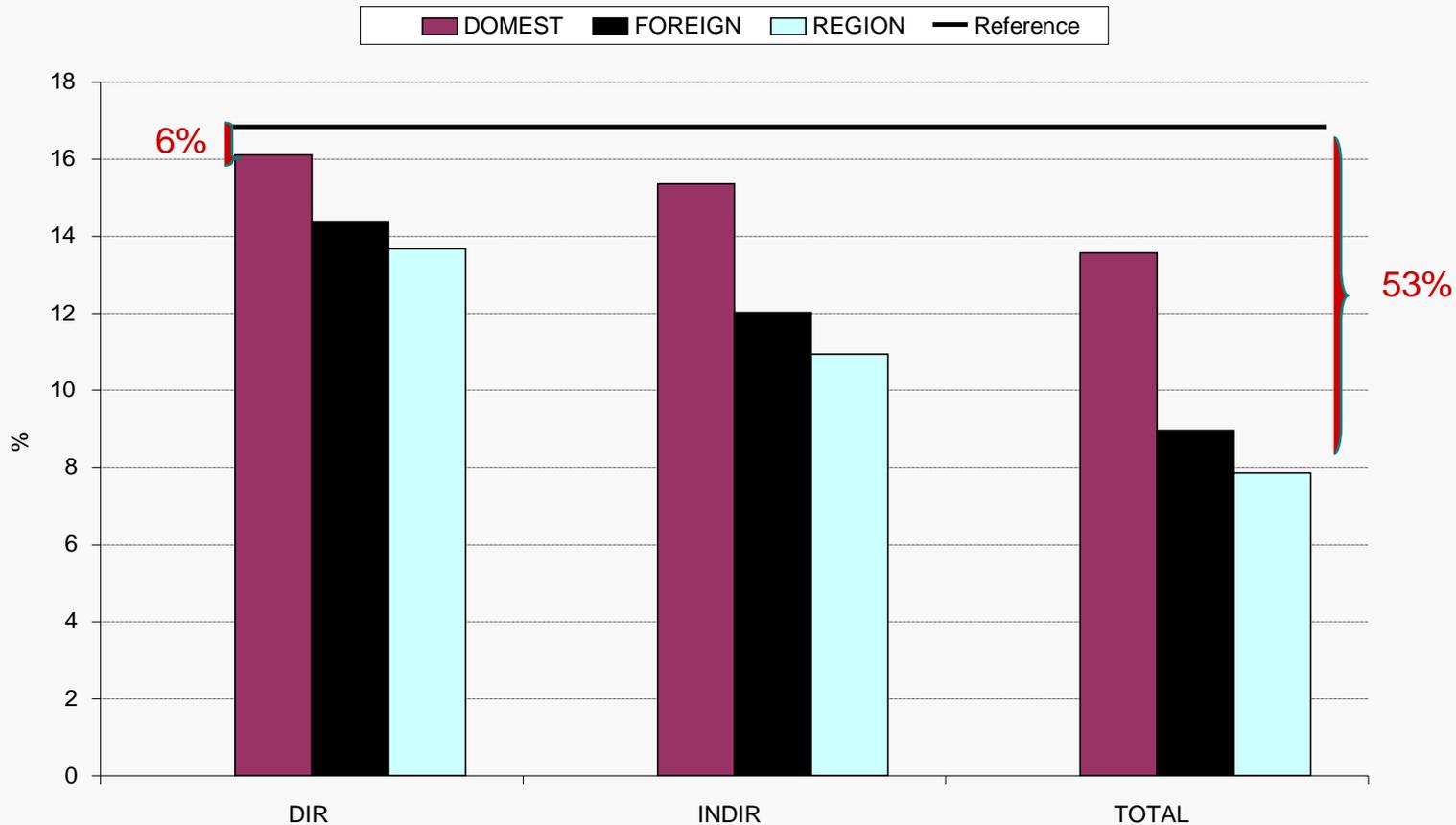
<p><u>TECHNOLOGY BASIS</u> of carbon content (sector-specific in all scenarios)</p> <p><b>REGION:</b> Region/country-specific</p> <p><b>FOREIGN:</b> Average non-coalition</p> <p><b>DOMEST:</b> Average coalition</p>	<p><u>EMBODIMENT</u> of carbon metric</p> <p><b>TOTAL:</b> Fully embodied (input/output-corr)</p> <p><b>INDIR:</b> Direct plus electricity</p> <p><b>DIR:</b> Direct emissions only</p>
<p><u>Coverage of products:</u></p> <p><b>EITE</b> sectors (chem, min, metals)</p> <p>All sectors</p>	<p><u>Coalitions:</u></p> <p><b>EU</b></p> <p>A1 (Annex 1 excl. Russia)</p> <p><b>CHI</b> = A1 + China</p>

# Embodied carbon in selected regions



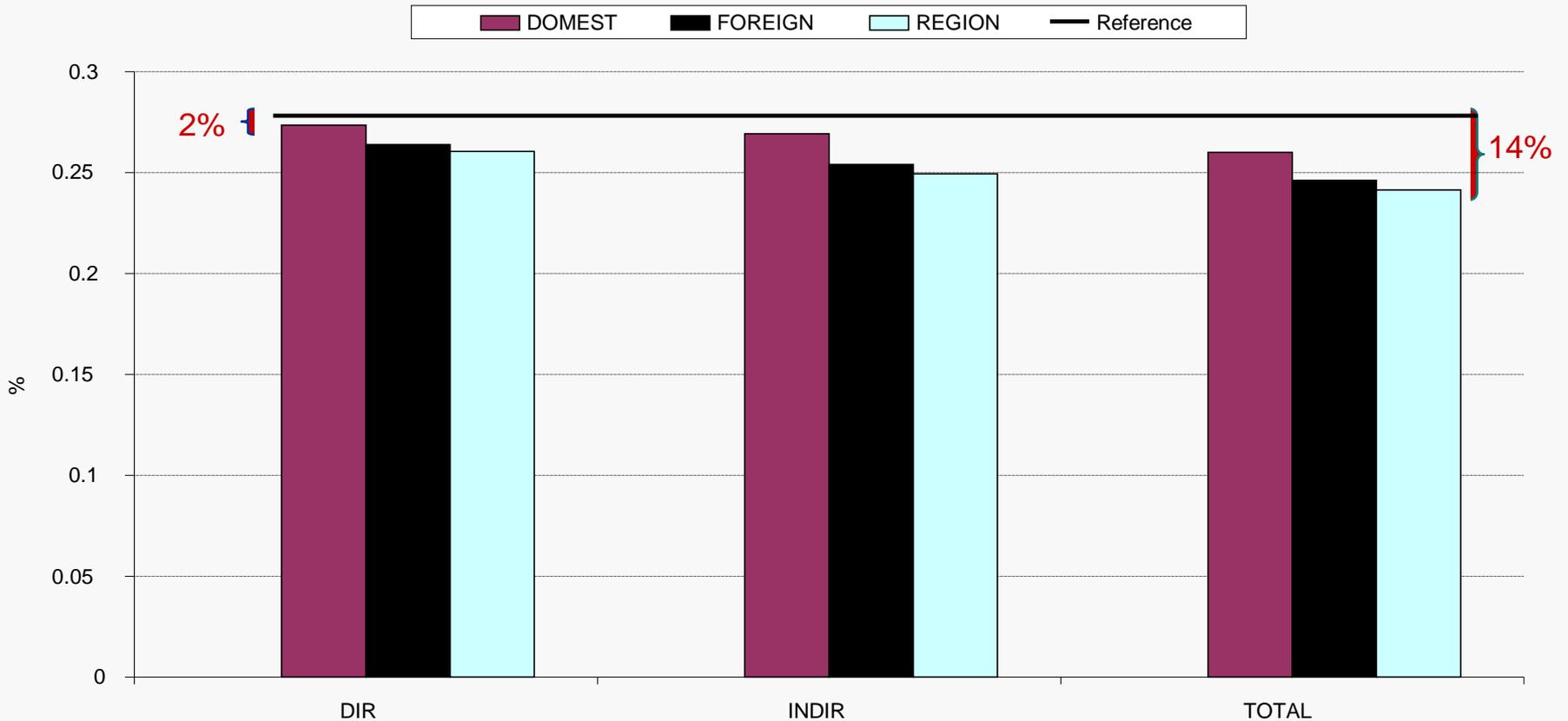
# Effects on carbon leakage

- Reference: The EU cuts 20% (allowance scheme)
- Carbon tariff on EITE (and adjusted EU-cap to maintain global emissions as in ref)



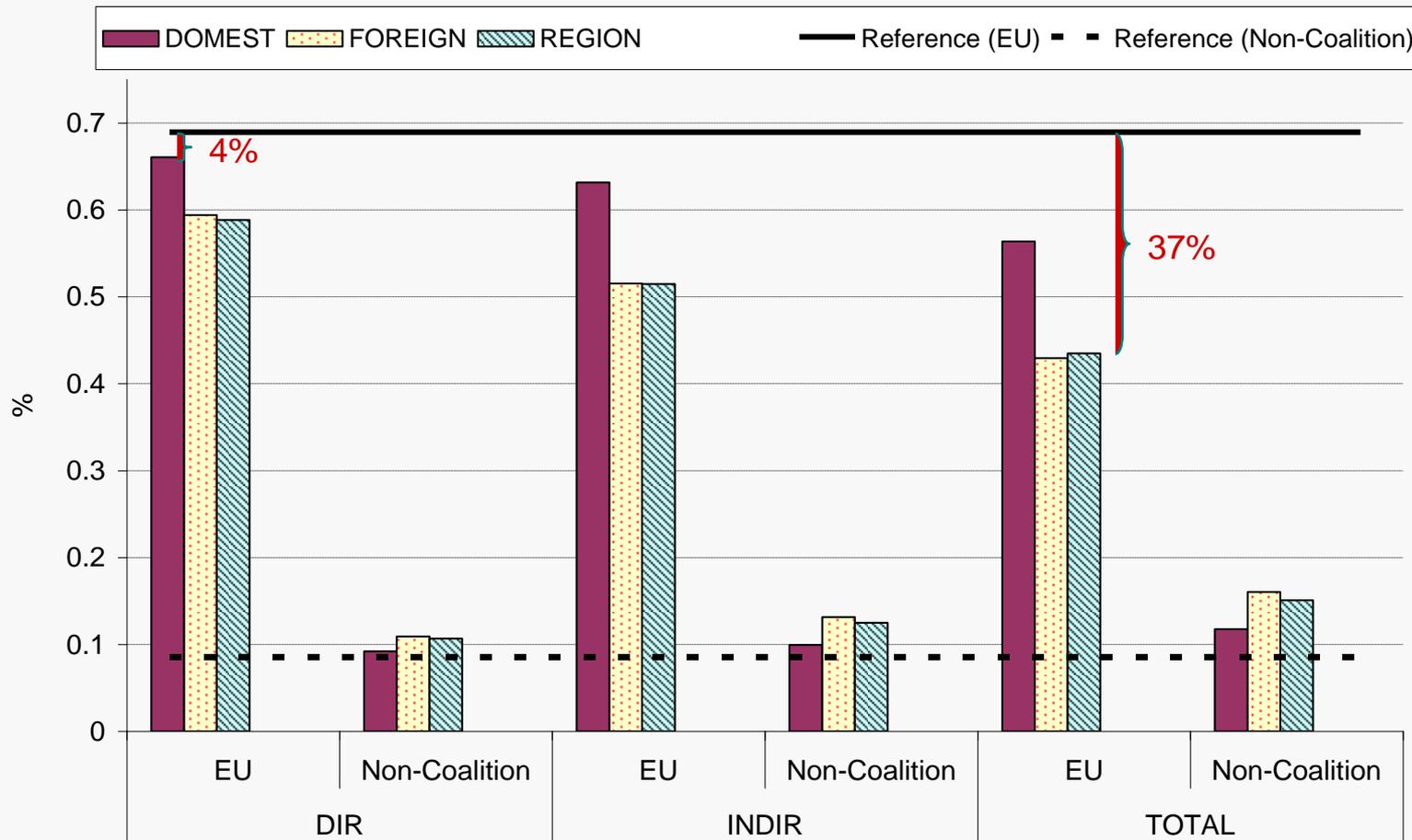
# Global welfare costs

- Reference: The EU cuts 20%
- Carbon tariff on EITE (and adjusted EU-cap to maintain global emissions as in ref)



# Distribution: Welfare costs of EU and non-EU

- Reference: The EU cuts 20%
- Carbon tariff on EITE (and adjusted EU-cap to maintain global emissions as in ref)



More dramatic for EITE: Can have *net* gain in EU, i.e. lost competitiveness in ROW<sub>0</sub>

# Conclusions

## 1) The hypothesis holds:

- The operationalised regimes increase global welfare, and more so the more targeted and comprehensive

## 2) High embodiment and coverage important for effectiveness:

- Input-output correction and *foreign* (average) carbon content info important
- Offsets half of the carbon leakage
- Save 13 % of global costs (20% if all goods)
- Comes at low administration costs? (official data)
- But high legal and political costs.....

## 3) Is the least effective worthwhile?

- legal and distributional costs call for less targeted, domestic carbon content
  - ◆ keeps tariffs low (north-south, trade wars)
  - ◆ avoid product-discrimination (WTO)
- However:
  - ◆ 6 % fall in carbon leakage, only
  - ◆ 2 % of the global costs saved

**Thank you**

[tfn@ssb.no](mailto:tfn@ssb.no)

**Read more:**

SSB DP no. 682

CREE WP no 1/2012

# CARBON LEAKAGE

$$\text{Carbon Leakage (\%)} = \frac{\text{Emission increase in other countries}}{\text{Emission cuts in regulating country}} (100\%)$$

Typical findings in the literature:

- Carbon Leakage of 10 - 30%
- Falling with the size of the coalition

Two main channels:

## **Competitiveness/trade effect:**

Energy-intensive, trade-exposed (EITE) firms in regulated countries move/lose market shares to competitors in non-regulated countries

-> Emissions are relocated (depend on effects on prices, elasticities, emission intensities)

## **Energy market/price effects:**

Lower energy demand in regulated countries reduces world market prices of energy.

-> Energy demand abroad – and emissions - increase (supply responses counteract)

Typical finding: Energy market effect the stronger

Note: Carbon tariffs will only have *direct* influence on competitiveness effect