

Modeling Climate Change Policies Using GTEM

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GTEM Structure: Main Features

GTEM – a CGE model of the world economy

It is

- Multiregional
- Dynamic
- Multisectoral
- Energy focused

GTEM *explicitly* models GHG emissions

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General Equilibrium

- Utility maximisation by households
- Cost minimisation by producers
- Prices determined to ensure supply = demand

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Dynamics in GTEM

GTEM contains the following intertemporal relationships:

- Ongoing input efficiency improvement
- Capital accumulation
 - Returns to capital:
 - Myopic (v1)
 - Rational expectation (v2)
- Debt accumulation
- Population and labor supply changes
- Intertemporal optimisation of quota sales

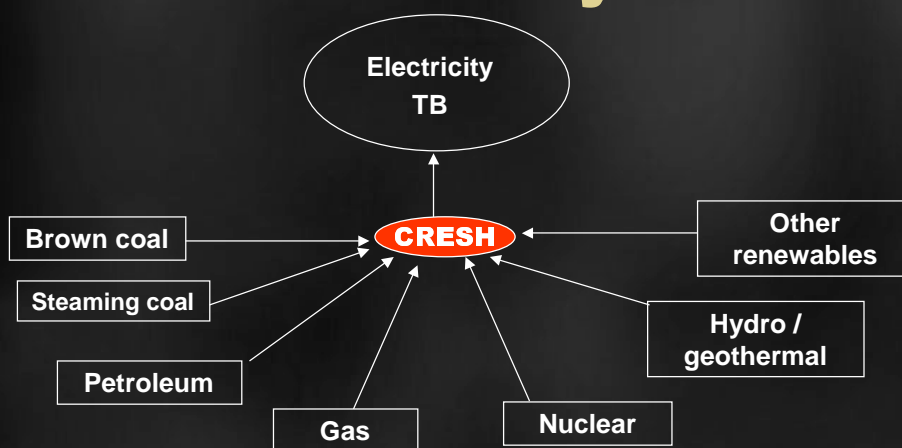
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Types of Production Technologies

- **Technology-bundle**
 - Electricity
 - Iron and steel
- **Conventional energy-factor substitution**
 - All other sectors

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Technology Bundle: Electricity



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GHG Sources

- **Carbon dioxide**
 - Combustion
 - Fugitive
 - Industrial processes
- **Methane and Nitrous Oxide**
 - Livestock and farming
 - Fugitive
 - Transport
 - Chemical industries

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A Possible Kyoto Scenario

- **Targets**
 - Kyoto targets adopted
 - US excluded from emission reductions
 - Tightening targets
- **International quota trading system**
 - CPR
 - Banking (intertemporal optimisation of quota sales)
 - Agriculture emissions excluded
 - Market power (FSU maximises GNP)
- **CDM: (2010 = 42 Mt; 2015 = 66 Mt CO₂-e)**

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Impacts

- **Quota price = Carbon penalty**
- **Change in competitiveness**
 - Emission intensive vs non-emission intensive
 - Annex B vs Non-Annex B
 - Carbon intensive vs Non-carbon intensive energy
 - Domestic abatement vs International abatement

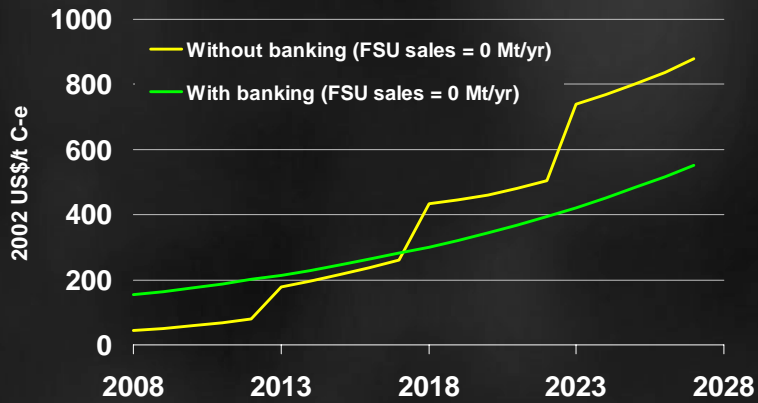
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Overall Impacts

- **Deadweight losses** as industries restructure
- **Trade impacts**
- **Quota revenue transfers**

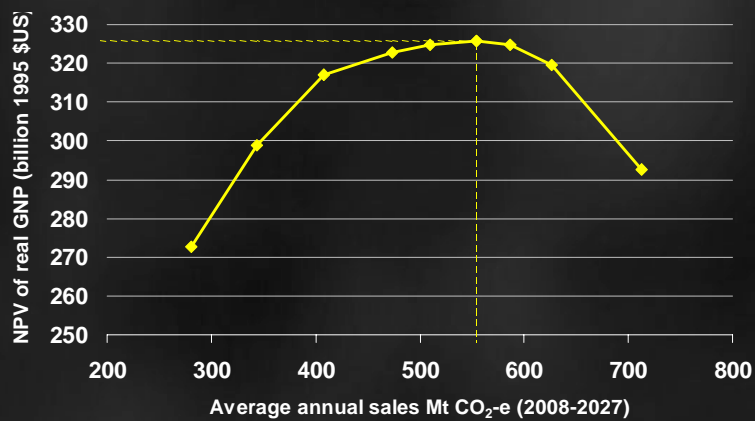
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Global Quota Prices With and Without Banking



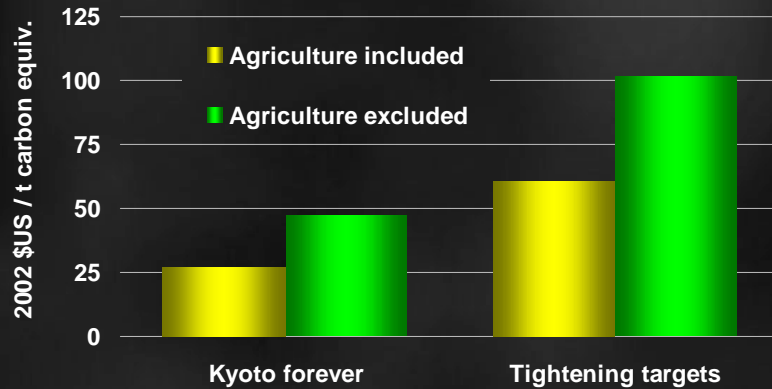
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Projected Russian Federation and the Ukraine GNP Under Different Quota Sales



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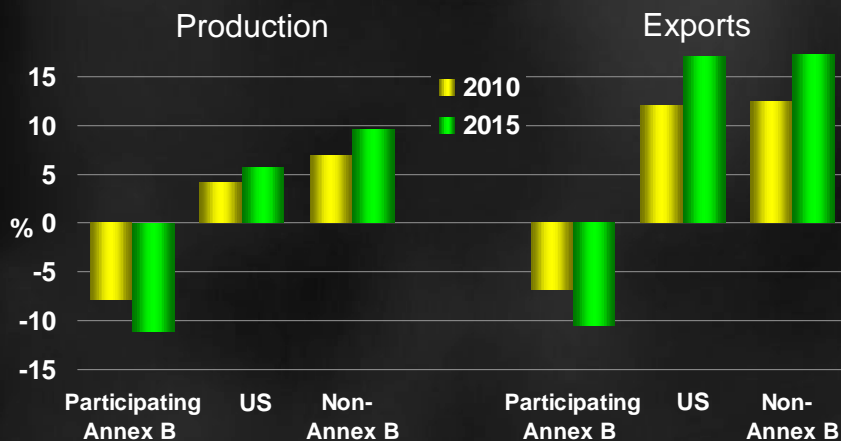
Global Quota Prices Under Different Policy Assumptions



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Change in primary aluminium production and exports Under tightening abatement targets

relative to the reference case



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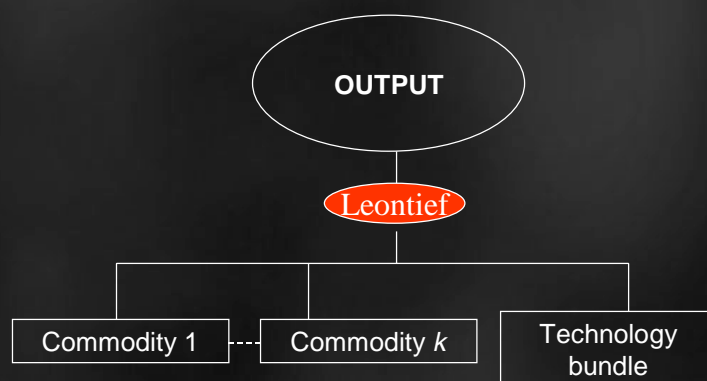
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Technology-Bundle Industries: Key Assumptions

- TB industries minimise production costs choosing a mix of *known* technologies
- Inputs in each technology used in fixed proportions

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Technology-Bundle Industries



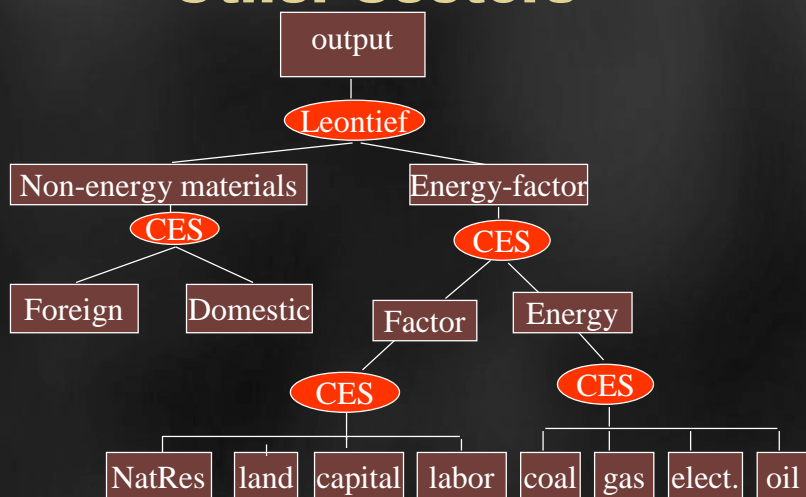
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Conventional Technology: Key Features

- Substitution among primary factors
- Substitution among energy inputs
- Substitution between energy- and factor-composites
- **No** substitution between *non-energy* material inputs and energy-factor composite

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Production Technology: Other Sectors



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