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# *Limited Sectoral Trading between the EU-ETS and China*



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*MIT Joint Program on the Science  
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# Context

By 2030, CO<sub>2</sub> emissions from non-OECD countries would represent 70% of the world emissions.

In these countries, the power sector would represent half of national emissions:

54% in China,

50% in India.

*Source: International Energy Agency (IEA)*

# Context

## Challenge for developing countries

### Development objectives

#### Growing energy demand

(ex: 300 million people without access to electricity in India)

### Climate change mitigation objectives

## Current policies

In the IEA current policies scenario, by 2040:

- China and India national emissions would be more than twice those indicated in the 450 scenario;
- the coal fired power capacity in these countries would be twice what the 450 scenario suggests.

# Context – The Clean Development Mechanism

- Involvement of developing countries in carbon markets through the Clean Development Mechanism (CDM)
  - Credits issued by the CDM board
  - For projects undertaken in developing countries
  - Under specific conditions (additionality...)
- Limited coverage (project-based mechanism)
- Environmental benefits have been questioned

# Context – New Market Mechanisms



- Sectoral trading/sectoral crediting
  - IEA papers
  - Discussions by Öko-Institut, International Chamber of Commerce, World Resources Institute, Center for Clean Air Policy
  - Discussions within the United Nations Framework Convention on Climate Change (UNFCCC)

*\*EU-ETS: European Union Emissions Trading Scheme*

# Context – New Market Mechanisms



- Previous research results (Hamdi-Cherif, Guivarch and Quirion, 2010; Gavard, Winchester, Jacoby, and Paltsev, 2011)
  - Mechanism that takes advantage of cheap abatement opportunities in developing countries : less low-carbon technologies deployment in Europe, more in China
  - Reduction in the overall cost of emissions reduction
  - Carbon price equalization between the regions involved
  - Welfare benefit for the industrialized country involved but welfare loss for the developing country.

# Context – Limited Sectoral Trading

If sectoral trading is used without any limit between the EU-ETS and Chinese or Indian electricity sector, several drawbacks:

- Decrease of the EU carbon price by more than 75%
- Partial reversal of the changes in the EU electricity sector under the EU-ETS
- Welfare loss for the developing country involved.

→ Limit on the amount of permits that can be traded

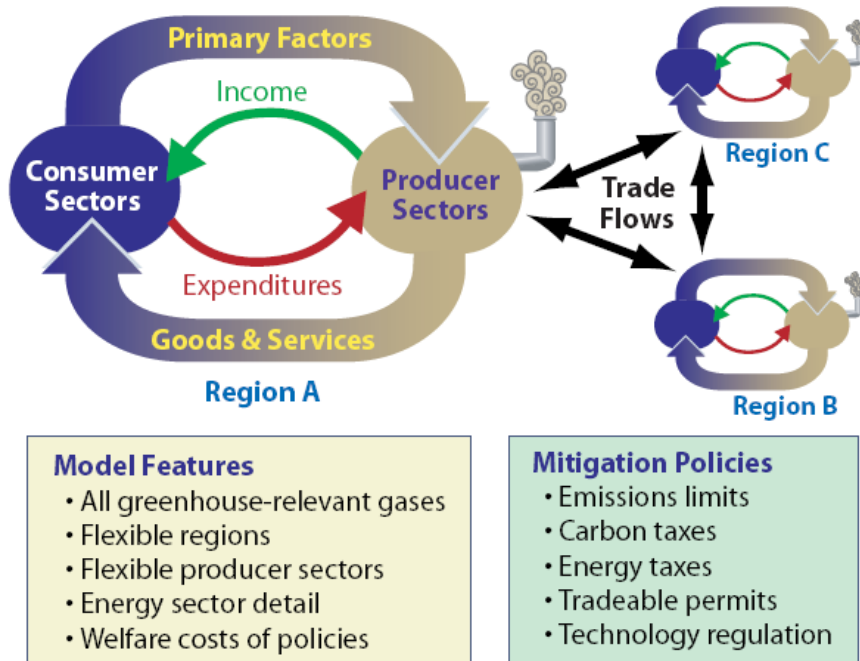
# Purpose of this Work

- Model limited sectoral trading
- Quantify the impacts to expect from limited sectoral trading between the EU-ETS and Chinese electricity sector on:
  - Emissions and volume of permits transferred
  - Carbon price in the two regions
  - Electricity generation
  - Carbon leakages and global emissions reductions
  - Welfare in each region involved



# Method – EPPA Model

## MIT Emissions Prediction and Policy Analysis (EPPA) Model



**Figure 2.** The circular flow of goods and resources in EPPA.

### Regions in EPPA 5

- United States (USA)
- Canada (CAN)
- Japan (JPN)
- Australia-New Zealand (ANZ)
- Europe (EUR)
- Mexico (MEX)
- Europe and Central Asia (ROE)
- Russia (RUS)
- East Asia (ASI)
- China (CHN)
- India (IND)
- Brazil (BRA)
- Africa (AFR)
- Middle East (MES)
- Rest of Latin America (LAM)
- Rest of Asia (REA)

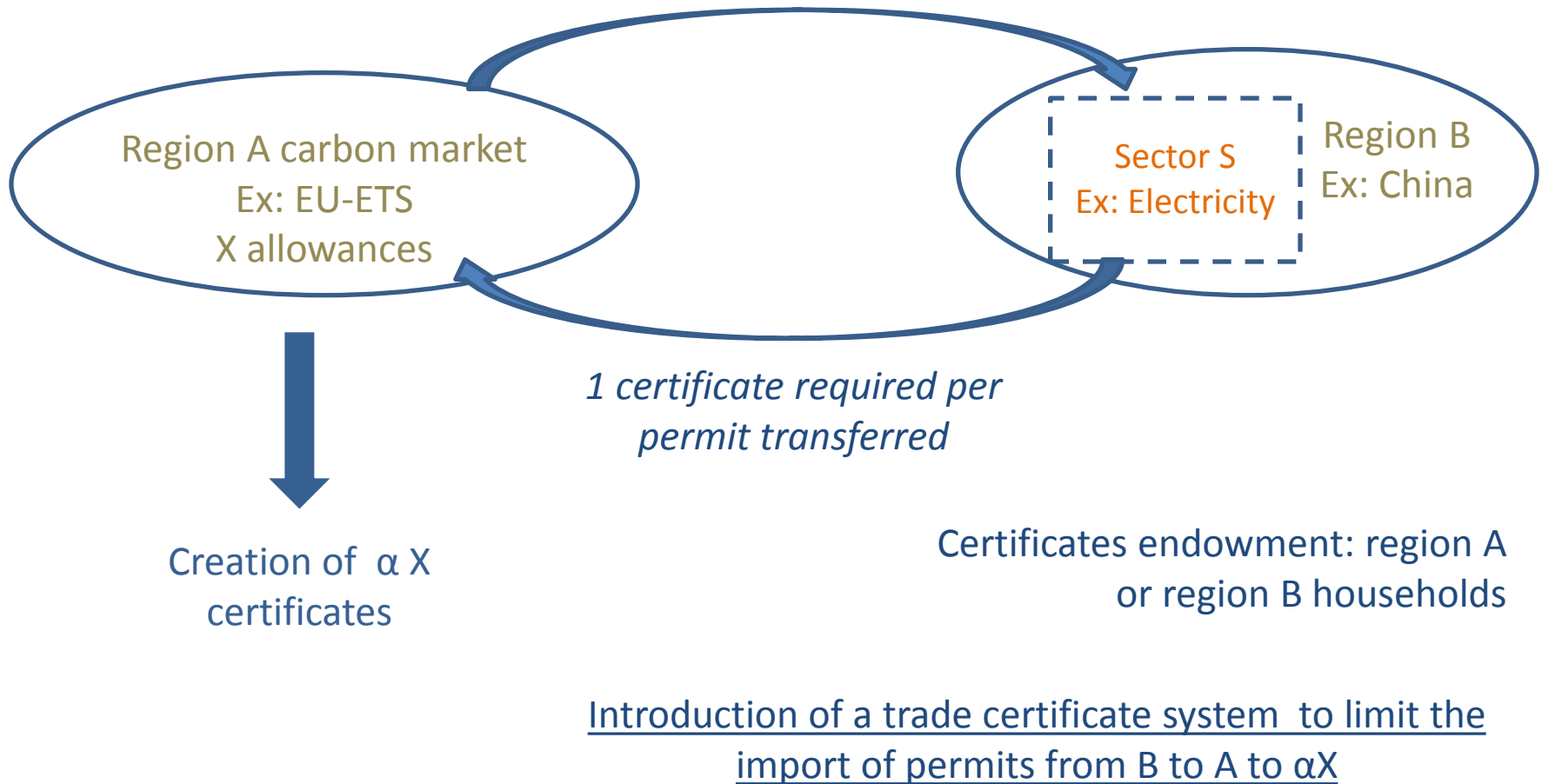
### Sectors in EPPA 5

- Agriculture – crops (CROP)
- Agriculture – livestock (LIVE)
- Agriculture – forestry (FORS)
- Food product (FOOD)
- Energy-intensive Industries (EINT)
- Transport (TRAN)
- Services (SERV)
- Other Industries (OTHR)
- Coal (COAL)
- Crude Oil (OIL)
- Refined Oil (ROIL)
- Gas (GAS)
- Electricity (ELEC)

### Electricity Generation

- Coal
- Gas
- Refined Oil
- Hydro
- Nuclear
- Wind and Solar
- Biomass
- NGCC
- NGCC-CCS
- IGCC-CCS

# Method – Implementation of Limited Sectoral Trading



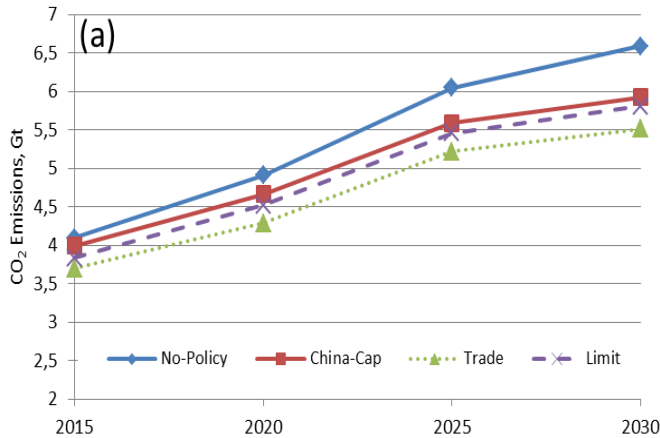
# Scenarios and Implementation

- Scenarios
  - **No-Policy**
  - **EU ETS:** 7,7 billion tons reductions between 2005 and 2030, on electricity and energy intensive sectors
  - **China-Cap:** 10 % emissions reduction target for the Chinese electricity sector by 2030
  - **Trade:** Unlimited sectoral trading between the EU-ETS and Chinese electricity sector from 2015.
  - **Limit:** Limited sectoral trading between the EU-ETS and Chinese electricity sector from 2015;  $\alpha = 0,1$
  - Alternative scenarios: **Limit**  $\alpha = 0,05$ ,  $\alpha = 0,15$ ,  $\alpha = 0,2$
- CO<sub>2</sub> only

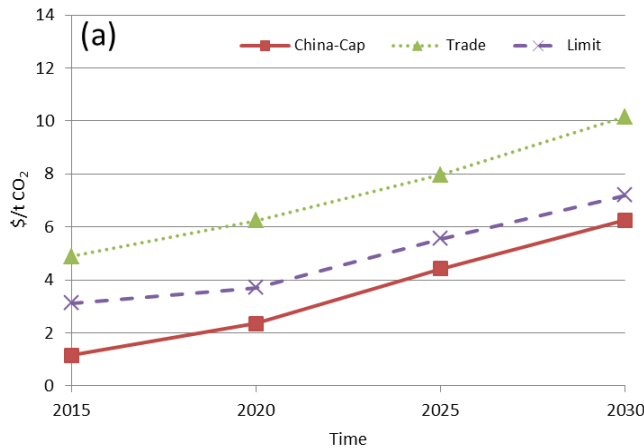
# Emissions and Carbon Price

In the Chinese electricity sector

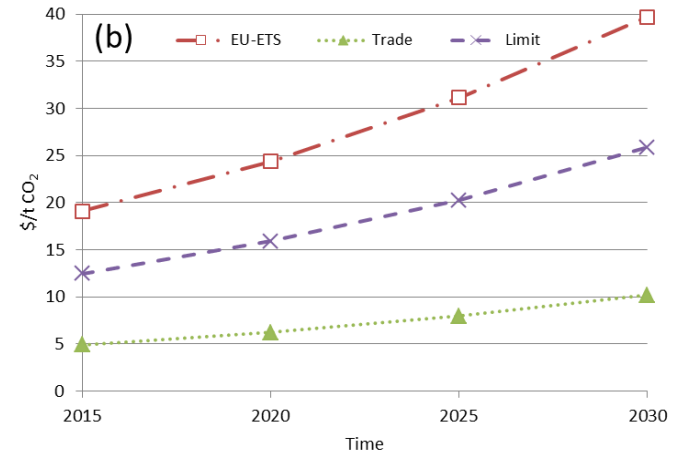
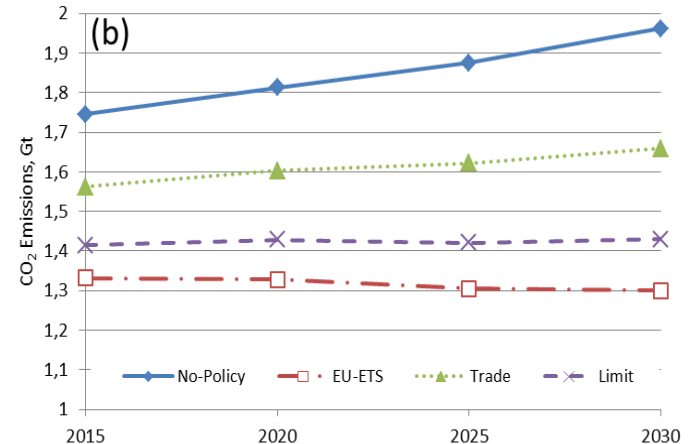
CO<sub>2</sub> Emissions, Gt



Carbon Price, \$/t



In the EU ETS sectors



# Carbon Prices and Volume of Permits transferred in 2030 as a function of the limit $\alpha$

	Volume of Permits Transferred (Mt CO <sub>2</sub> )	Chinese Carbon Price (\$/t)	EU Carbon Price (\$/t)
China-Cap	-	6,24	-
EU-ETS	-	-	39,7
Limit $\alpha=0,05$	57	6,78	31,4
Limit $\alpha=0,1$	113	7,2	25,9
Limit $\alpha=0,15$	170	7,62	20,3
Limit $\alpha=0,2$	228	8,05	15,7
Trade	410	10,2	10,2

# Electricity Generation in China and Europe

- In China
  - In the **Trade** and **Limit** scenarios:
    - Electricity price increases.
    - Substitution towards coal in the rest of the Chinese economy.
    - Limited impact on nuclear and renewable energies: emissions reduction achieved through efficiency improvement and energy saving.
- In Europe
  - In the **Trade** scenario
    - Most of the changes induced by the EU-ETS are reversed.
  - In the **Limit** scenario
    - This effect is reduced.

# Welfare Analysis and Carbon Leakage

- Welfare
  - If the certificate rent is allocated to the developing country's households, it is possible to find a limit for which both regions involved are better off.
  - In our simulation, this is achieved for a limit of 5 to 10%.
- Carbon leakage
  - Less carbon leakage with limited sectoral trading than with unlimited sectoral trading → More global emissions reductions

# Conclusion

- Sectoral trading mechanism would allow some emerging economies to get involved in the carbon markets of some industrialized countries.
- Way to take advantage of cheap abatement opportunities in developing countries and achieve more emissions reductions globally.
- A limit on the amounts of carbon permits traded can make both regions involved better off compared to the case for which they have their own constraints and no trading is allowed.
- Then, limited impact on the carbon price and power sector in OECD countries and total carbon leakages are reduced.
- Potential candidates ?
  - Interest in India to replace the CDM and support existing renewable energy and energy efficiency programs?



# Thank you for your attention!

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*This work was done while C. Gavard was completing her PhD at the Centre d'Economie de la Sorbonne, Paris 1 Panthéon-Sorbonne University, Paris School of Economics and visiting the MIT Joint Program on the Science and Policy of Global Change. It benefited from comments by J. Chevallier, H. D. Jacoby, K. Millock, P. Quirion, L. Ragot, and K. Schubert.*