

# FROM KYOTO TO COPENHAGEN: MEETING THE CLIMATE-CHANGE CHALLENGE

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**Beyond the Three Pillars: The New Agenda in Agri-Food Trade**  
**Joint Workshop: CAES and CATPRN**  
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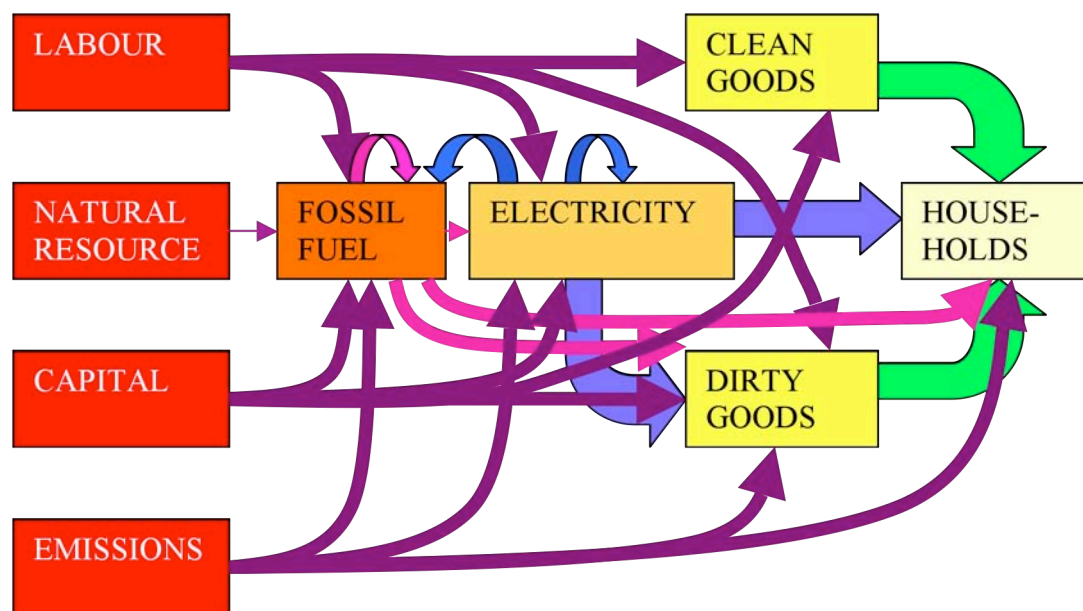


Figure: Julia Sagidova

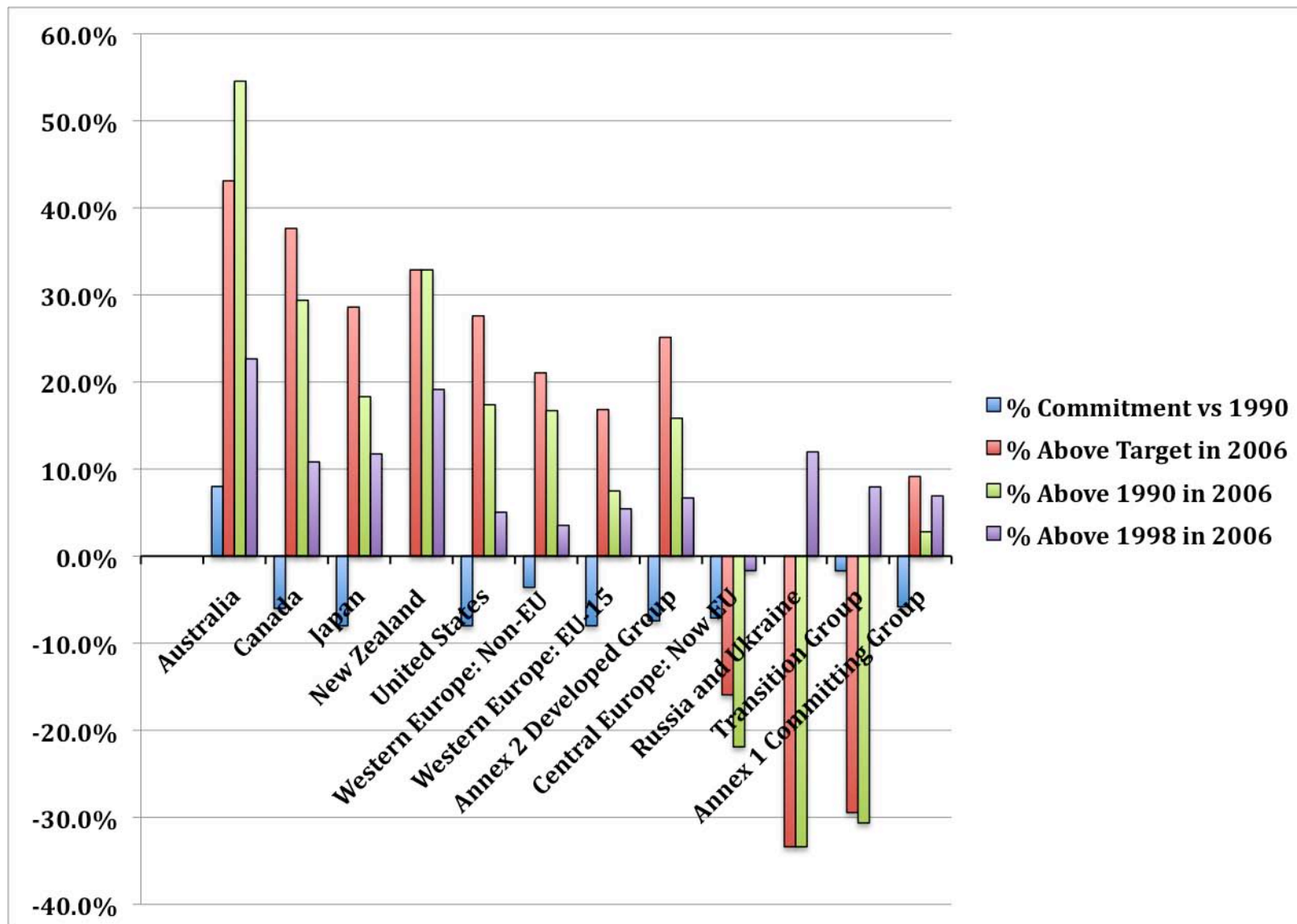
## Copenhagen Constraints arising from the Kyoto Quagmire

**Question 1:** Are Developed Countries are on track to meet their Kyoto commitments for GHG emission reductions?

**Issue:** Credibility of GHG emission cuts is in question.

- If Developed Countries have struggled to meet their Kyoto commitments, then any new GHG emission reduction commitments made in Copenhagen appear problematic.

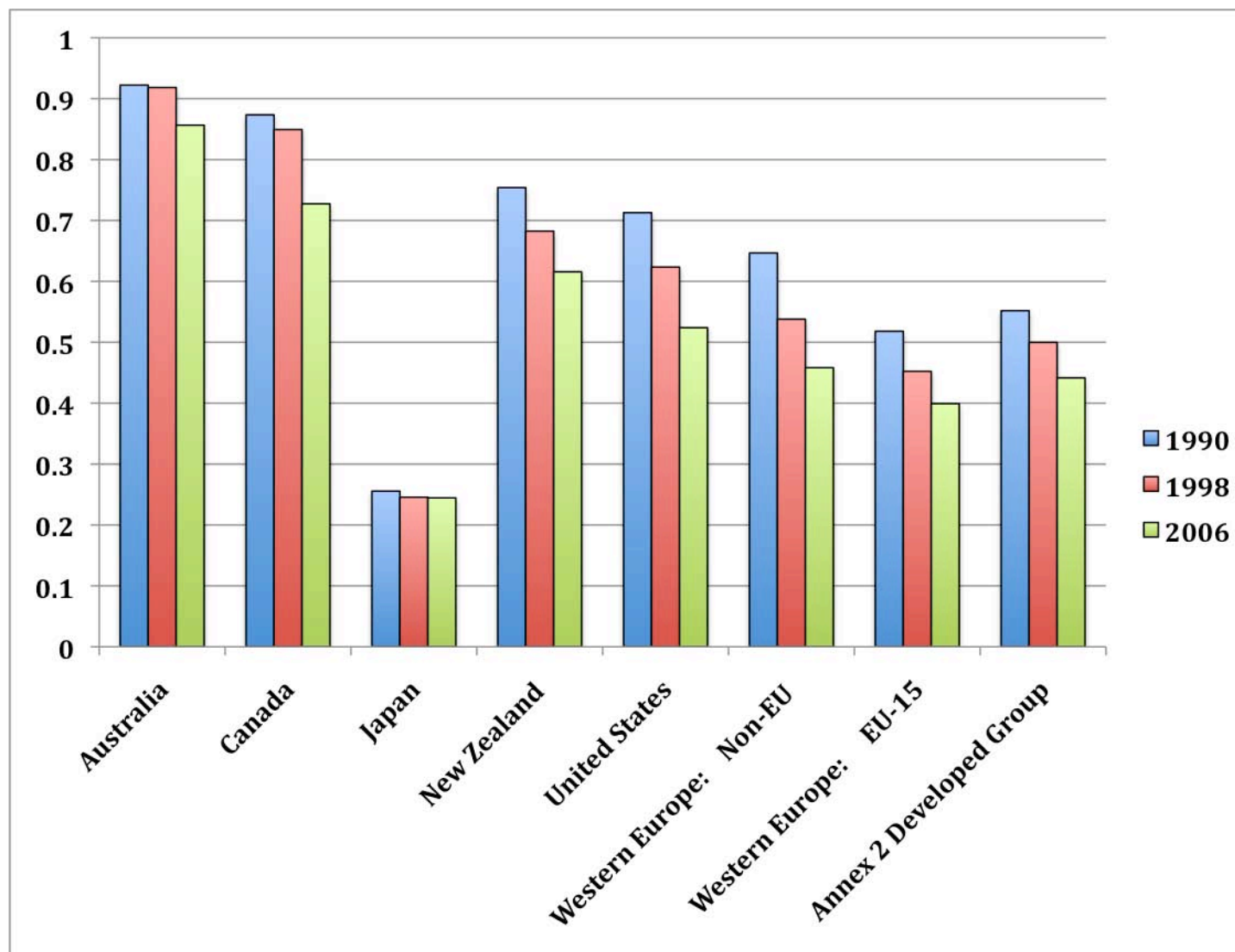
## Committing Group: Carbon Dioxide Emission Increases (%)



Data Source: US Energy Information Administration.

## Annex 2 Developed Group: Carbon Dioxide Intensities

(Kg of CO<sub>2</sub> per Real (2000) USD of GDP)



Data Sources: US Energy Information Administration; World Bank, World Development Indicators.

**Question 2:** Have the Developing Countries held the line on their GHG emissions?

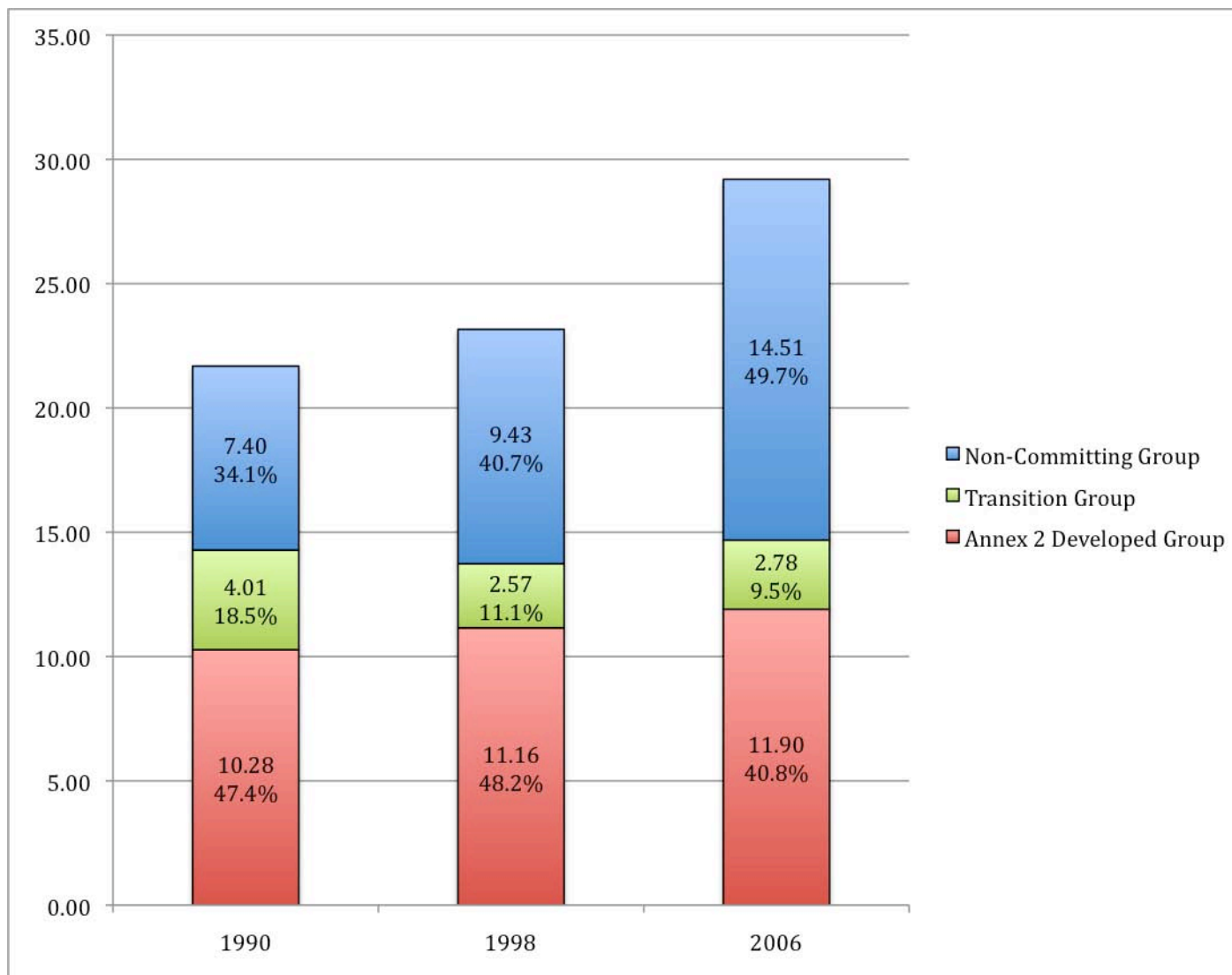
**Issues:** Developed Countries cuts alone may no longer be an effective option.

- If Developing Countries account now account for a large fraction of world GHG emissions, then significantly reducing those emissions would require their participation.

CO<sub>2</sub> leakage or arising from trade could partially or fully **nullify** any GHG reductions.

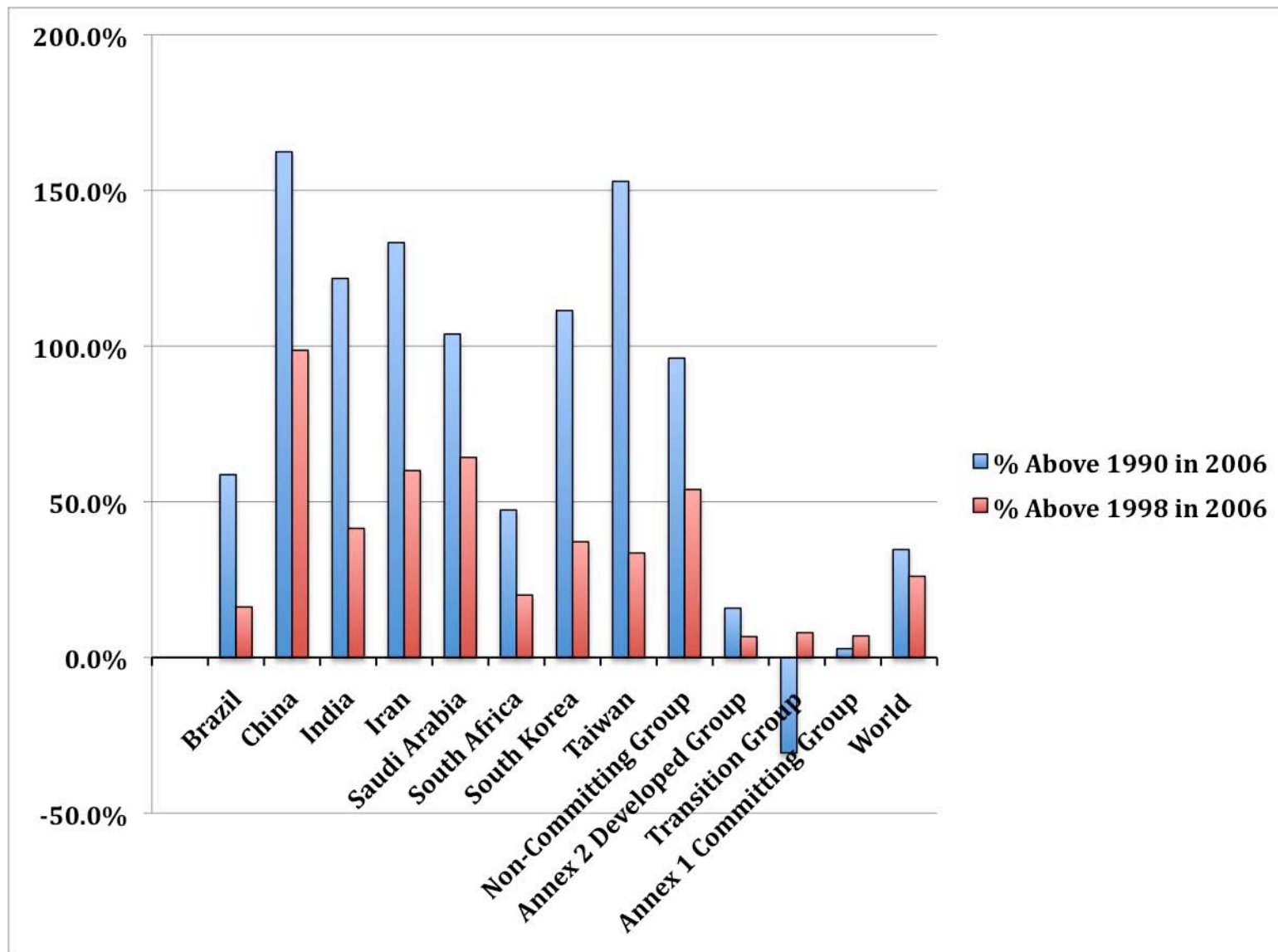
- If Developing Countries do not have effective limits on GHG emissions, then as Developed Countries reduce their emissions, the production of the “dirtiest” goods may be shifted to Developing Countries in a trading world.

## World Distribution of Carbon Dioxide Emission (Billion Metric Tons CO<sub>2</sub>)



**Data Source:** US Energy Information Administration.

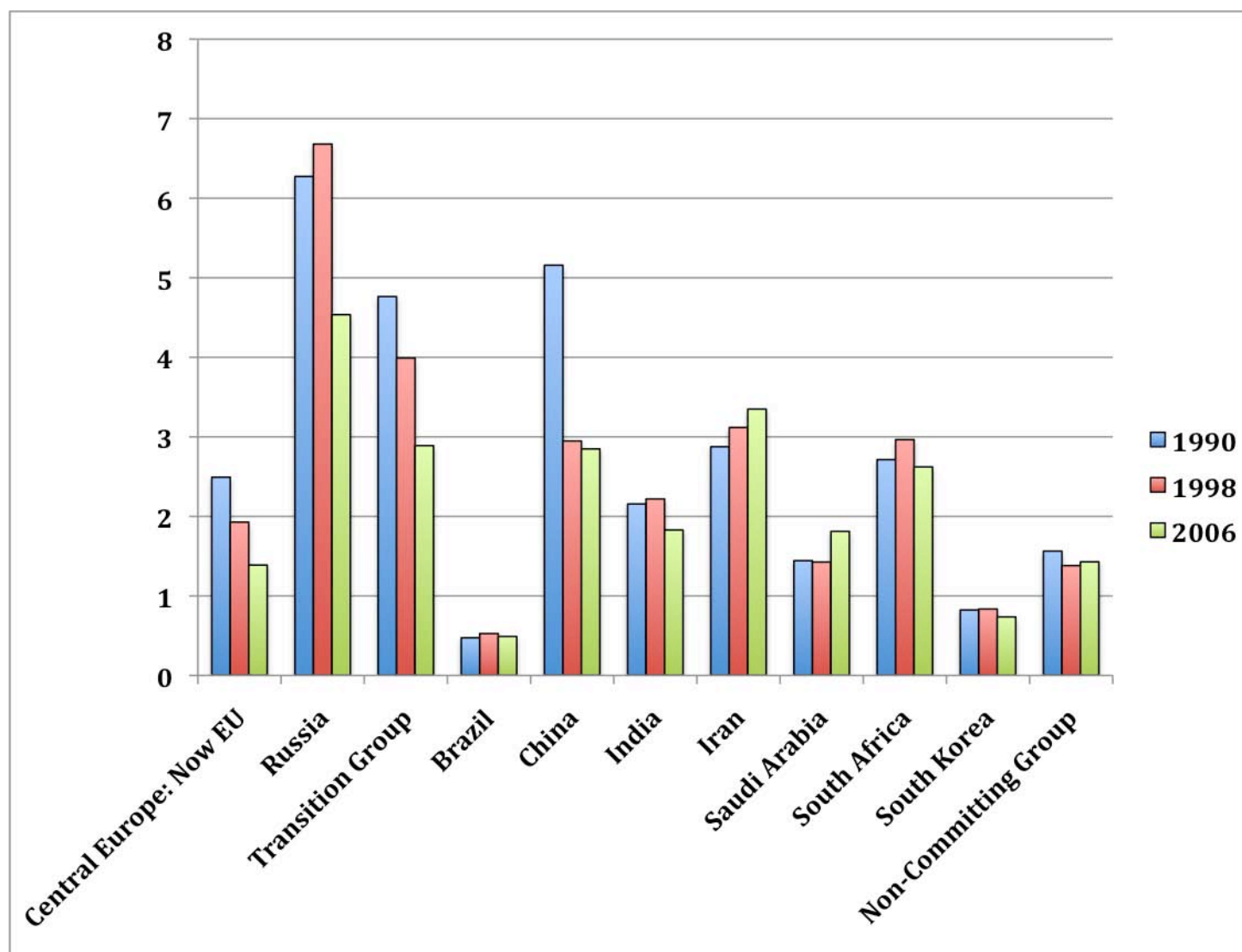
## Non-Committing Group: Carbon Dioxide Emission Increases (%)



Data Source: US, Energy Information Administration.

## Transition and Non-Committing Groups: Carbon Dioxide Intensities

(Kg of CO<sub>2</sub> per Real (2000) USD of GDP)



Data Sources: US Energy Information Administration; World Bank, World Development Indicators.



**Question 3:** Are Developing Countries “dirtier” than Developed Countries or do they just produce a “dirtier” mix of goods?

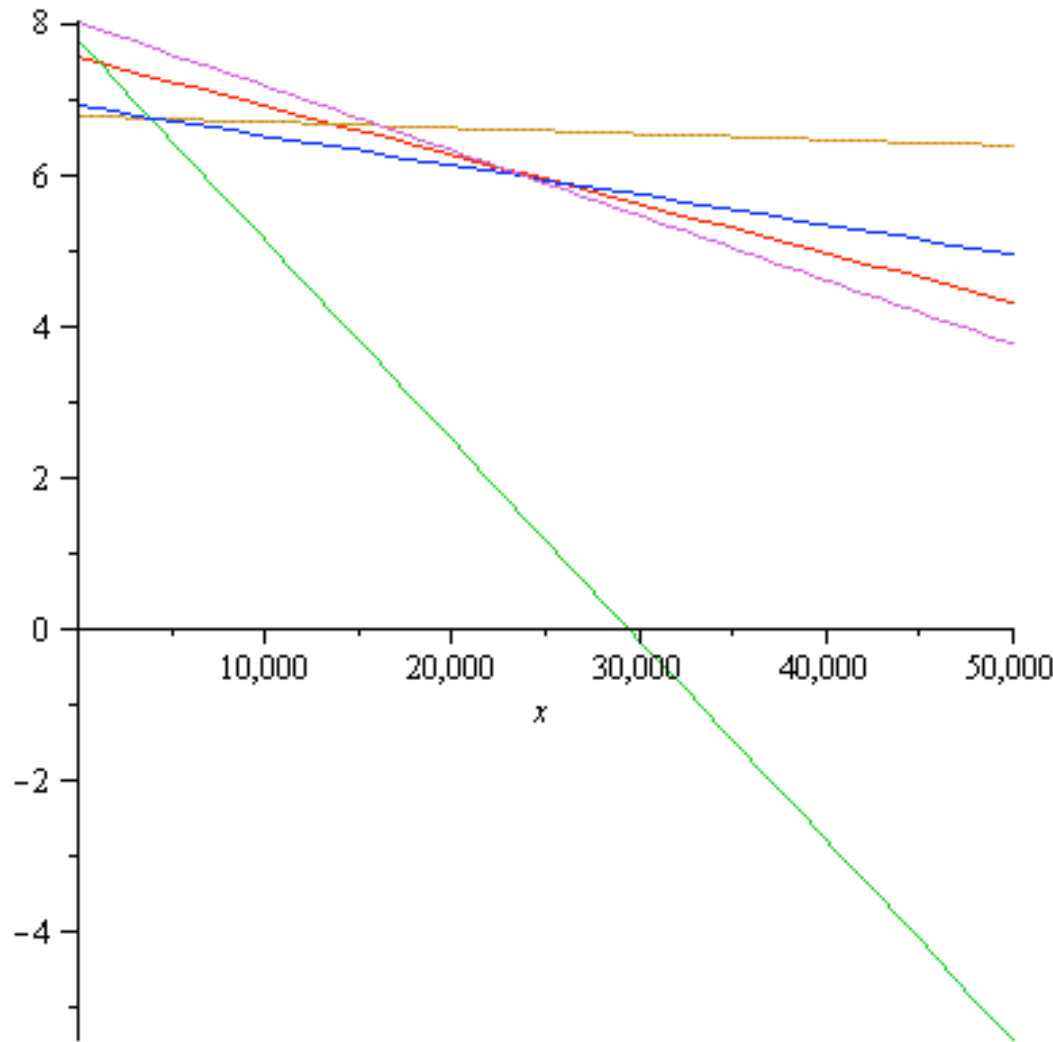
**Issue:** CO<sub>2</sub> leakage arising from trade could **increase** world GHG emissions.

- If like industries in developing countries are significantly dirtier, then for each “dirty” good shifted from a Developed Country to a Developing Country, GHG emissions would increase.
- If world output of “dirty” GHG-intensive goods does not fall, then world emissions could rise.

## Dirtier Versus Cleaner Countries?

(x: PPP GDP Per Capita; versus y: Ln Kg of CO<sub>2</sub> per Real US Dollar)

Regression Results: David Still



Key	
Red	World averages
Green	100% Agriculture
Yellow	100% Services
Blue	100% Other Industry
Purple	100% Manufacturing

## Regression Results

	ln (CO <sub>2</sub> /GDP)	
GDP Per Capita [pc]	-7.96E-05 ***	[0.000]
Agriculture/GDP	-2.48E-03	[0.188]
(Agriculture/GDP) *(GDP Per Capita)	-1.79E-06 **	[0.014]
Services/GDP	-1.25E-02 ***	[0.000]
(Services/GDP) *(GDP Per Capita)	7.75E-07 ***	[0.000]
Other Industry/GDP	-1.11E-02 ***	[0.000]
(Other Industry/GDP) *(GDP Per Capita)	4.61E-07 ***	[0.008]
(Natural Gas/Fossil Fuel)*(GDP Per Capita)	-1.80E-05 **	[0.036]
(Coal/Fossil Fuel)*(GDP Per Capita)	2.00E-06	[0.837]
% Clean Electricity	-4.56E-03 ***	[0.000]
(% Clean Electricity)*(GDP Per Capita)	-4.17E-08	[0.399]
Land Per Capita	-1.04 ***	[0.000]
Constant	8.21 ***	[0.000]
Observations	2376	
Countries	122	
Panel Type	Unbalanced	
Random versus Fixed Effects	Fixed	
R-squared within	0.1426	
R-squared between	0.2599	
R-squared overall	0.2009	

\* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%., Robust p values in brackets.

## TASKS

### 1. Explaining the Data:

- Why are like industries in South “dirtier” or more GHG-intensive than North?

### 2. Probing Further:

- Could slowing emissions growth in the North under the Kyoto Protocol be contributing to increasing emissions in the South?
- Could slowing emissions growth in the North be causing greater growth in world GHG emissions than otherwise would have been the case?

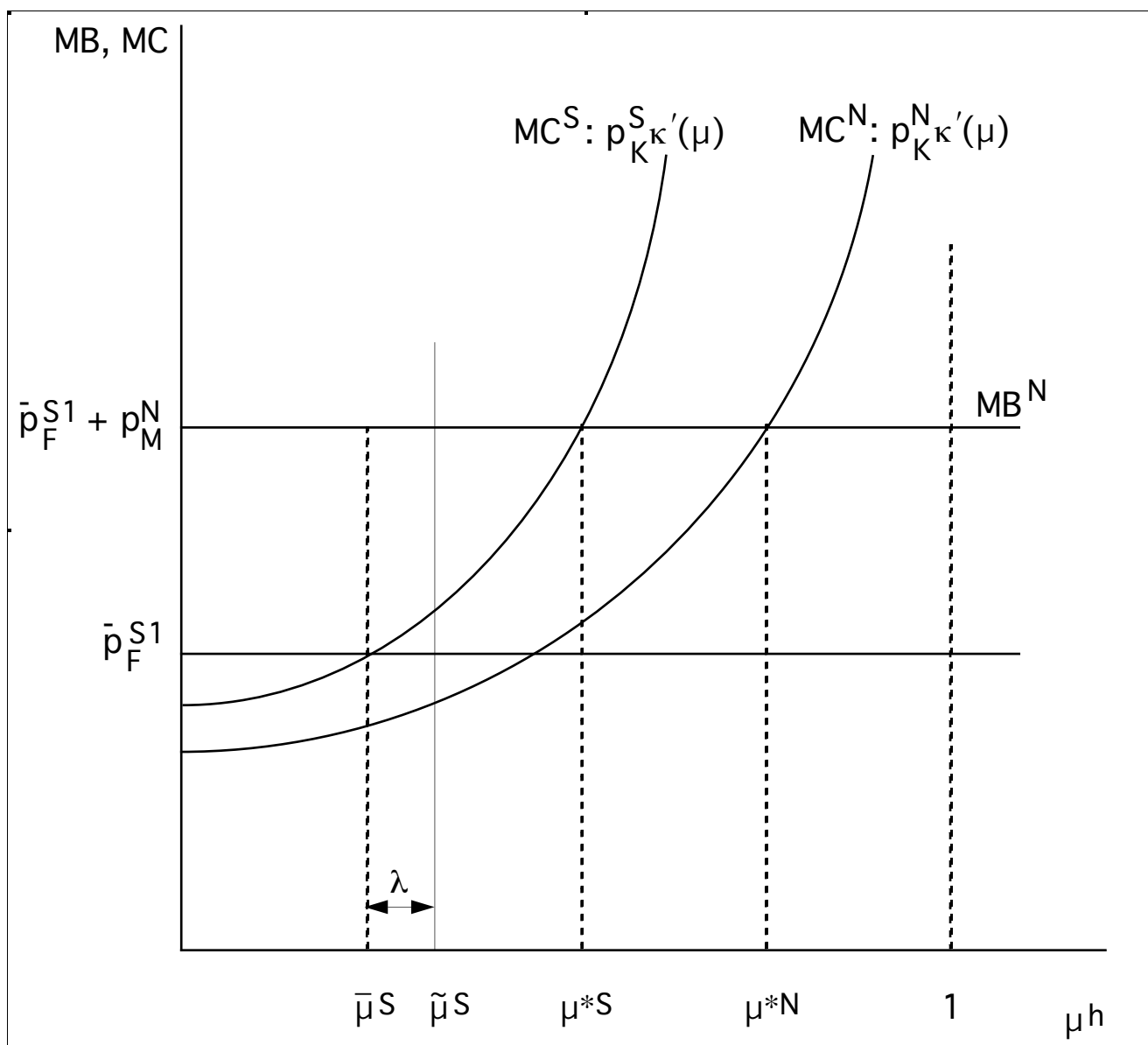
## OUTLINE OF THE BASELINE MODEL

- **GHG emissions arise from fossil fuel use!**
  - ⇒ We focus on fossil-fuel-saving investment rather than abatement.
  - ⇒ Capital-using fuel-saving technologies: increasing total and marginal costs.
- **Four sectors:** Clean Goods, *C*; Dirty Goods, *D*; Electricity, *E*; and Fossil Fuel, *F*.
  - ⇒ Fossil fuel use in consumption by households causes GHG emissions.
  - ⇒ Fossil fuel use in the production of dirty-goods (e.g., heavy industry), electricity (e.g., generation) and fossil-fuel itself (e.g., energy) causes GHG emissions.
  - ⇒ Electricity is consumed by households and used in production as an intermediate input.
  - ⇒ Competitive markets.
  - ⇒ Free trade in clean goods, dirty goods and fossil fuel; electricity is non-tradable.

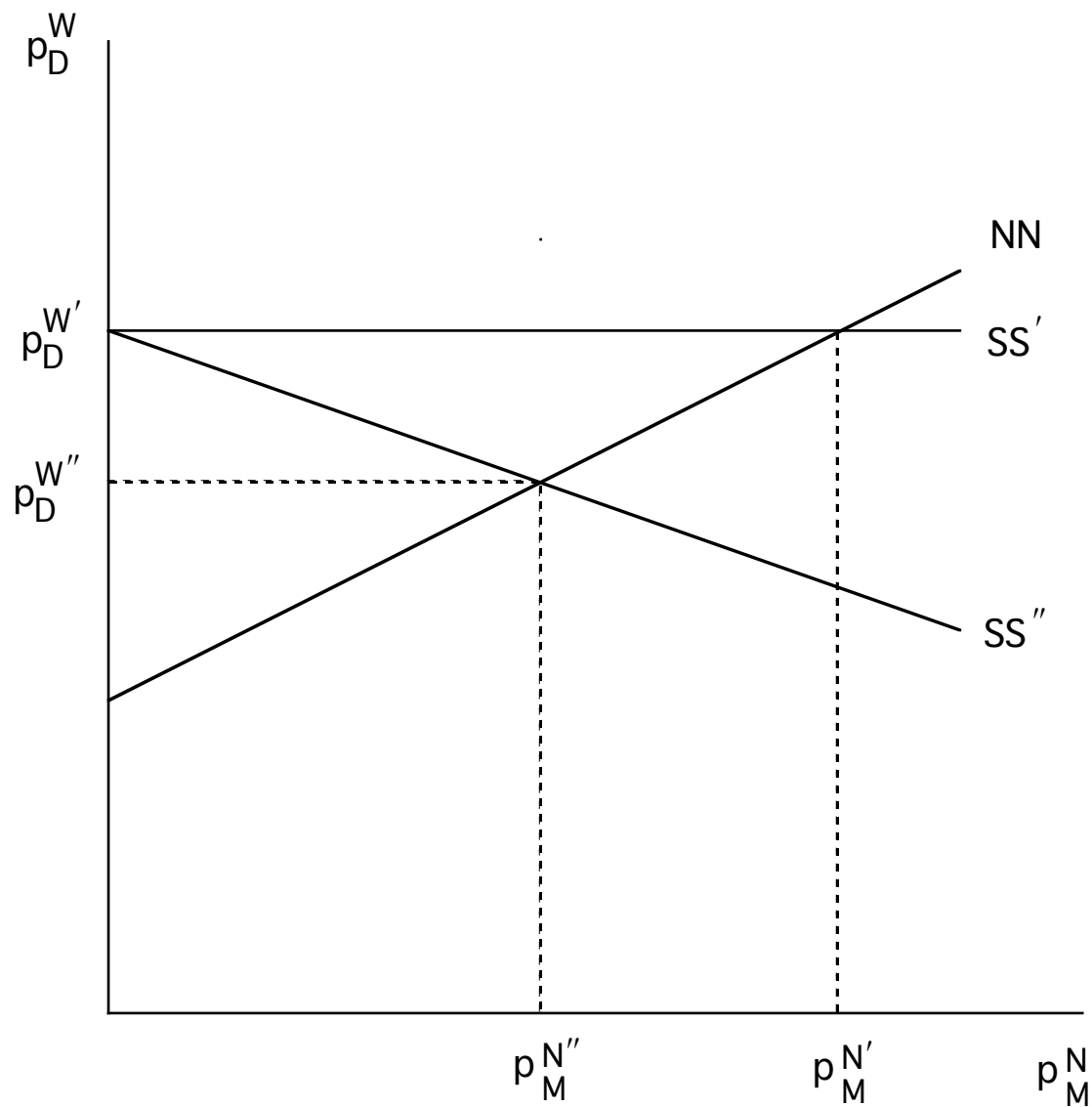
## OUTLINE OF THE BASELINE MODEL (Continued)

- **Two regions:** North,  $N$ , and South,  $S$ .
- **Two sub-regions of South:** OPEC;  $S1$  and Non-OPEC,  $S2$ .
  - ⇒ OPEC sets/resets the world fossil fuel price
  - ⇒ OPEC is like the non-OPEC South in other respects.
  - ⇒ Diversification: All regions/sub-regions produce some dirty and clean goods.
- **Three standard inputs:** Capital,  $K$ ; Labour,  $L$ ; and a Natural Resource,  $R$ .
  - ⇒ Supply of capital is perfectly elastic with:  $p_K^N < p_K^S = p_K^O$ .
  - ⇒ Labour and natural resource endowments are fixed.
  - ⇒ Natural resource is a specific factor: used only in the fossil fuel sector.

### Profit-Maximizing Fuel Saving in North versus South



### Diversified Production in North and South





## IMPACT OF A TIGHTER NORTHERN CAP ON WORLD EMISSIONS

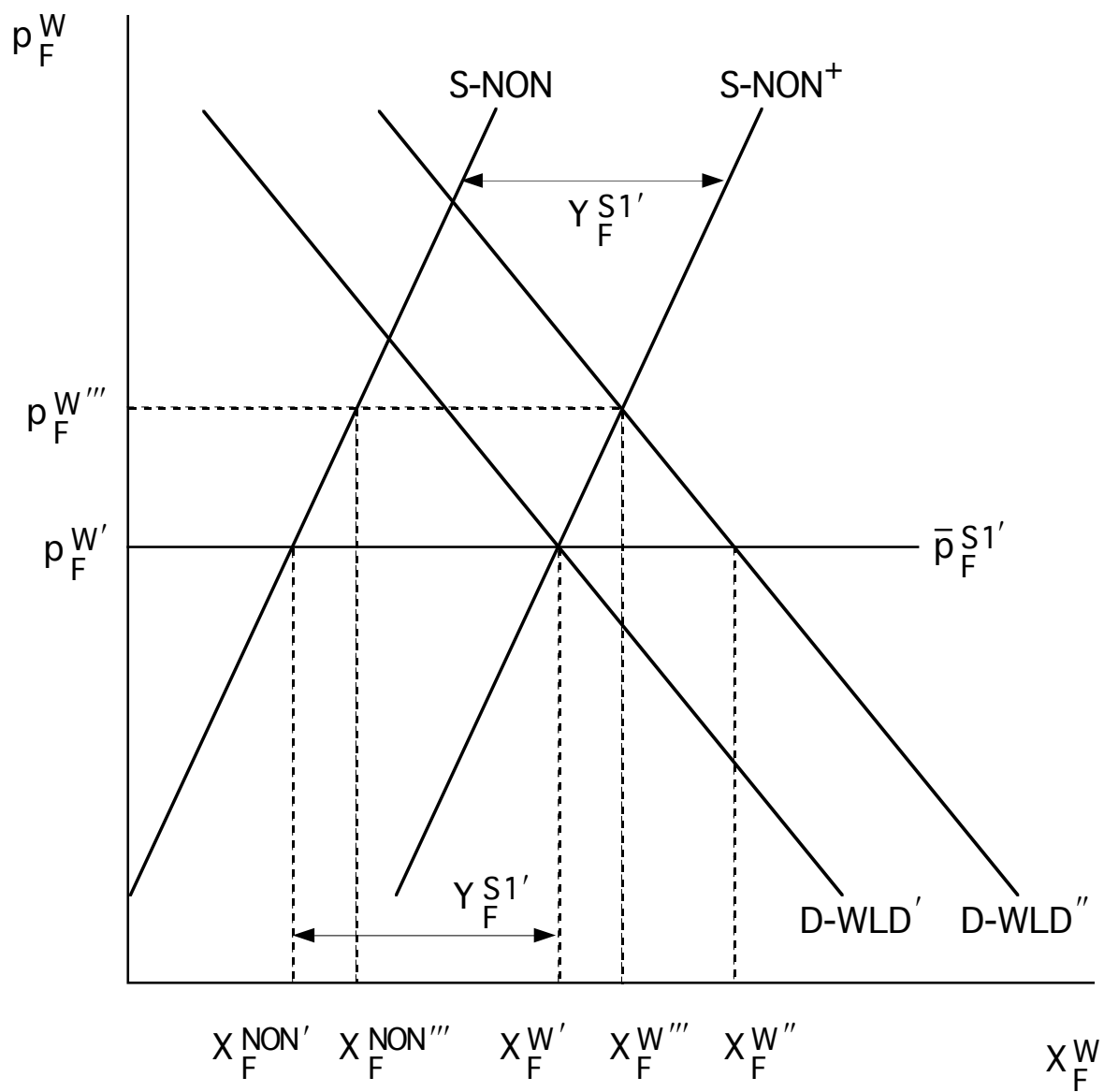
World Emissions change in fixed proportion to world fossil fuel use

### ***Shifts in the World Demand for Fossil Fuel***

- Direct Effect: Increased World Demand
  - Dirty goods shifted from North to South; More fuel saving in North than South!
- Cross Price Effects: None in the baseline model.
- North's (Normal) Income Effect: Reduced World Demand
  - A tighter cap implies reduced income from emission permits in North
  - Demand shift will be small if permit revenue is a small fraction of North's income.
- OPEC's (Normal) Income Effect: Intensified Demand Shift
  - OPEC's income rises if and only if there is a net increase in world demand

***Shifts in the Non-OPEC supply of Fossil Fuel:*** None in the baseline model.

### Impact of a Tighter Northern Cap on World Emissions



## IMPACT OF INCREASING ALLOWABLE CREDITS ON WORLD EMISSIONS

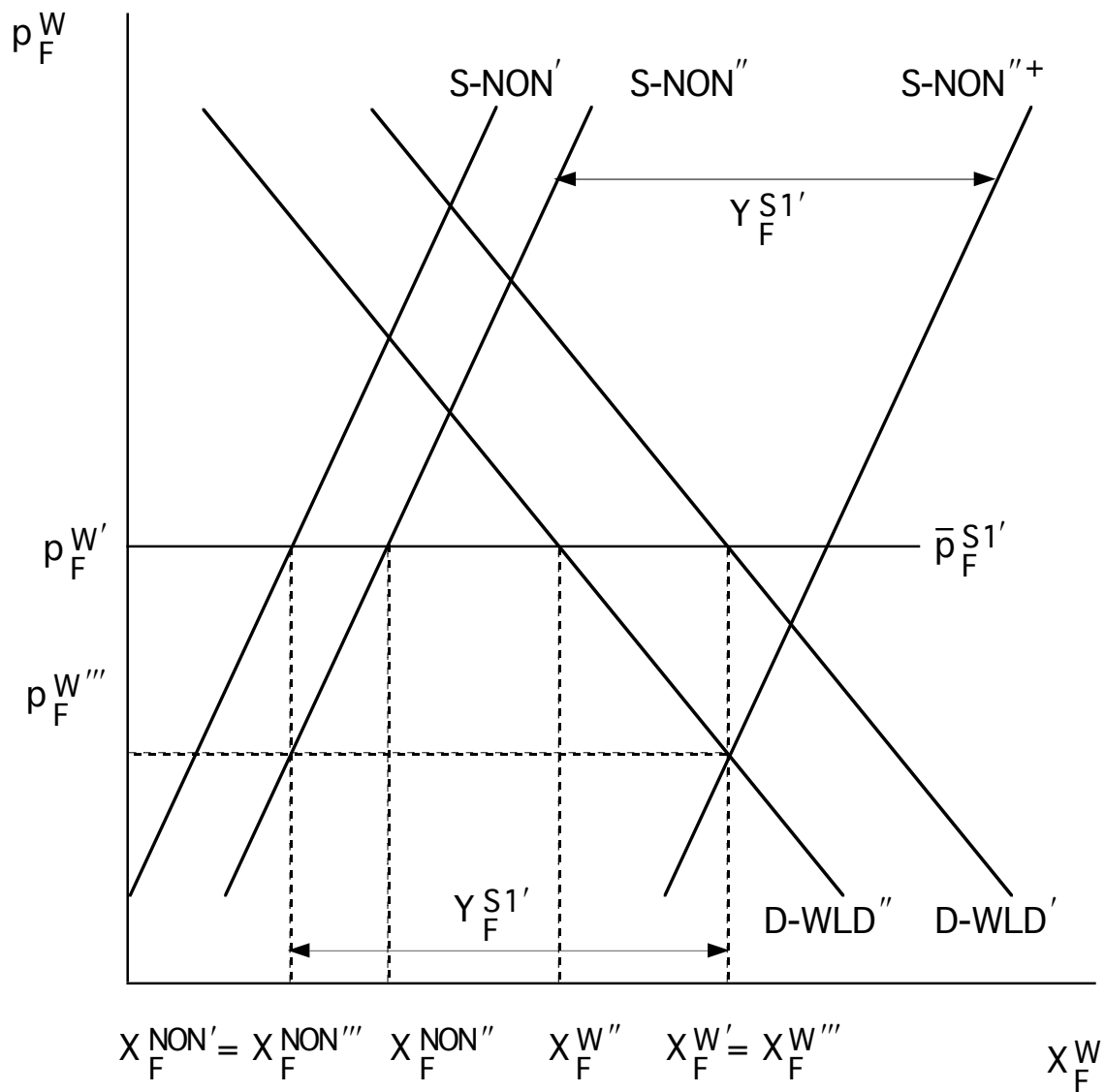
### ***Shifts in the Non-OPEC supply of Fossil Fuel:*** Increased Non-OPEC Supply.

- Greater efficiency: lower resource rents and a higher output-to-resource ratio.

### ***Shifts in the World Demand for Fossil Fuel***

- *Direct Effects:* Ambiguous – Less demand in South; More demand in North.
  - Increased fuel saving in South; Reduced fuel-saving in North.
- *Cross Price Effects:* Increased World Demand Likely.
  - Greater Efficiency: lower prices for both Dirty Goods and Electricity, and lower opportunity cost for using fossil fuel.
- *South's (Normal) Income Effect:* Reduced World Demand.
  - Increased credit revenue raises South's income.
- *OPEC's (Normal) Income Effect:* Intensified Demand Shift Likely.
  - OPEC's income rises if and only if there is a increase in its net demand

## Impact of Increasing Allowable Credits on World Emissions



## ADDING AGRICULTURE

### New Features:

1. *Change in GHG Emissions is more complex.*
  - Agricultural Methane Emissions PLUS GHG Emissions from Fossil Fuel use.
2. *GHG (Methane) Abatement as well as Fuel-Saving arise in Agriculture.*
  - More methane abatement in North than South if abatement is capital intensive.

### Comparative Statics:

1. ***Adverse Impact on Food Production due to Climate Change***
  - Rising food prices imply more ag-inputs to mitigate the output reduction
  - Results depend on fossil-fuel intensity of agriculture vs contracting sector(s).
    - World methane emissions are likely to decline somewhat.
    - Greater overall world GHG emissions are, nevertheless, possible.
2. ***Previously Uncapped Agricultural Methane is taken under North's Cap***
  - *Direct Effect:* North's Agricultural Methane and Fossil Fuel emissions fall.
  - *Rising Food Prices:* South's Agricultural Methane and Fossil Fuel emissions rise.
  - *Other Cross Price Effects:* Complex
    - Greater overall world GHG emissions are, again, possible.