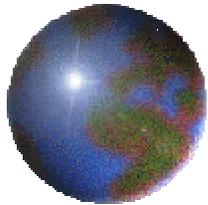


# *Second Generation Model for China*



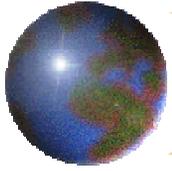
**Ron Sands**

*Pacific Northwest National  
Laboratory, USA*

**Jiang Kejun**

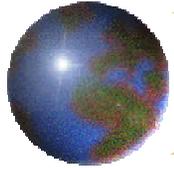
*Energy Research Institute, China*

4<sup>th</sup> Sino-Korea-U.S. Economic and  
Environmental Modeling Workshop  
23-25 May 2001, Beijing



# Overview

- ⊕ SGM background
- ⊕ Uses for top-down economic models
- ⊕ Recent analysis using SGM
  - ⊞ Energy Modeling Forum
  - ⊞ 1998 Administration analysis
- ⊕ SGM-China
- ⊕ Current SGM activities and development



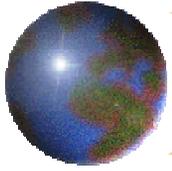
# *SGM Regions*

## ● Annex I

- United States
- Canada
- Western Europe
- Japan
- Australia/NZ
- Former Soviet Union
- Eastern Europe

## ● Non-Annex I

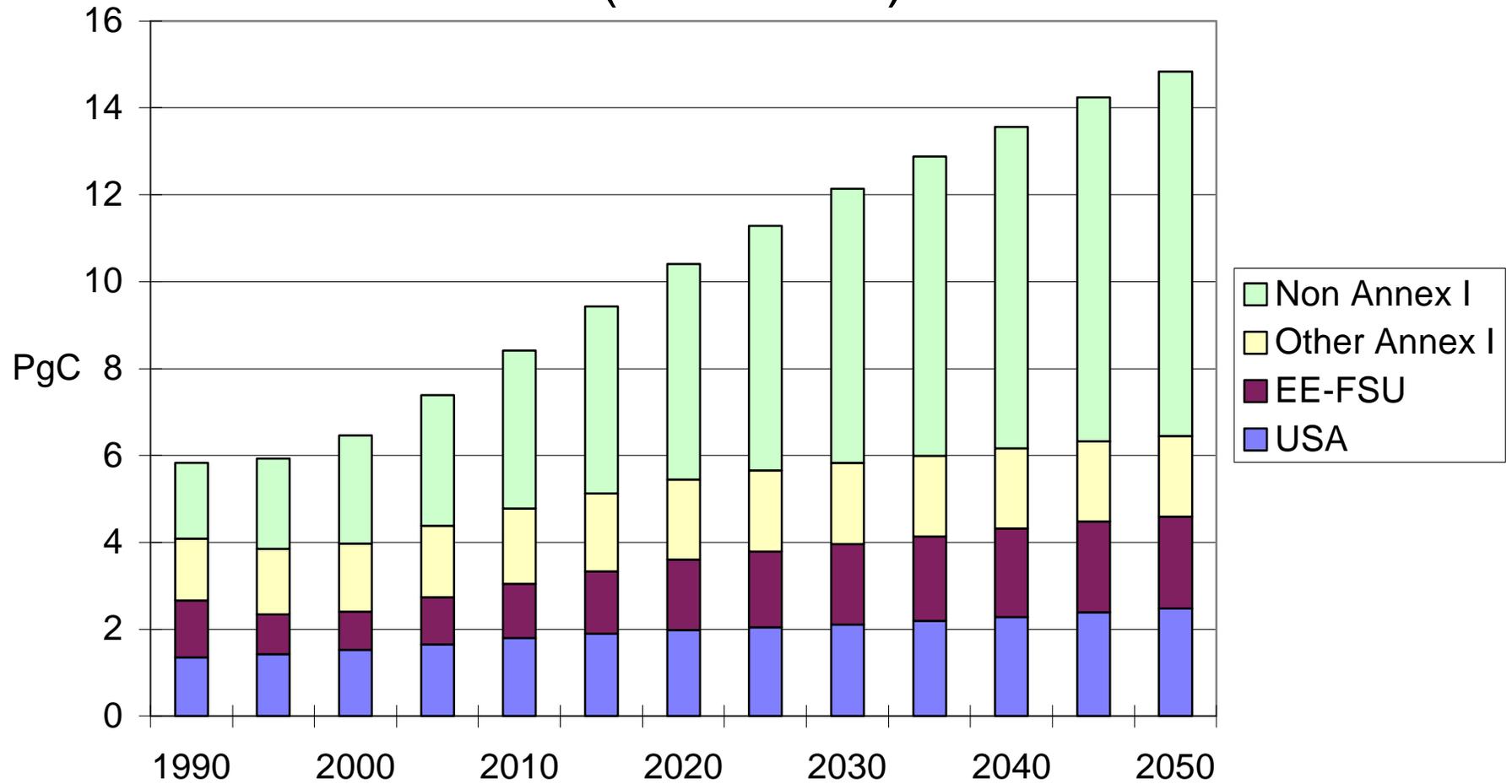
- **China**
- India
- Middle East
- Mexico
- **South Korea**
- **Brazil**
- **Rest of World**

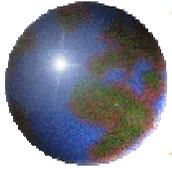


## *Top-Down Economic Models*

- ❖ Project baseline carbon emissions over time for a country or group of countries
- ❖ Find the least-cost way to meet any particular emissions constraint
- ❖ Provide a measure of the carbon price, in dollars per metric ton
- ❖ Provide some measure of the overall cost of meeting an emissions target

# Reference Case Carbon Emissions (BAU Med)





# Production Sectors in SGM

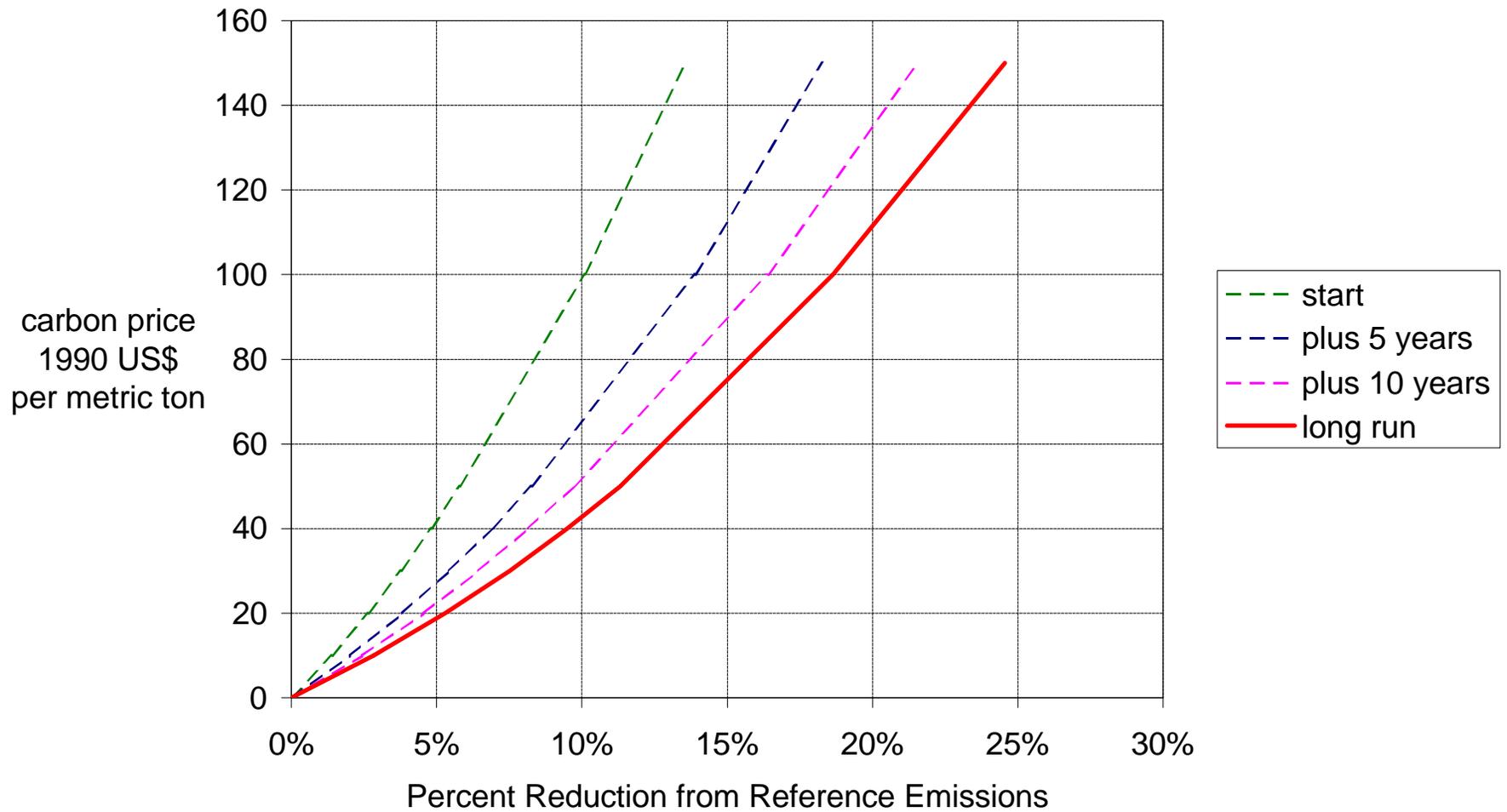
## SGM 98

- 1 Agriculture
- 2 Everything Else
- 3 Oil Production
- 4 Gas Production
- 5 Coal Production
- 6 Biomass
- 7 Nuclear Fuel
- 8 Electricity Production
  - Oil-Fired
  - Gas-Fired
  - Coal-Fired
  - Nuclear
  - Hydro
- 9 Oil Refining
- 10 Gas Distribution

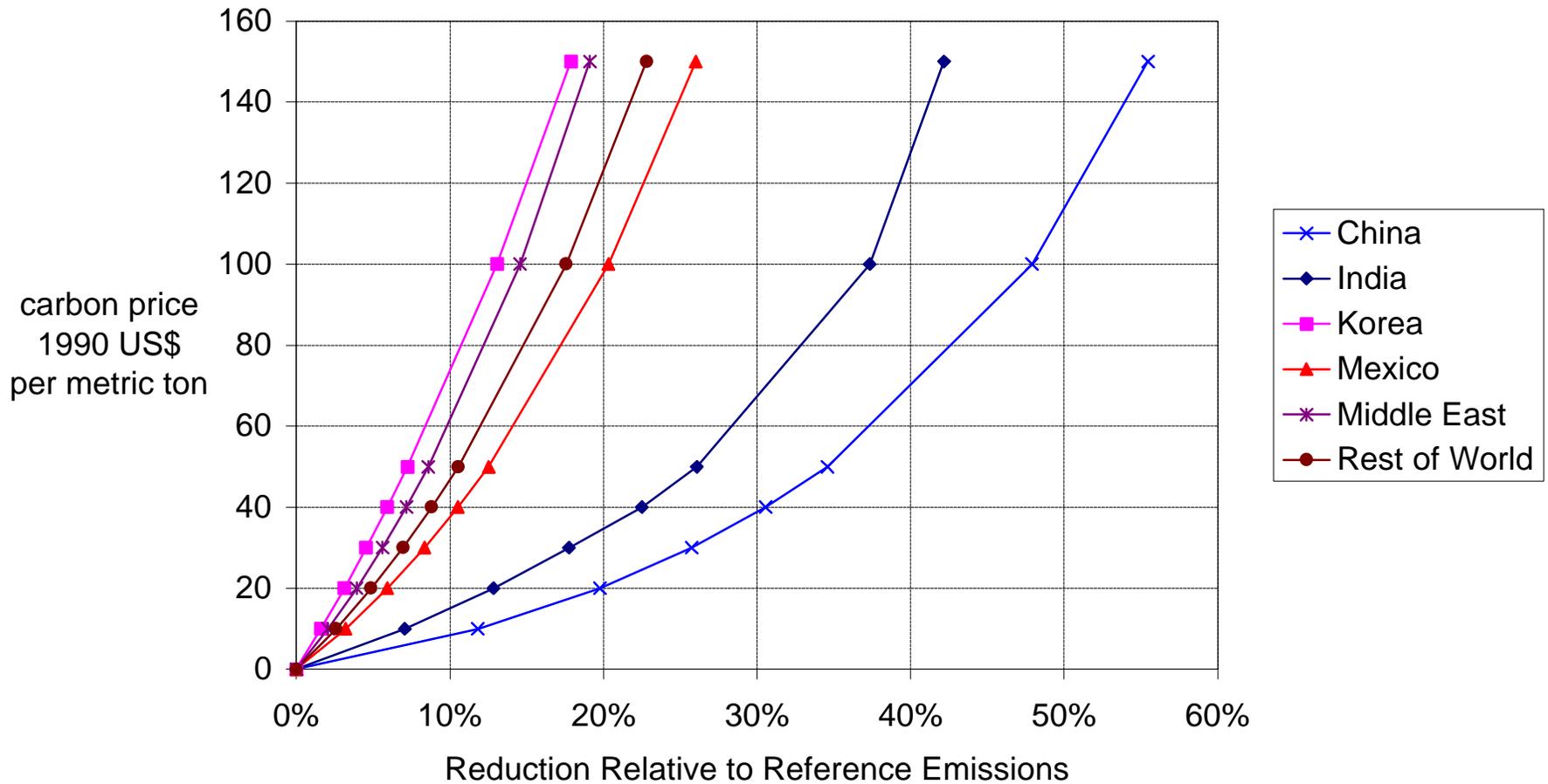
## SGM 2000

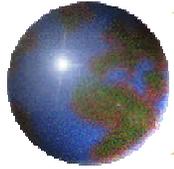
- 1 Other Agriculture
- 2 Everything Else
- 3 Oil Production
- 4 Gas Production
- 5 Coal Production
- 6 Coal Products
- 7 Biomass
- 8 Electricity Production
  - Oil-Fired
  - Gas-Fired
  - Coal-Fired
  - Nuclear
  - Hydro
- 9 Oil Refining
- 10 Gas Distribution
- 11 Paper and Pulp
- 12 Chemicals
- 13 Cement
- 14 Primary Iron and Steel
- 15 Primary Non-Ferrous Metals
- 16 Other Industry
- 17 Passenger Transport
- 18 Freight Transport
- 19 Grains and Oil Crops
- 20 Animal Products
- 21 Forestry
- 22 Food Processing
- 23
- 24
- 25

# Marginal Abatement Curves United States



# Marginal Abatement Curves for Non-Annex I Regions





# *Measuring and Reporting Cost*

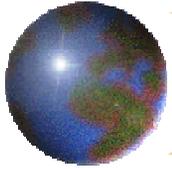
## ⊕ Direct Cost

- ⊞ area under marginal abatement curve

## ⊕ International Transfer Payments

## ⊕ Indirect Costs

- ⊞ terms of trade (energy)
- ⊞ terms of trade (non-energy)
- ⊞ energy tax/subsidy distortions
- ⊞ revenue recycling



# *Recent Analysis*

- ⊕ EMF 14

- ⊞ Stabilize atmosphere

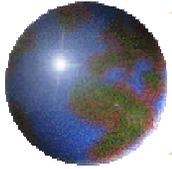
- ⊕ EMF 16

- ⊞ Kyoto emissions targets

- ⊕ 1998 Administration Analysis

- ⊕ EMF 19

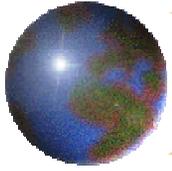
- ⊞ Modeling technological change



# EMF 16 Results

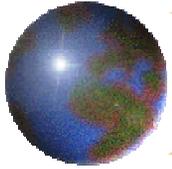
## US Permit Prices in 2010 (1990 US\$)

	No Trading	Annex I Limit on Sales	Annex I Limit on Purchases	Full Annex I Trading	CDM	Double Bubble	Annex I plus China and India	Global Trading
Kyoto Targets	<b>188</b>	181	103	<b>85</b>	73	59	27	<b>22</b>
Kyoto Targets + 5%	149							



# *1998 Administration Analysis*

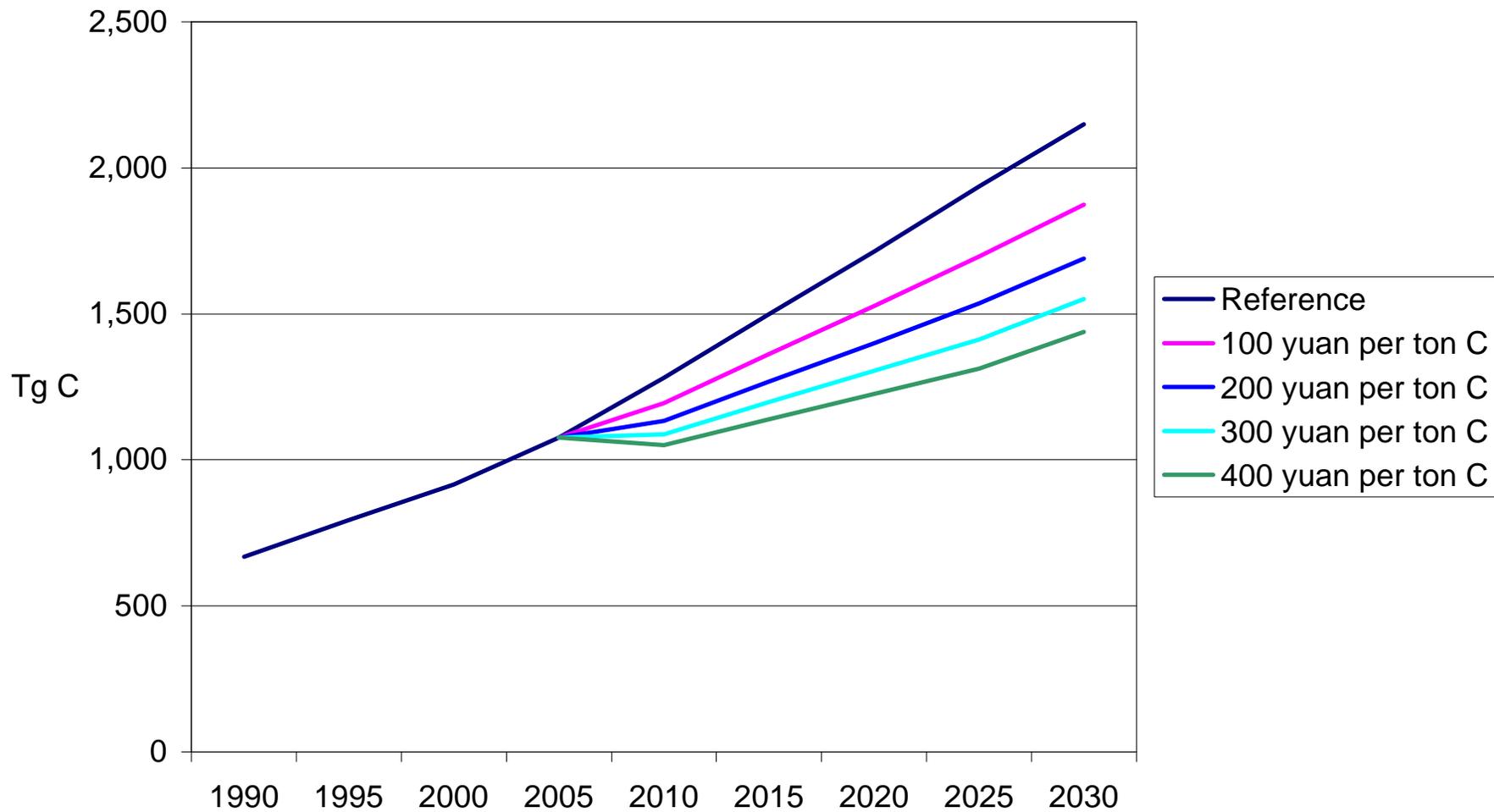
- Analysis by U.S. Council of Economic Advisers
- Reduced form analysis
  - SGM was not run directly
  - Marginal abatement curves derived from many SGM model runs
  - Emissions baselines taken from a different source (U.S. Energy Information Administration)
  - Supply curve for non-CO<sub>2</sub> greenhouse gases (U.S. Environmental Protection Agency)

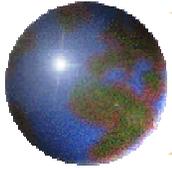


# *SGM Data Requirements*

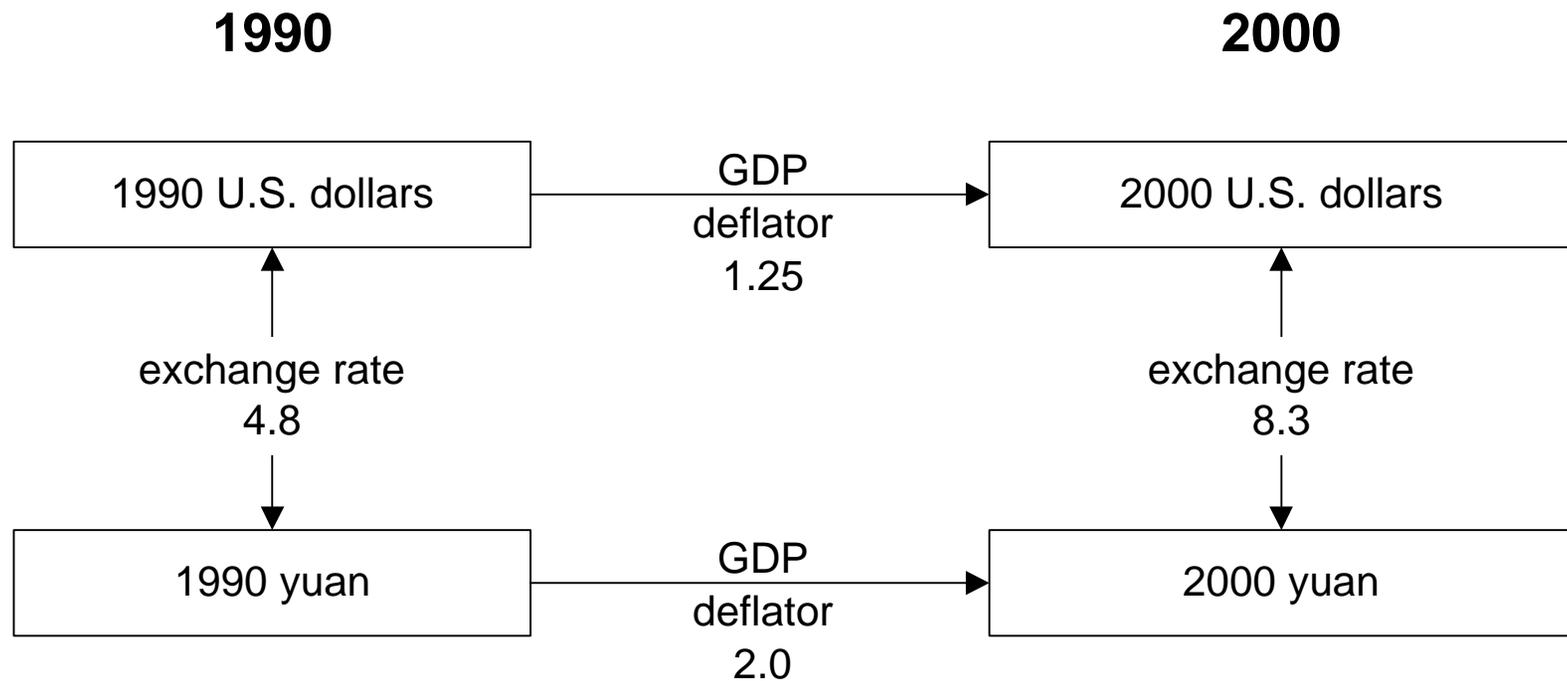
Original Data	Derived Data for SGM
1990 Input-Output Table 1990 Energy Balances	Hybrid Input-Output Table
Annual Investment Data by Sector	Capital Stocks by Sector
Data on Fossil Fuel Resources	Resource Grades
Electricity Supply: generation, installed capacity, energy consumption, capital costs, operating costs	Input-output representation of electricity generation by fuel
National Income Accounts	tax rates, savings rates

# SGM-China Carbon Emissions Response to Carbon Price



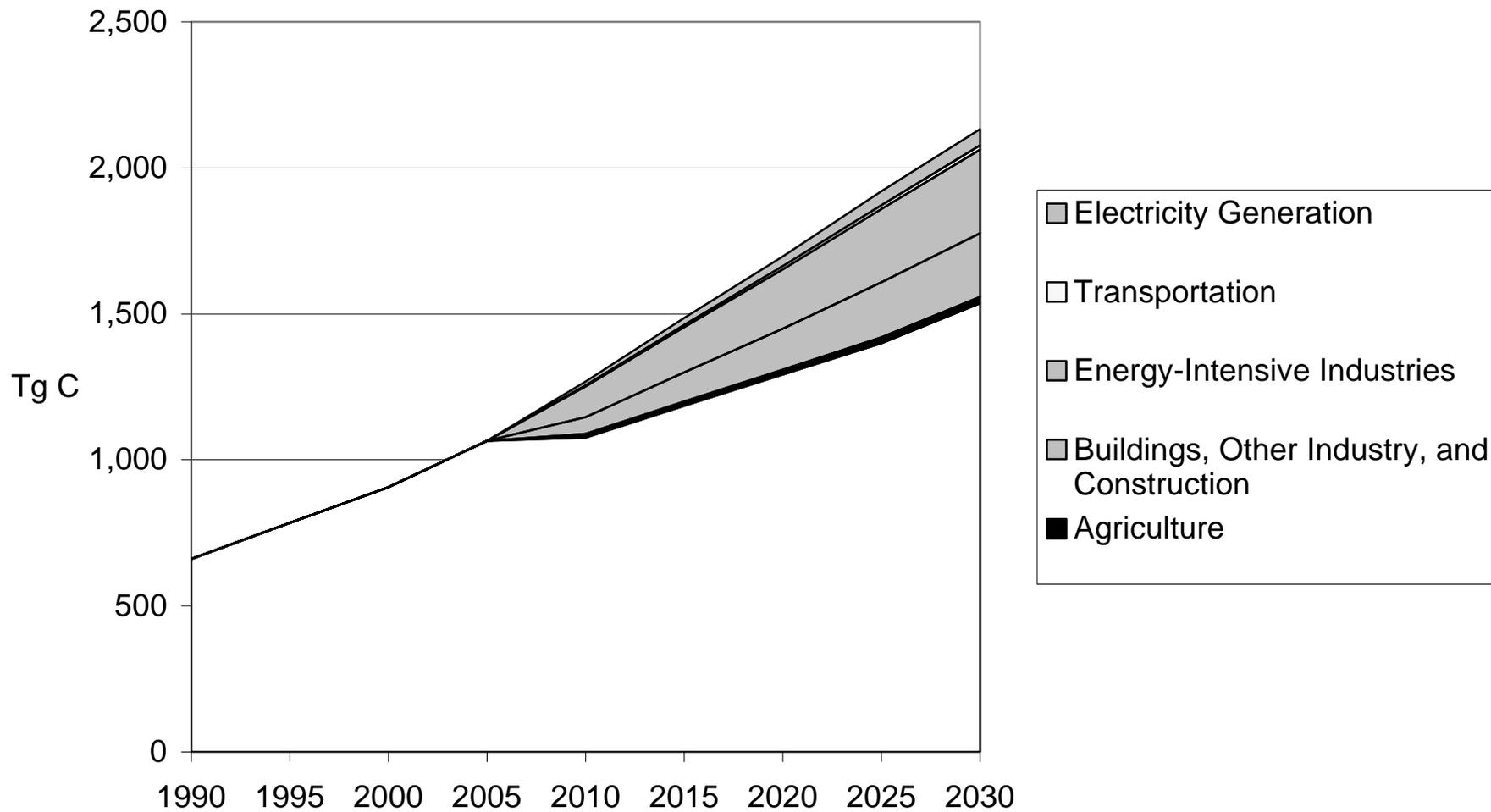


# Currency Conversion

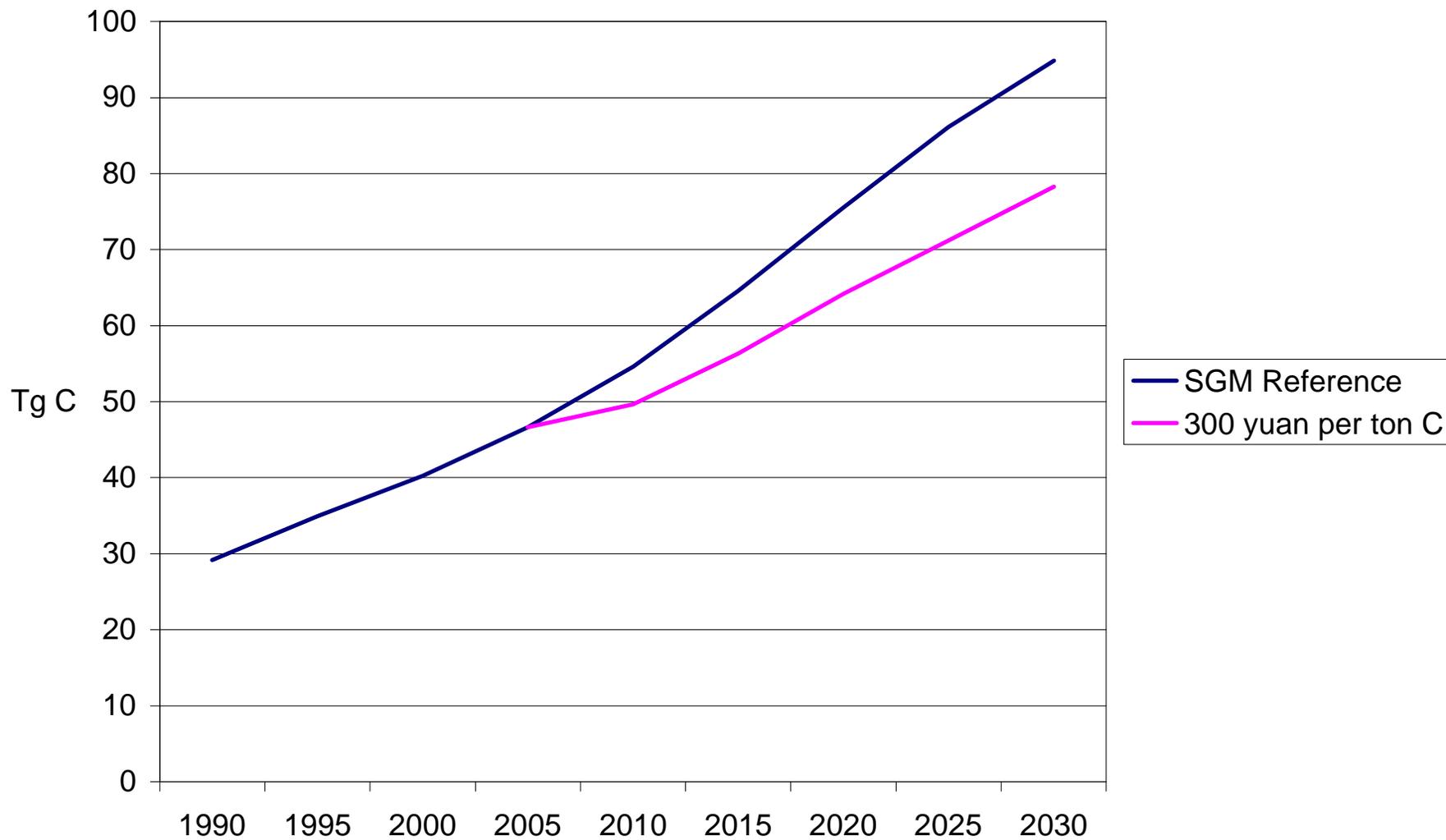


# SGM-China Carbon Emissions

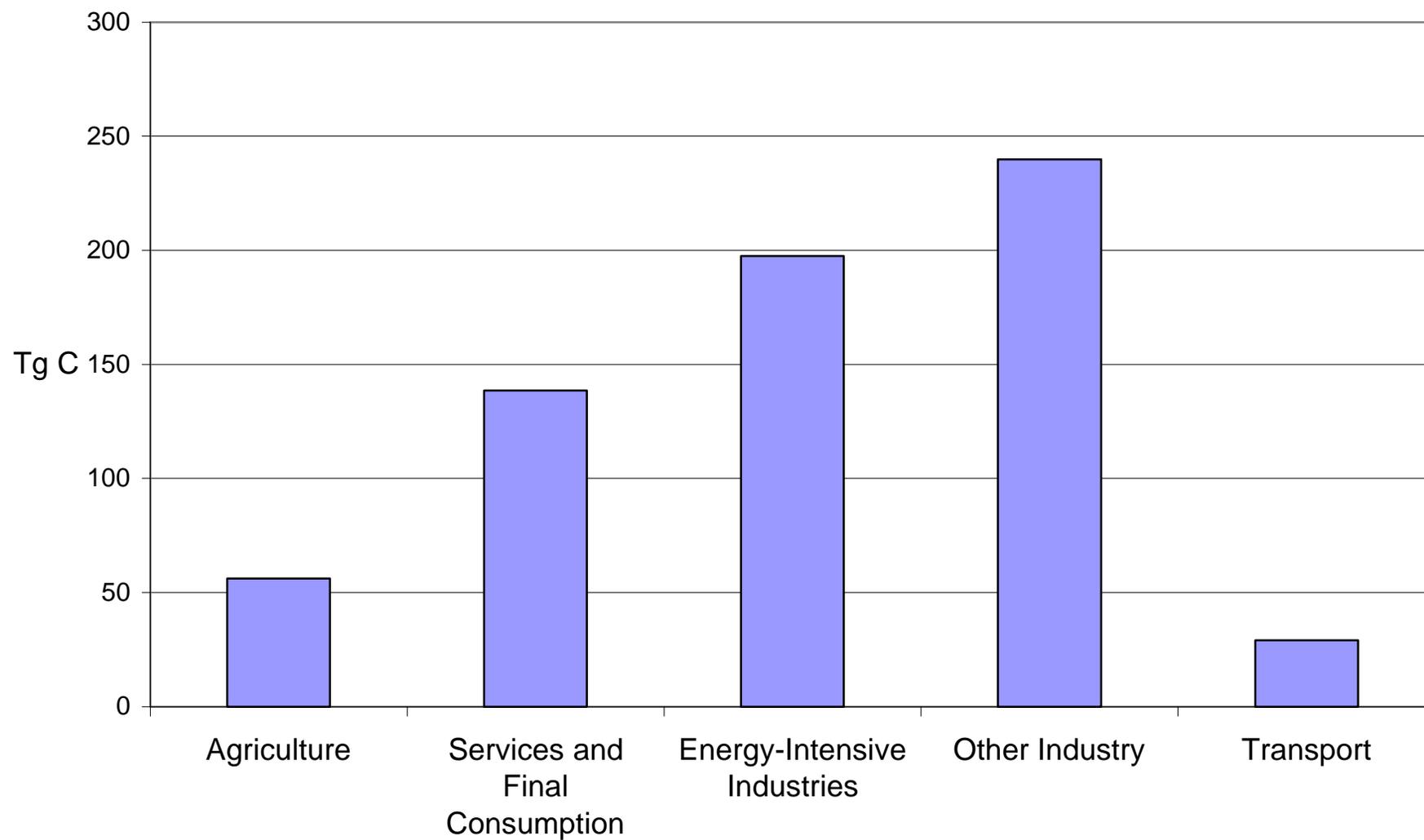
## Response to 300 yuan per ton carbon price in 2010

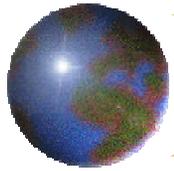


# SGM-China Transport Sector Carbon Emissions



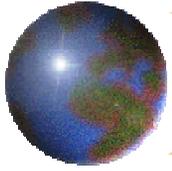
## China Carbon Emissions by Sector in 1990





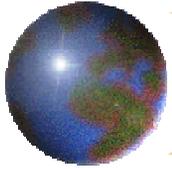
## *Status and Future Work (1)*

- ❖ Improve sector baselines
- ❖ Improve technology representation in electric power and energy-intensive industries
- ❖ Empirical support for substitution elasticities

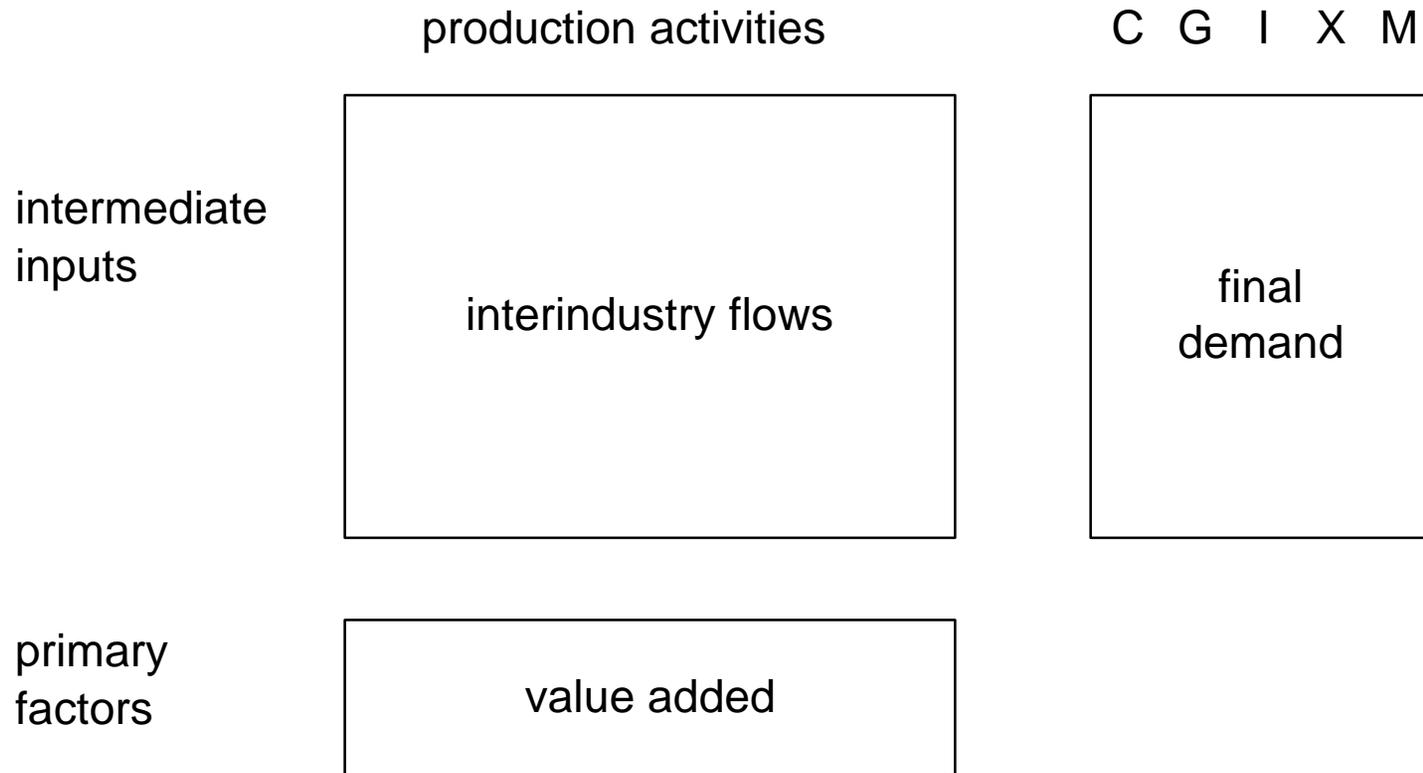


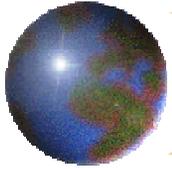
## *Status and Future Work (2)*

- Improve ability to simulate emissions trading within a country
  - Sector targets
  - Emissions trading among sectors
- Improve modularity
  - Allow sector specialists to work independently
  - FORTRAN to C++



# *Input-Output Table*





# *Energy Balance Table*

## energy inputs (fuels)

production  
imports  
exports

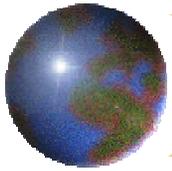
sources

electricity generation  
oil refining  
coking

energy transformation

agriculture  
industry  
transport  
residential buildings  
commercial buildings

final consumption



# Which Baseline?

