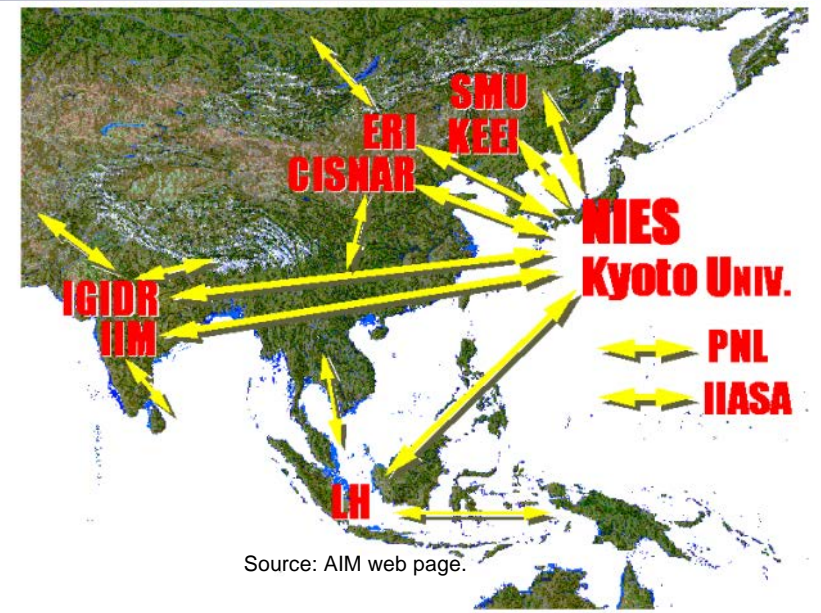
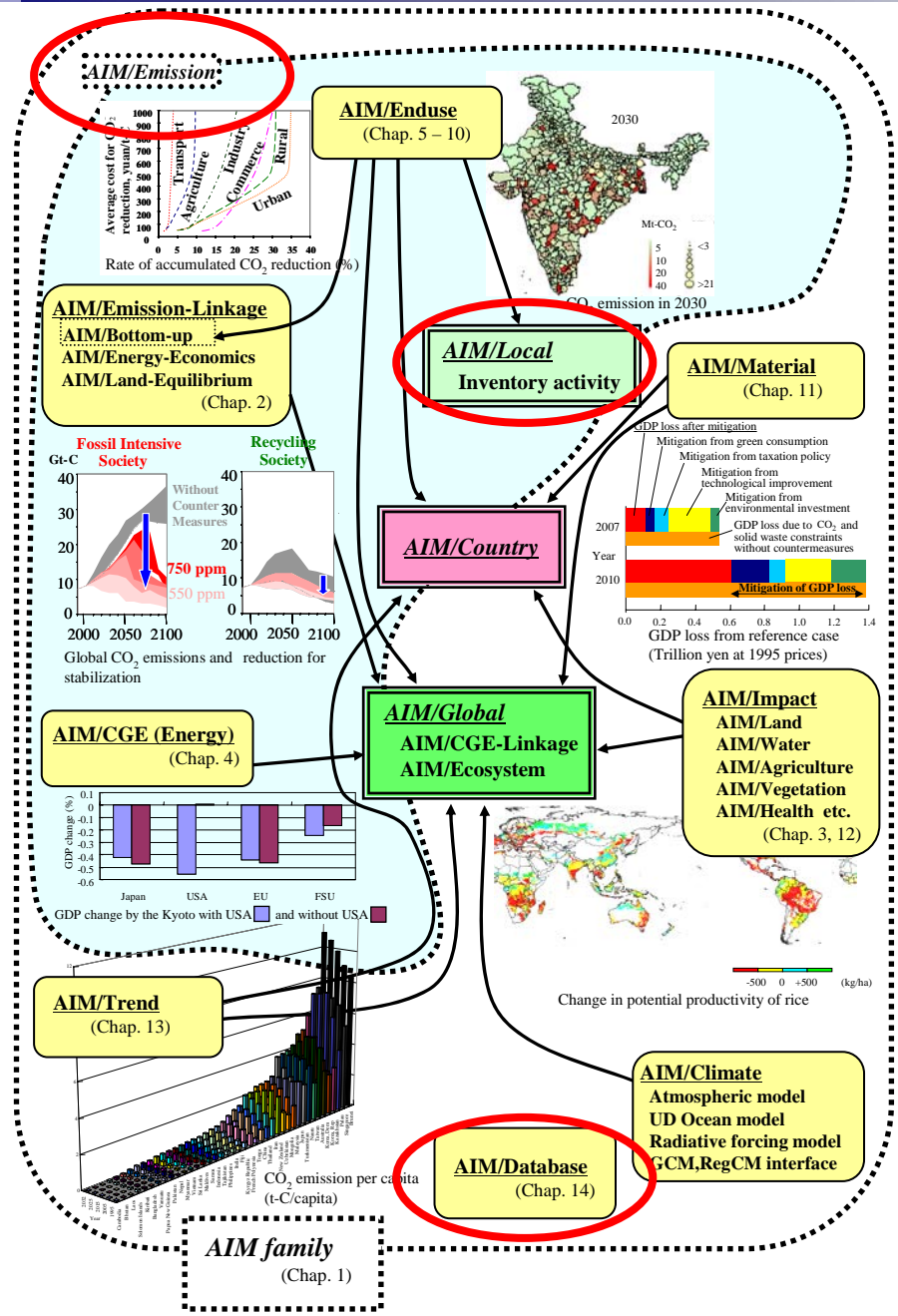




Climate Policy Modeling: Some Experiences in China

Hongwei YANG

Energy Research Institute, China

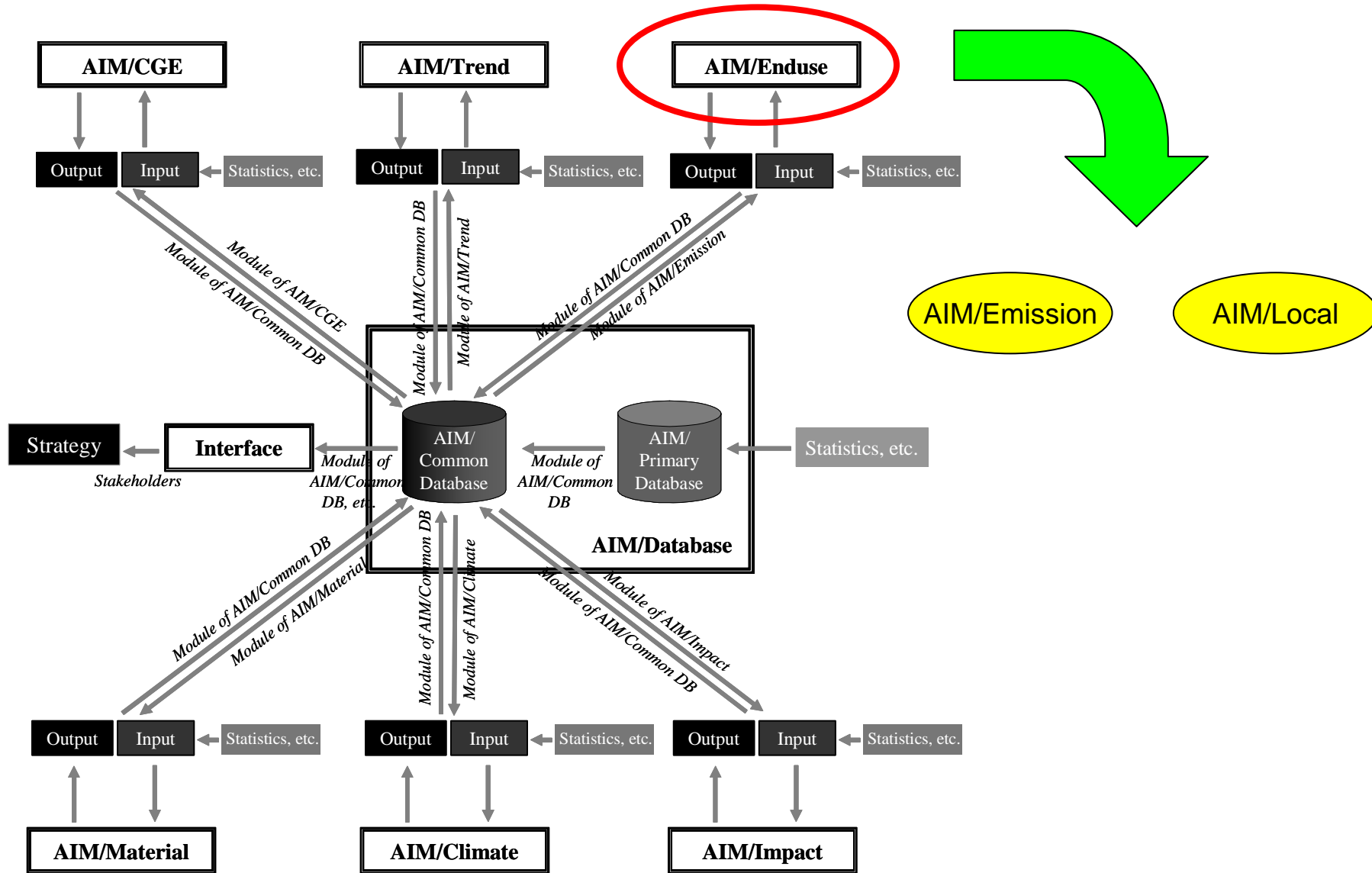


Source: AIM web page.

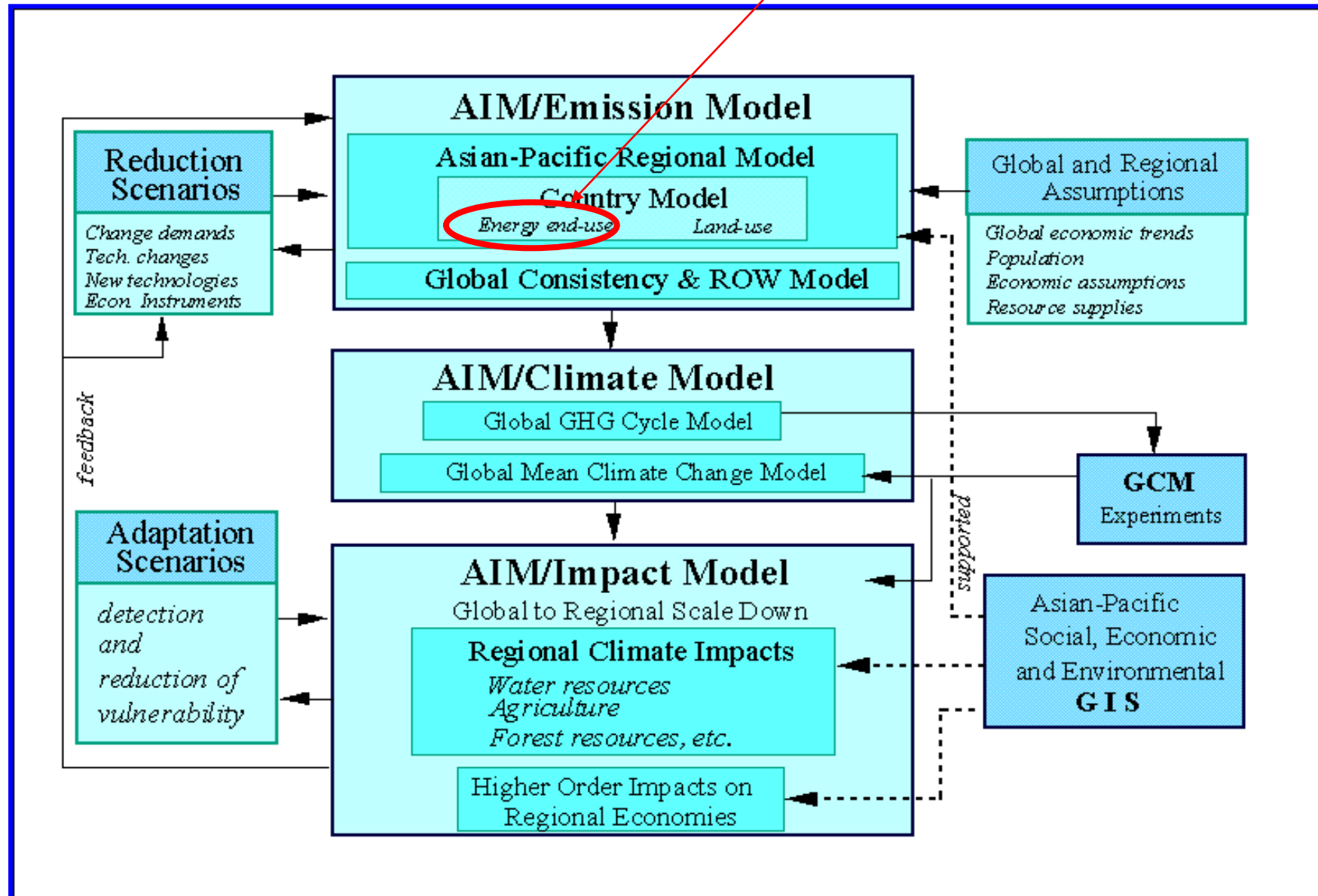
ERI: Bottom-up approaches

- AIM/Enduse (AIM/Emission)
- AIM/Local
- AIM/Database

1. AIM/Database



2. AIM/Emission study for China's energy end-use sectors

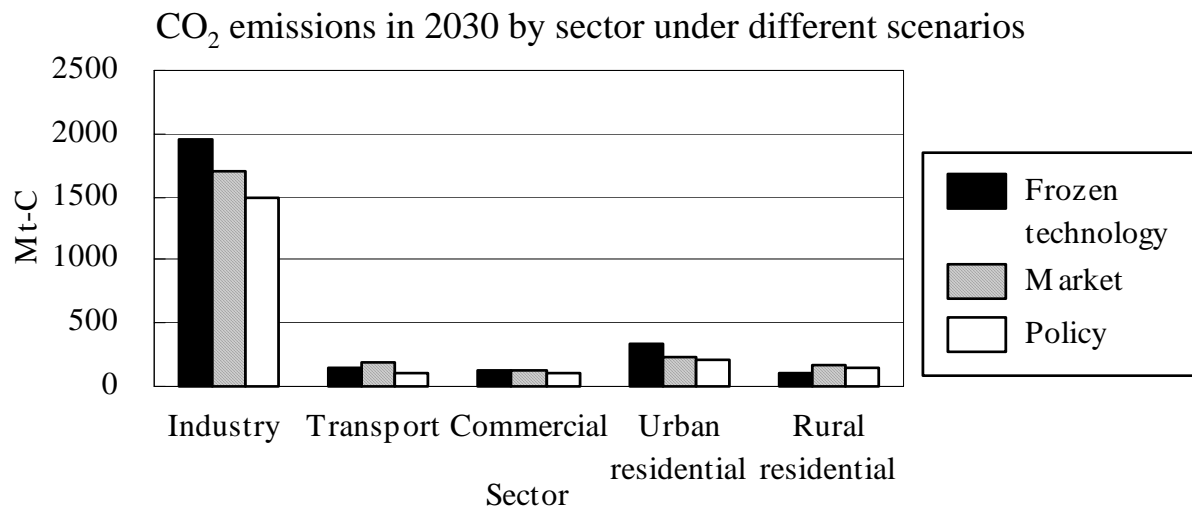
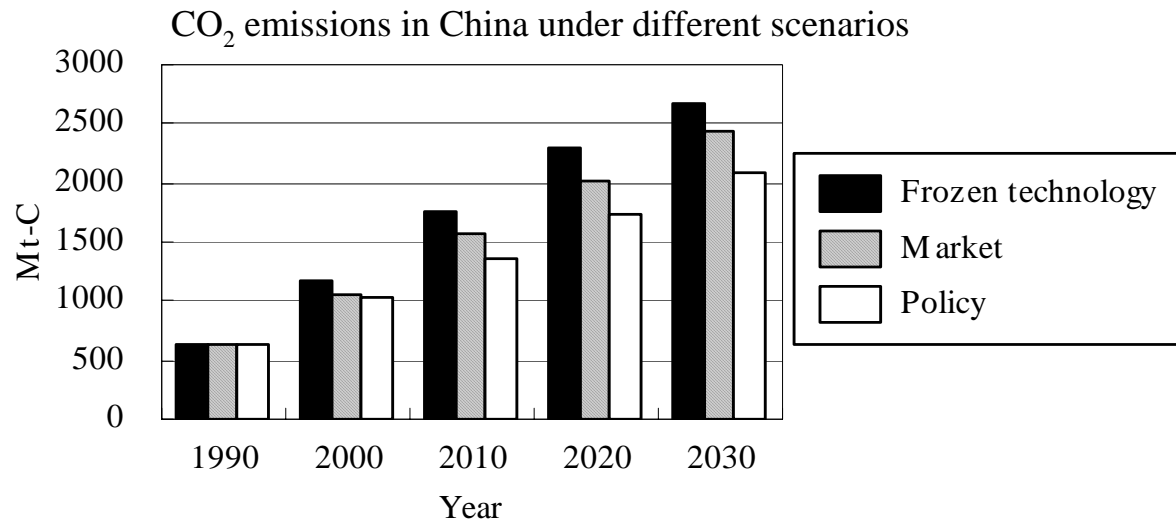


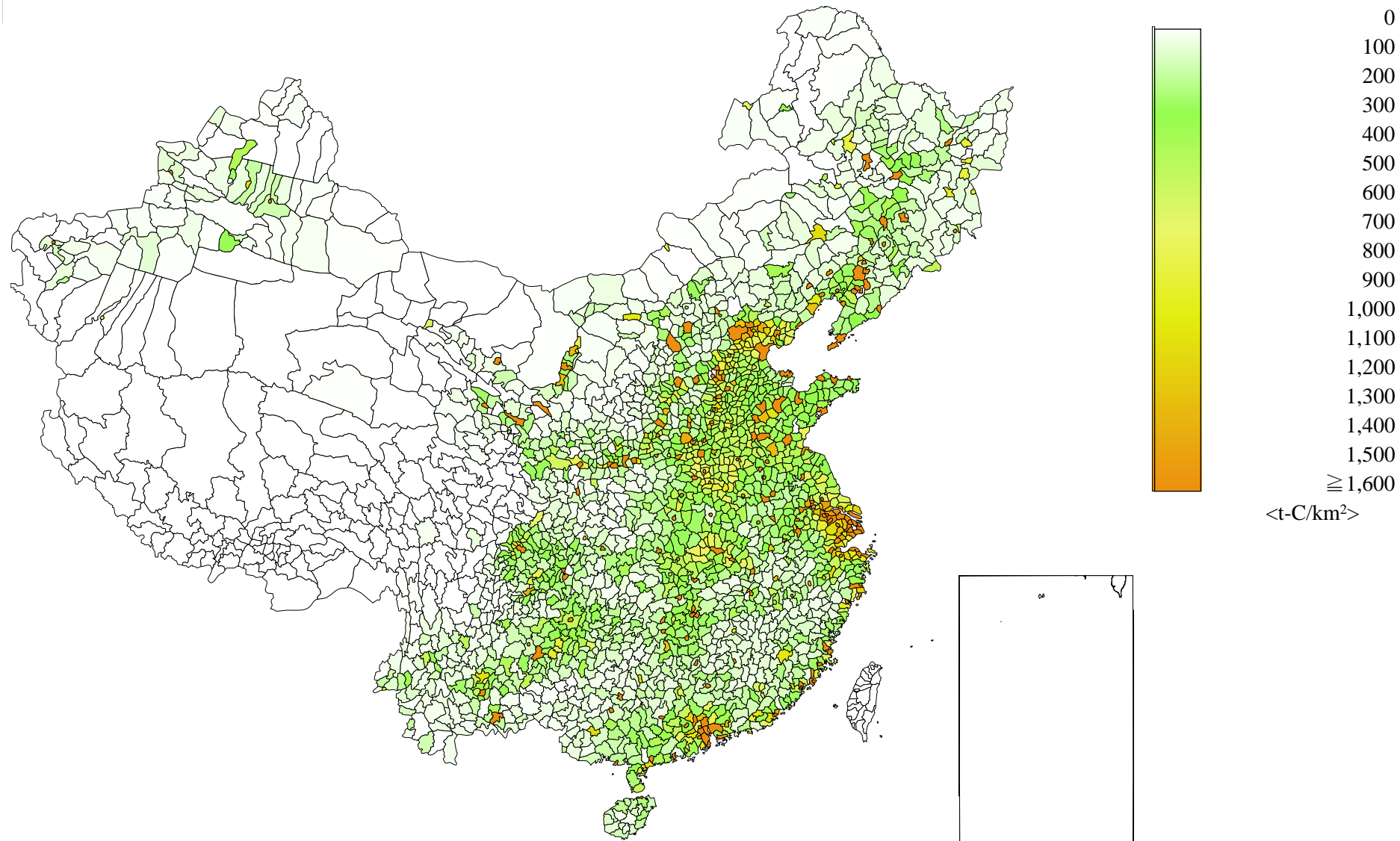
Classification of Energy End User Sectors

Sectors	Industrial sector	Agricultural sector	Residential sector	Services sector	Transport
Sub-sectors or products	Iron and steel Non-ferrous metals Building materials Chemical industry Petrochemical industry Paper-making Textile Machinery Power generation Oil refinery	Irrigation Farming work Agricultural products processing Fishery Animal husbandry	Urban energy use Rural energy use Space heating Cooling Lighting Cooking and hot water Household electric appliances	Space heating Cooling Lighting Cooking and hot water Electric appliances	Railway transport Road transport Waterways transport Air transport

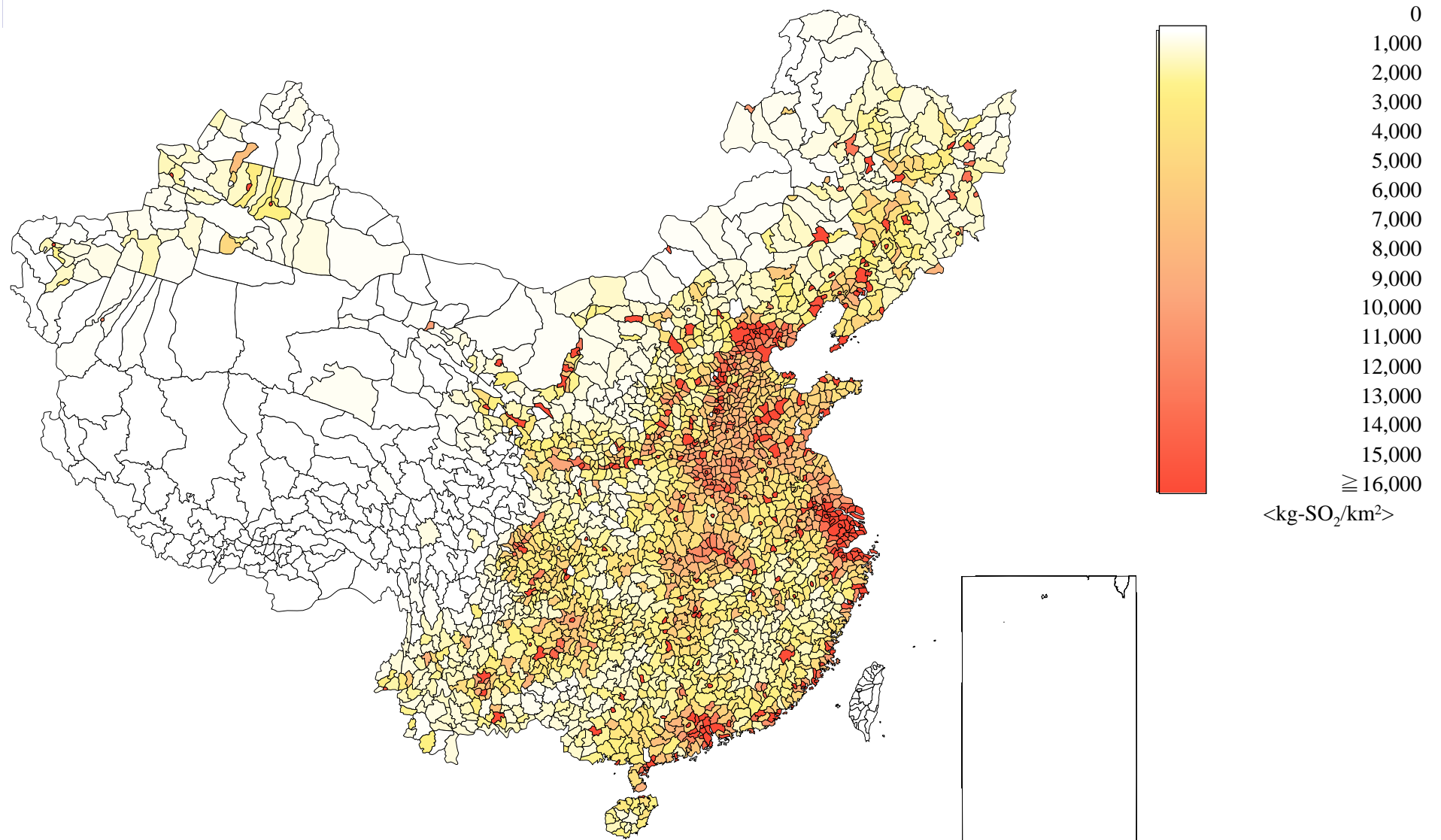
Energy services technologies used in this simulation

Classification	Technologies (equipment)
Iron and steel	Coke oven; Sintering machine; Blast furnace; Open hearth furnace (OH); Basic oxygen furnace (BOF); AC-electric arc furnace; DC-electric arc furnace; Ingot casting machine; Continuous casting machine; Continuous casting machine with rolling machine; steel rolling machine; Continuous steel rolling machine; Equipment for coke dry quenching; Equipment for coke wet quenching; Electric power generated with residue pressure on top of the blast furnace (TRT); Equipment for coke oven gas; OH gas and BOF gas recovery; Equipment for co-generation
Non-ferrous metals	Aluminum production using the sintering process; Aluminum production using the combination process; Aluminum production using the Bayer process; Electrolytic aluminum using the upper-insert cell; Electrolytic aluminum using the side-insert cell; Crude copper production with flash furnace; Crude copper production using an electric furnace; Blast furnace; Reverberator furnace; Lead smelting-sintering in a blast furnace; Lead smelting using a closed blast furnace; Zinc smelting using the wet method; Zinc smelting using the vertical pot method
Building materials	Cement: Mechanized shaft kiln; Ordinary shaft kiln; Wet process kiln; Lepol kiln; Ling dry kiln; Rotary kiln with pro-heater; Dry process rotary kiln with pre-calciner; Self-owned electric power generator; Electric power generator with residue heat Bricks and tiles: Hoffman kiln; Tunnel kiln Lime: Ordinary shaft kiln; Mechanized shaft kiln Glass: Floating process; Vertical process; Colburn process; Smelter
Chemical industry	Equipment for synthetic ammonia production: Converter; Gasification furnace; Gas-making furnace; Synthetic column; Shifting equipment for sulphur removal Equipment for caustic soda production: Electronic cells using the graphite process; Two-stage effects evaporator; Multi-stage effects evaporator; Equipment for rectification; Ion membrane method Calcium Carbide production: Limestone calciner; Closed carbide furnace; Open carbide furnace; Equipment for residual heat recovery Soda ash production: Ammonia and salt water preparation; Limestone calcining; Distillation column; Filter Fertilizer production: Equipment for organic products production; Equipment for residual heat utilization
Petrochemical industry	Facilities for atmospheric and vacuum distillation; Facilities for rectification; Facilities for catalyzing and cracking; Facilities for cracking with hydrogen adding; Facilities for delayed coking; Facilities for light carbon cracking; Sequential separator; Naphtha cracker; De-ethane separator; Diesel cracker; De-propane cracker; Facilities for residual heat utilization from ethylene
Paper-making	Cooker; Facilities for distillation; Facilities for washing; Facilities for bleaching; Evaporator; Crusher; Facilities for de-water; Facilities for finishing; Facilities for residue heat utilization; Facilities for black liquor recovery; Co-generator; Back pressure electric power generator; Condensing electric power generator





Estimated CO₂ emission intensity in China for 2010



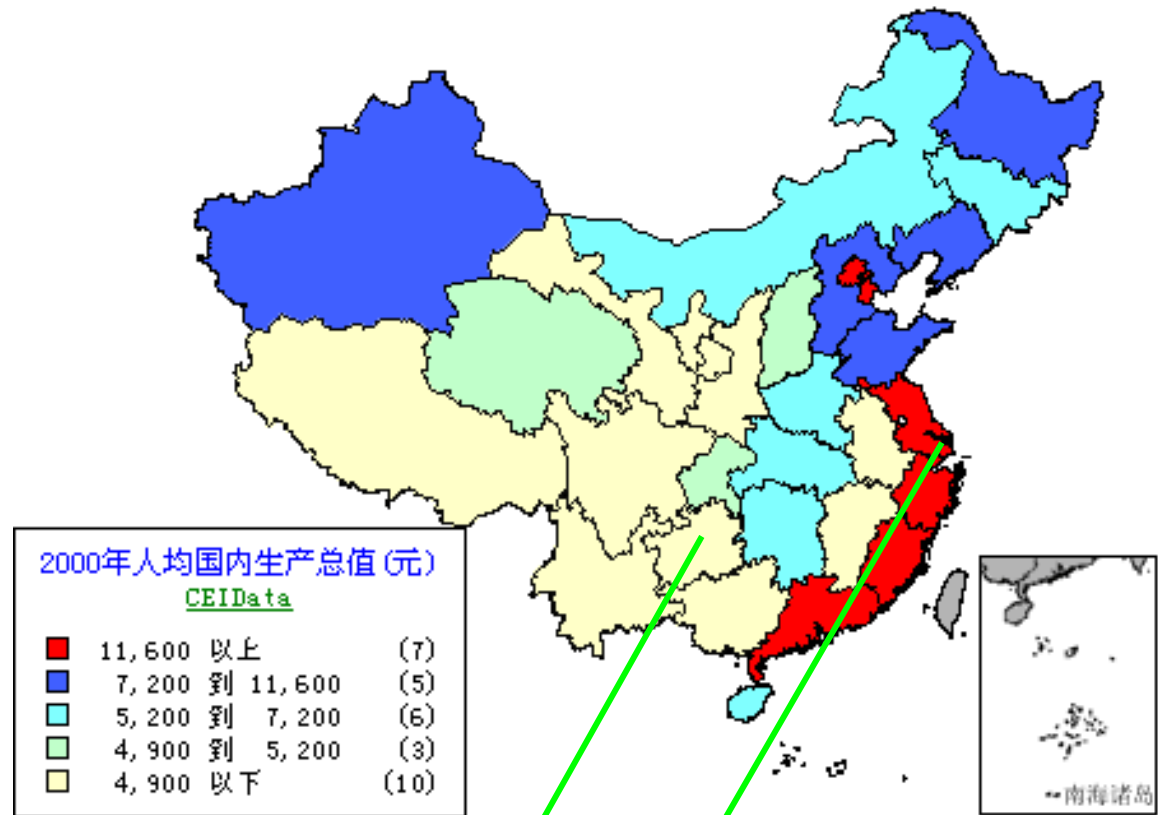
Estimated SO₂ emission intensity in China for 2010

3. AIM/Local study at provincial and sector level in China

Per capita GDP in 2000 across China's provinces

Source: CEI webpage based on China Statistical Yearbook 2001.

Why local?

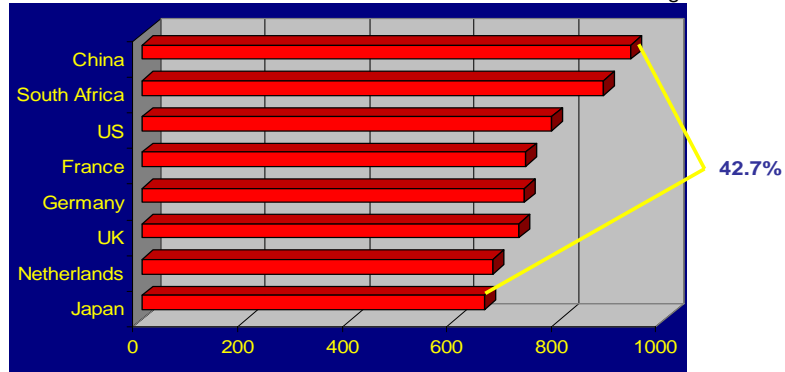


Guizhou: 2,662

Shanghai: 34,547

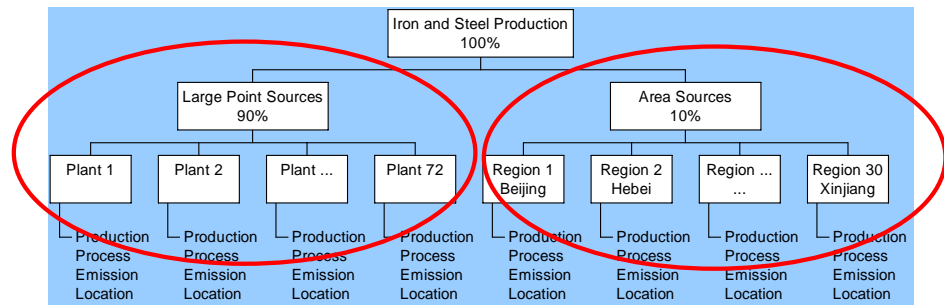
3.1 AIM/Local study for iron & steel industry in China

Comparison of unit energy consumption of crude steel production, 1997
Unit: kgce/t-steel



Sources: China Steel Statistical Yearbook 1998;
Key Statistics of Japan's Steel Industry, 1998.

Breakdown of China's iron and steel production in this study



Large scale plants
> 500,000 ton/a

Other plants
< 500,000 ton/a

Large point sources / Area sources

Min {total costs}

Subject to:

- Service supply constraint
- Energy supply constraint
- Emission constraint
- Technology share constraint
- Technology stock exchange constraint
- Technology operating constraint

Projection of future emissions

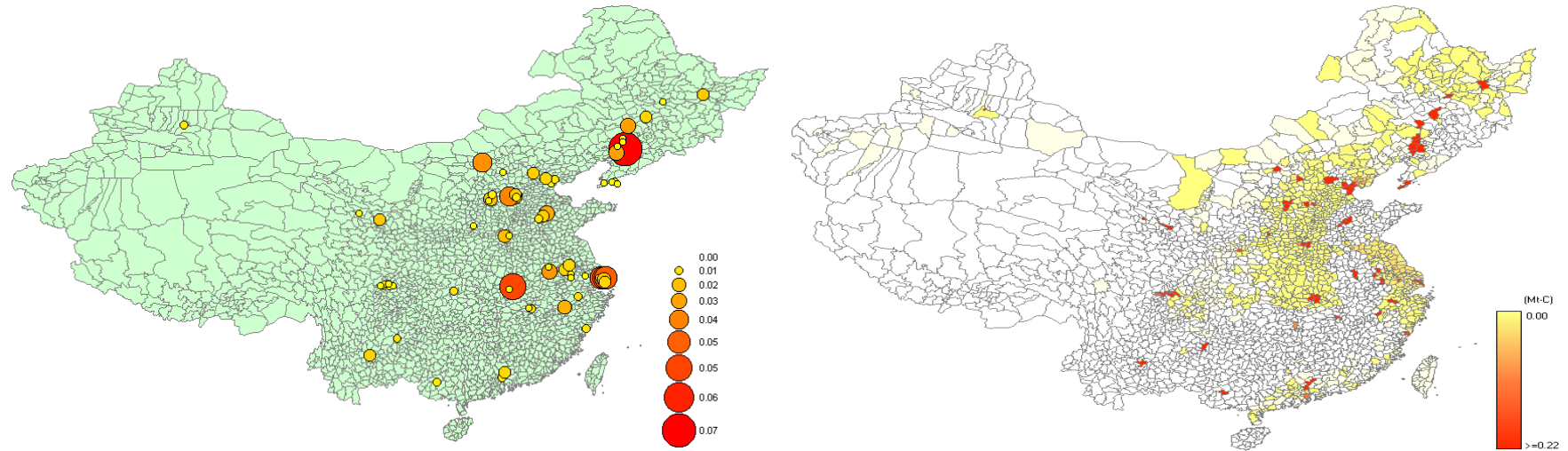
Min {total CO₂ emissions}

Subject to:

- Service supply constraint
- Energy supply constraint
- Other emission constraint
- Technology share constraint
- Technology stock exchange constraint
- Technology operating constraint

Estimation of theoretical maximum reduction

3.1 AIM/Local study for iron & steel industry in China



- Projection of future emissions with/without CDM

Shares of the accumulated production by technologies under different scenarios (%)
 Period: 2000-2030

Scenario	Open- hearth	Oxygen	AC Electric	DC Electric	Heat Recovery	DIOS	Total
Market	0.4	81.3	18.3	0.0	0.0	0.0	100
CDM1	0.4	73.7	19.4	1.4	5.2	0.0	100
CDM2	0.4	58.2	24.5	11.0	5.9	0.0	100
Min CO ₂	0.4	42.6	24.3	30.7	2.1	0.0	100

Present technologies in China

Advanced technologies from Japan

3.2 AIM/Local study for Beijing

➤ *Classification of sectors and services*

<u>Sector</u>	<u>Service</u>
Thermal power generation	Electricity
Industrial sector	Cement
	Steel
	Ethylene
	Refinery
Residential	Heating
	Cooling
	Lighting
	Cooking
	Hot water
Commercial	Heating
	Cooling
	Lighting
	Cooking
	Hot water
Transportation	Passenger transportation
	Freight transportation
Other sectors	Other

Beijing Yanshan Petroleum and Chemical Group Corporations

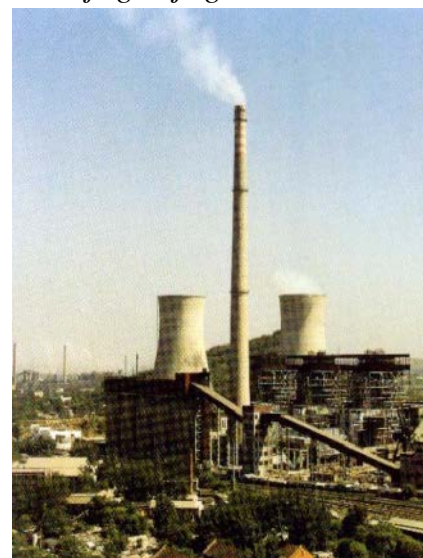


Ethylene



Technology: Diesel oil based process
 Capacity : 0.45 Mt /a
 Location: Fangshan District, Beijing City

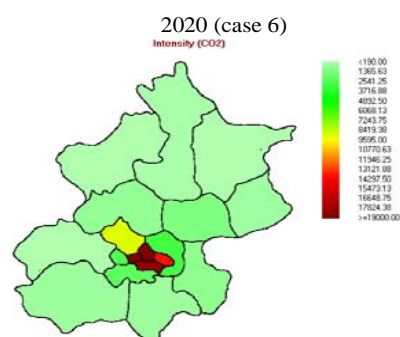
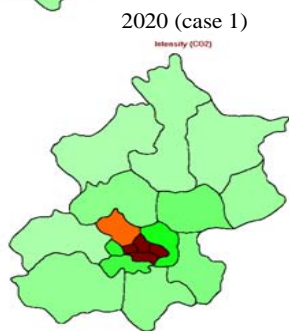
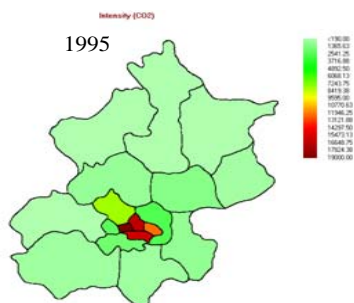
Beijing Shijingshan Thermal Power Plant



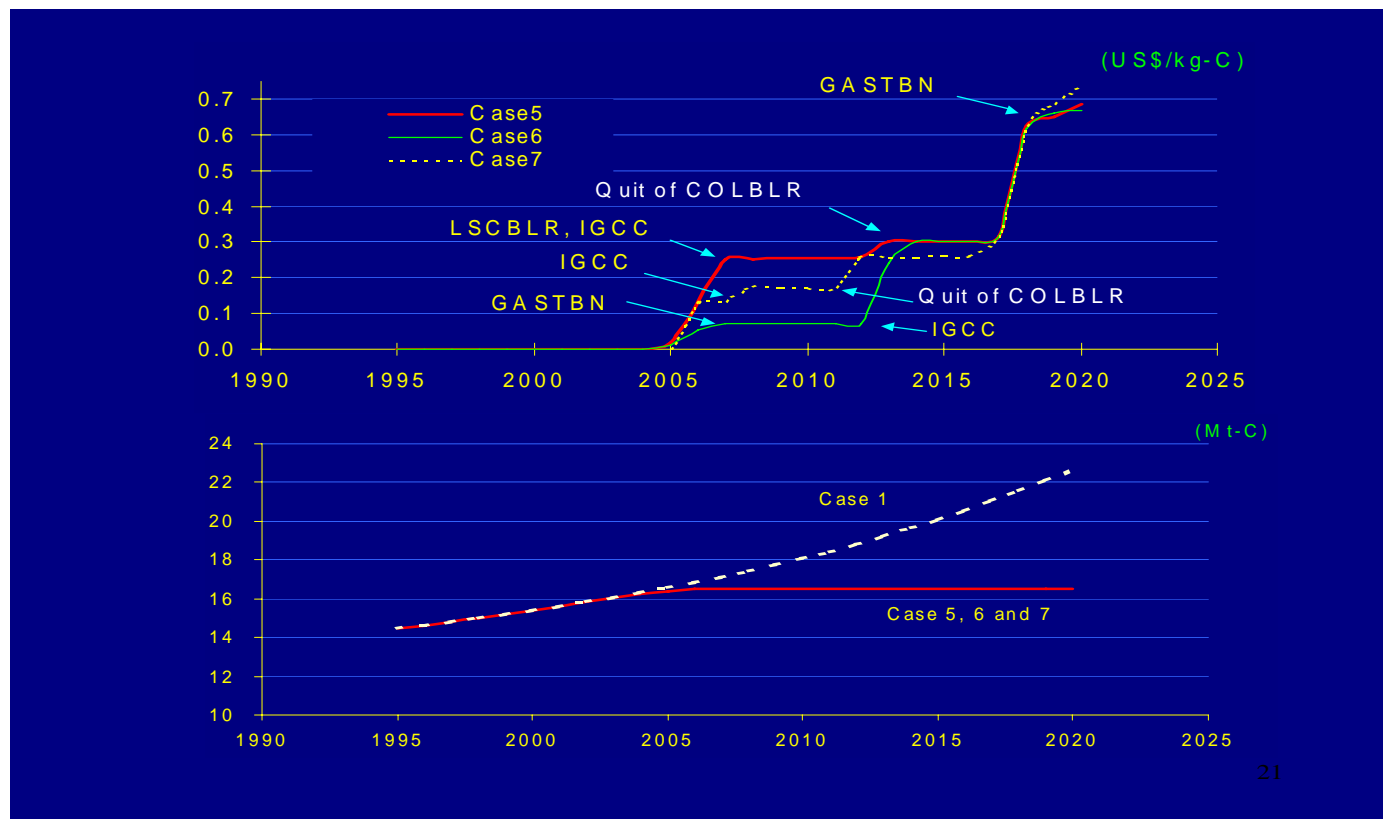
Technology: coal boiler
 Capacity : 4000 MW
 Location: Shijingshan District, Beijing City



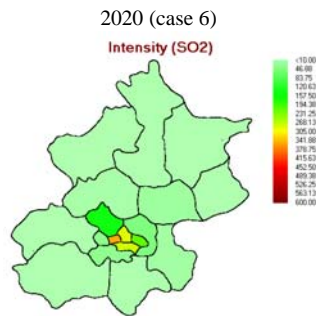
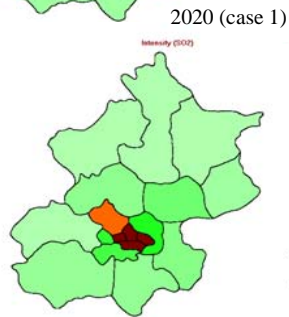
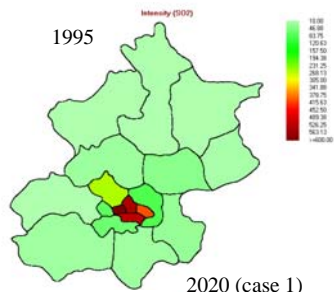
3.2 AIM/Local study for Beijing



CO₂ intensity (t-C/km²)



3.2 AIM/Local study for Beijing



SO₂ intensity (t-SO₂/km²)

