

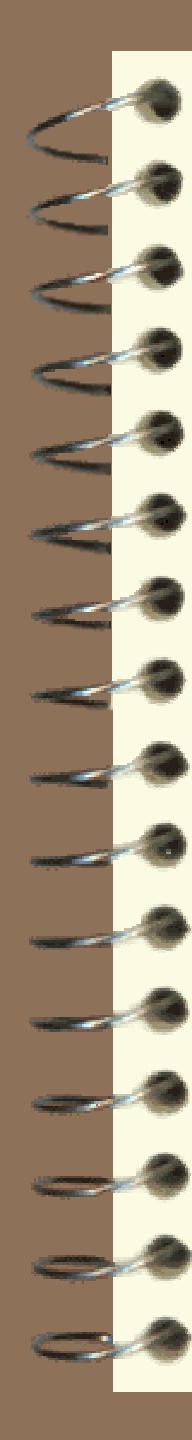


The Approach for Integrated Assessment of Energy Option and Health Benefits

- A IES Case Study, Shanghai China

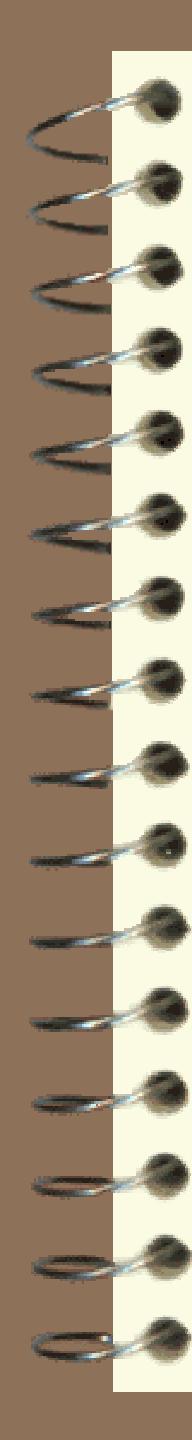
Changhong CHEN
Shanghai Academy of Environmental Sciences

**Sino-Korea-U.S. Economic and Environmental
Modeling Workshop**
Beijing, 7 November, 2002



Overview

- Introduction
- Methodologies
- Policy/Option Scenarios
- Emission/Exposure/Health Outcomes
- IES Findings

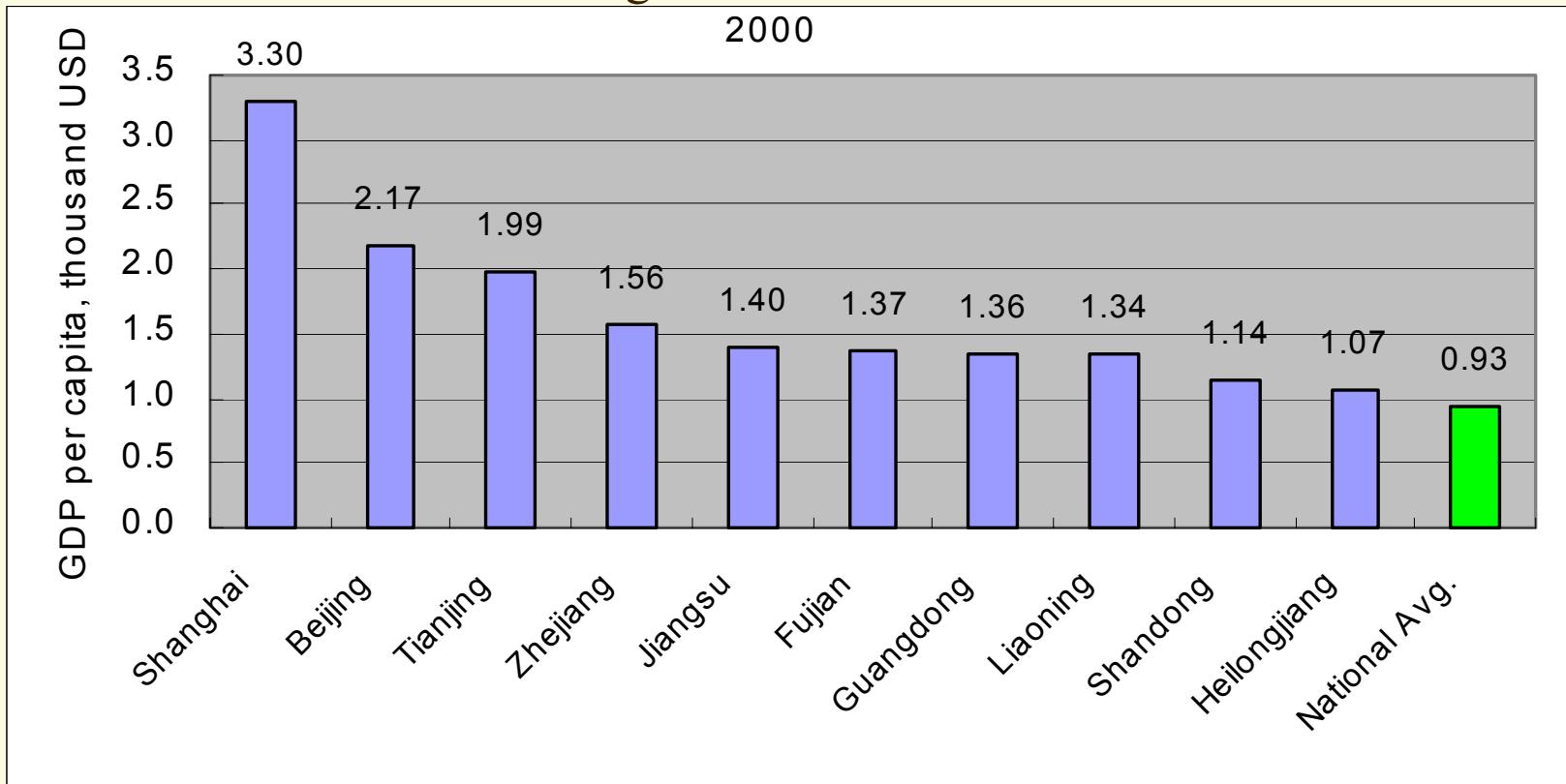


Introduction

- ~~~IES: Integrated Environmental StATEGY
- ~~~Shanghai IES initiated in 1998 by U.S. EPA as ICAP, the International Co-Control Analysis Program
- ~~~An integrated international environmental policy program designed:
 - to build support for Shanghai's integrated strategies to address local environmental concerns and GHG mitigation
 - to build linkages between local & global environmental policy

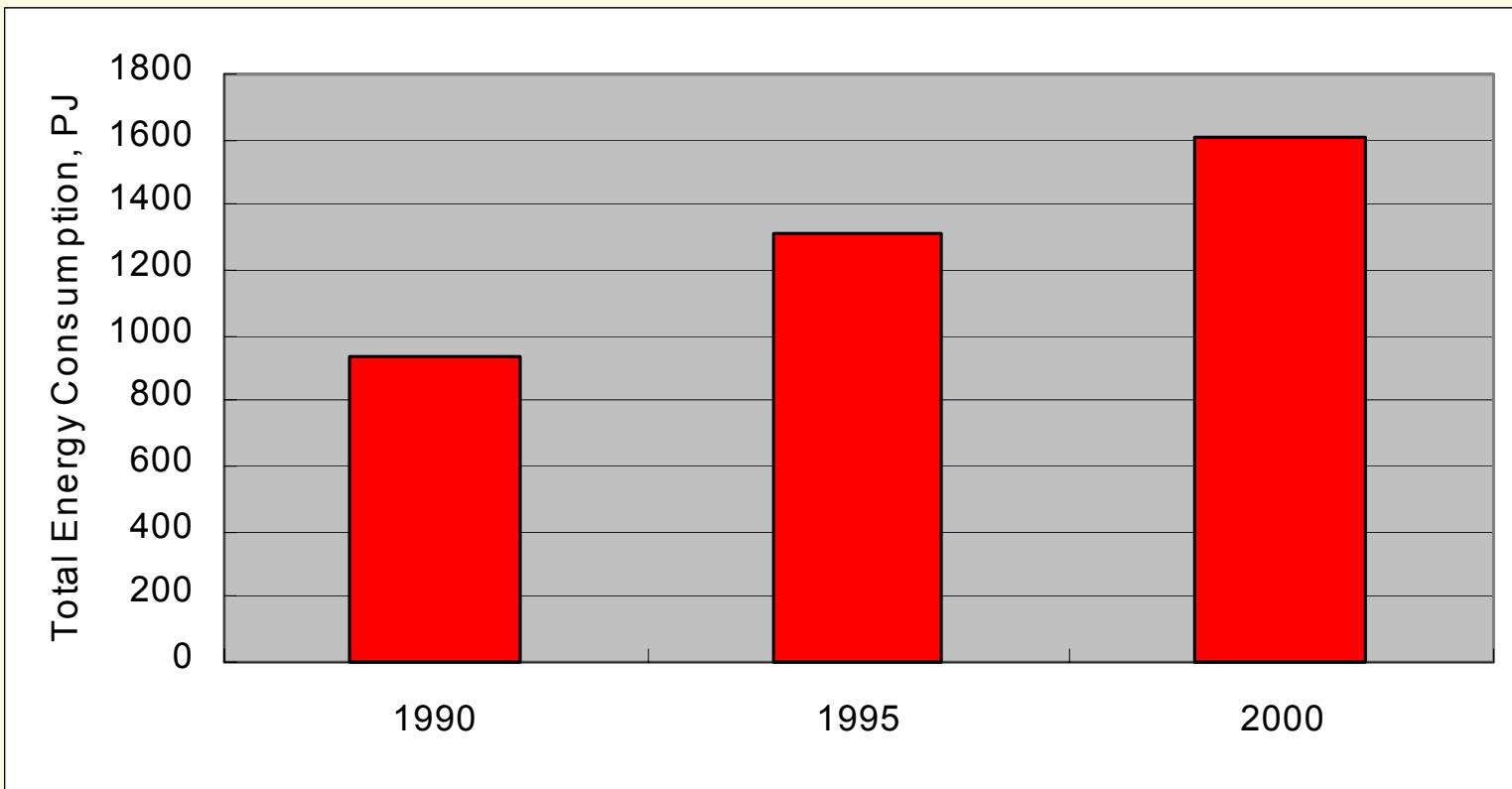
Shanghai GDP

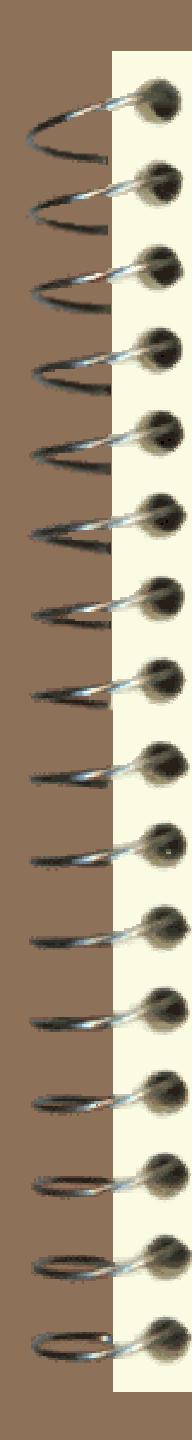
1. In 2000, its total GDP reached 455.1 billion Yuan, and GDP per capita reached 27.2 thousand Yuan (approximately 3300 USD), being 3.5 times of the national average.



Energy Consumption

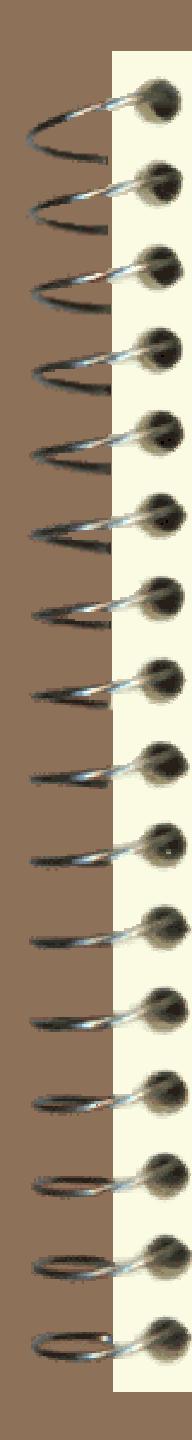
-
- 2. As economic development, total energy consumption grows smoothly with a growth rate of 5.6% during 1990 to 2000.





Pollution control policies implemented

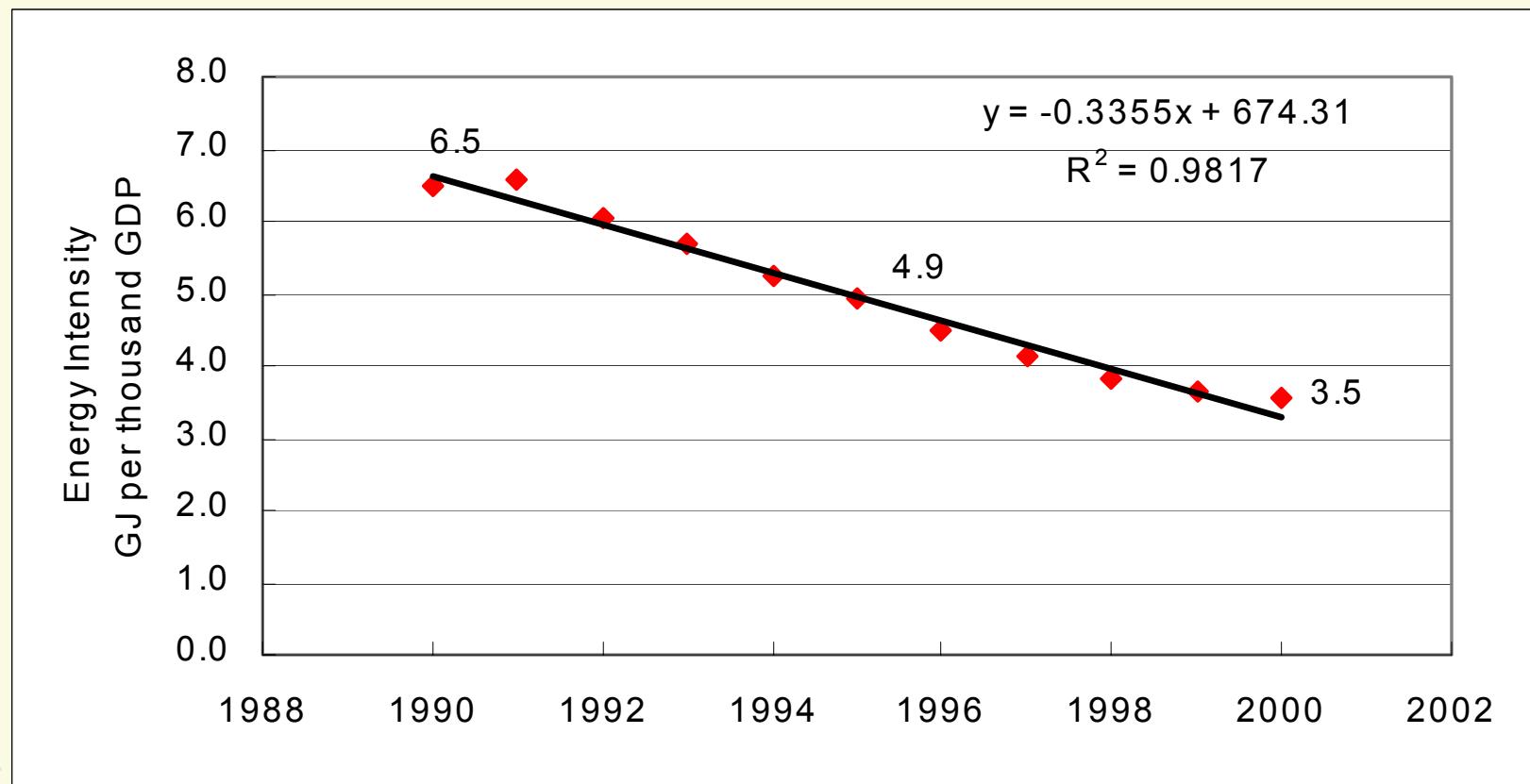
- City planning related
 - Plants relocation
- Energy related
 - Introducing Hi-tech
 - Close down the plants with high energy consumption, lower energy efficiency, heavy pollution.
 - Energy switch from coal to town gas.



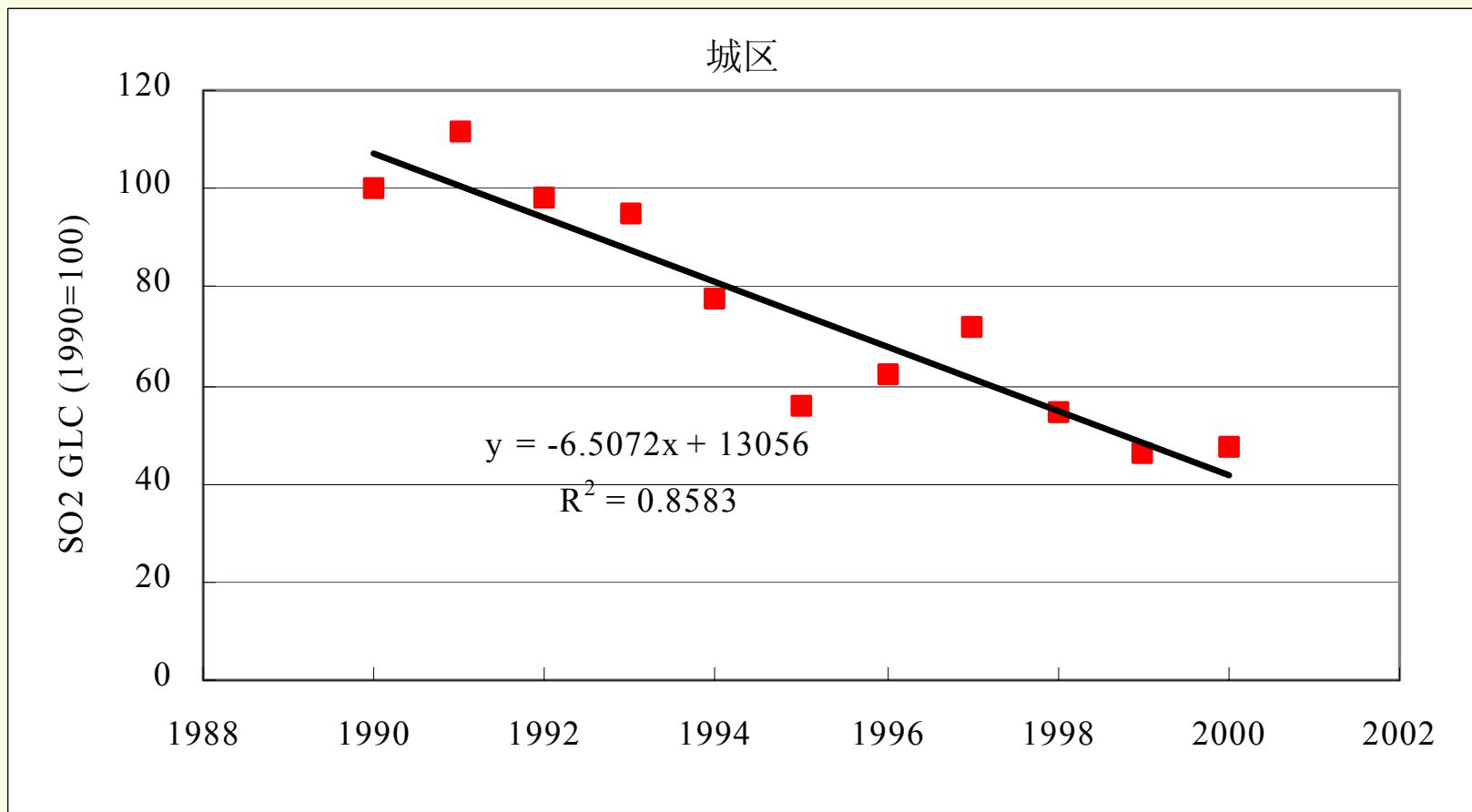
Pollution control policies implemented

- Economic and energy related
 - Economic structure adjustment
- Pollution control related
 - Black Smoke Control
 - Non-black smoke zone
 - Emission control
 - Non-coal-burning zone

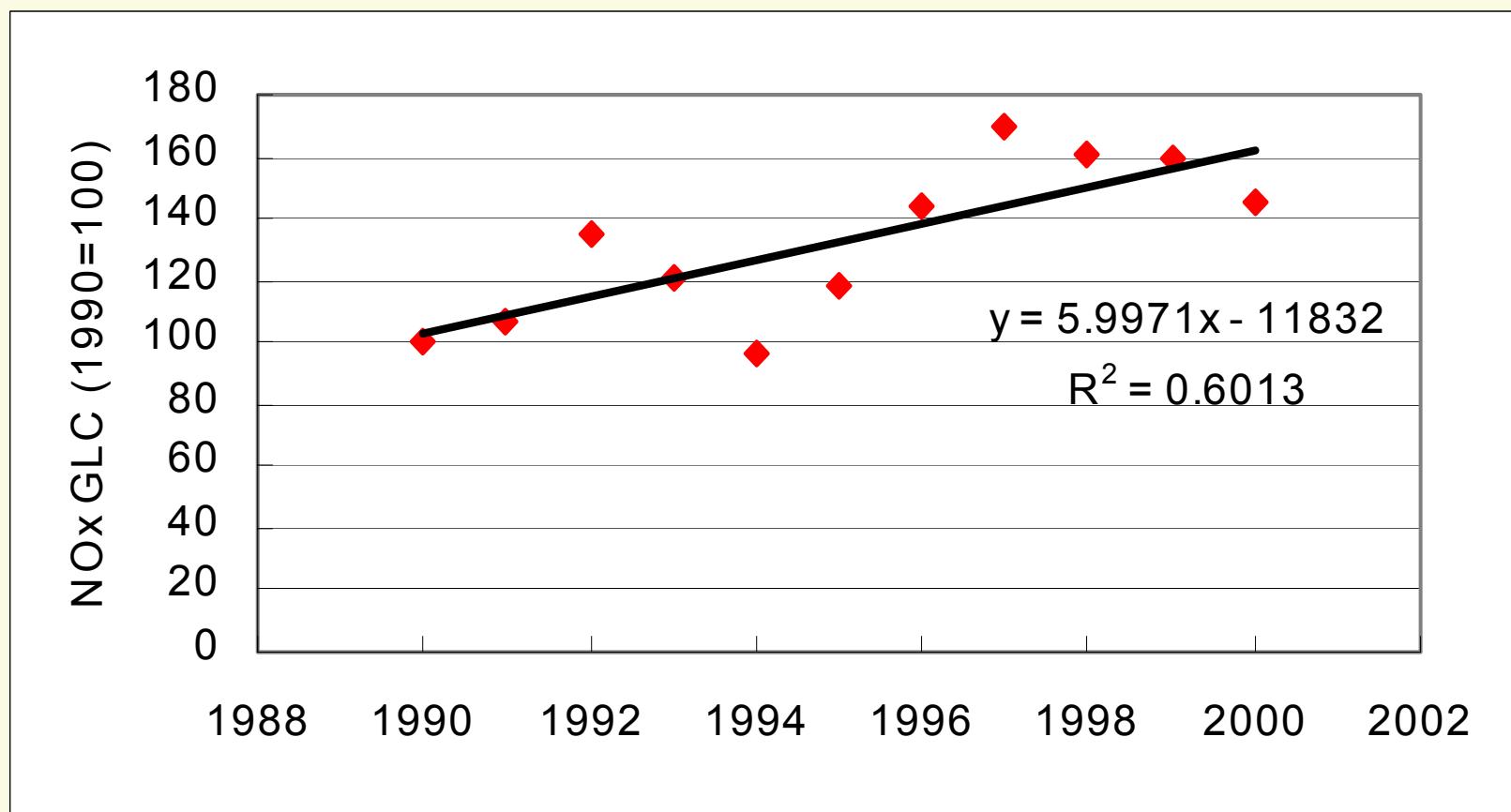
Energy Intensity, 1990-2000 (00's price)



Local Air Quality, 1990-2000

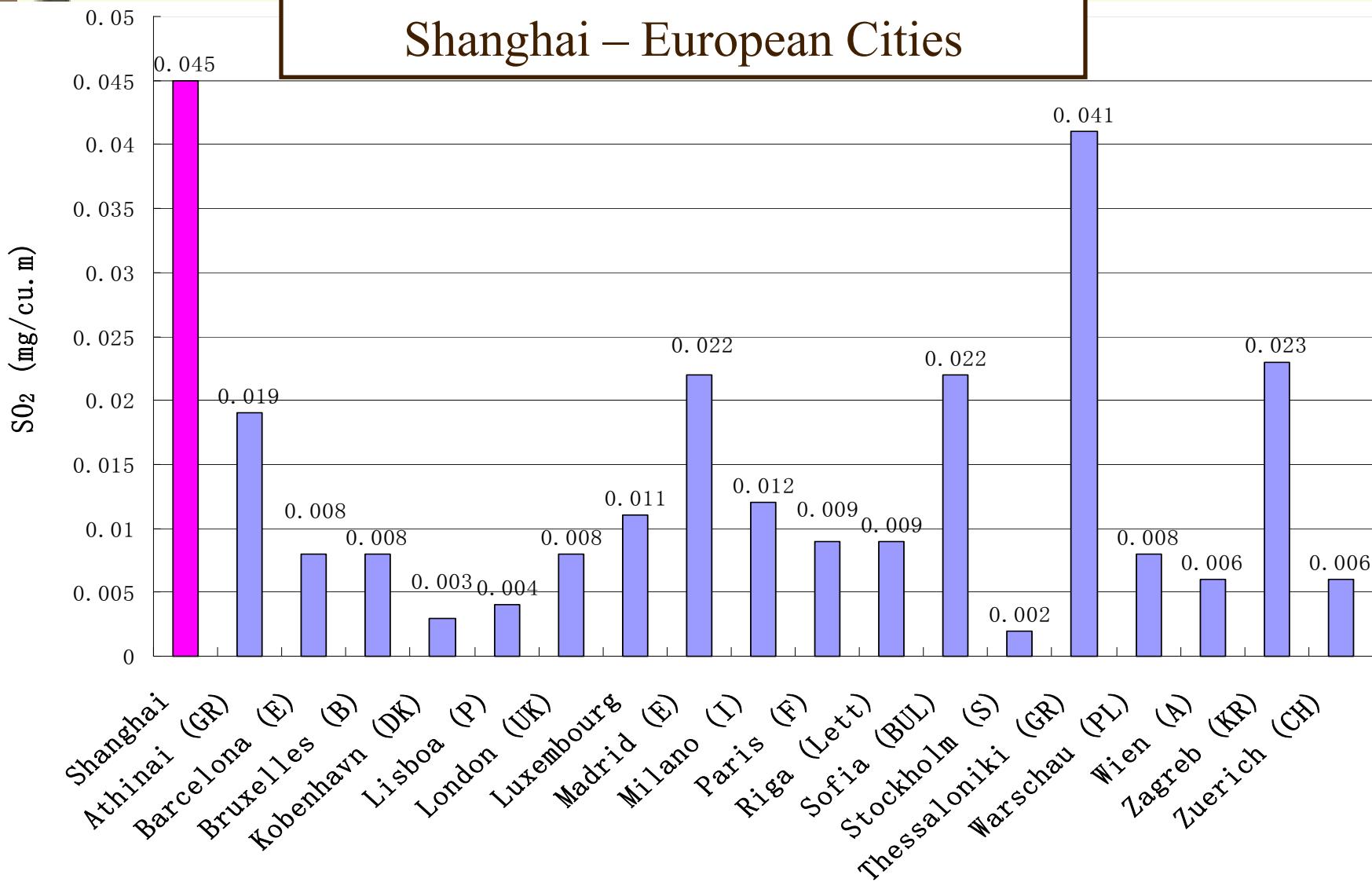


Local Air Quality, 1990-2000



Annual Average Concentration of SO₂ in 2000

Shanghai – European Cities

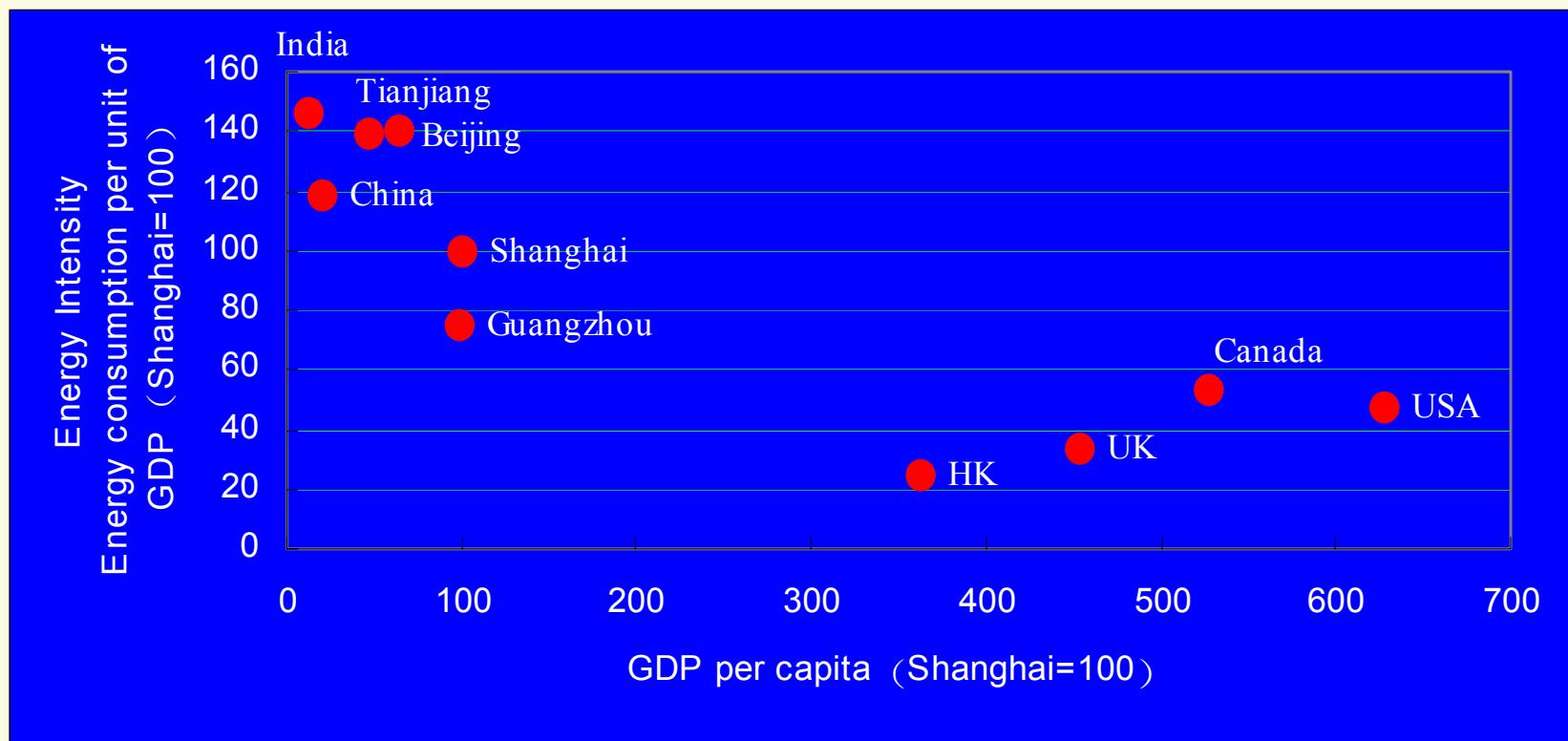


Energy intensity comparison

能源效率相对较低

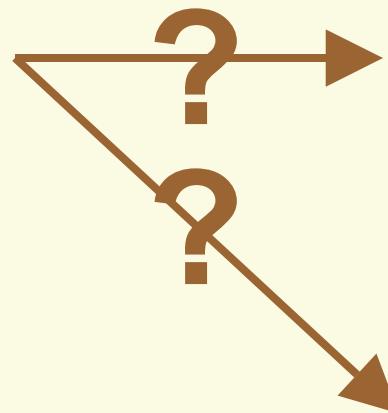
需要调整能源结构，需要提高能源技术

能源效率相对较高



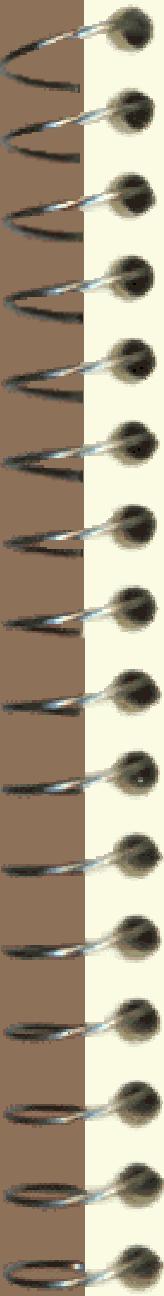
QUESTIONS

Energy
options



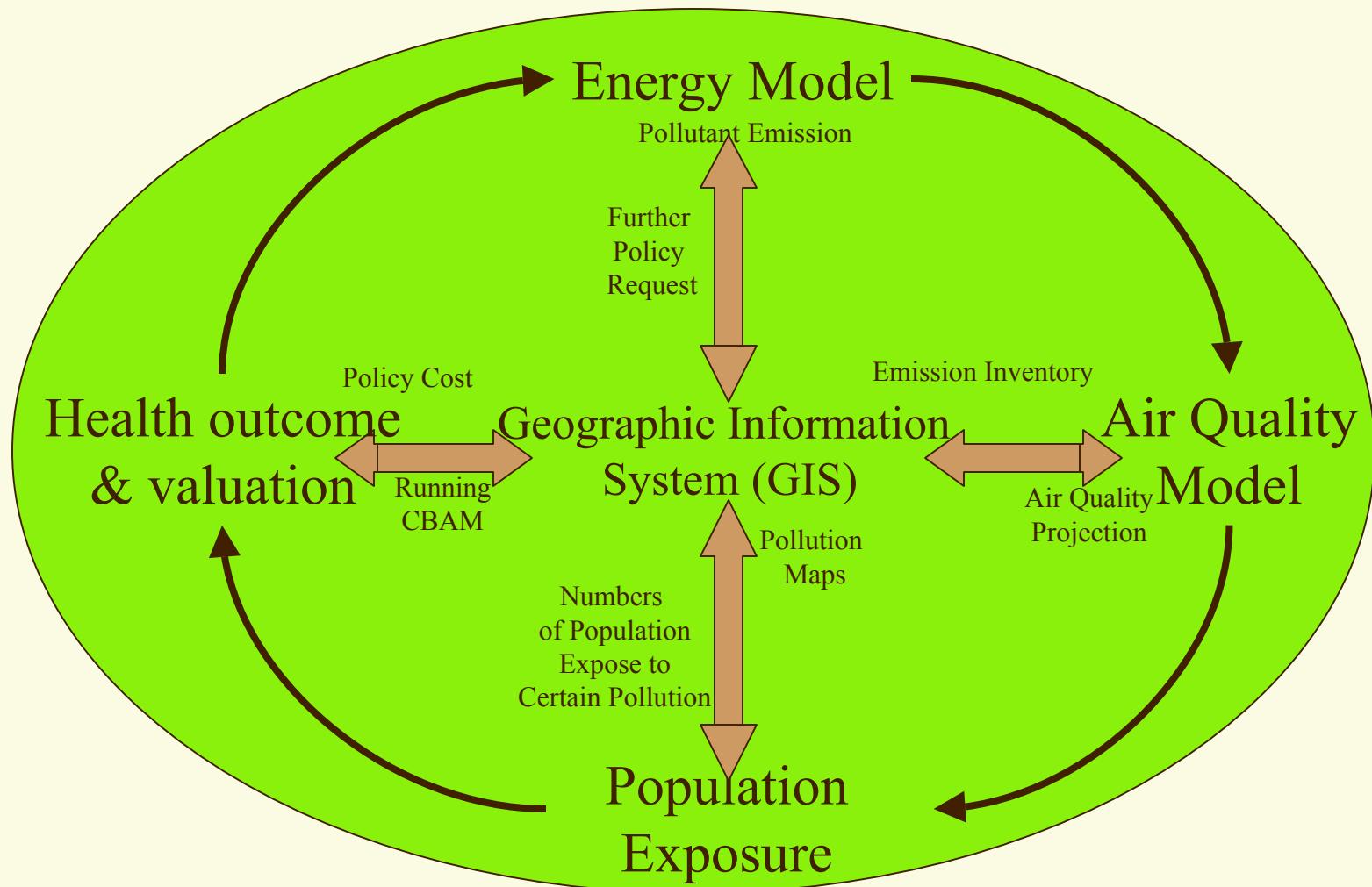
Health benefits -
local air quality

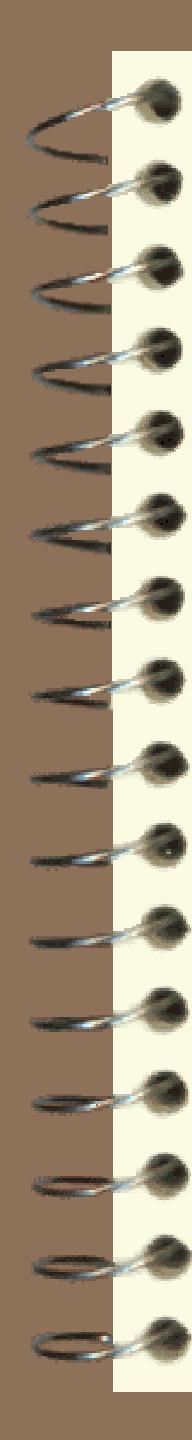
Co-benefit - global
environment benefit



Methodologies of Shanghai IES Project

Integrated Model for Shanghai IES Project





Policy Scenarios

Base Case

Energy Efficiency Improvement

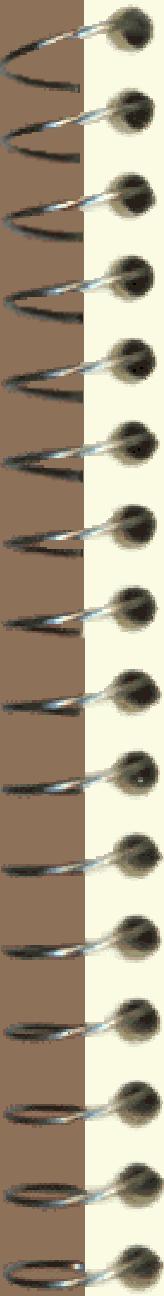
Energy Switch from Coal to Natural Gas

Expanding Gas Use

SO₂ Emission Target control

SO₂+NO_x1 Emission Target control

SO₂+NO_x1 Emission Target + CO₂ Tax

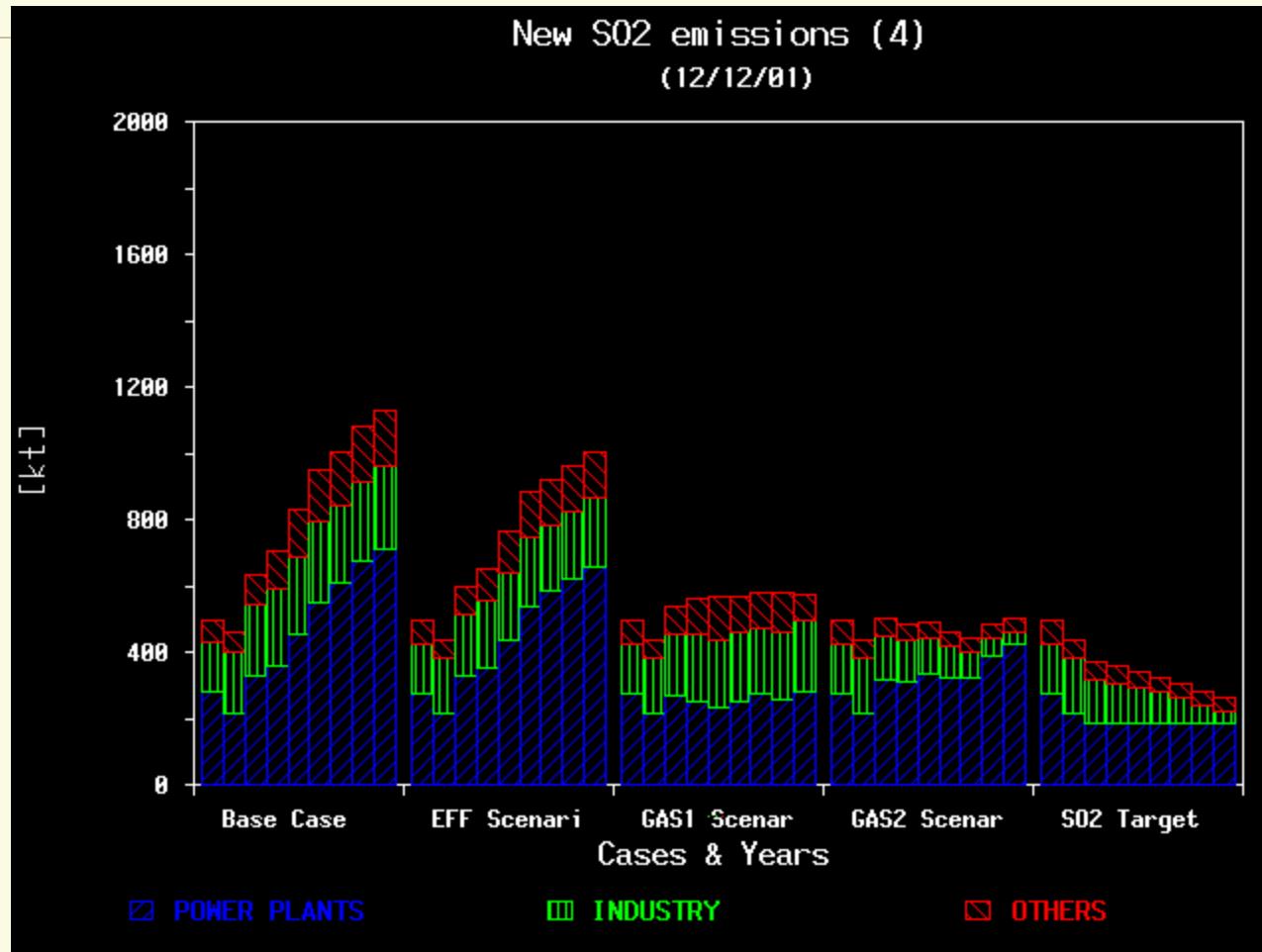


Emission Scenarios

VS

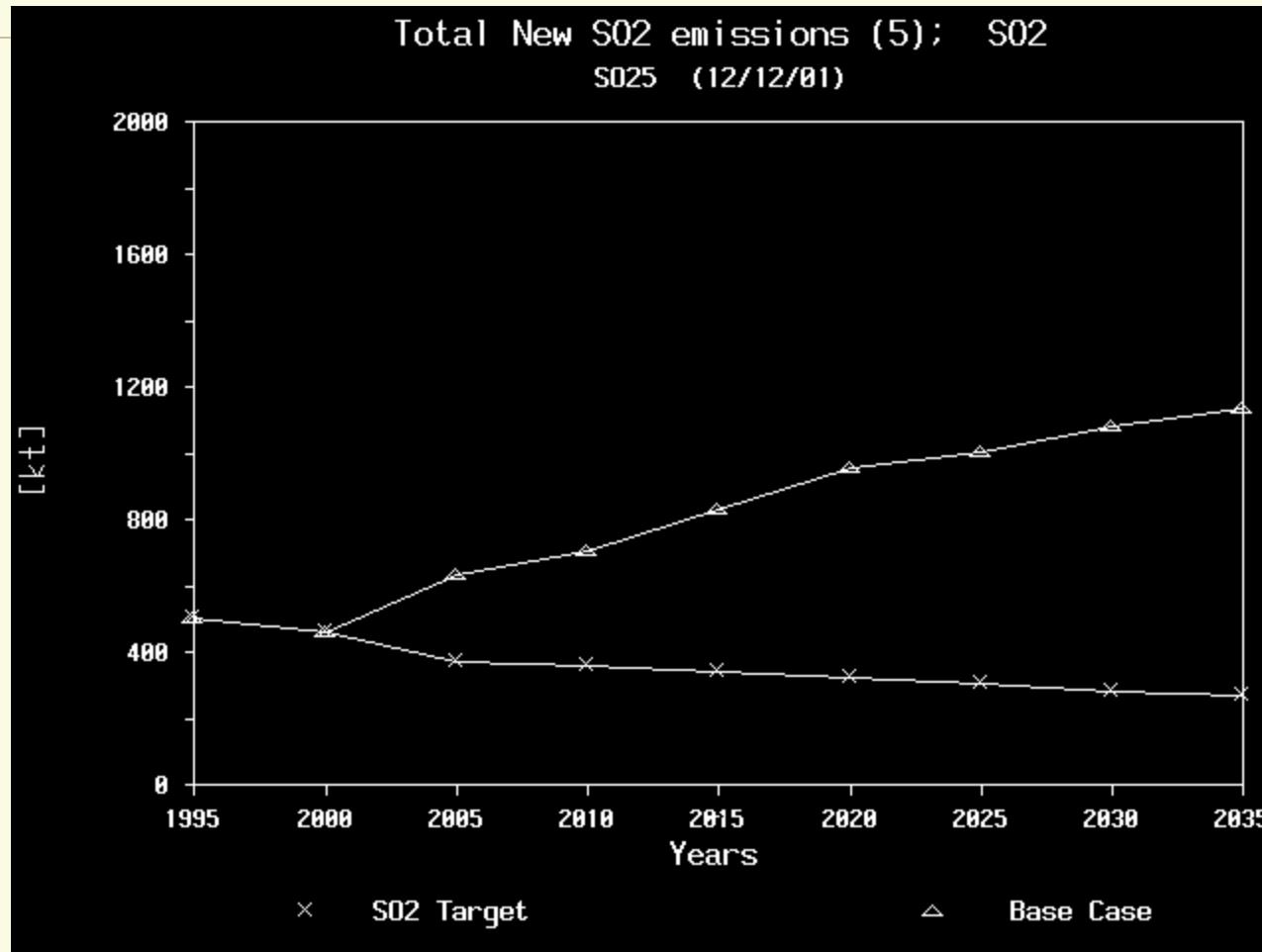
Energy and Environmental Policy

MARKAL Results: Local air pollutant emission



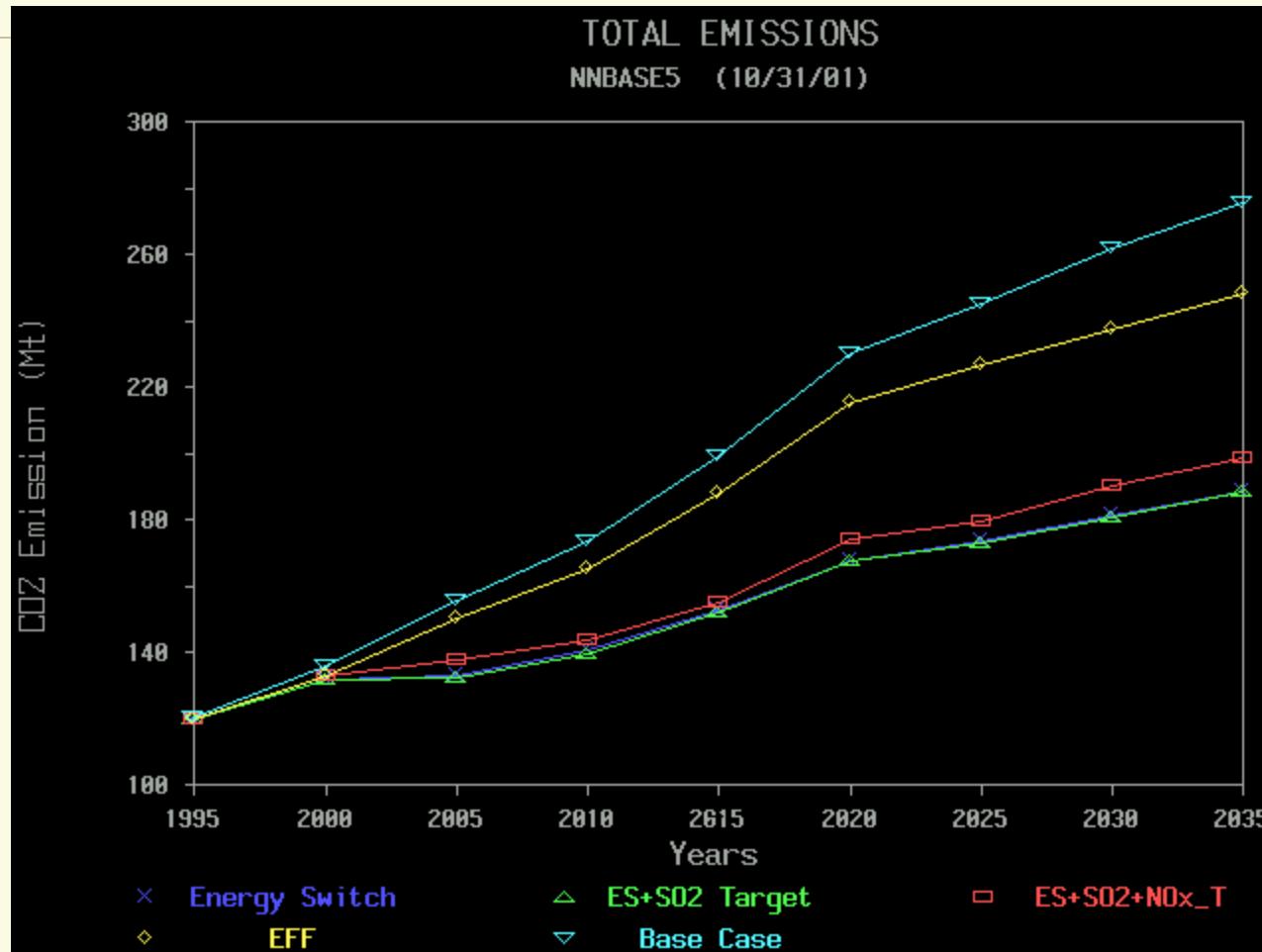
SO₂ Emission vs Energy and Environmental Policy

MARKAL Results: Local air pollutant emission



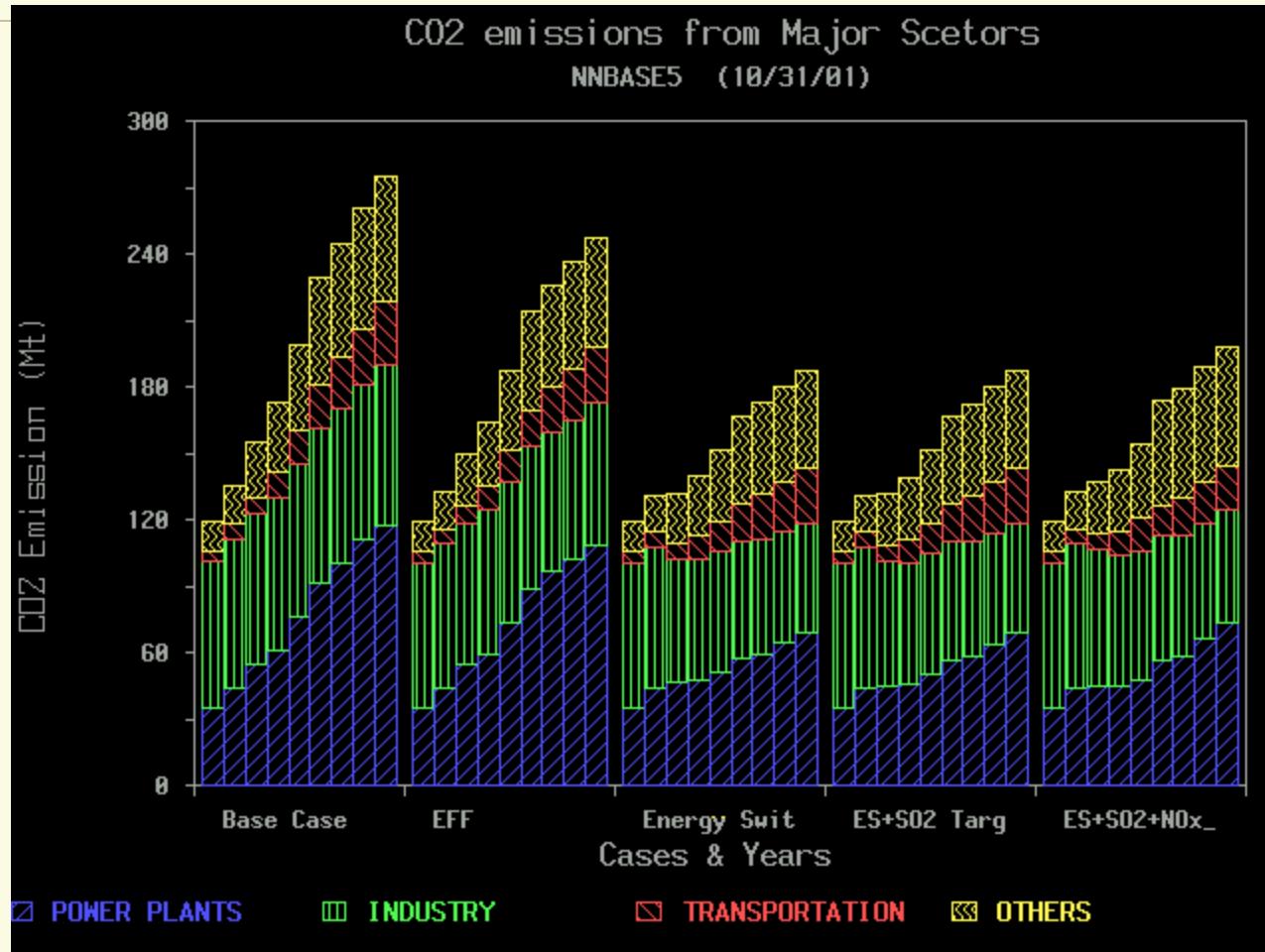
SO₂ Emission

Co-benefit of Chinese Local Energy and Environmental Policies



CO₂ Emission vs Energy and Environmental Policies

Co-benefit of Chinese Local Energy and Environmental Policies

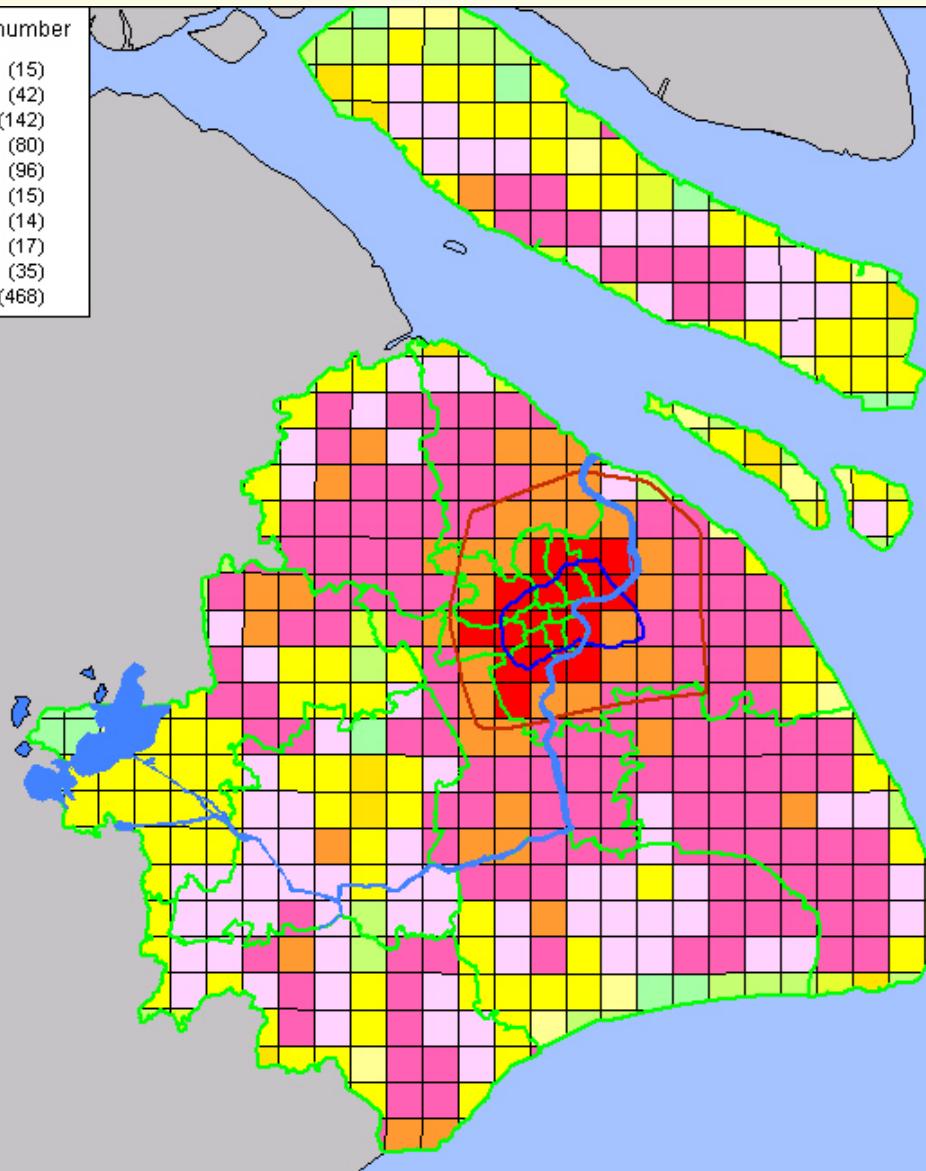
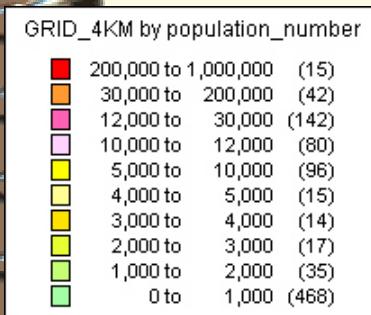


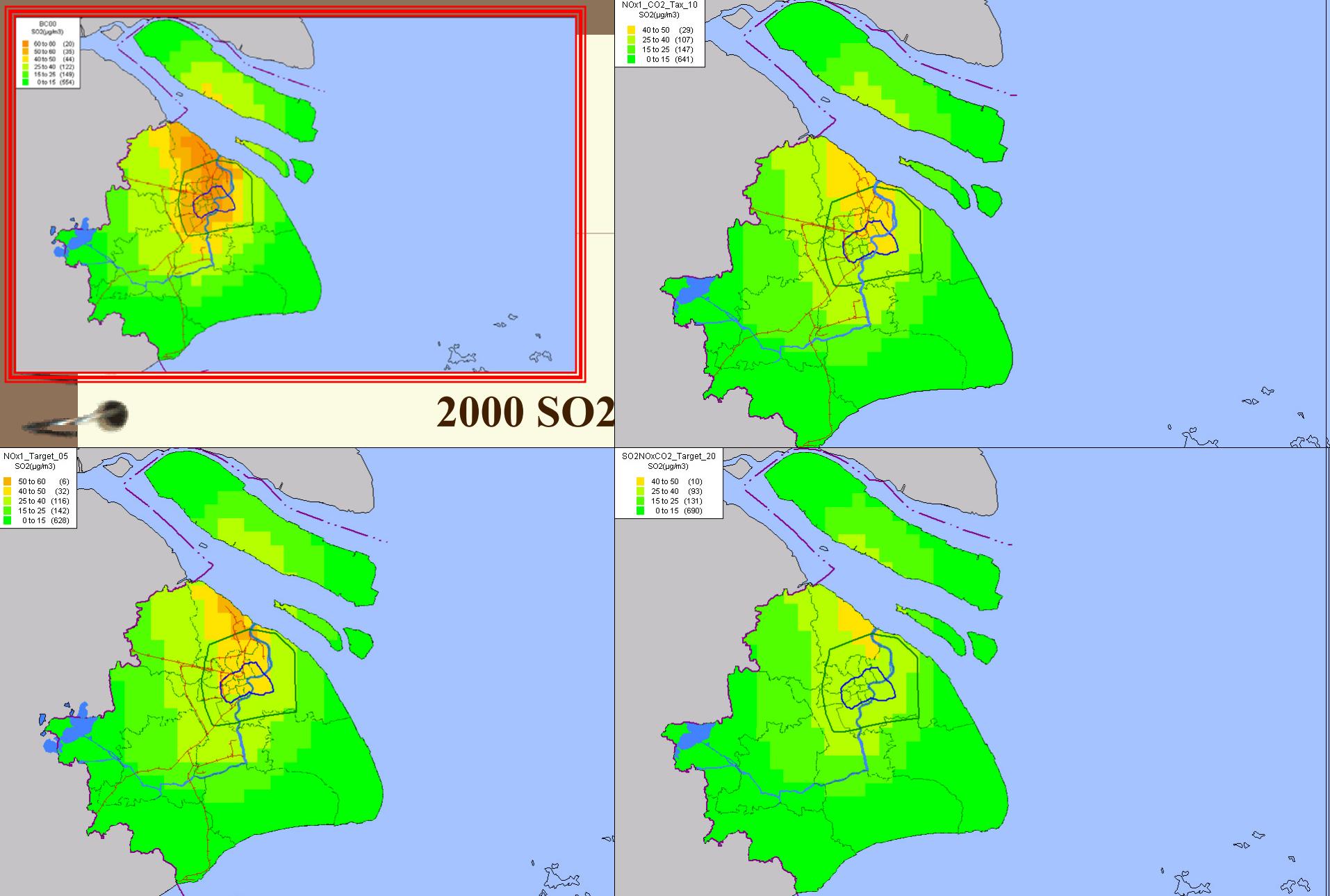
CO₂ Emission vs Energy and Environmental Policies



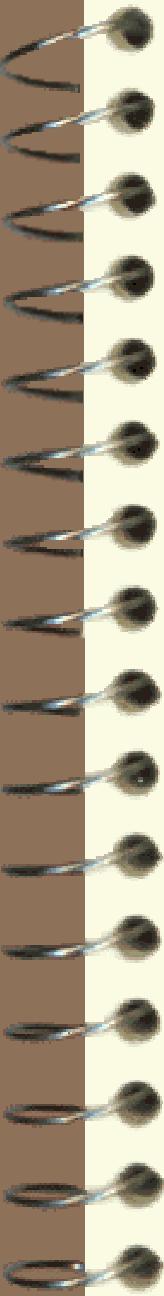
Air Quality Projection

Population Grid by $4 \times 4 \text{ km}^2$





**Base Case → EFF → Gas2 → SO₂ Target → SO₂+NO_x1
→ SO₂+NO_x1 + CO₂ Tax Scenario**

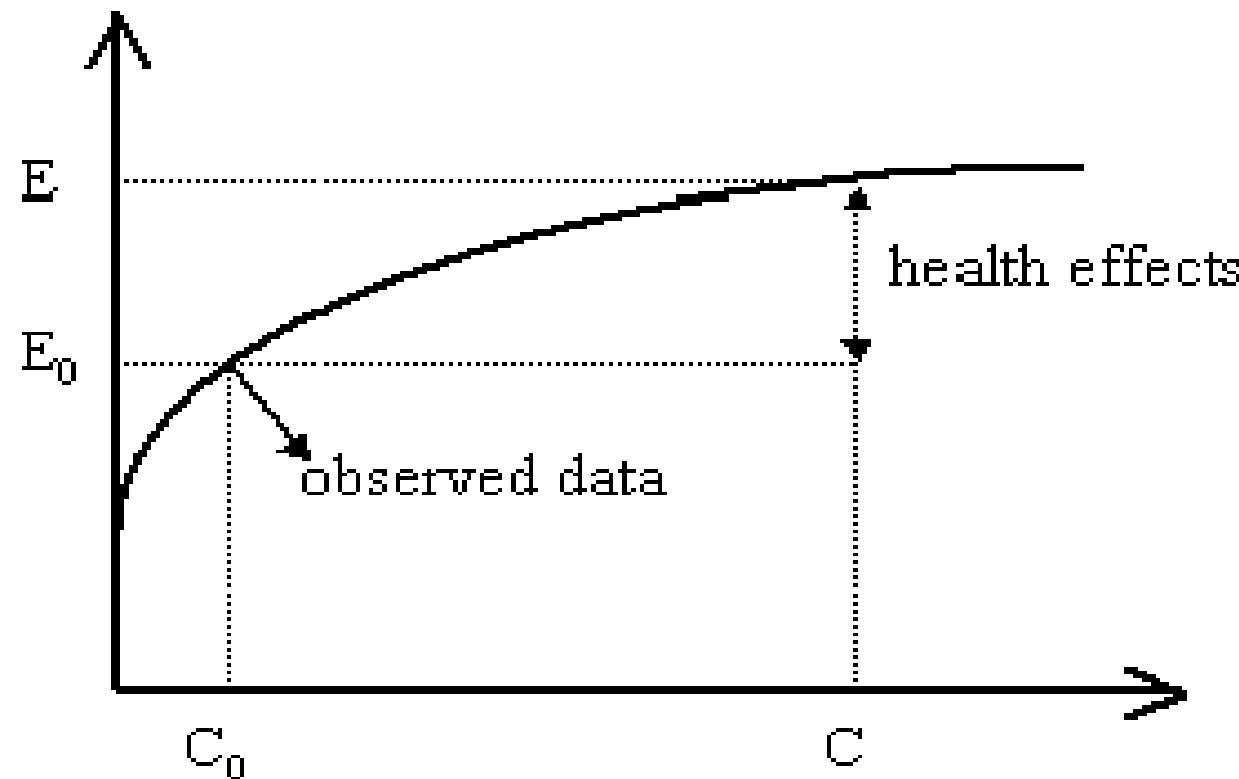


Health Outcome & Valuation

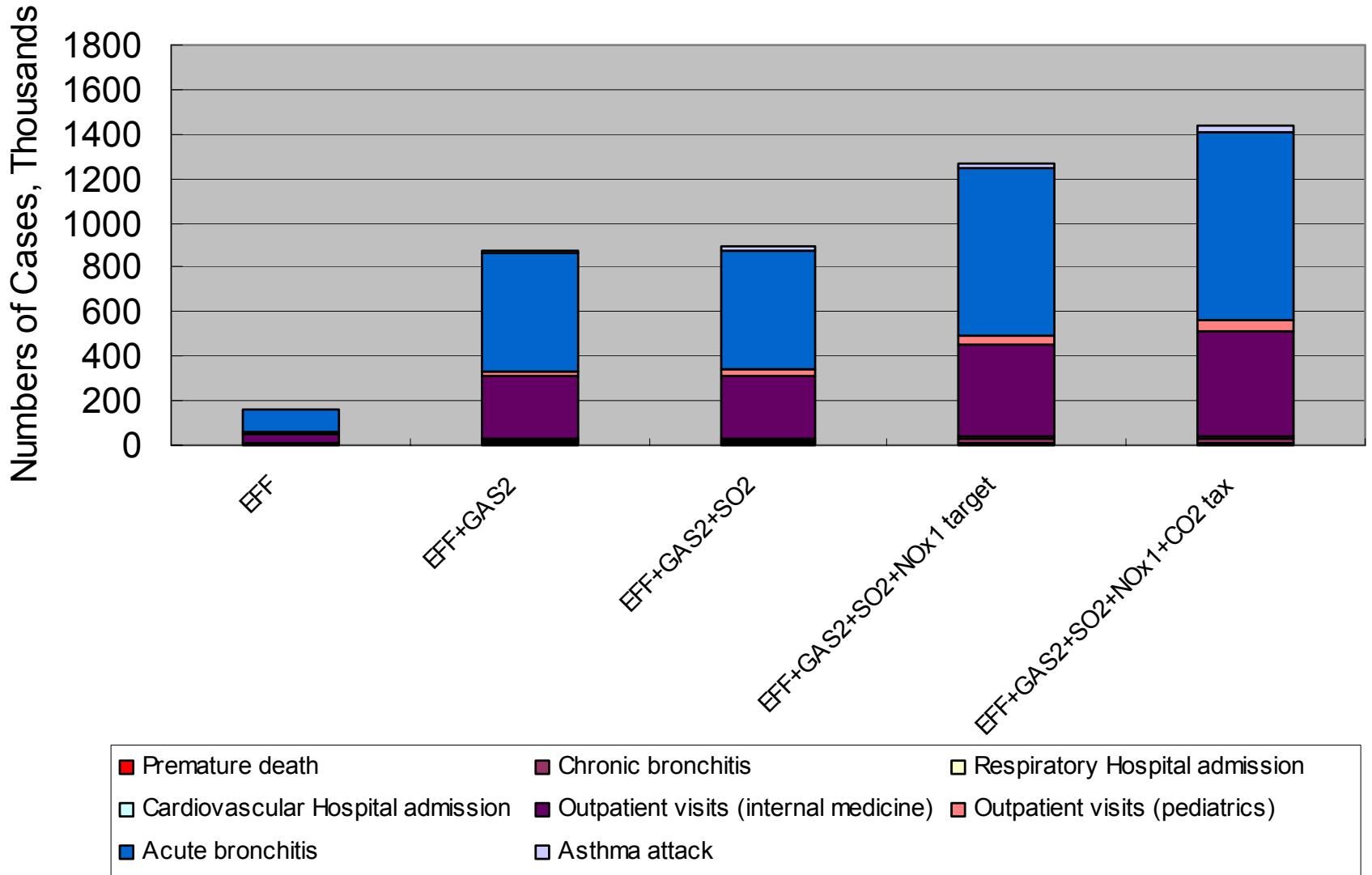
Health Effects Estimation Model

C-R Function

$$E = \exp(\beta \times (C - C_0)) \times E_0$$



Health benefits in 2020 (compared to Base Case)



Results: 2020 (millions of 2000 US\$)

Premature death: 300.4-2646.0

(早死)

Chronic bronchitis: 21.6-188.8

(慢性支气管炎)

Res hospital admission: 1.1-10.2

(呼吸系统住院)

Car hospital admission: 1.1-10.3

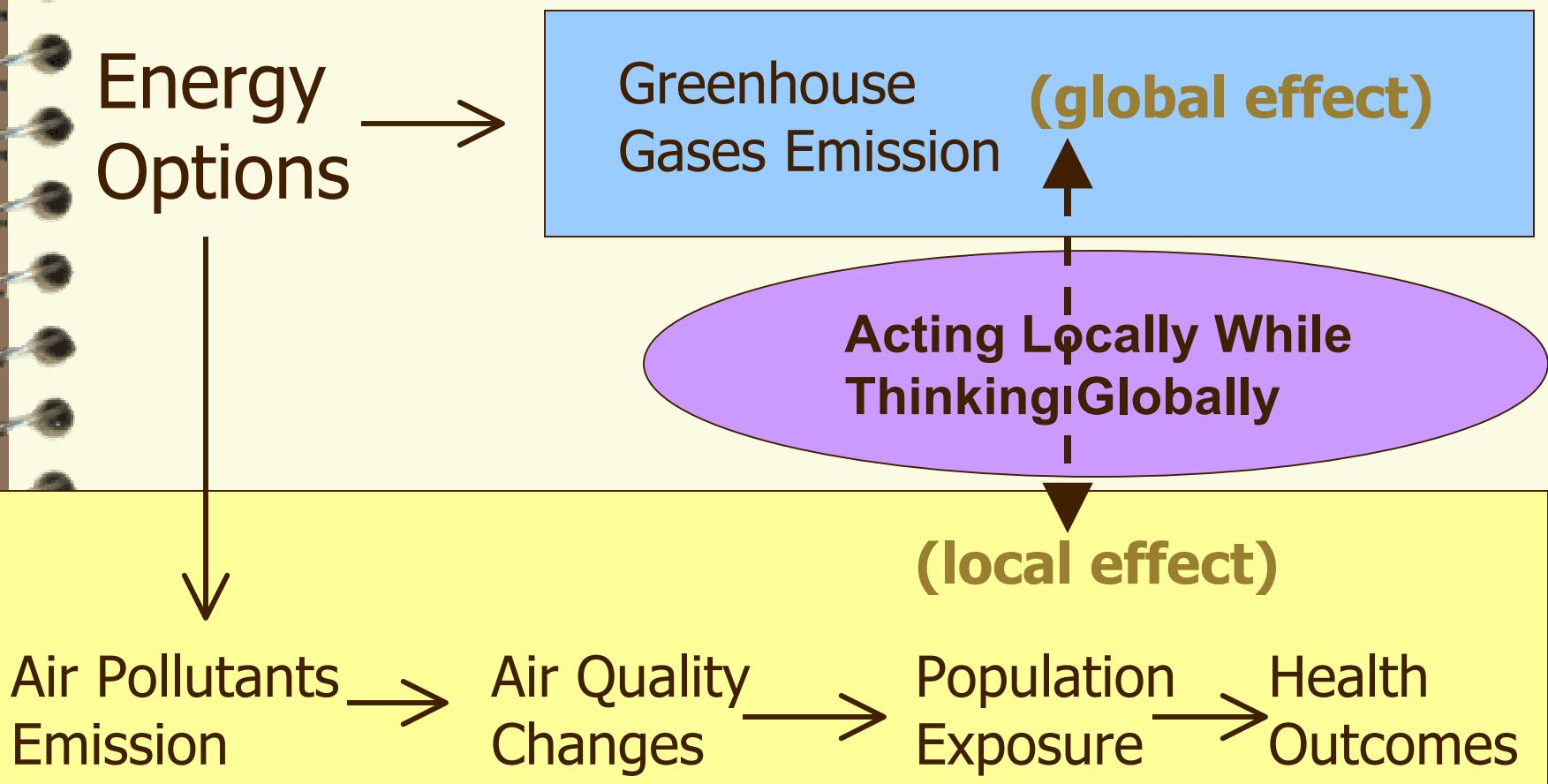
(心血管系统住院)

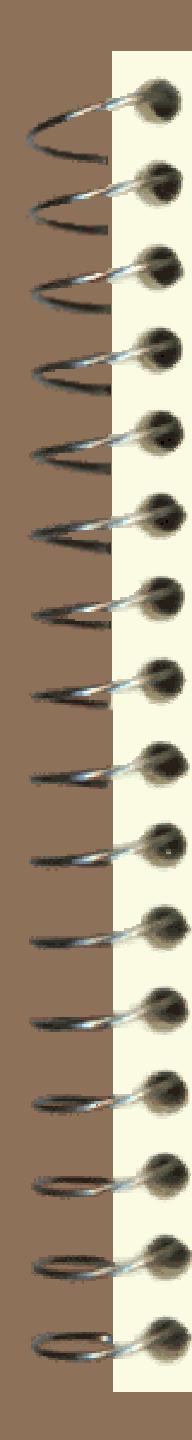
TOTAL: 327.4-2884.0

Conclusion

- Chinese energy policy is very positive
 - Significantly reduce local air pollutant emission
 - Greatly reduce the growth rate of CO₂ emission (Co-benefit)
- Further reduction on LAP will be largely relied on the induction of advanced energy technology and end pipe technology
- The introduction of end pipe technology will be depended on financial policy (stimulative policy)
 - internal cost
 - external cost???

Conclusion

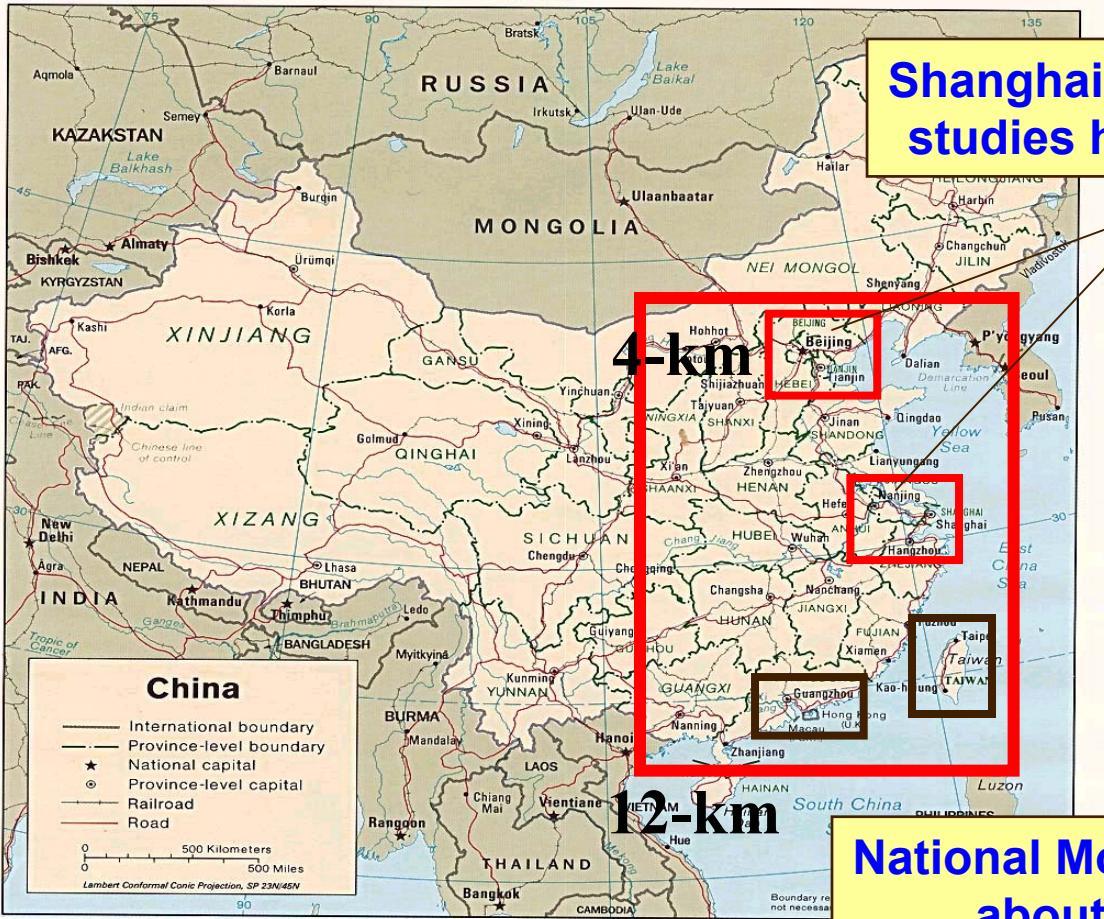




Future Research

- Case study provide some experience and approach for other Chinese cities.
- Local energy and environmental policy will definitely improve local air quality and will have some health benefit, and also will have some benefit on reducing CO₂ growth rate in the future.
- Some large scale and sophisticated air quality model (Models-3) is available for regional and national level studies.

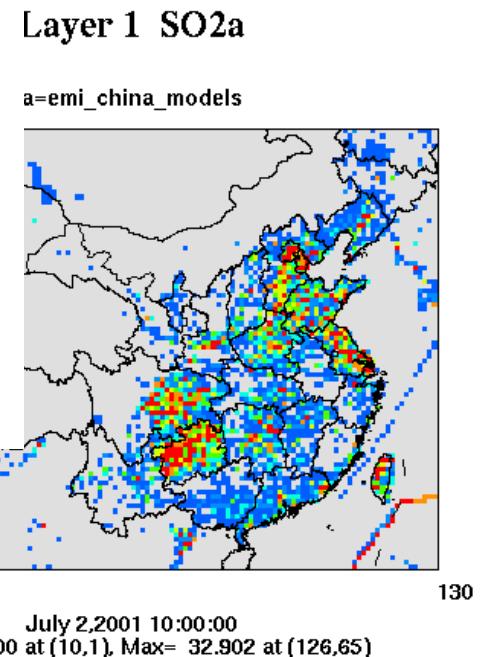
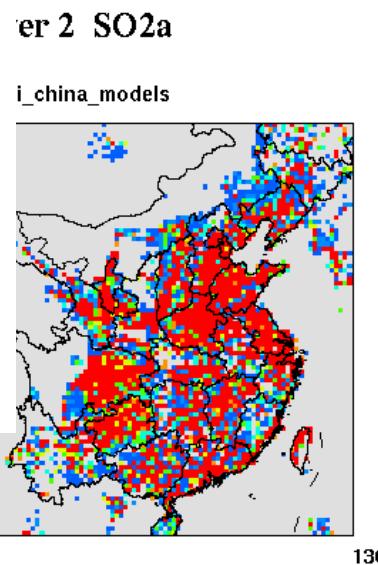
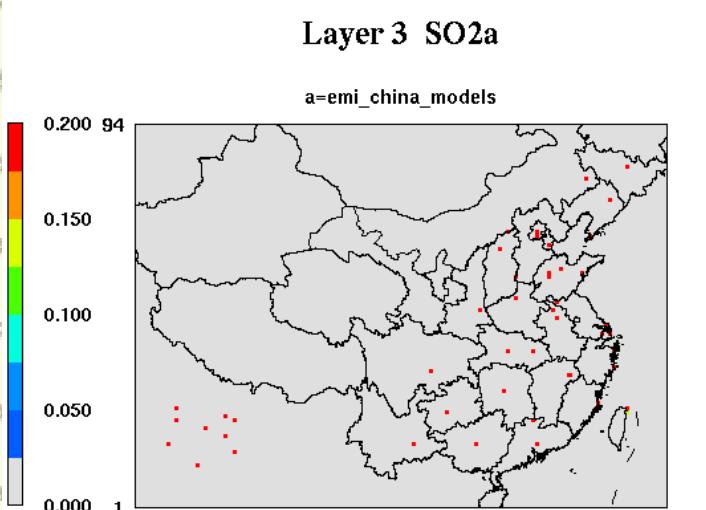
Air Quality Modeling Assessment Projects over Greater China Regions



Shanghai and Beijing regional studies have been proposed

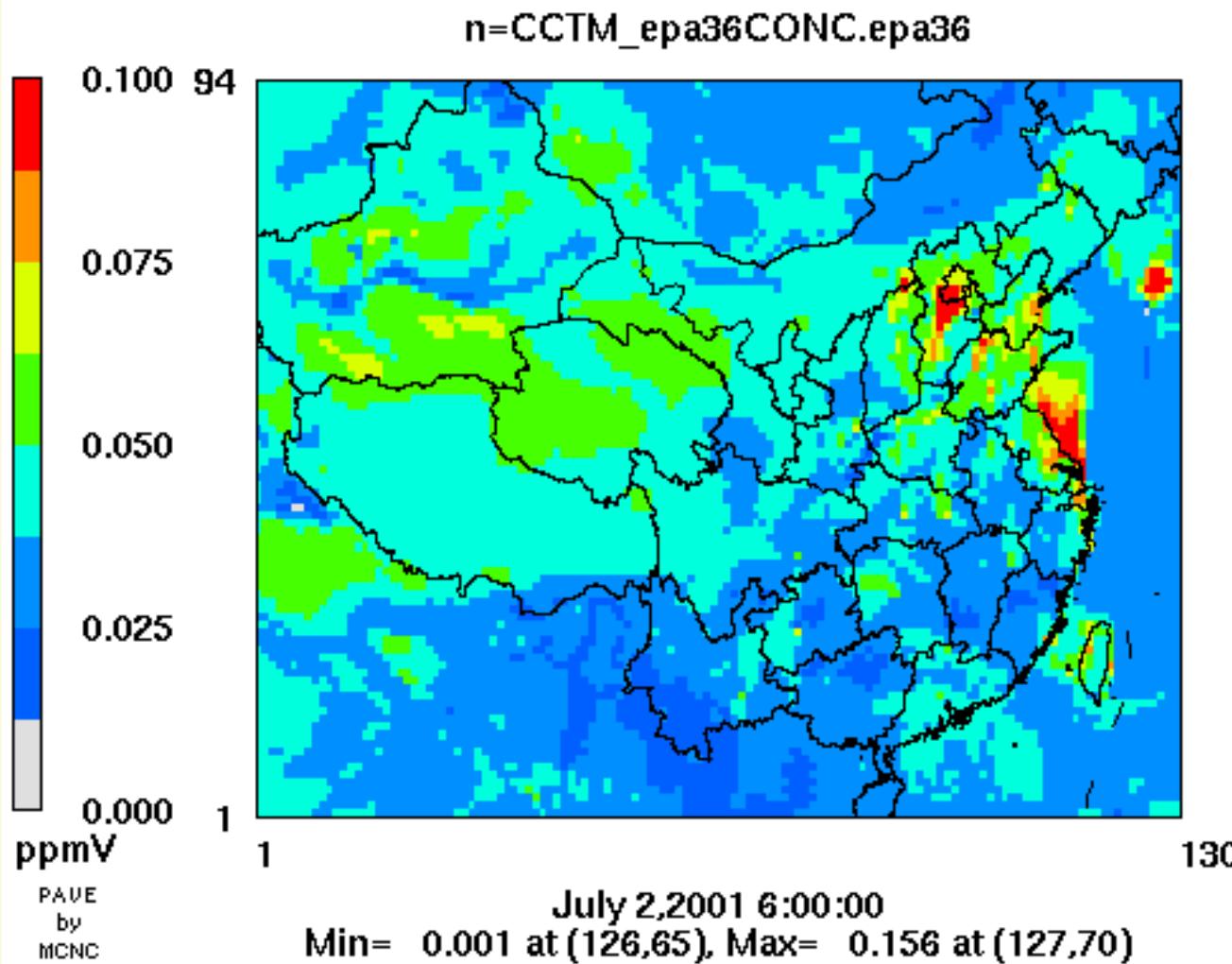
National Models-3/CMAQ modeling about to begin (fine grid)

SO₂ emissions, showing Layer 3 (power plants), Layer 2 (industry), and Layer 1 (residential and transport)



Air Quality Modeling Assessment in China

Ozone





A photograph of a spiral-bound notebook page. The page is cream-colored with a subtle texture. The spiral binding is visible along the left edge. In the center of the page, the words "Thank You" are printed in a large, bold, brown serif font.

Thank You