

Modeling the Health Benefits of Carbon Emissions Reductions in China

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Overview

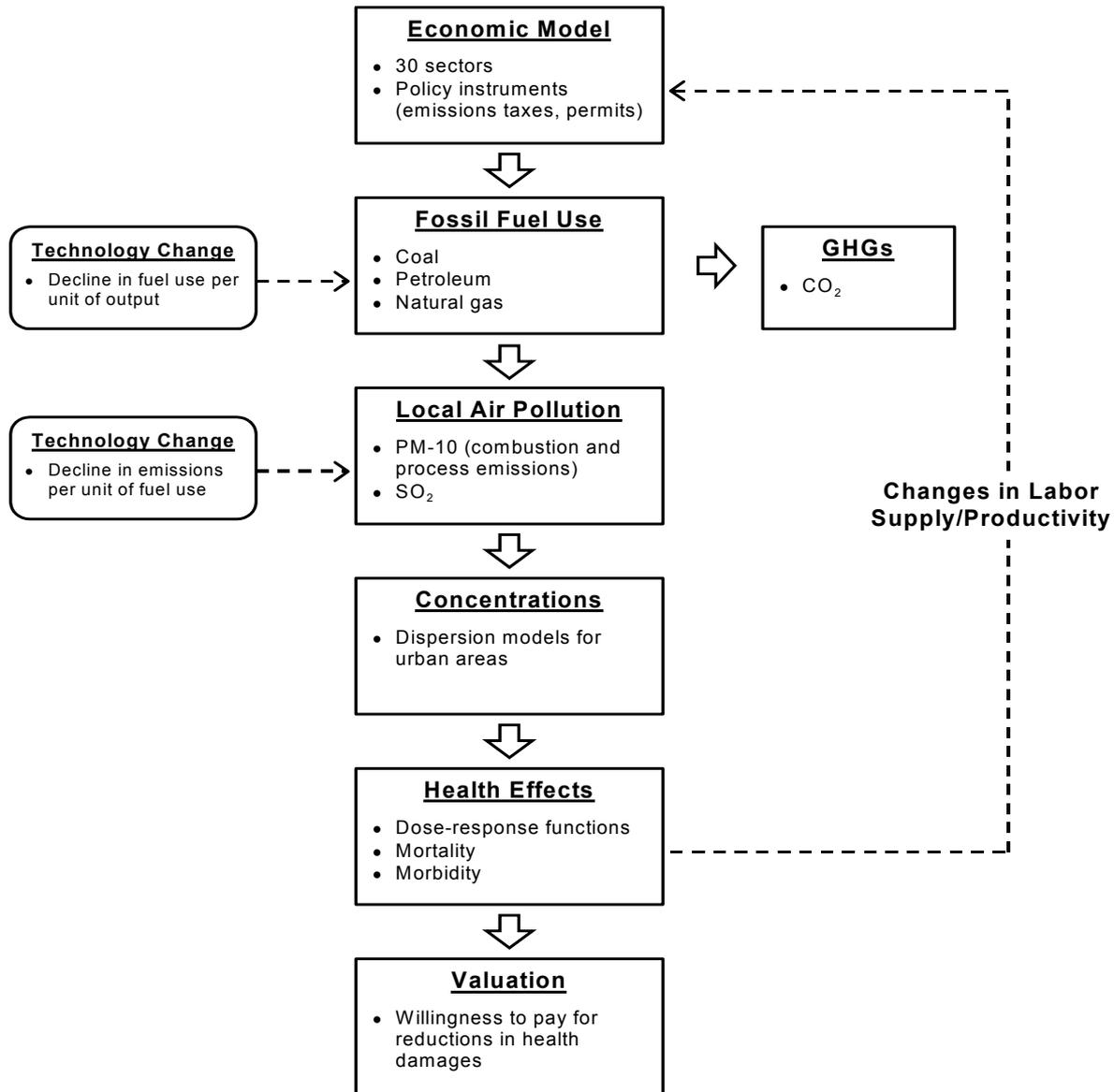
- **Our work is a preliminary effort to estimate the potential health benefits from policies to reduce carbon emissions in China.**
- **To do this we have integrated a model of the health effects of urban air pollution with a CGE model of the Chinese economy.**
- **In addition to the standard economic variables, outputs from the model include effects on human health and valuation of the damages.**

Estimated Health Effects of Air Pollution in Urban China, 1995

- **178,000 premature deaths in urban areas.**
- **Hospital admissions 346,000 higher than if China's air pollution standards were met.**
- **6.8 million additional emergency room visits.**
- **4.5 million additional person-years lost because of pollution-related illness.**
- **Health damages valued at 5% of GDP.**

Source: World Bank (1997).

Flowchart: China CGE Model with Health Effects



Design of Carbon Tax Simulation

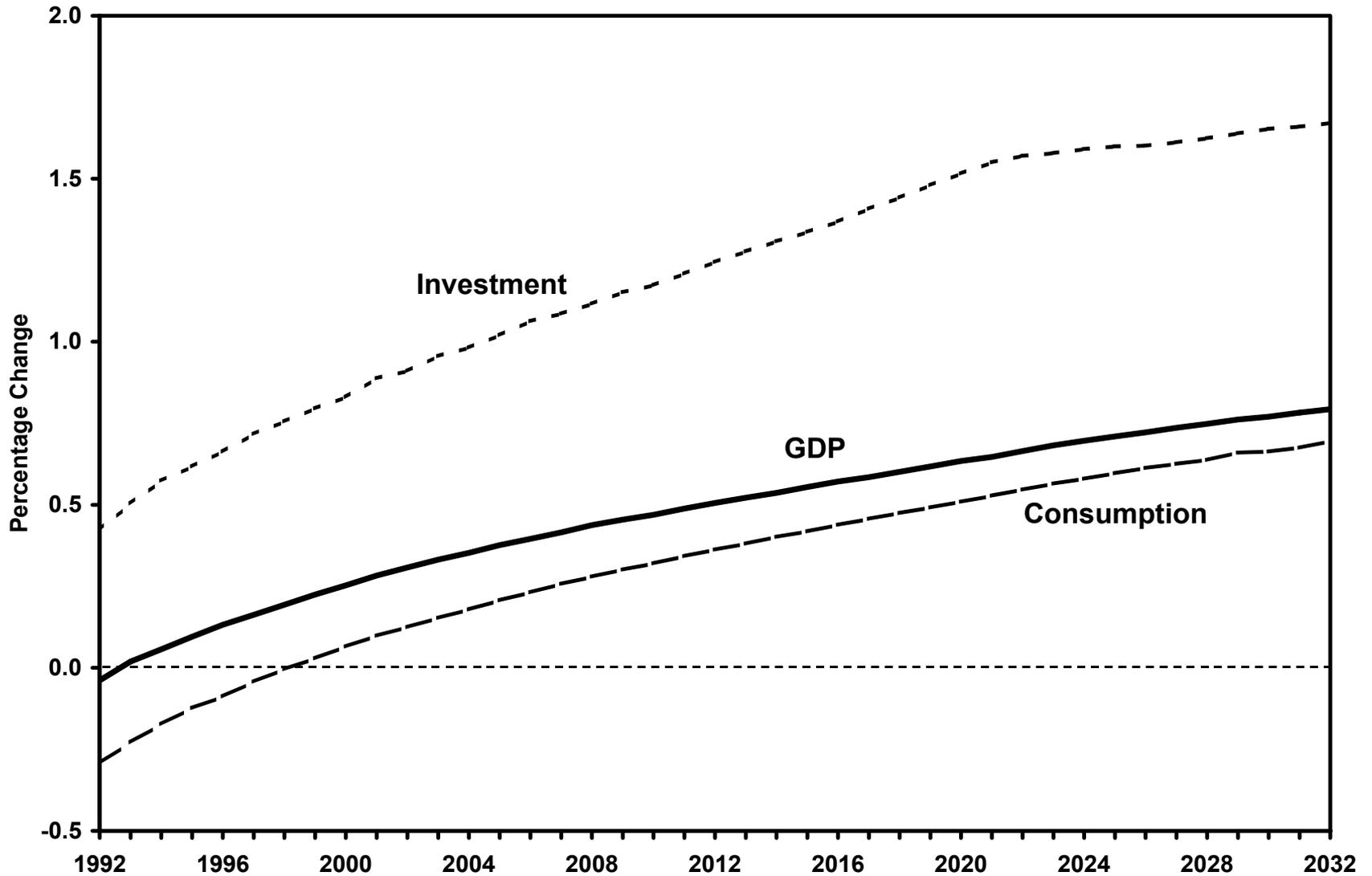
- 1) Run base case (business as usual) simulation.
- 2) Rerun model holding output of carbon to 90% of the base case in each period.
 - a) Carbon tax is made an endogenous variable.
 - b) Other taxes are reduced proportionately to keep simulations revenue neutral.

Health Impacts of a 10% Reduction in Carbon Emissions, 2010

- **13% increase in (tax inclusive) price of coal**
- **12% reduction in use of coal**
- **6% reduction in particulate emissions**
- **7% reduction in premature deaths**
- **7% reduction in cases of chronic bronchitis**

Macroeconomic Effects of Carbon Tax

(Percentage changes relative to base case)



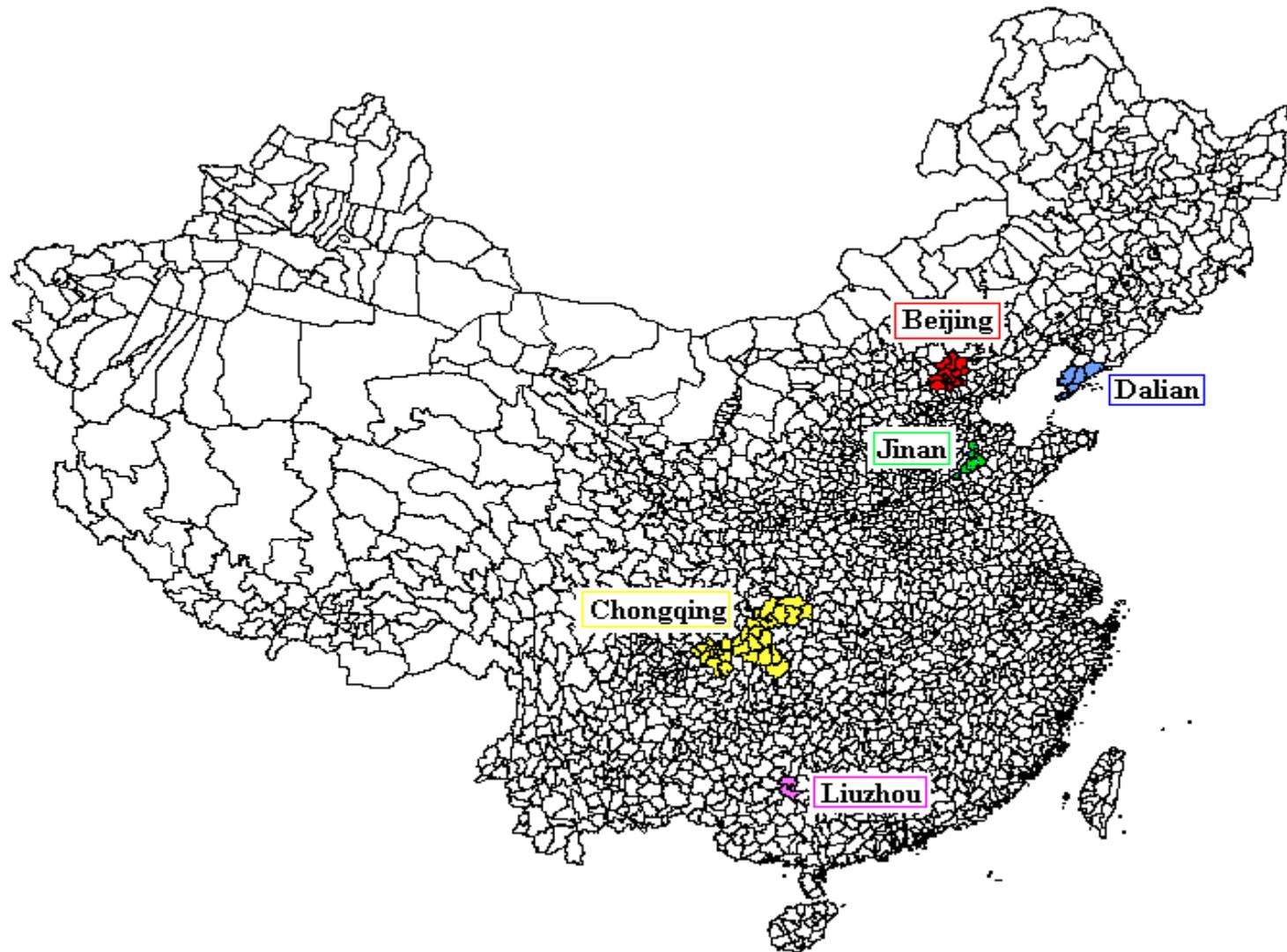
An Alternative Health Effects Model

- **The model developed by the World Bank for translating air pollution emissions into health effects in China is crude and was in large part adapted from studies of other countries.**
- **However, the more sophisticated methodologies and models usually used in developed countries require significant resources for data collection and analysis that are not currently available in China.**

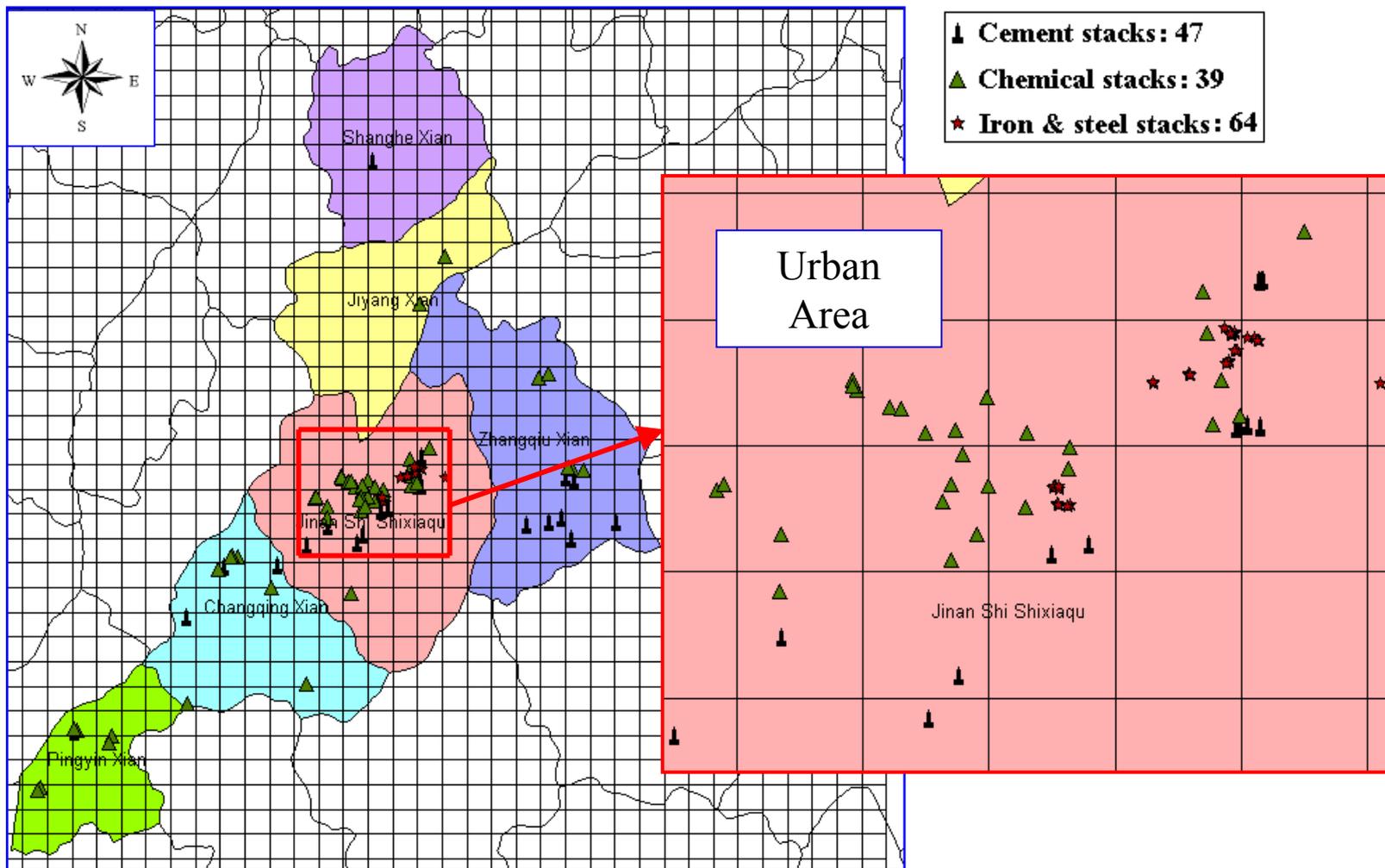
Harvard-Tsinghua Joint Project

- **Research in China funded by the Energy Foundation.**
- **Intake fractions were estimated for PM-10 and SO₂ for the iron and steel, chemical, electric power generation, and building materials sectors.**
- **In addition, preliminary estimation was done for the transportation sector.**
- **Samples taken in five cities: Dalian, Beijing, Jinan, Chongqing, and Liuzhou.**

Cities in Harvard-Tsinghua Study



Stacks in Jinan City Sample



Pollution Taxes

- Improved estimates of sectoral damage functions can be used to determine efficient pollution taxes.
- Pollution taxes could be based on emissions, fuel use, or output.
- Because of limited monitoring capacity, a tax based on emissions is not possible.
- Pollution taxes set equal to the marginal damage.
- Revenues can be used to reduce other taxes.

Preliminary Results

- The output-based tax falls primarily on the building materials, electricity generation, and transportation sectors.
- The fuel tax falls very heavily on the coal sector.
- Per *yuan* of tax, the fuel tax results in a much greater reduction in health effects than the output tax.
- Macro effects are similar to a carbon tax -- initially investment displaces consumption, but in later years, consumption (and GDP) rise above the baseline.