

Sustainable Energy Use and Modernization in Beijing



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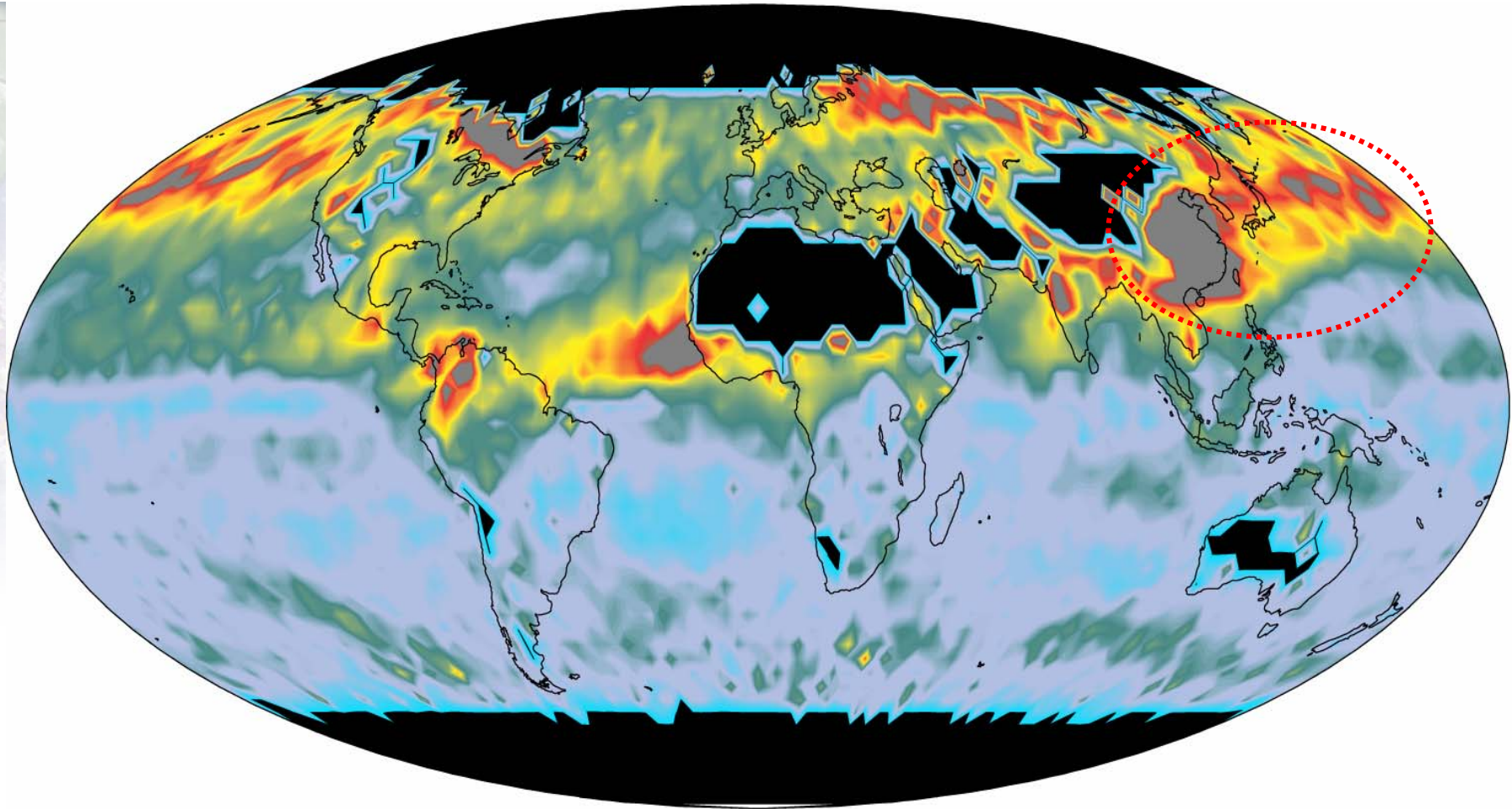


Overview of Two Priorities for Energy/Environment Policy

- Like all dynamic economies, China faces a wide variety of resource and environment challenges.
- Among these, the long term challenges posed by residential energy use from electricity and transport demand are among the most prominent.
- In this research, we use a new resource and environment CGE model to evaluate policies toward long term energy use.

China's Carbon Challenge

Aerosol Optical Depth (2001) NASA-TERRA Satellite





The Energy Challenge

Not industrialization, but rising living standards.

Annual Kilograms Per Capita

Country	Steel Production		Oil Consumption
	1992	2001	2000
China	59	132	905
Korea	499	809	2071
Japan	635	575	4136
France	382	390	4366
United States	330	373	8141

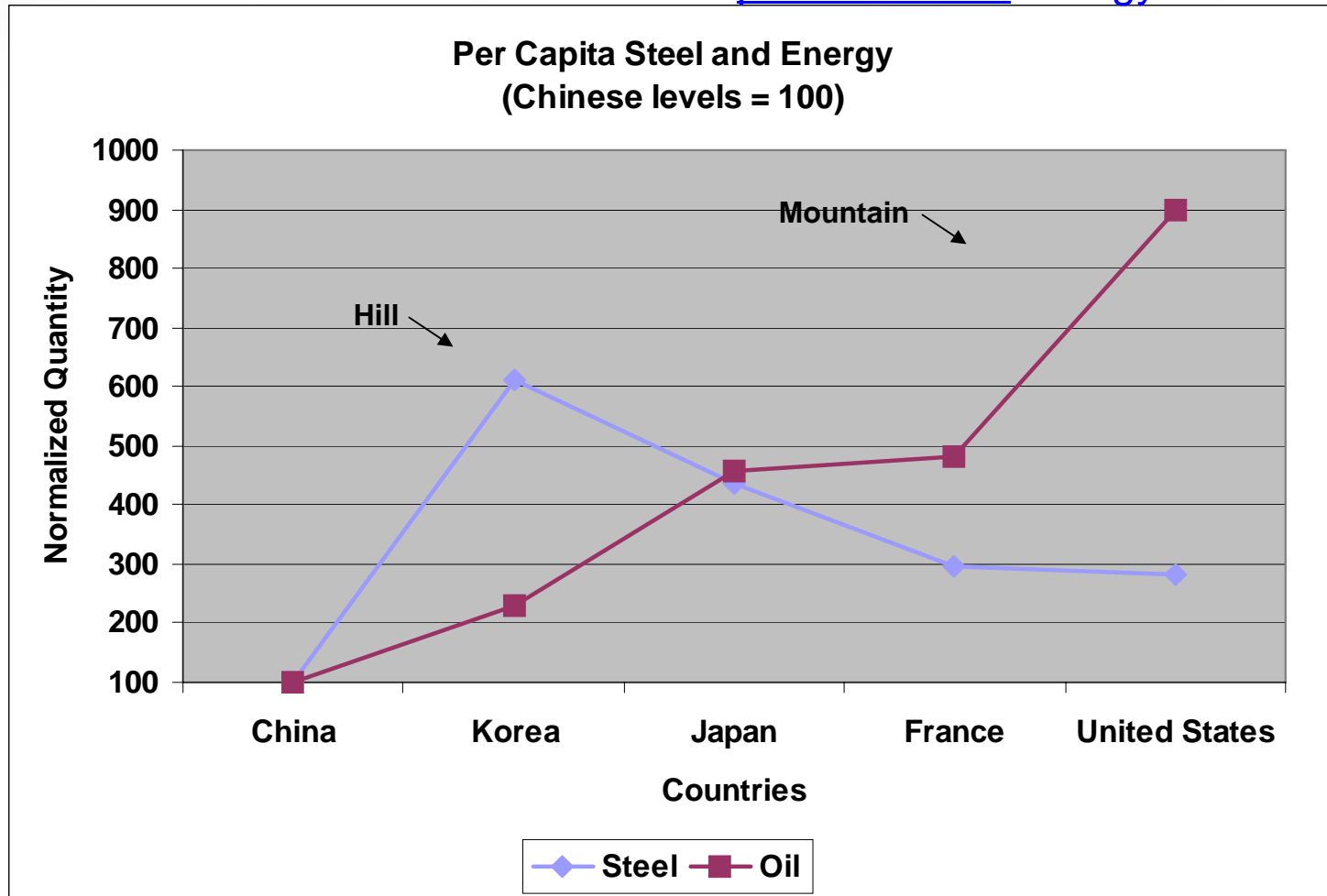
INDUSTRIAL

POST-INDUSTRIAL

Industrialization may be energy-intensive, but affluence is much more so.

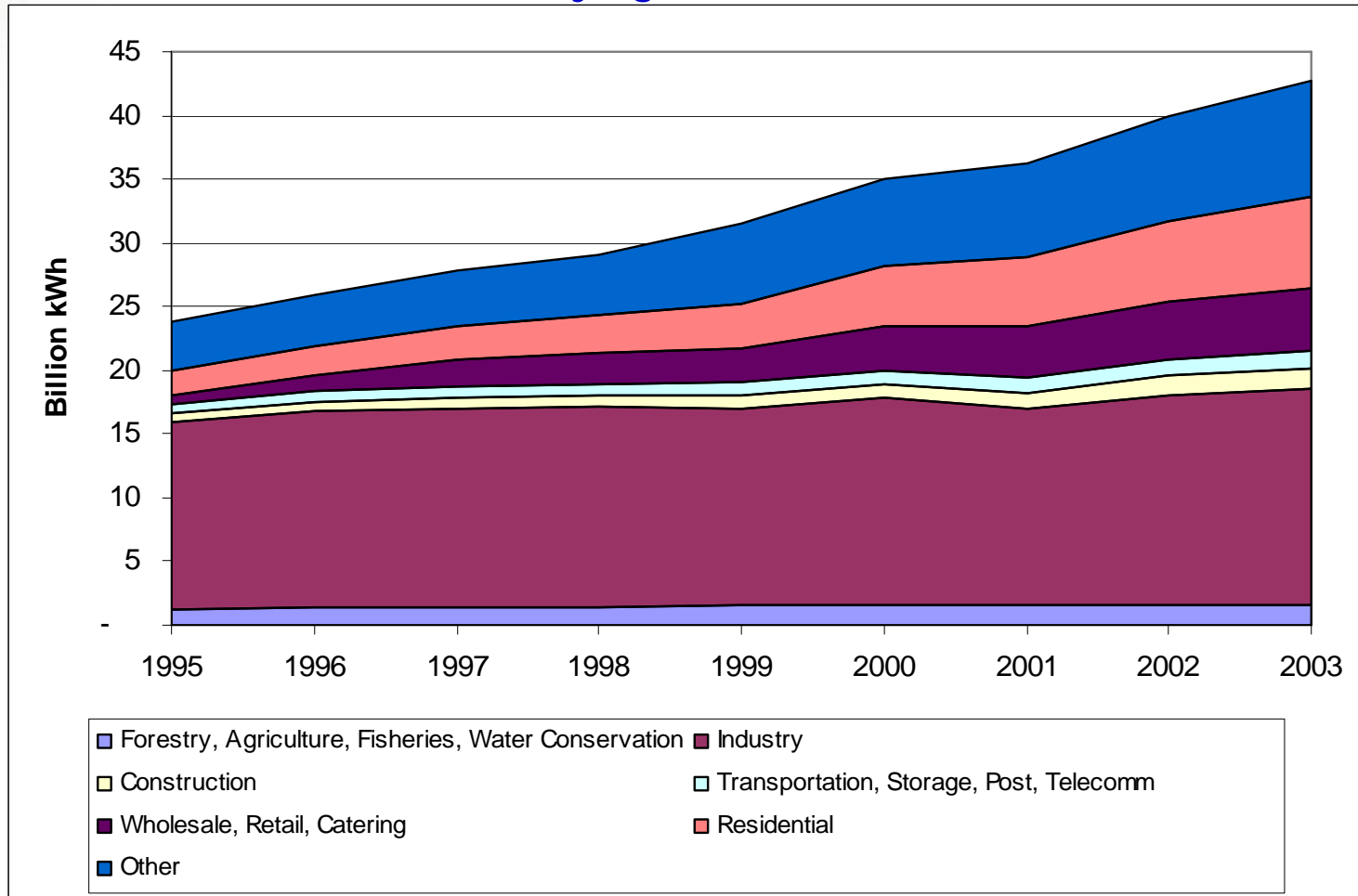
The “mountain” of industrialization is only a hill.

The real mountain for China to climb is post-industrial energy demand.



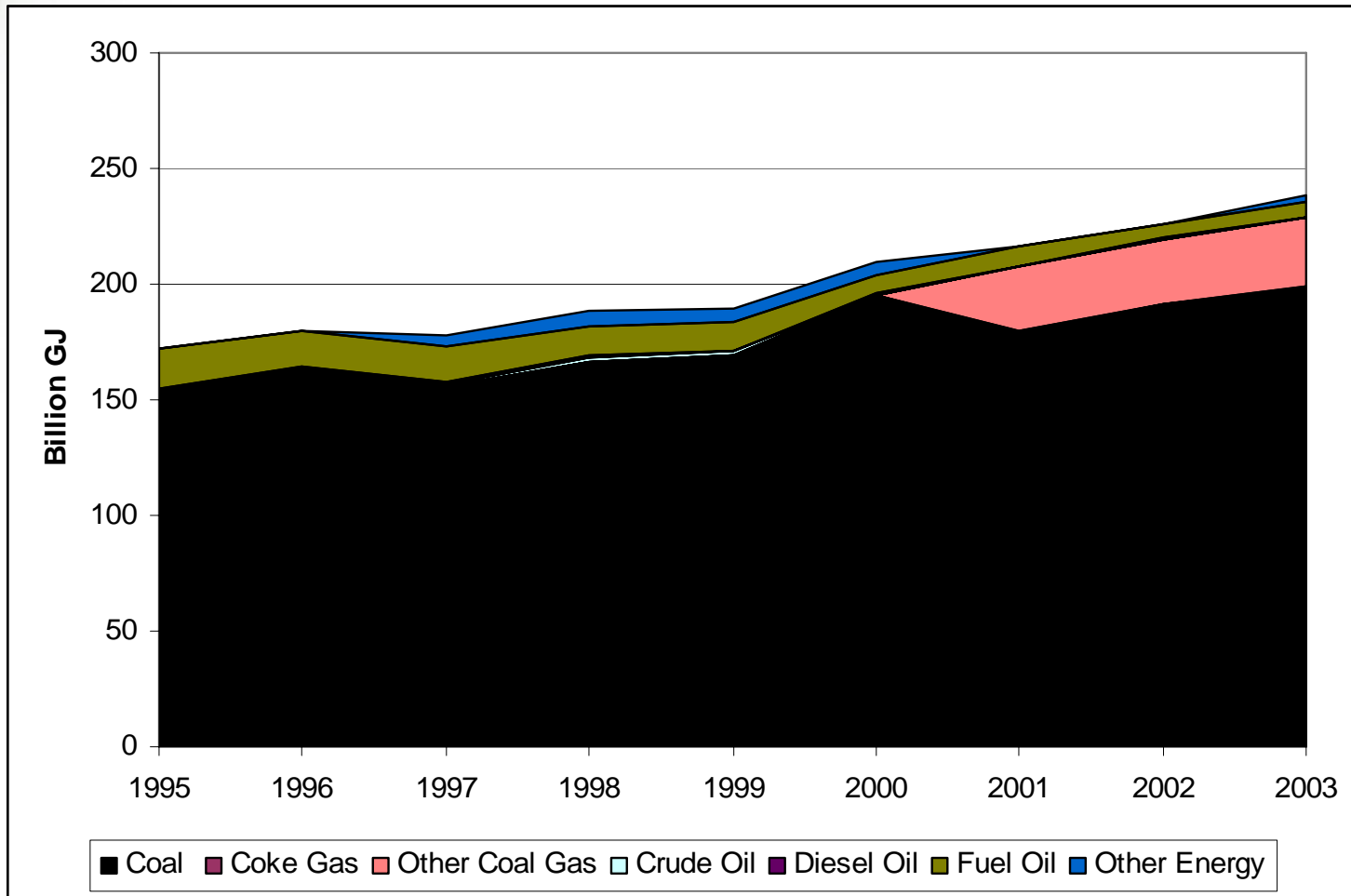
Electricity demand is already accelerating at home and in services.

Electricity Demand by Destination
Beijing 1995-2003



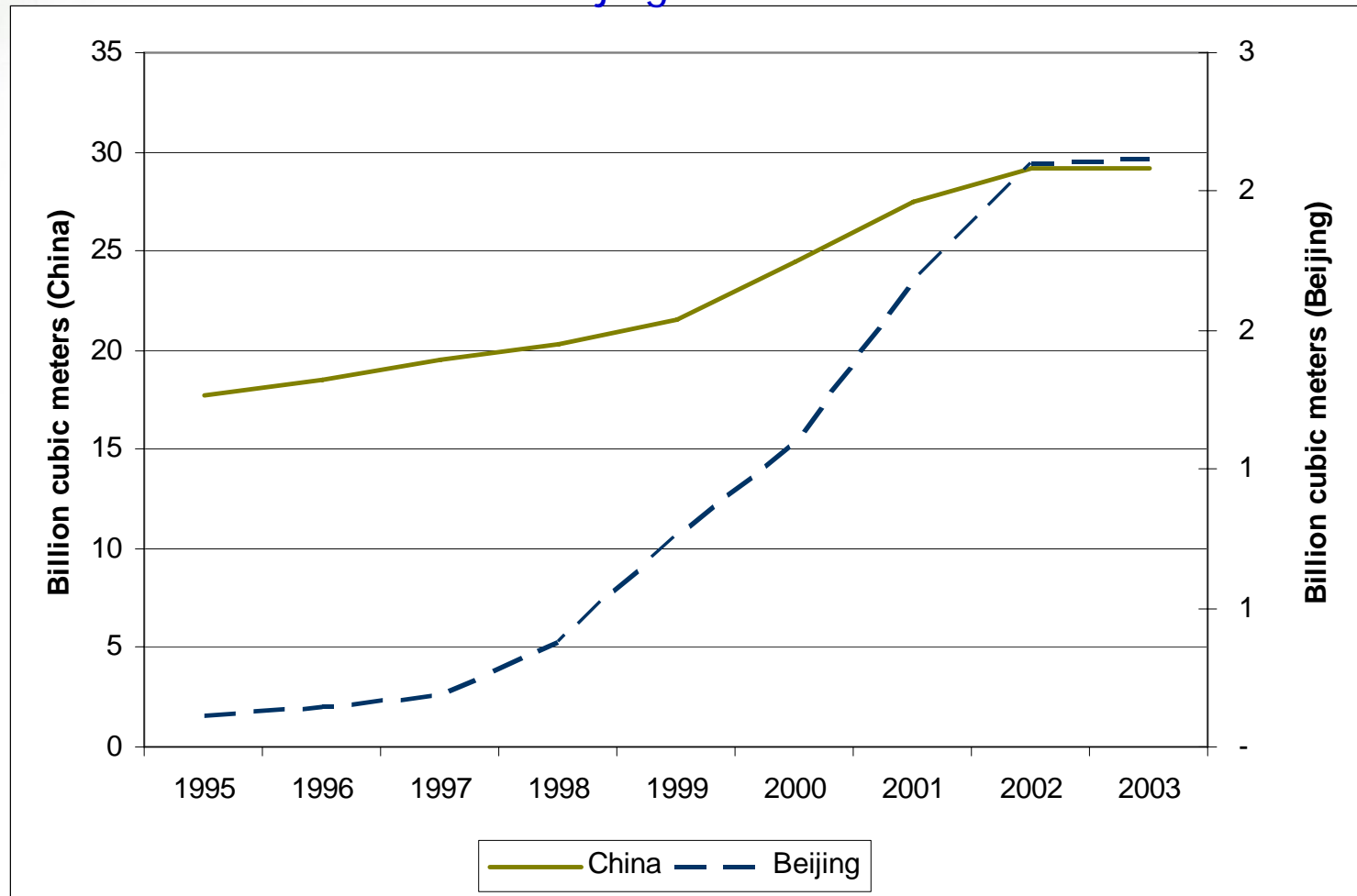
Coal remains the dominant electric energy source

Energy Inputs for Electricity Generation
Beijing 1995-2003



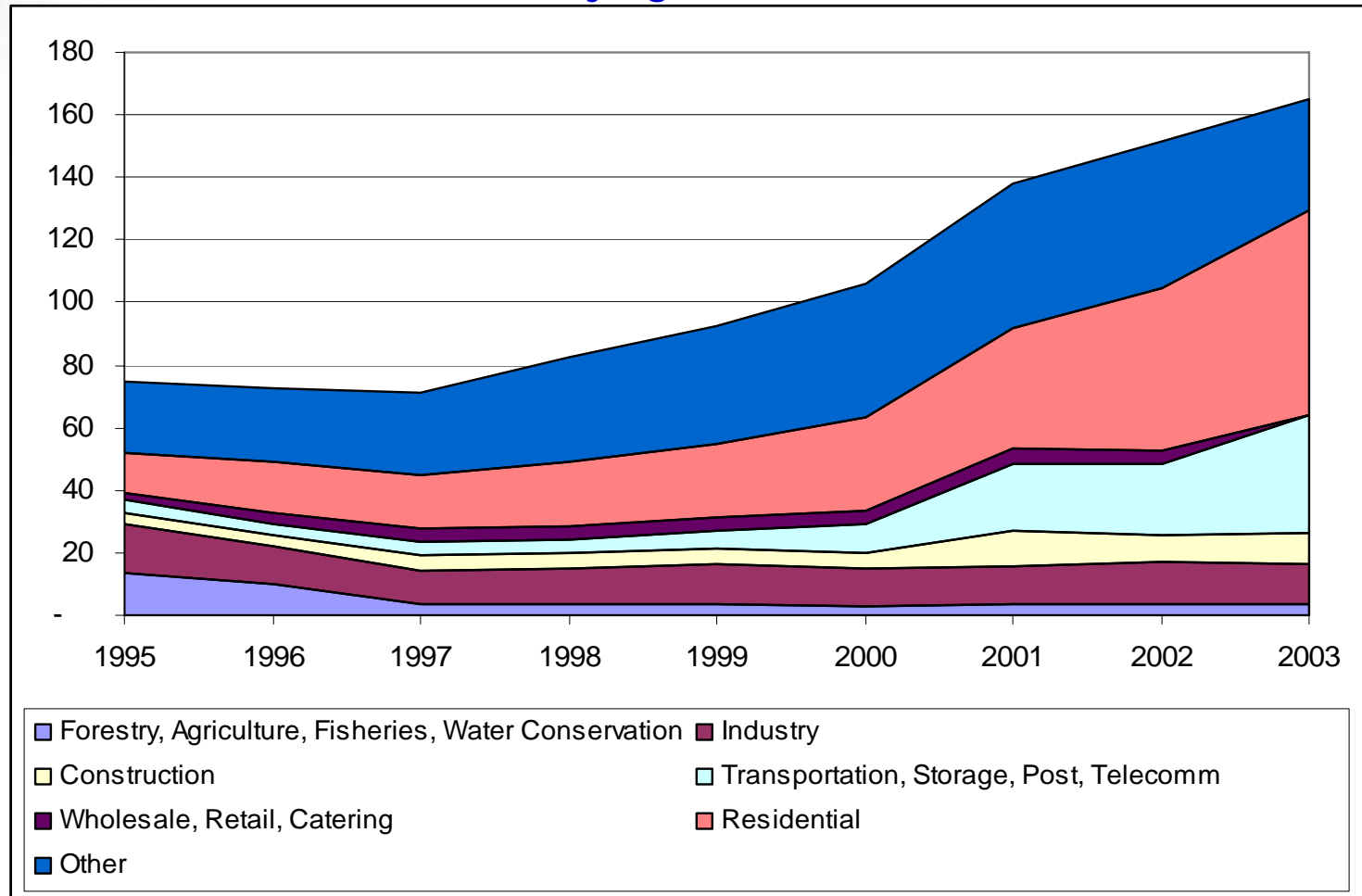
Other Carbon Fuels are Rising Rapidly

Natural Gas Consumption Beijing 1995-2003



Transport fuel growth is rapid and dominated by Households

Gasoline Use by Sector
Beijing 1995-2003





Model Structure

The modeling facility consists of two components:

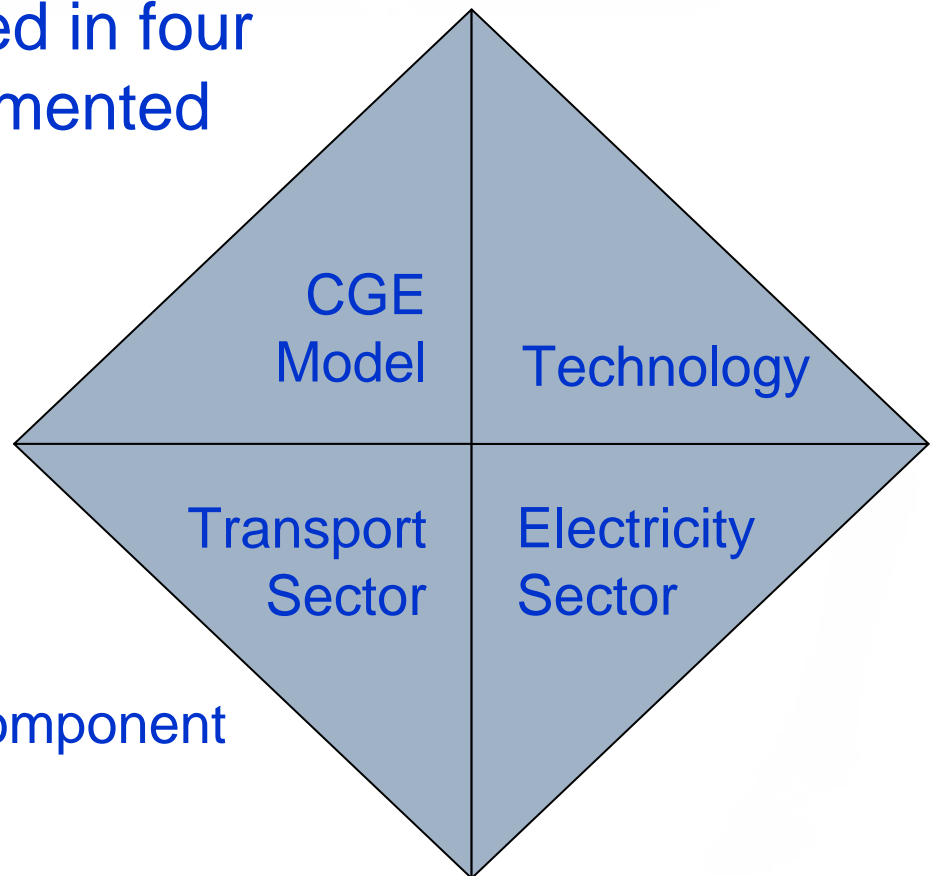
1. Detailed data on economy and emissions
 - 34 sectors
 - 2 household groups
 - detailed fiscal accounts
 - 14 emission categories
2. Pollution And National Development Assessment (PANDA) Model – a dynamic CGE forecasting model focusing on economy-energy-environment

PANDA Overview

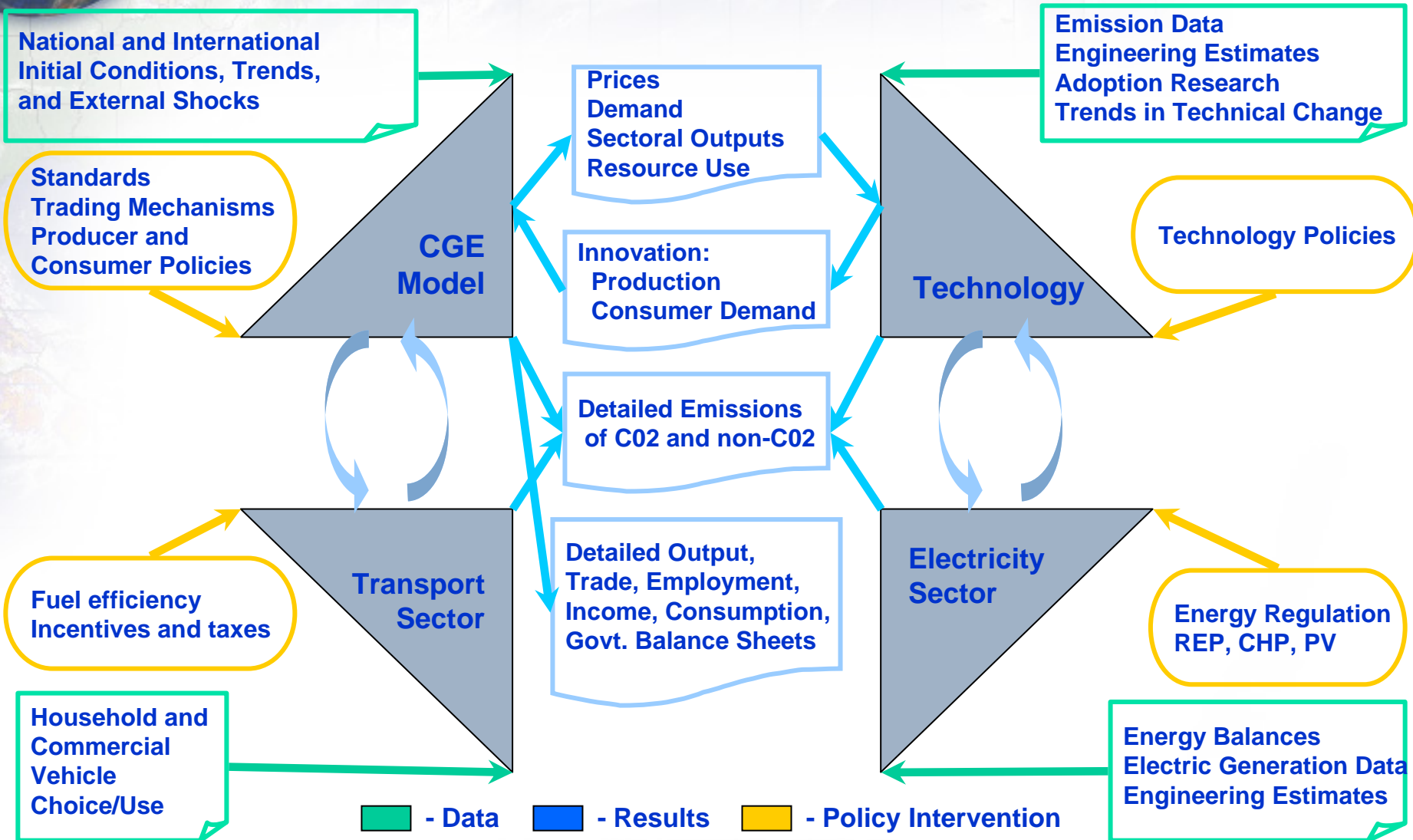
PANDA is being developed in four components and implemented over two time horizons.

Components:

1. Core GE model
 2. Technology module
 3. Electricity modeling
 4. Transportation component



Detailed Methodology





Electricity Sector Modeling

Power generation accounts for a substantial percentage of CO₂ emissions in China.

Based on detailed producer data, we plan to model technology and emissions in China's electricity sector

- Heterogeneous generation technologies
- Heterogeneous fuels



Transportation Modeling

- The transport sector accounts for sharply rising shares of Chinese CO₂ emissions
- To meet emission goals, patterns of vehicle use and technology adoption need to be better understood



Time Horizons

PANDA is being developed for scenario analysis over two time horizons:

1. **Policy horizon: 2005-2025**

Detailed structural change:

1. 34 sectors
2. 2 household income groups
3. Labor by occupation and capital by vintage

2. **Climate horizon: 2005-2100**

Aggregated:

1. 5 sectors
2. 3 income groups
3. labor and capital



Energy Policy Scenarios

We have seen that the energy/emission challenges for China are in household income/demand growth (transport and electricity).

To show how PANDA can support policy analysis, we offer **preliminary** results in two important areas:

1. Vehicle Efficiency Standards (VES)
2. Renewable Energy Portfolio (REP)

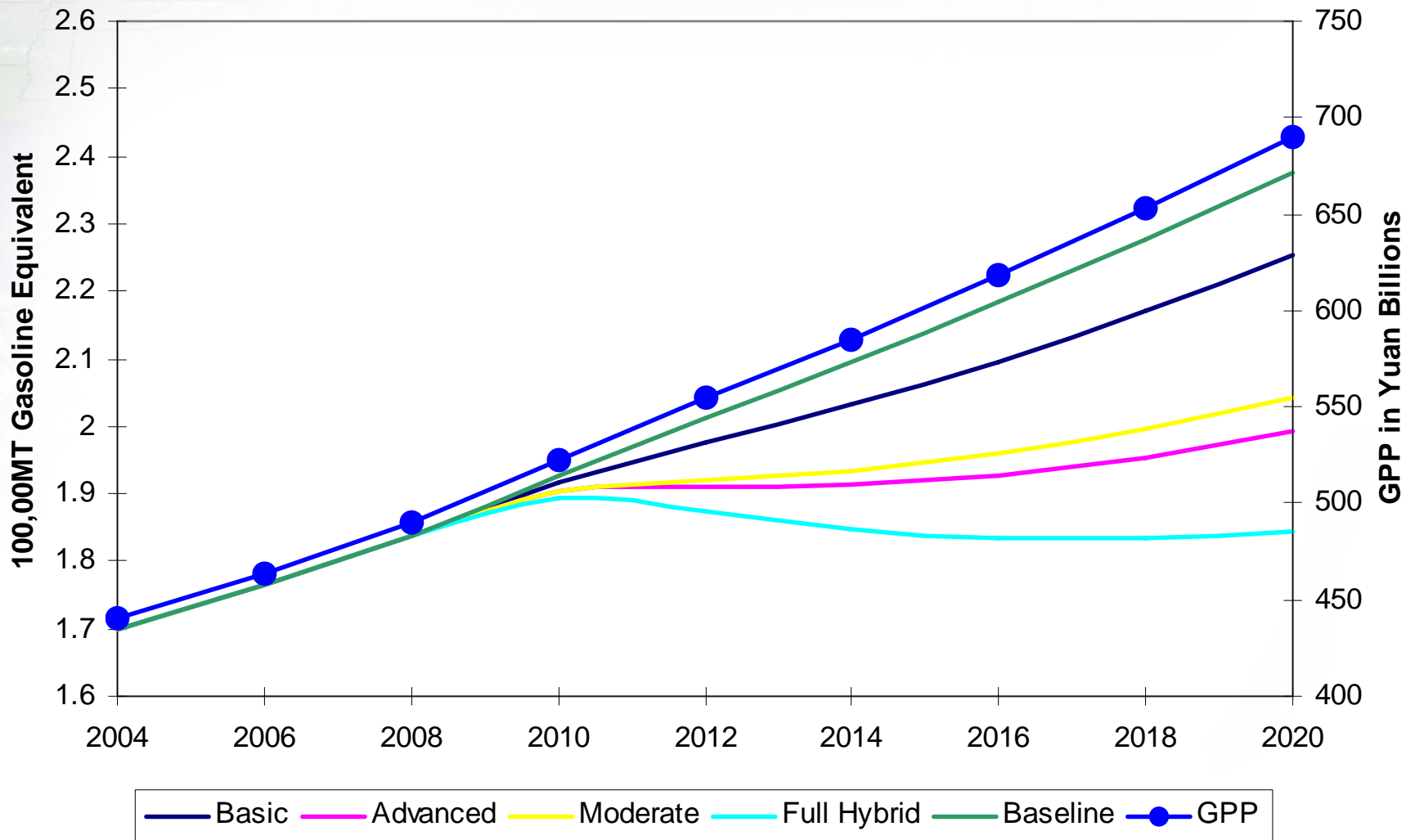


Vehicle Efficiency Standards

1. Scenario 1: **Basic Fuel Economy** - Combination of fuel efficiency measures applied to light-duty vehicles starting in 2008 and S-diesel (synthetic diesel) blended with other diesel fuels
2. Scenario 2: **Moderate + Fuel Cell Technologies** - Incorporates fuel efficiency improvements in light-duty vehicles, substantial penetration of light-duty fuel cell vehicles, and again diesel blends of GTL or S-diesel fuels.
3. Scenario 3: **Advanced Fuel Economy** - Scenario 1 with more aggressive fuel economy technologies in light-duty vehicles.
4. Scenario 4: **Full Hybrid Vehicles** - Similar to 3 but even more aggressive with the introduction of all hybrid technologies starting in all light-duty vehicles in 2008. This case is based on ACEEE — full hybrid technologies and costs. The scenario also includes S-diesel blends.



Energy Impact: Efficiency with Growth





Vehicle Efficiency Standards

Results

- Substantial CO2 mitigation (less than half of Baseline growth).
- Gross Provincial Product (GPP) largely unchanged.
- Slight increase in consumer cost.
- Substantial gasoline savings.

Drivers

- Small reduction in auto demand.
- Large reduction in fuel demand.
- Demand diverted from import-intensive autos and fuel to more diversified demand, of which a majority is within-province or domestic services/goods.

Assumptions

- The car stock is homogeneous in use and replacement.
- All savings are in gasoline use.

Critical

- Households are assumed to own and adopt uniformly.
- World oil prices are constant.



Renewable Energy Portfolio

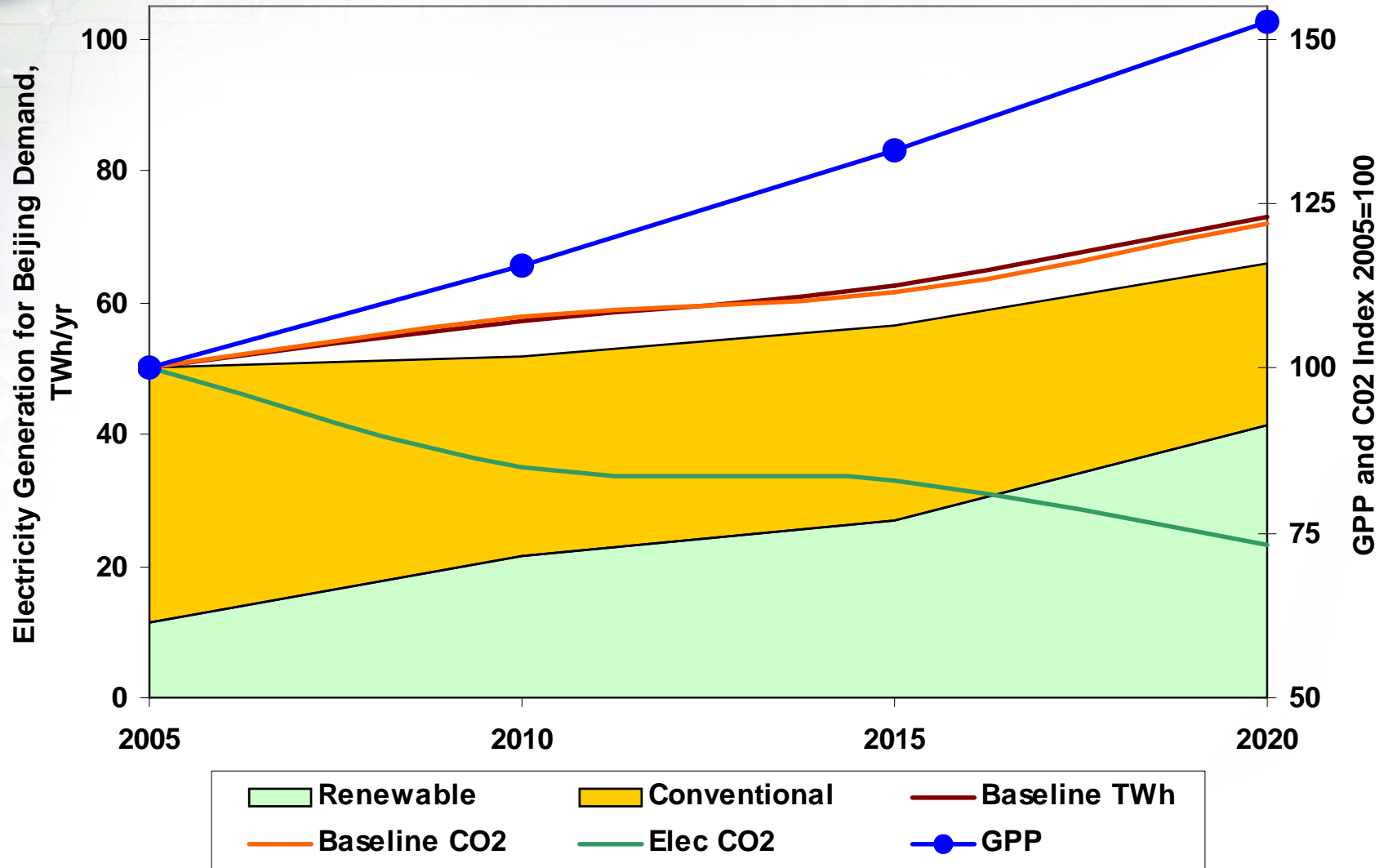
In the long term, residential electricity consumption will be a primary component of energy consumption.

Coal's dominance in electric power fuels may lead to unsustainable CO₂ emissions.

In this scenario, we assume that:

1. Renewables technologies (biofuels, solar, etc.) are subsidized to be cost competitive with the current average energy feedstock price.
2. An average progress ratio of 80%, i.e. renewable adoption costs fall 80% with each doubling of the renewable technology market.
3. Decarbonization (efficiency gains in convention electricity technology) of 2%/year.

Emissions and Output: Market-oriented Renewable Scenario





RES: Renewable Energy Portfolio

Results

- Potentially significant CO₂ mitigation
- GPP largely unchanged from Baseline trend.

Drivers

- Significant substitution of fuel sources toward renewables

Assumptions

- The policy is uniformly implemented across the generating industry.
- All savings are in reduction of fossil fuel inputs.
- No adoption or other direct adjustment costs.
- Alternative energy source is as polluting as the service sector.

Critical

- Electricity generators are assumed adopt uniformly and costlessly.
- National energy prices are constant.



Conclusion: Innovation, Efficiency, and Growth

- China is the world's most dynamic economy, which presents unique opportunities and challenges for policy makers and private stakeholders.
- The environment-growth trade-off is a fallacy, and in China we can prove this.
- Energy efficiency policies re-direct demand toward more labor-intensive, higher value added sectors than energy, stimulating employment and income growth.
- The Energy sector needs to join IT, Biotech, and other knowledge-intensive Chinese industries to establish global standards for technical innovation and economic growth.



Scenario Extensions

- Market-oriented policies: Cap and trade schemes
- Incentive policies: Taxes/subsidies for abatement, clean up, and technology adoption, modeling both collection and recycling/rebate components
- Energy market policies
- More renewables options
- Photo-voltaic policies
- Carbon Sequestration
- Exogenous (e.g. federal) policy shocks
 - Taxes and subsidies
 - Regulation (env., trade, labor, R&D, etc.)



Future Research Capacity

Things to come:

- Location/mapping
- Urbanization and regionalization
- Integration of water and land resources
- Public health modeling – closing the economy/environment loop