Energy Policy for Sustainable Development in China:

中国可持续发展的能源政策

A project of the UNDP and the Government of China

联合国开发计划署 / 中国政府项目

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首席技术顾问

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The Role of Energy Policy Models
能源政策模型的作用

1. **Choosing a strategy**
   选择一种发展战略
2. **Understanding trends and challenges**
   了解发展趋势和挑战
3. **Clarifying policy choices**
   阐明政策选择
4. **Evaluating effectiveness and cost of policies**
   评价政策执行的效果和成本

Models Can Test Policy Tools
模型可以用来测试政策

- **Market pricing** 市场定价
- **Environmental pricing (taxes)** 环境价格（税）
- **Standards** 标准
- **Financial and fiscal incentives** 金融和财政的激励信息
- **Information**
- **Research and development** 研究和开发

Five Warning Signs for Model Users

对模型使用者的五种警示

- **Uncertainty in oil prices**

  油价的不确定性

- **Rapid increase in automobiles**

  汽车的高速增长

- **Prospect for energy obsolescence**

  能源逐渐枯竭的前景

- **“External” pollution costs**

  “外部性”的污染成本

- **Potential for climate shocks**

  气候震动的可能性

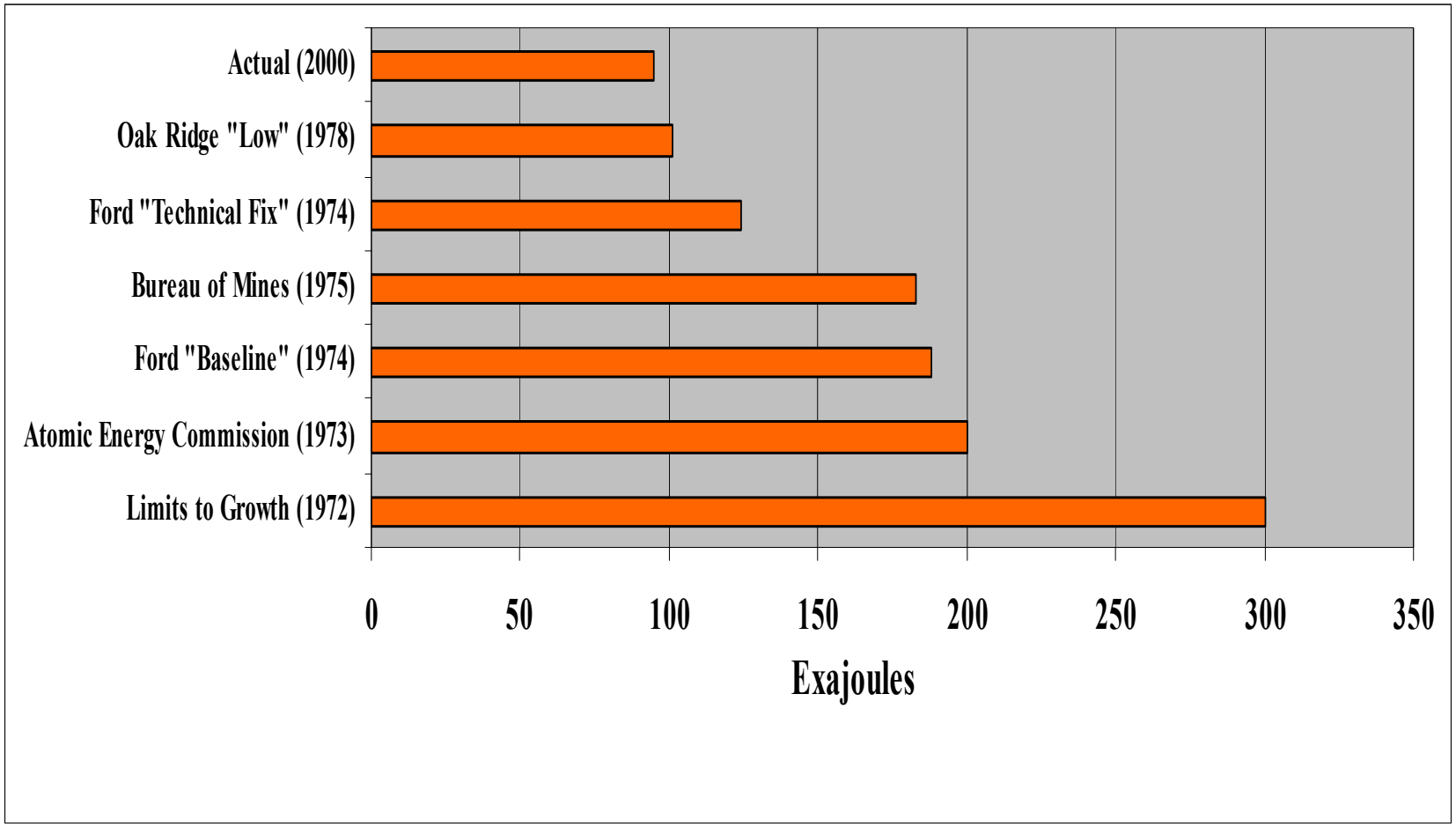
Limits and Risks of Using Energy Models
使用能源模型的局限和风险

1. **Reality does not always match economic theory.** 事实并不总是与经济理论相一致
2. **Data are constrained.** 数据是牵强的
3. **Surprises can dramatically change assumptions.** 突发事件会戏剧性地影响假设
4. **Being wrong can be costly.**
   出现错误要付出代价

The Energy Forecasting Record 能源预测记录

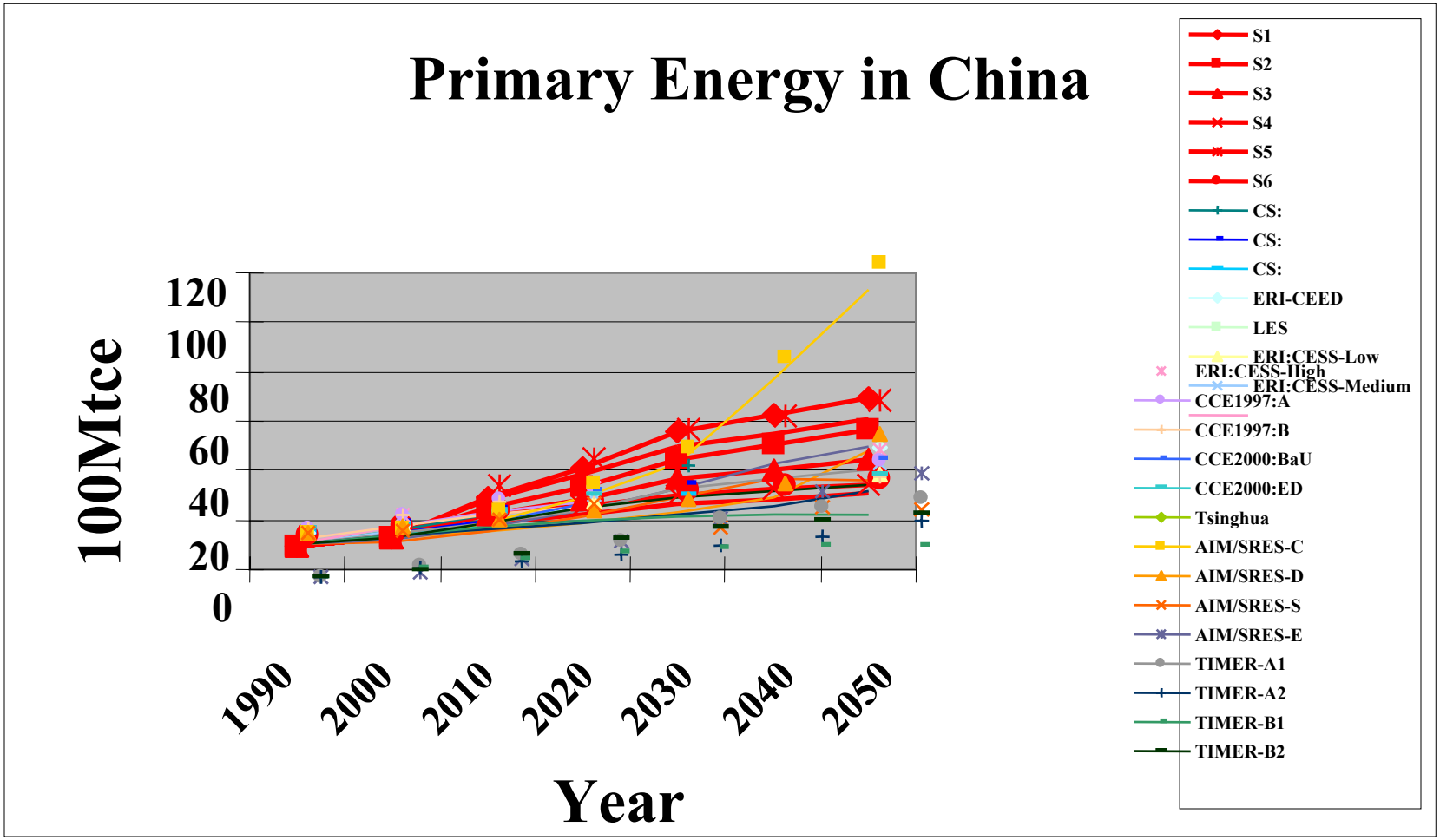
Year 2000 Projections Made for the United States in 1972-78

1972-1978年预测的美国2000年能源需求



Application of Models: Chinese Researchers

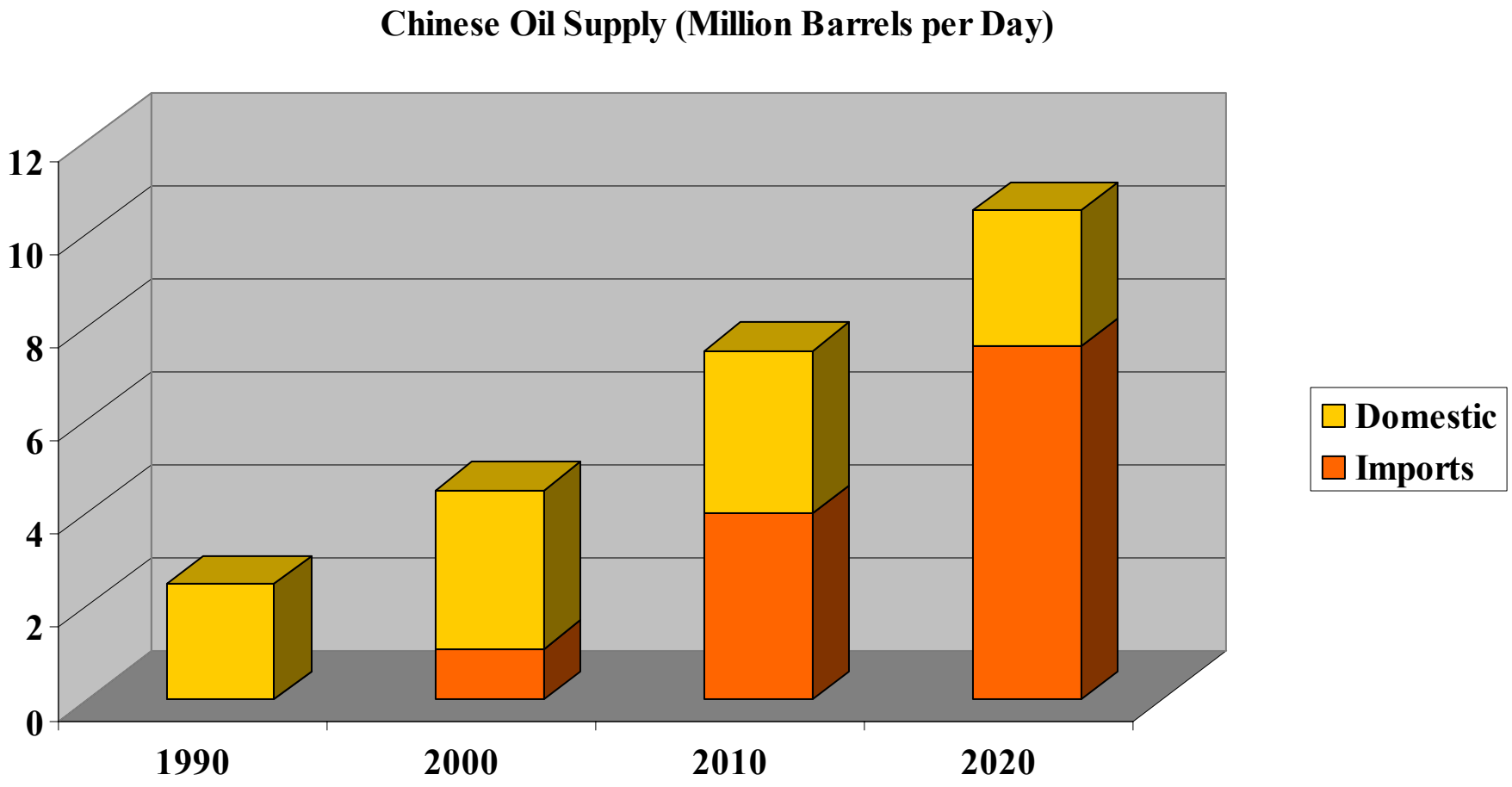
模型的应用：中国学者



Assessing Energy Trends and Risks: 评估能源的趋势和风险

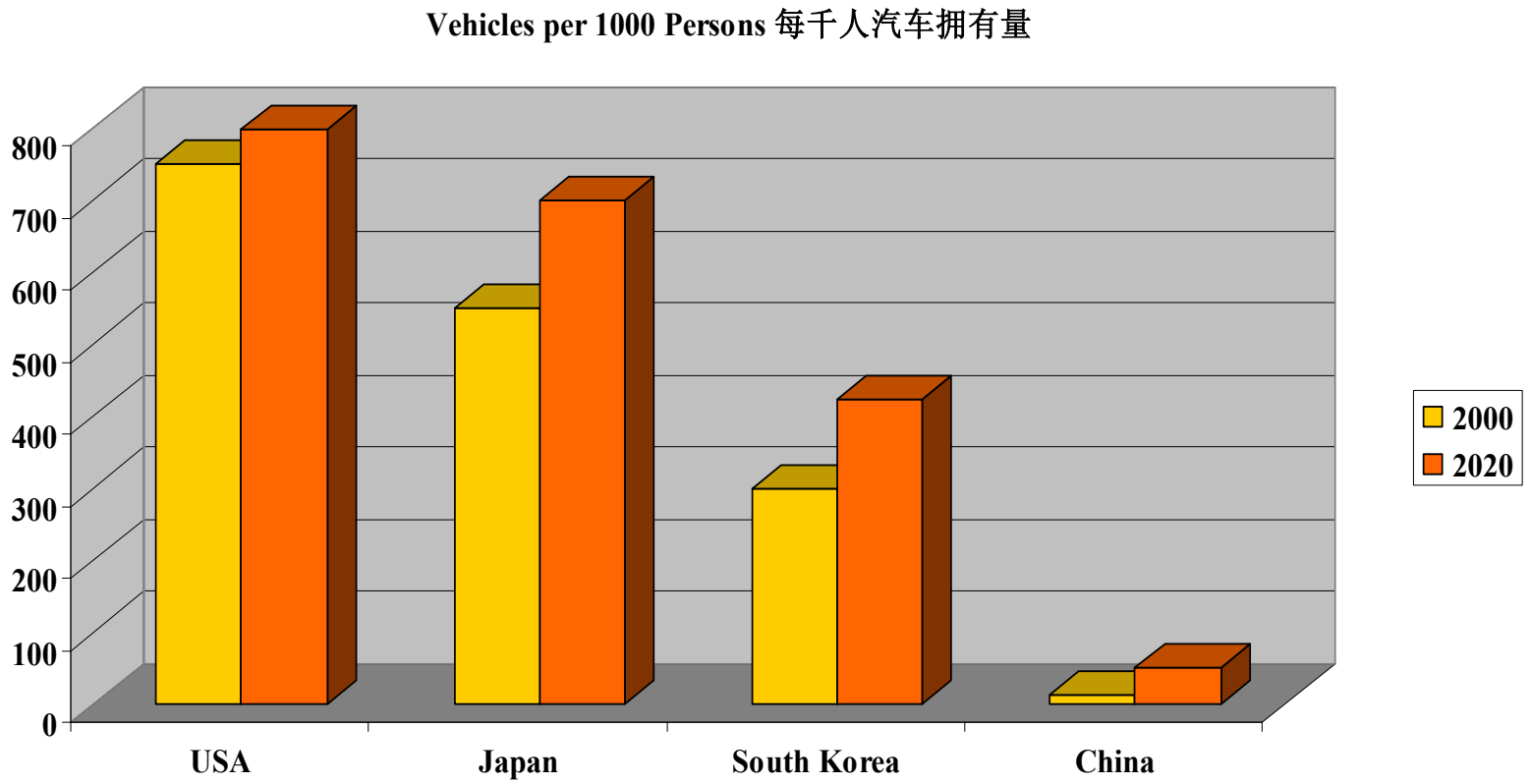
Projection for Chinese Oil Imports, 2020

国际能源署预测 2020年中国石油进口



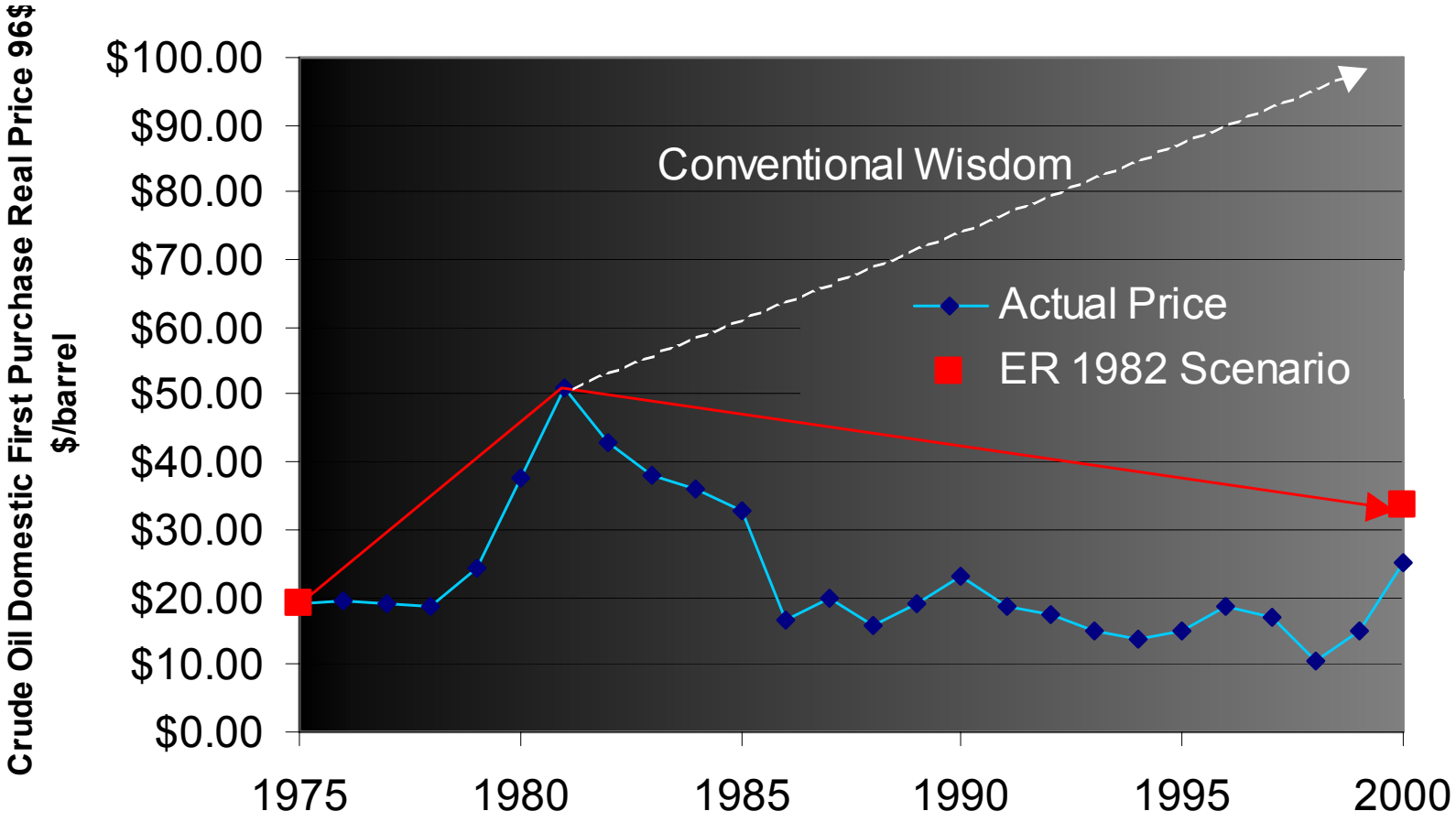
Source: U.S. Energy Information Agency, 2002; International Energy Agency, Paris, 1997

Forecasting Demand for Transportation Energy: Light Vehicles 交通用能需求预测：轻型汽车



When Assumptions are Wrong当假设是错的:

Forecasting the Price of Oil 预测油价



Valid Models Must Be:
有效的模型应该具备：

- **Transparent**
  透明
- **Based on sound assumptions**
  基于合理的假设
- **Reproducible**
  可重复性

Modeling Best Practice 建模的最佳实践

***Key tools include** 关键工具包括*

- **Long-run marginal cost analysis** 长期运行边际成本分析
- **Scenario analysis** 情景分析
  - **Economic modeling** 经济模型
  - **Delphi method** **Delphi方法**
  - **Sensitivity analysis** 灵敏度分析
- **Technology analysis** 技术分析
  - **Portfolio assessment** 配额评价
  - **Technology assessment** 技术评价

Types of Models

模型的种类

- **Macroeconomic or "top down" models**

  宏观经济的或"从上至下"的模型

  - **Equilibrium** 均衡模型
  - **Partial equilibrium** 部分均衡模型

- **Microeconomic or "bottom up" models**

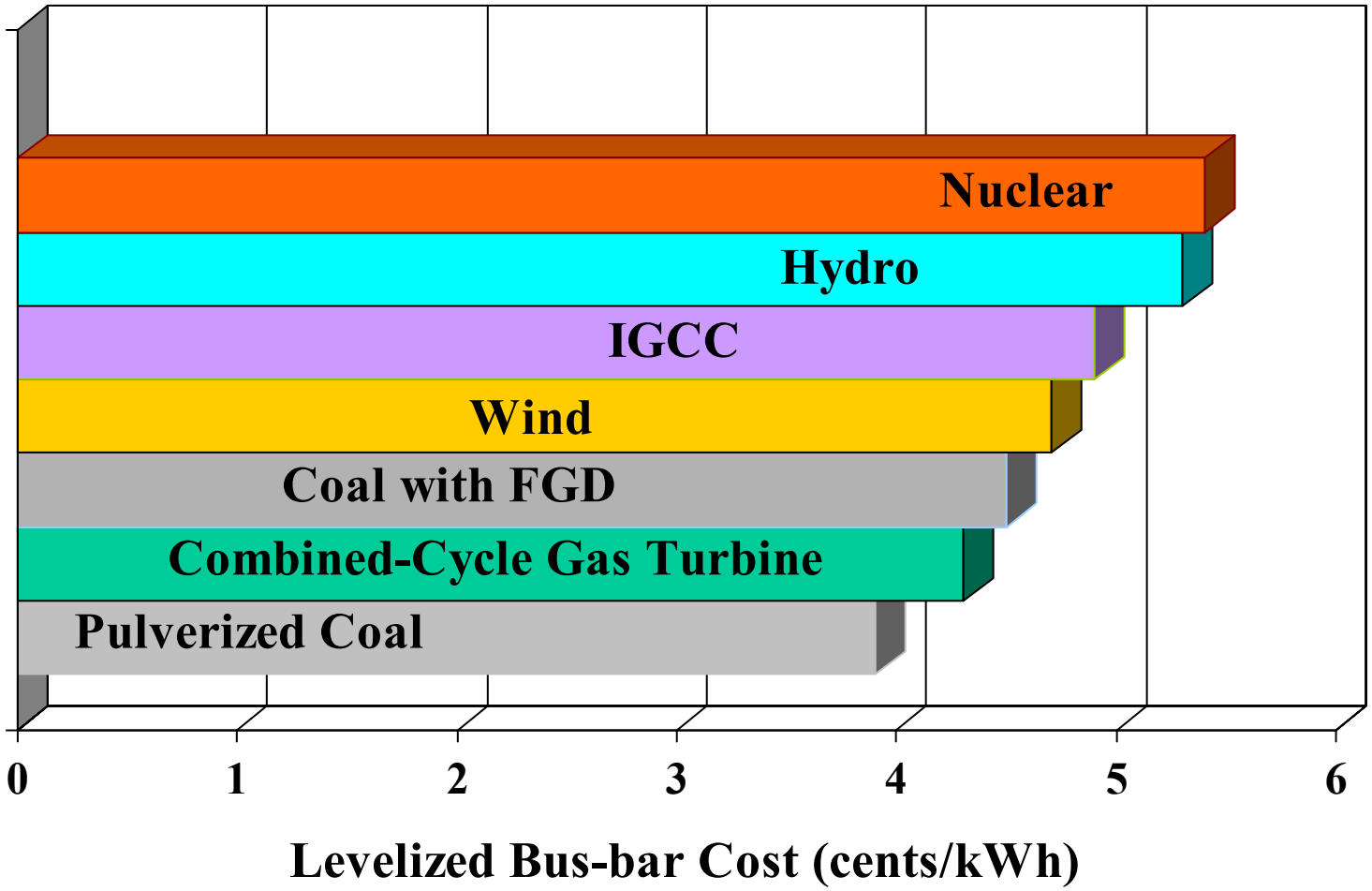
  微观经济的或"自下而上"的模型

  - **Linear programming (optimization)** 线形规划（优化）
  - **Accounting (spreadsheet)** 会计式（电子数据表格）
  - **Economic-Engineering** 经济工程

Application of Models: Levelized Cost Analysis 模型应用：杠杆成本分析

Cost of Electric Power Options in Shanghai

上海的电力选择成本



Key Variables in Energy Models
能源模型中的关键变量

- **Population growth—Labor Force**
  人口增长——劳动力大军
- **GDP growth—GDP elasticity**
  GDP 增长 —— GDP 弹性
- **Energy prices—Price elasticities**
  能源价格——价格弹性
- **Technical change—Structure, Efficiency**
  技术变化——结构、效率

Energy Projections, China 2020
中国2020年能源预测
An International Perspective 国际观点

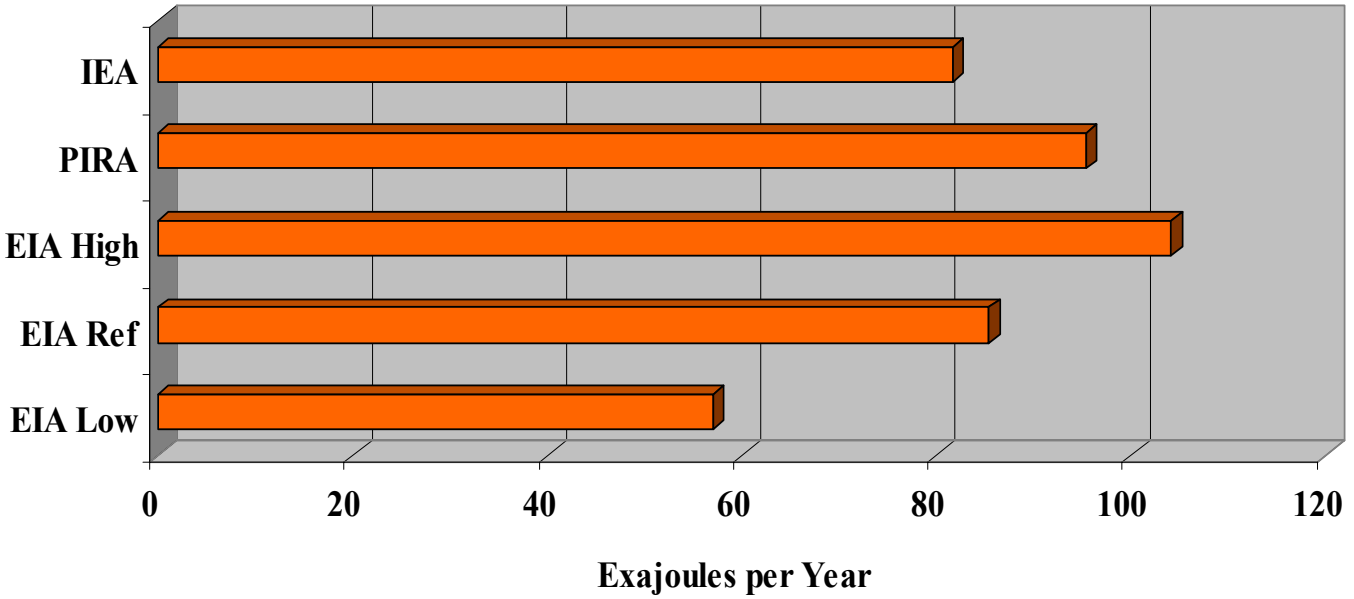


Illustration of the Effect of Changing Assumptions on Model Results: *GDP Growth Rate*

变更假设条件对模型结果的影响： *GDP增长率*

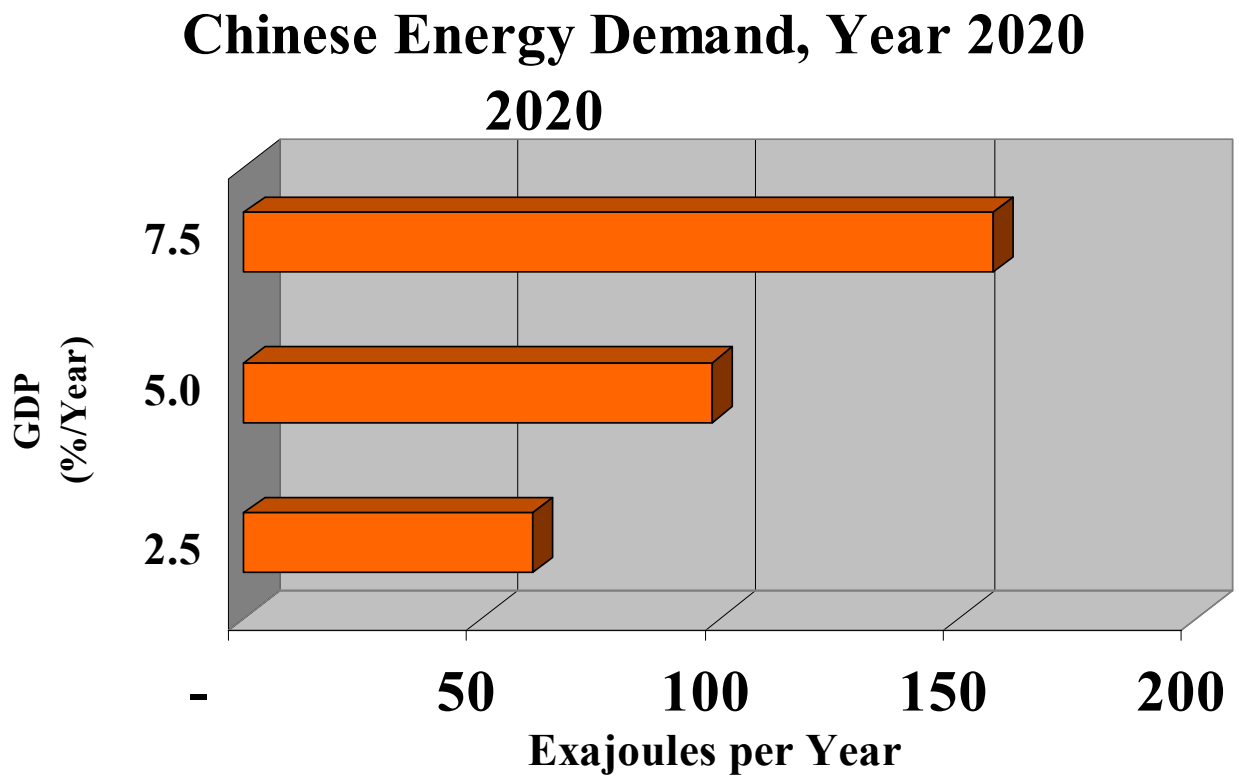


Illustration of the Effect of Changing Assumptions on Model Results: *GDP Elasticity*

变更假设条件对模型结果的影响： *GDP弹性*

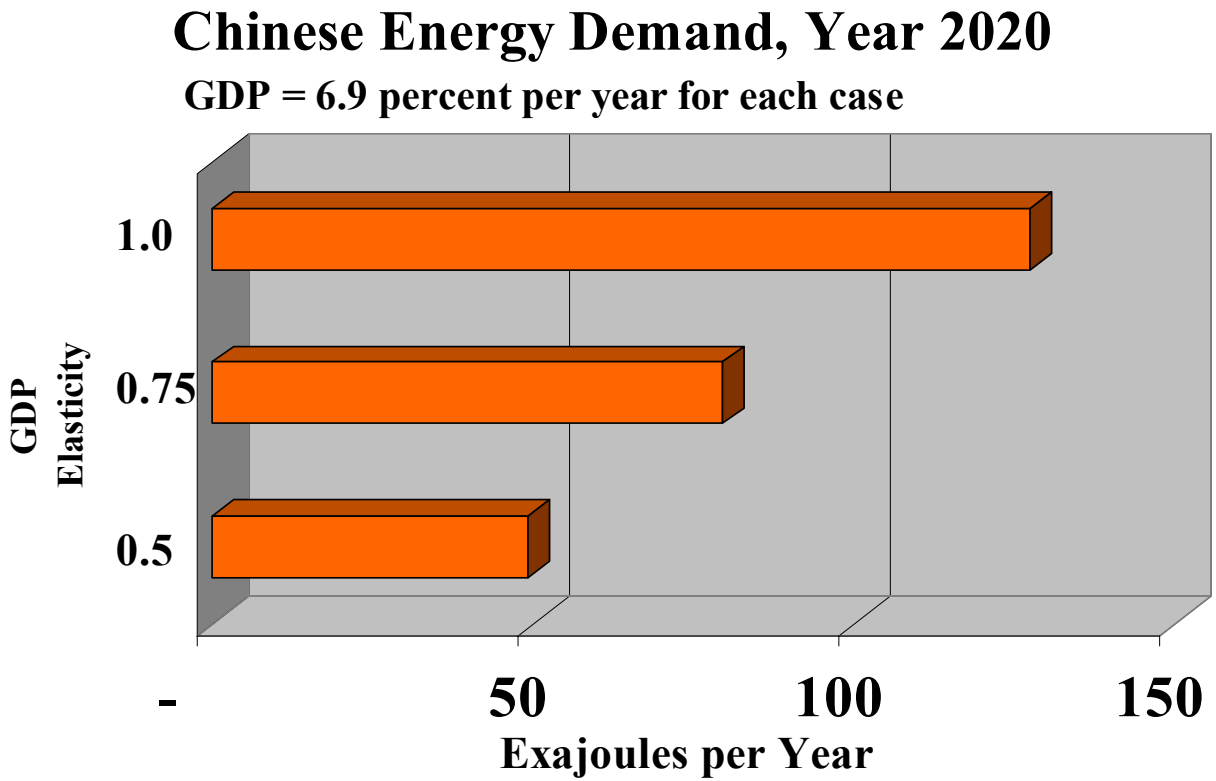


Illustration of the Effect of Changing Assumptions on Model Results: *Energy price changes*

变更假设条件对模型结果的影响：*能源价格变化*

For each case: GDP = 6.9 percent per year; Price elasticity价格弹性=0.75

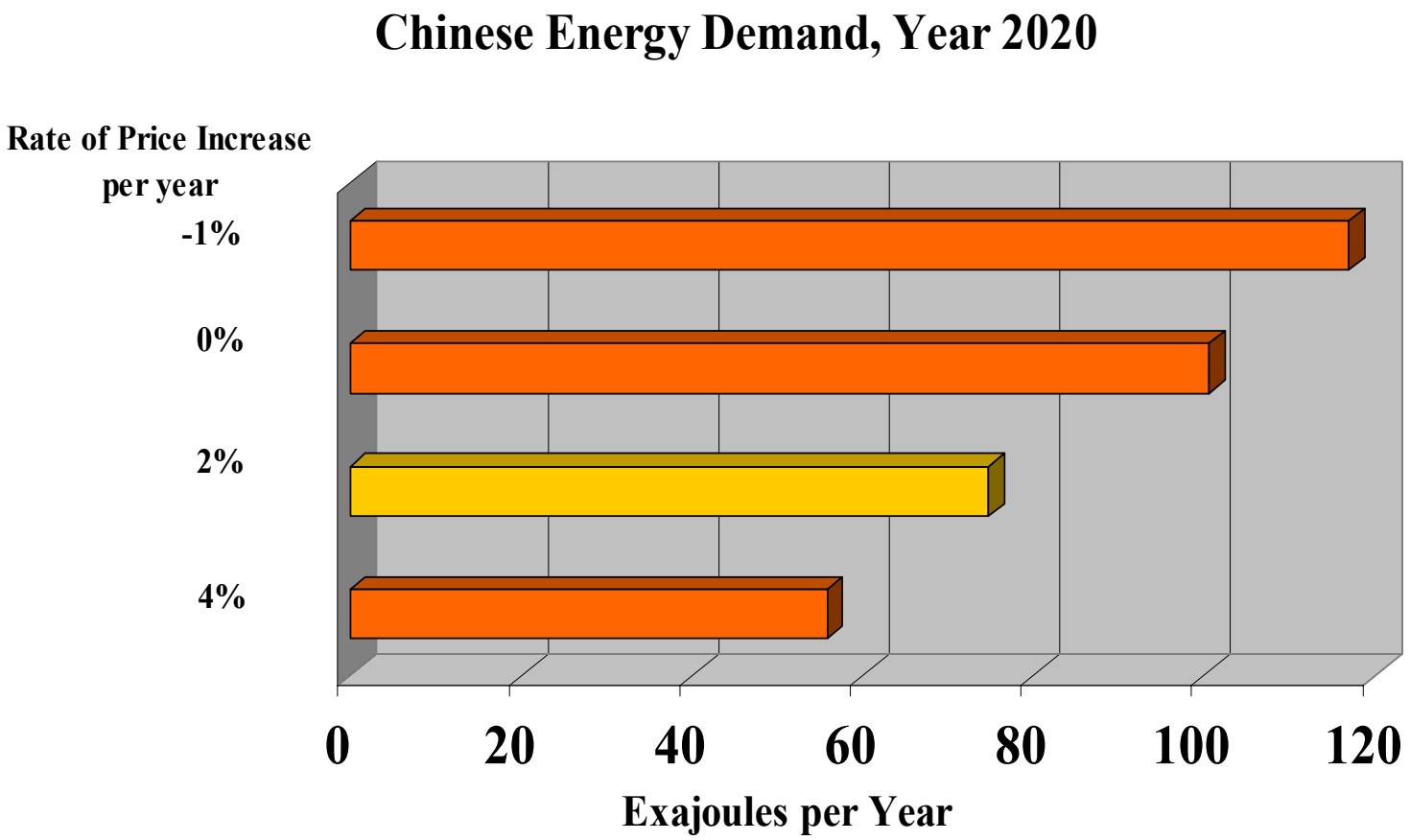
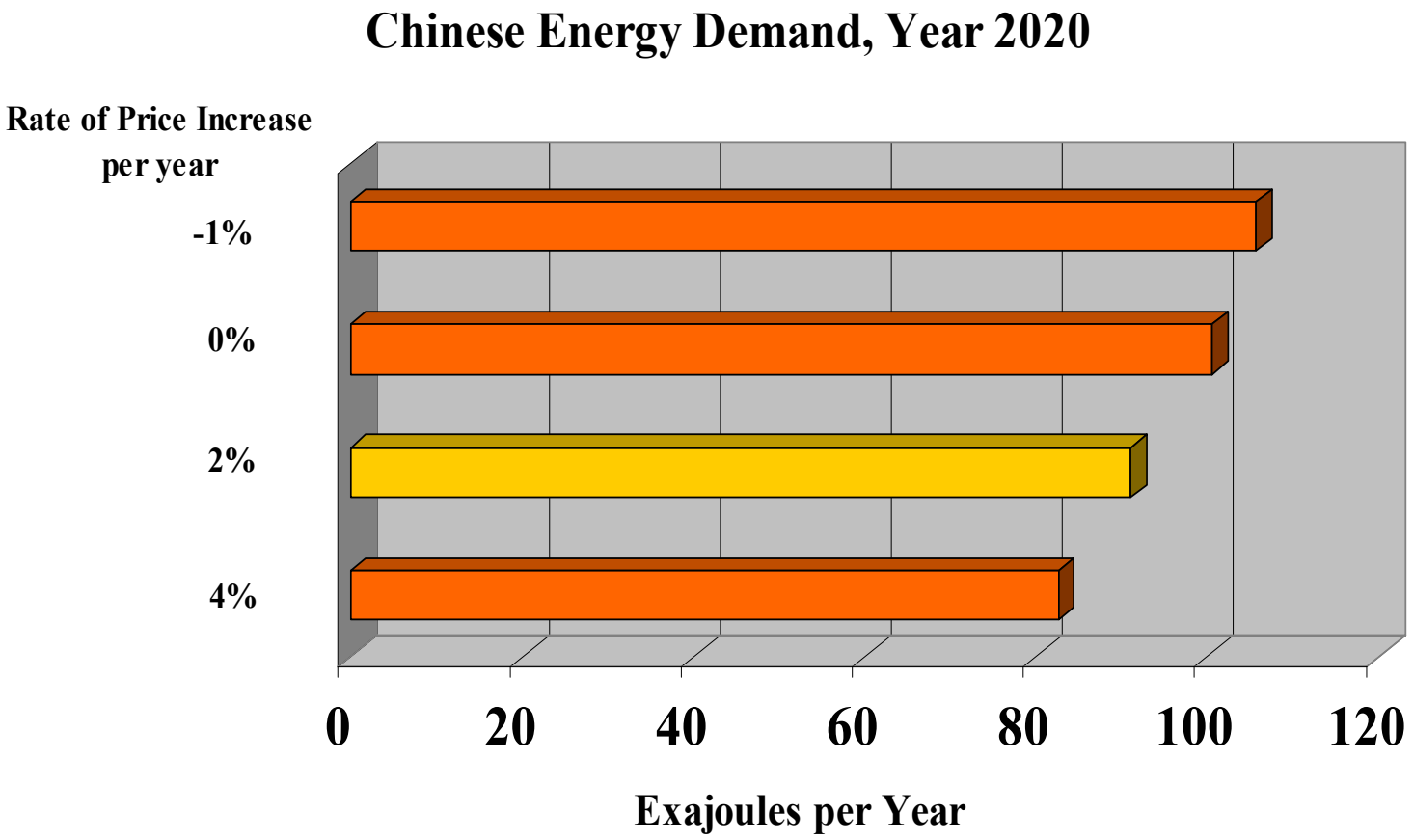


Illustration of the Effect of Changing Assumptions on Model Results: *Energy price changes*

图解假设变化对模型结果的影响：*能源价格变化*

For each case: GDP = 6.9 percent per year; Price elasticity 价格弹性= 0.25



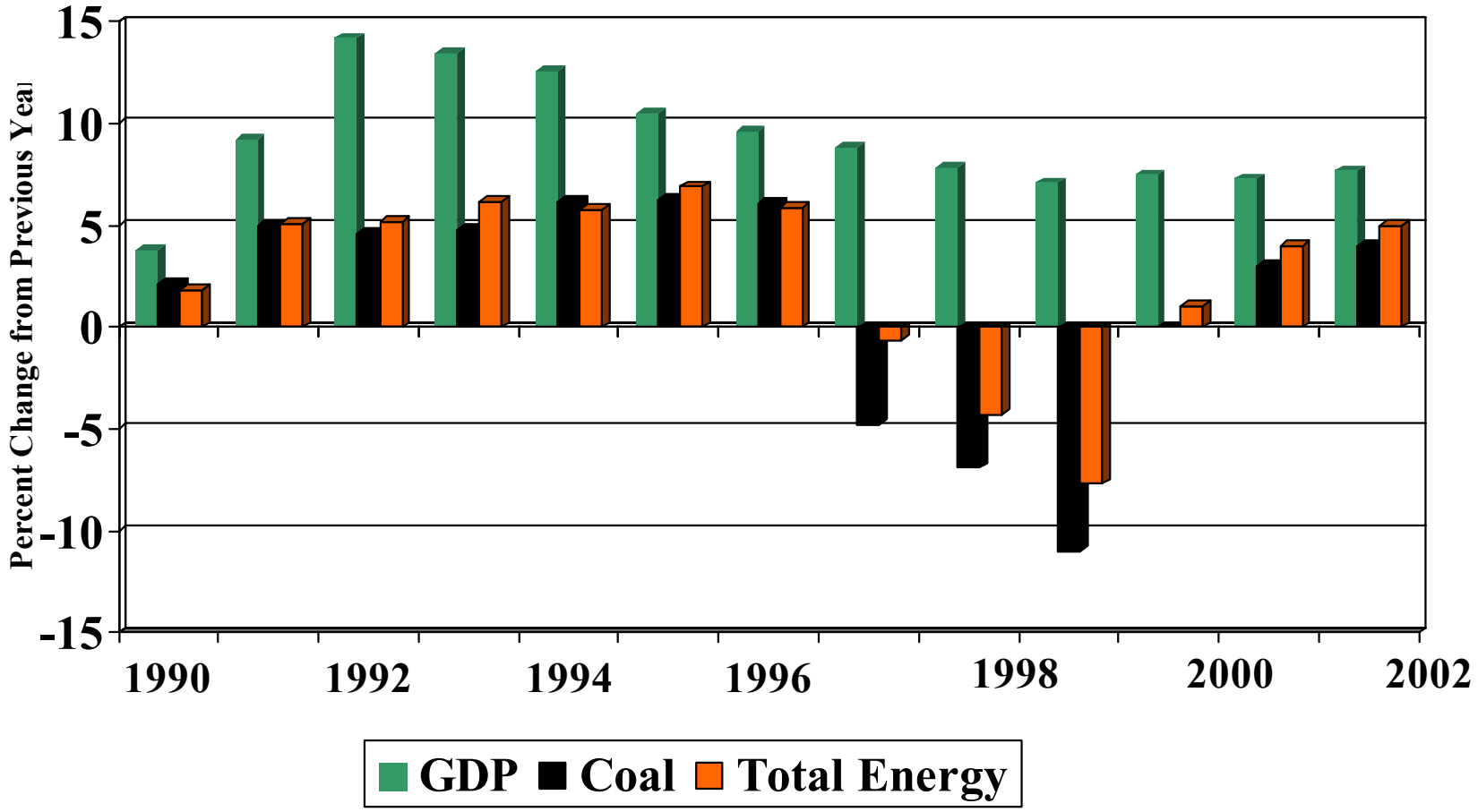
Improving Models: 改进模型
Clarifying Assumptions for China's Future
阐明中国未来的各种假设

- **GDP to grow 5-7% annually through 2020?**
  至2020年GDP年增长率为5-7%？
- **Population growth—only 0.7%？**
  人口增长率—仅为0.7%？
- **Labor force growth rate?**
  劳动力的增长率？
- **Structural shift to accelerate (agriculture to services)?**
  加速结构转换 （从农业到服务业）
- **Liberalization to continue?**
  进一步的市场化？

“It is very difficult to predict anything, especially the future....”

“任何预测都是非常困难的，特别是预测未来”

- Niels Bohr



Using Models to Test Policies

应用模型效验政策

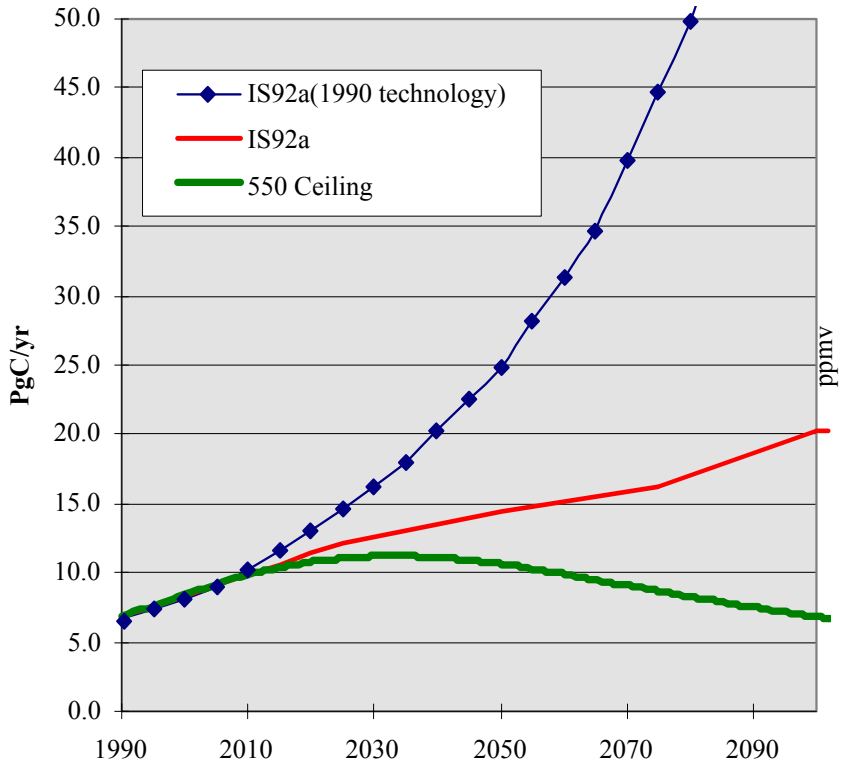
Policy 政策	*Methodology 方法论*
• **Market reform** 市场改革	**Top-down model** 自上而下模型
• **Energy tax or pollution tax** 能源税或污染税	**Top-down or bottom-up model** 自上而下或自下而上的模型
• **Standards** 标准	**Bottom-up model** 自下而上的模型
• **Government procurement policy** 政府采购政策	**Bottom-up model** 自下而上的模型
• **Financial incentives** 财政激励政策	**Bottom-up model** 自下而上的模型

Issues “External” to Models 模型的外部因素

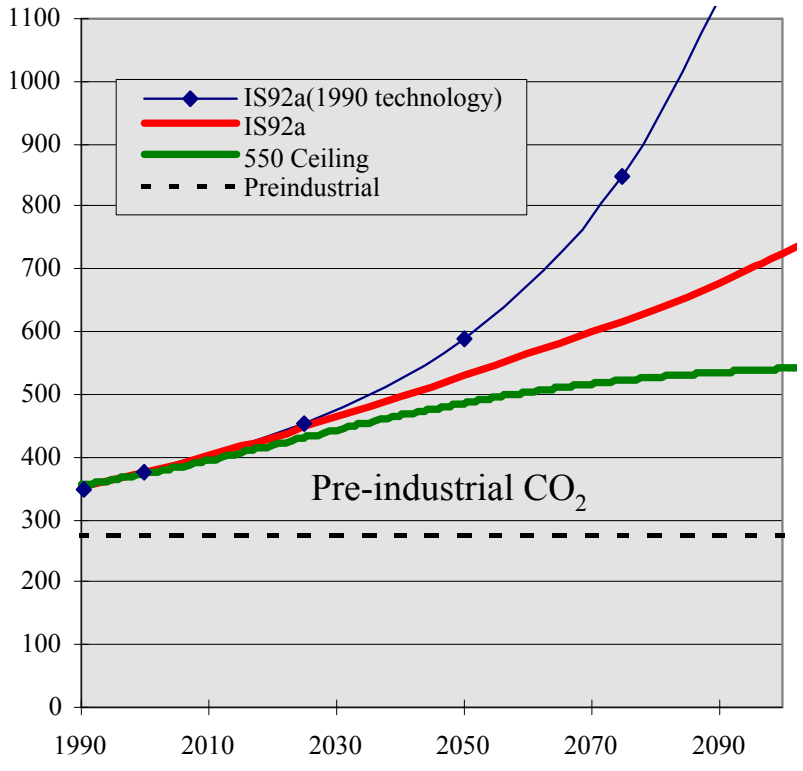
- **National security** 国家安全
- **Worker health and safety** 劳动者的健康和安全
- **Environmental costs to the “commons”** 公共环境成本
- **Inter-generational equity** 代间的共平

Climate Change-Emissions and Concentration
气候变化——排放和浓度

Emissions 排放



Concentration 浓度



China and Climate Change

中国和气候变化

China has already reduced growth in annual carbon emissions:

中国已经降低了每年碳排放的增长速度：

- **150 million tons with slower population growth**

  人口增长率的降低减少了1.5亿吨的碳排放

- **100 million tons with reduced energy intensity**

  能源密度的降低减少了1亿吨的碳排放

- Chandler *et al.*, *Climate Change Mitigation in Developing Countries*, 2002

Testing Priority Policies

测试优先政策

- **Pricing energy for efficiency**

  为提高能源效率调整能源价格

- **Controlling automobile oil use**

  控制汽车的油品消费

- **Reducing uncertainty in price and demand growth**

  减少价格和需求增长的不确定性

- **Encouraging natural gas use (including imports)**

  鼓励天然气的利用（包括进口）

- **Controlling environmental impacts**

  控制环境影响

Possible Strategy for Providing Modeling Capabilities 提高模型能力的可能战略

- **Establish multiple modeling capabilities**

  建立多样化的模型

  -Model types

  模型类型

  - Institutions

  机构

- **Government as *client* for model results**

  政府是模型结果的用户

- **Sustain a *policy review* capability for model results**

  保持对模型结果的政策回顾能力