

Coal vs. Natural Gas: The Political Economy of Fuel Choice in China

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PESD Research: The Political Economy of Energy

1. Energy Services for the Very Poor

- Shift from traditional to modern fuels and technologies

2. Electricity Market Reforms

- Five-country comparison (Brazil, China, India, Mexico, South Africa)
- Independent Power Producers (IPPs)

3. Global Natural Gas Markets

- Looking to 2040
- Looking at 'gasification' of key new markets (China, India)

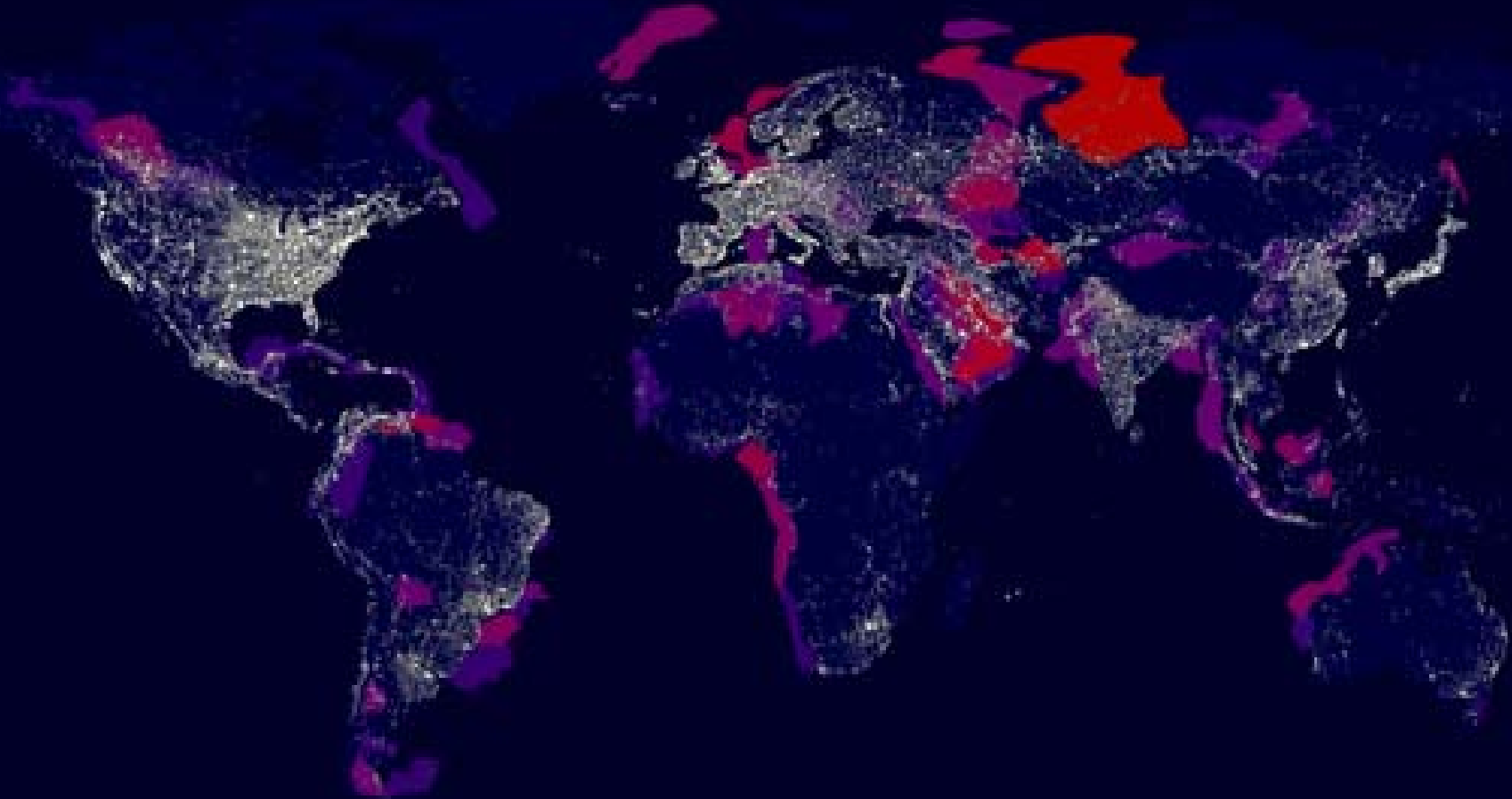
4. Climate Change Policy

- Beyond Kyoto
- Engaging developing countries
- Energy efficiency

5. The Role of National Oil Companies

- Causal relationship between strategies, political influence and performance
- Studies underway on 15 countries

Gas Resources and Potential Demand



White: where the lights are on, satellite imagery

Blue → Red : Gas resources, with increasing size (USGS)

Critical time to estimate demand for natural gas in China

- Nascent gas market currently
- Uncertain demand projections

...which lead to huge implications for

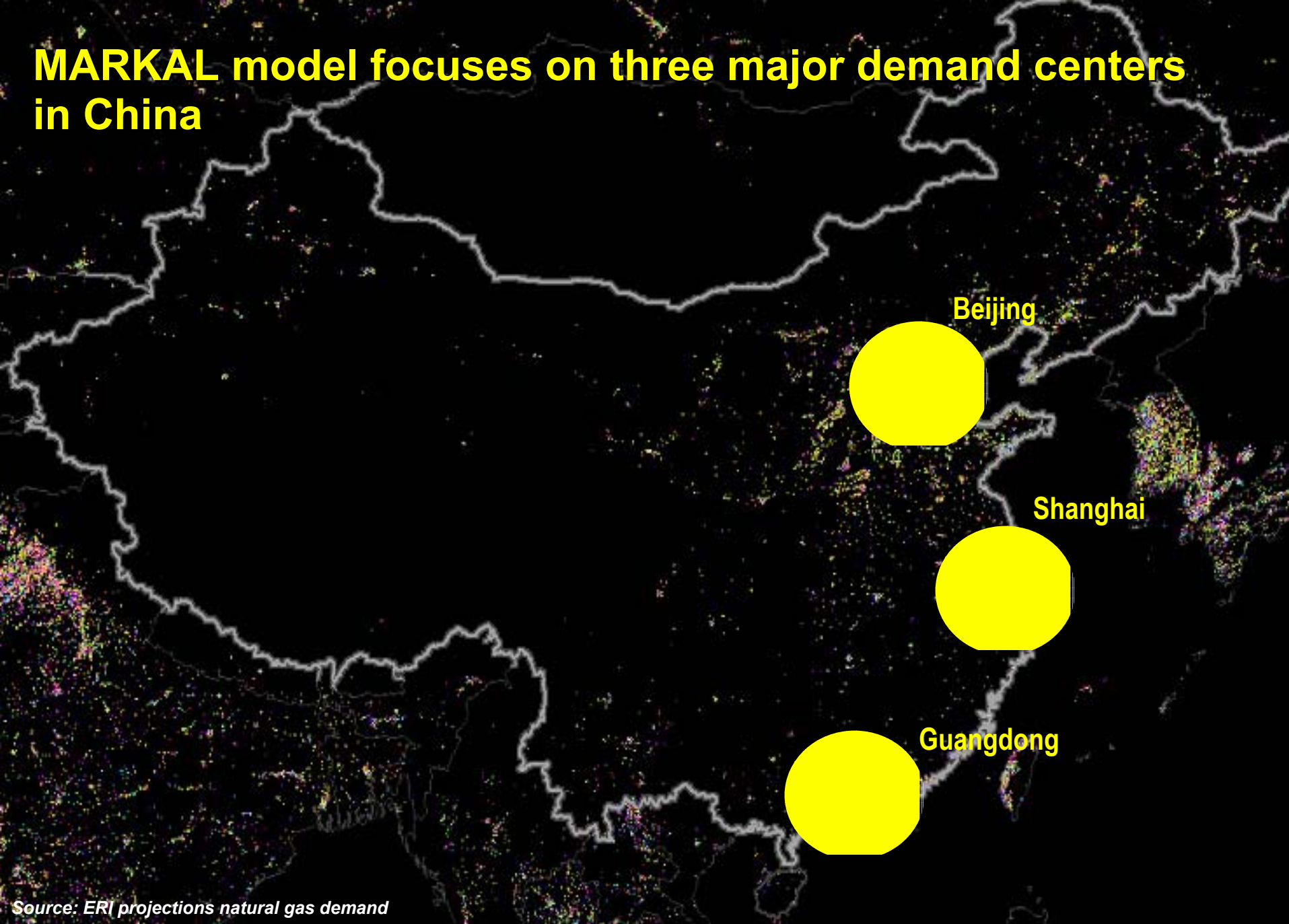
- Carbon emissions
- Energy security
- Geopolitics

Drivers of natural gas consumption in China

Utilizing MARKAL – least cost optimization energy modeling

- Environmental constraints – SO₂ emissions reduction
- Cost of capital for each sector
- Penetration of end-use demand technologies
- Pricing and availability of natural gas

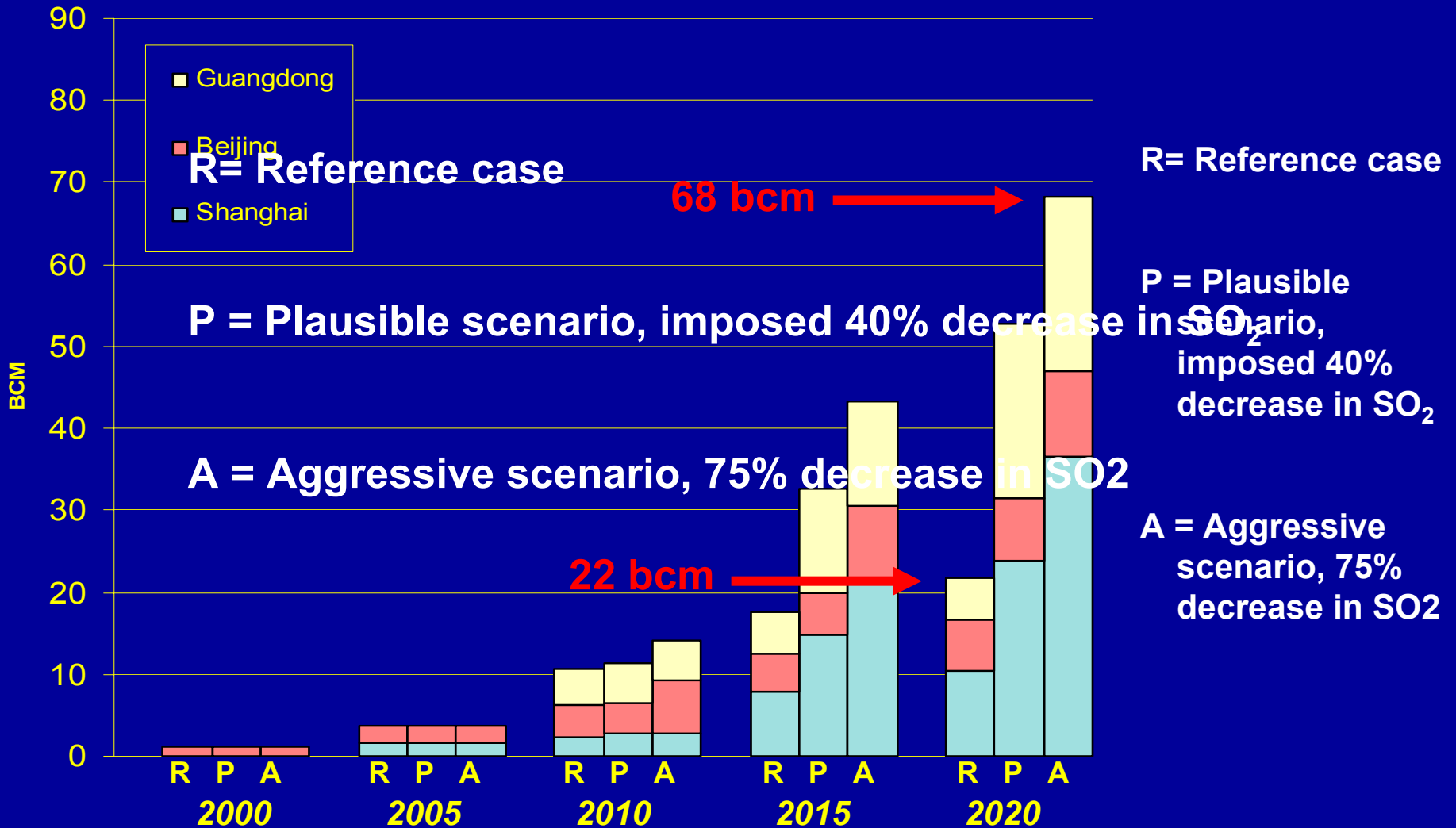
MARKAL model focuses on three major demand centers in China



Source: ERI projections natural gas demand

Environmental Controls

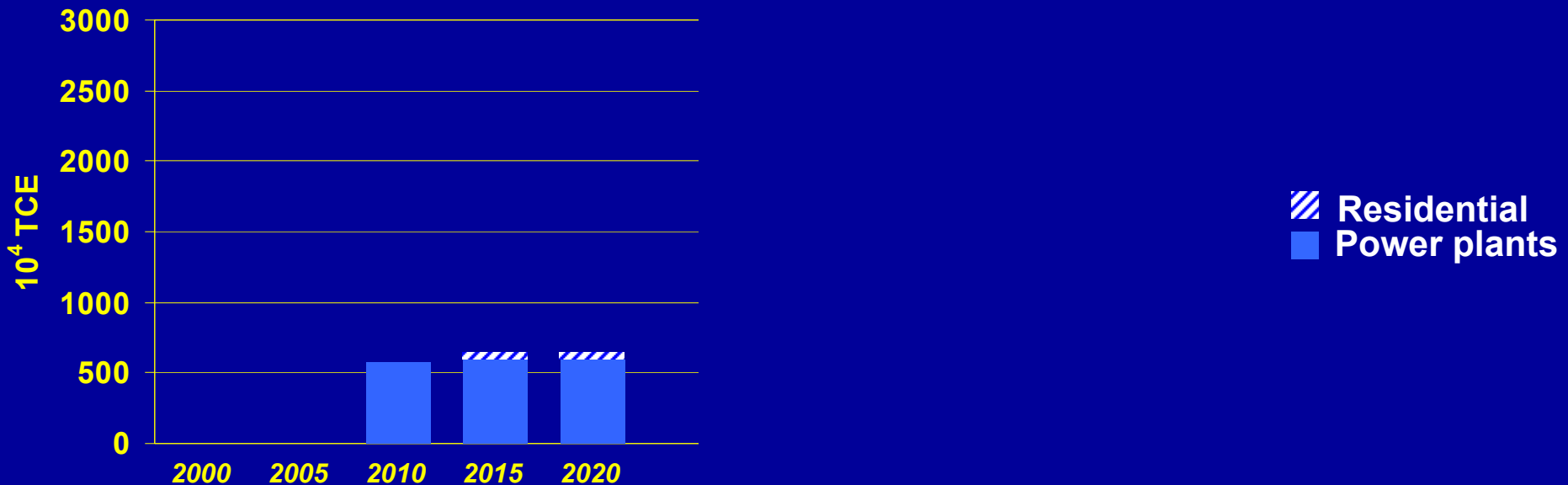
Demand for natural gas in the three regions is highly sensitive to environmental constraint



Guangdong: Demand for gas is in power plants

Natural Gas Consumption

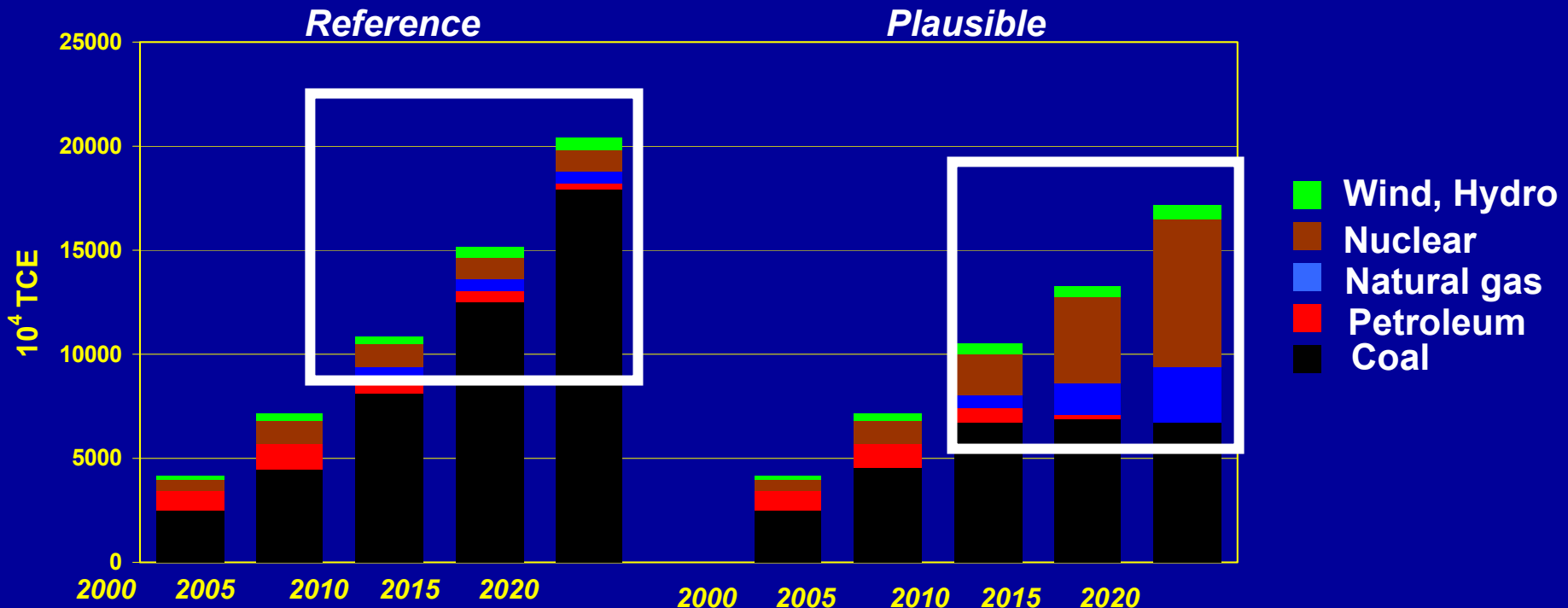
Reference



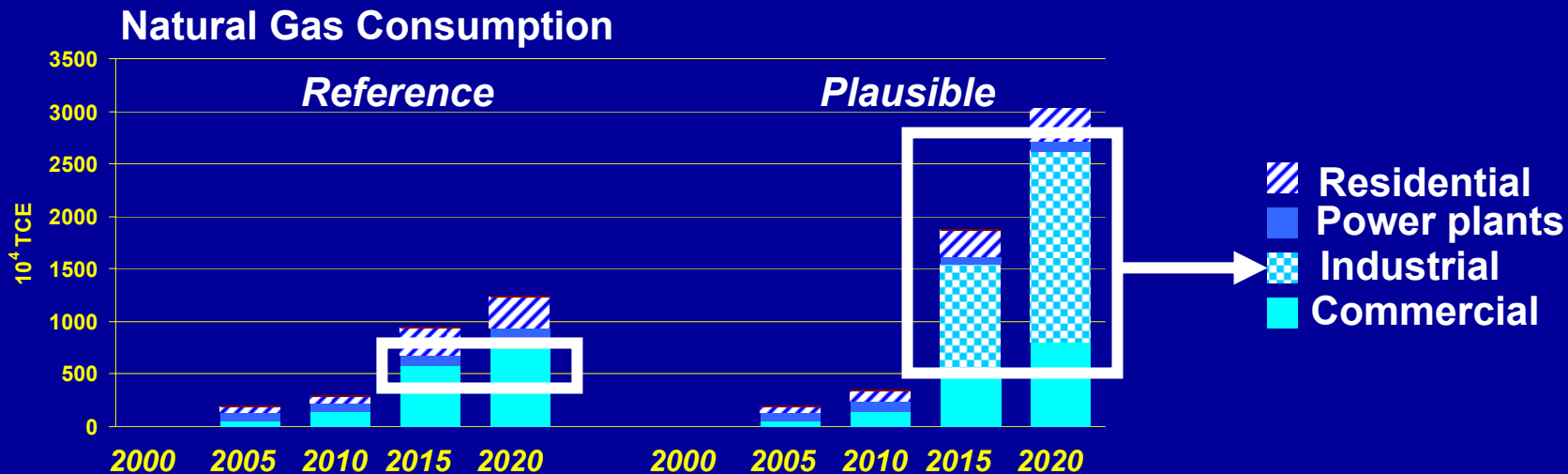
Fuel switching occurs in peaking power plants that substitute heavy oil for natural gas, no piped natural gas supply, dependent upon LNG

Guangdong: Nuclear plays big role

Power Sector Fuel Consumption



Shanghai: Demand for gas is in industrial sector



Fuel switch

Coal, oil → natural gas boilers

Affected industries

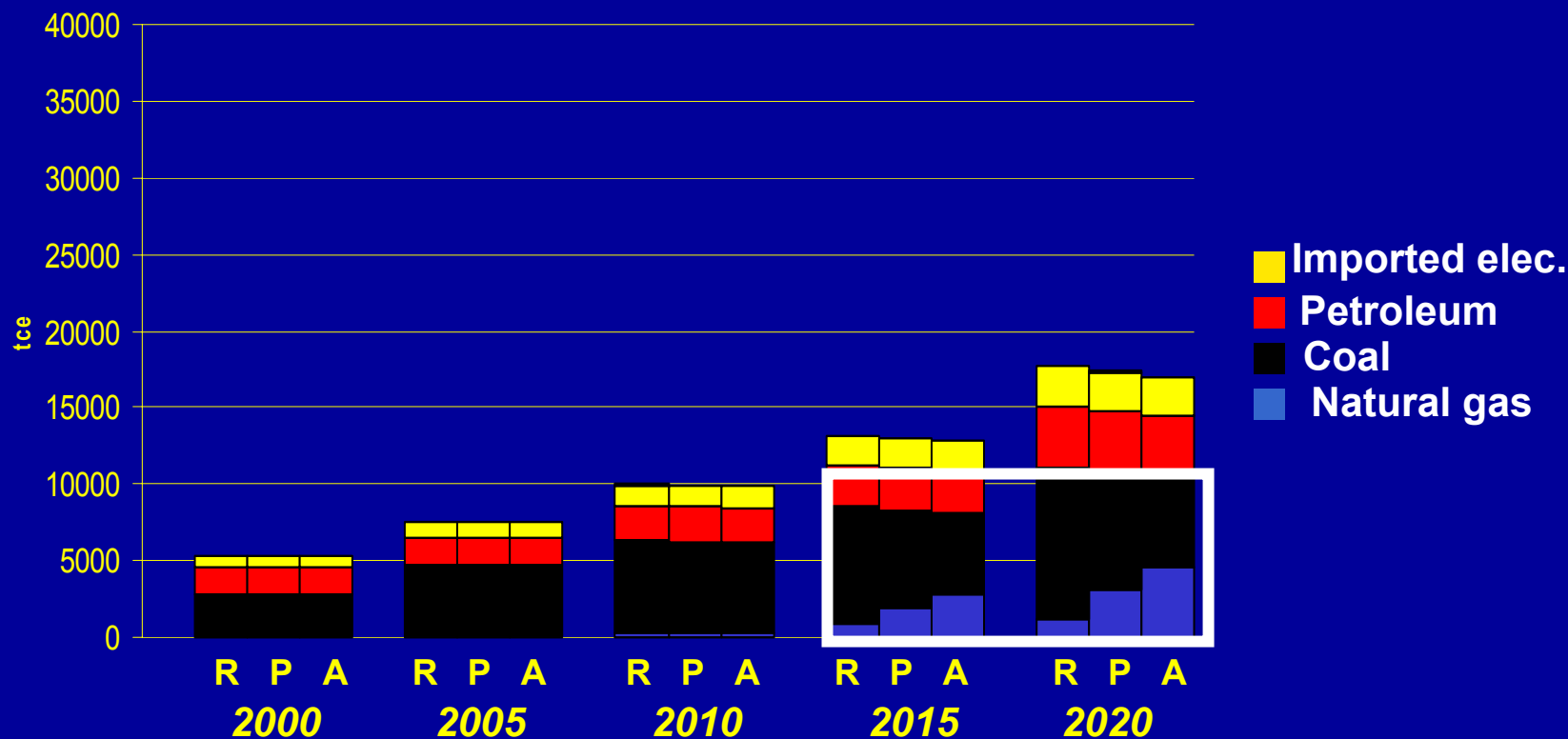
Petroleum and chemicals

Processing heat (metal prod, textile, manufacturing)

Steel and iron

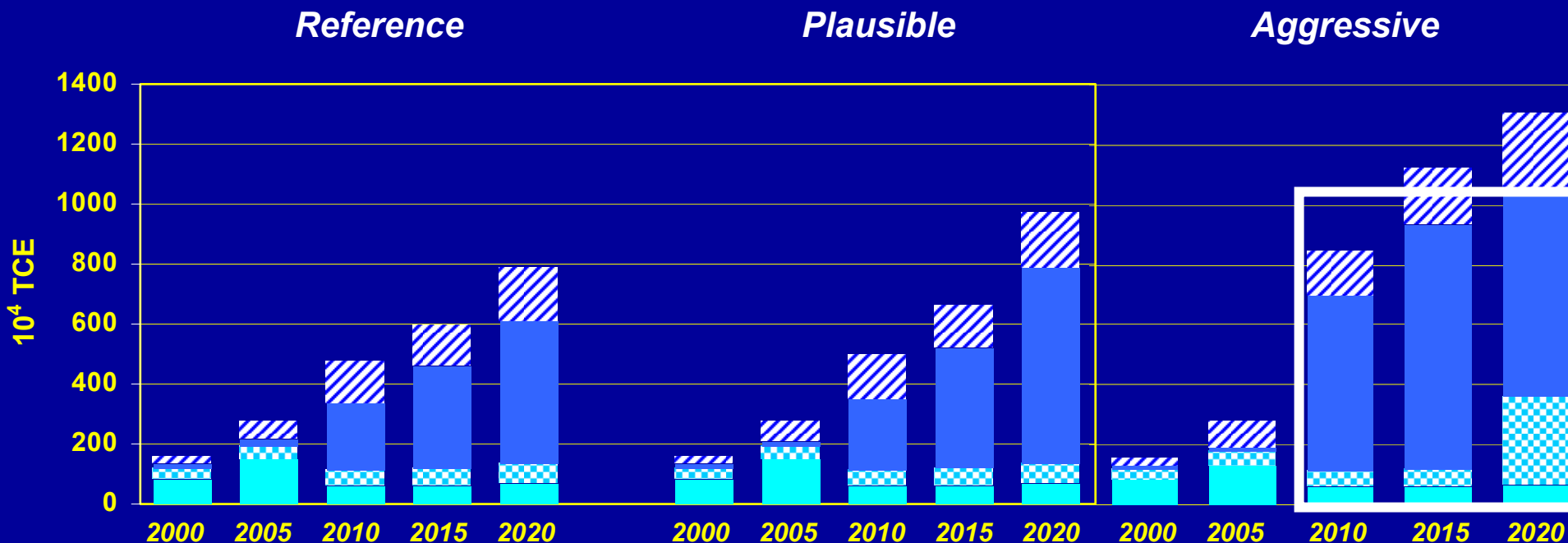
Large number of inefficient coal boilers in energy intensive industries provides opportunities for fuel switching

Fuel consumption in Shanghai reveal effects of coal vs. gas competition



Beijing: Little change in fuel consumption patterns until more stringent environmental constraints are applied

Natural Gas Consumption



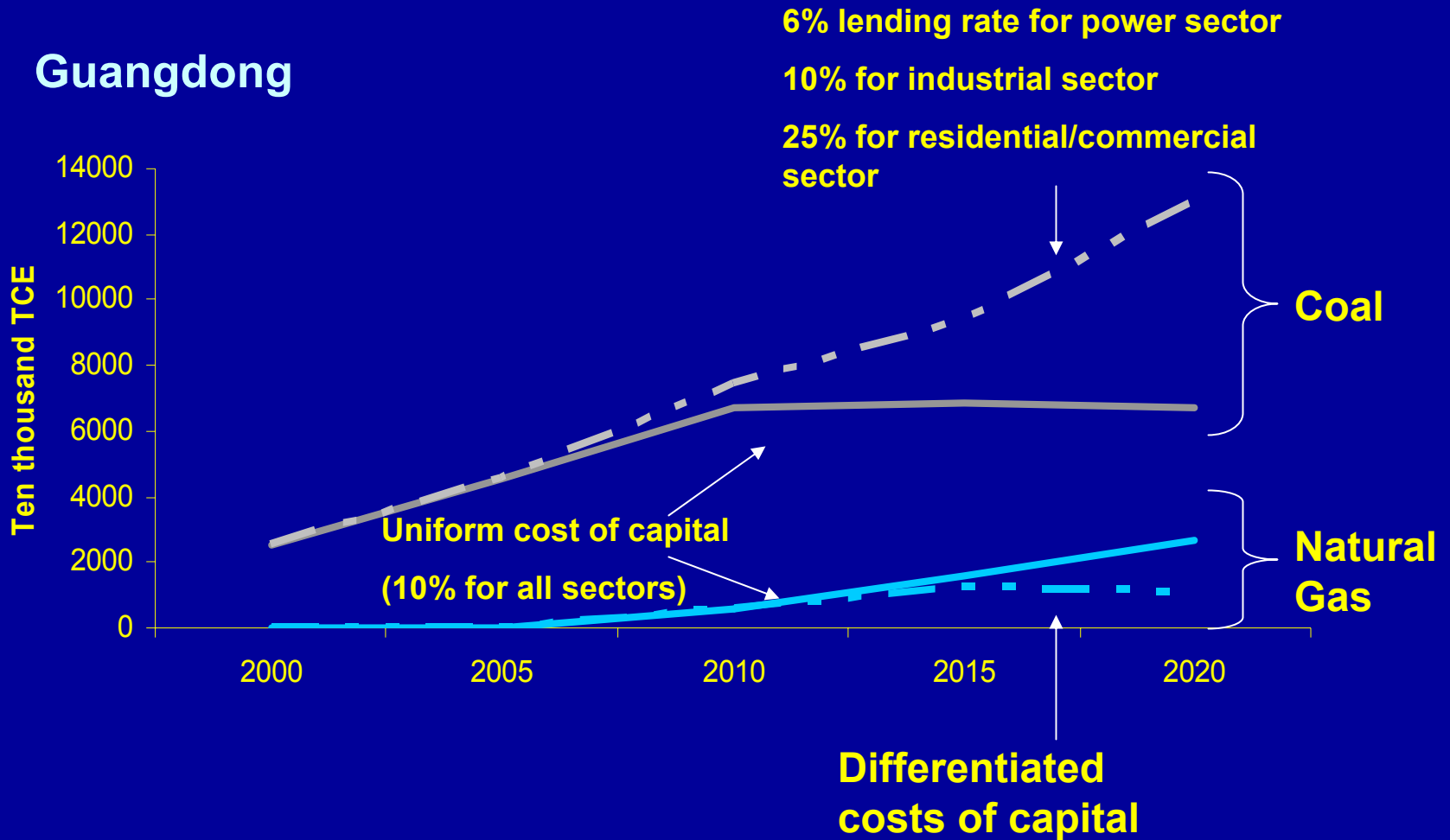
-  Residential
-  Power plants
-  Industrial
-  Commercial

SO₂ reductions are met through installations of FGD units initially, then supplemented with additional fuel switching in the power and industrial sectors

Financial reforms

Low cost of capital for power plants spurs coal consumption

Guangdong



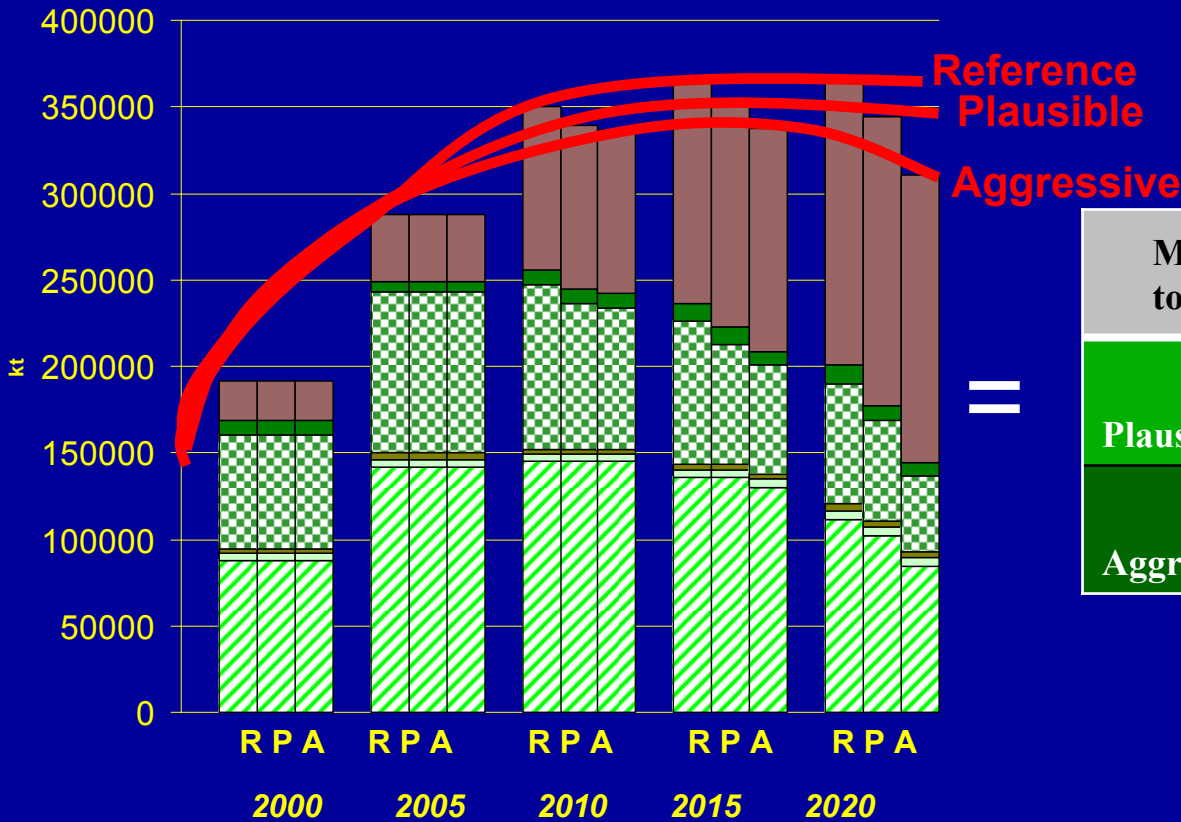
Implications for coal vs. natural gas consumption

- The power sector will likely continue to be dominated by coal. However, for certain areas and sectors, fuel switching from coal to natural gas can be a cost-effective option
- SO₂ controls could lead to more demand for natural gas
- Higher cost of capital for the power sector could promote the consumption of more natural gas

Implications for CO₂: Do CO₂ emissions decrease?

Guangdong CO₂ emissions by sector

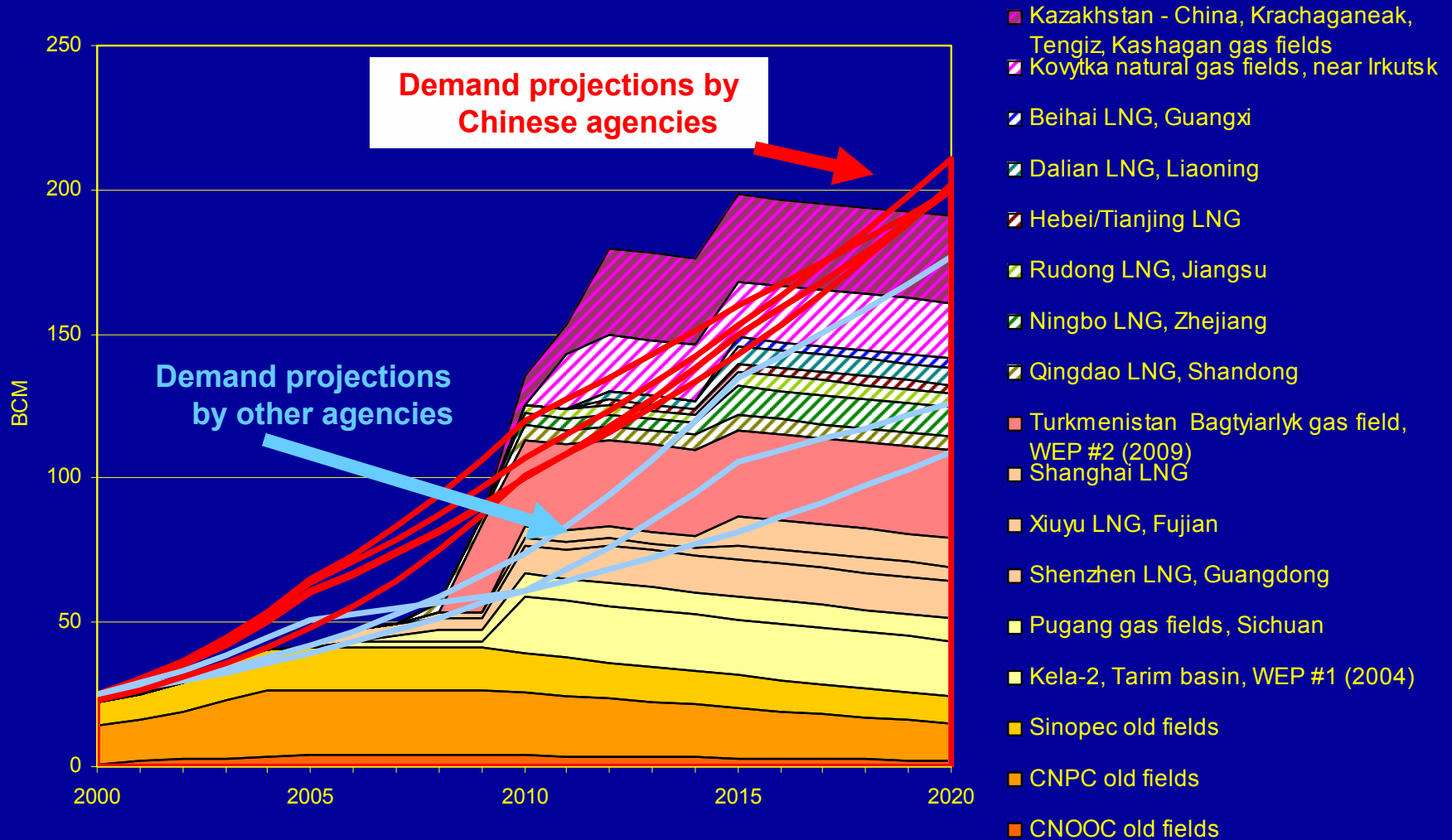
CO₂ emissions savings



| Million tons | 2010 | 2015 | 2020 |
|--------------|------|------|------|
| Plausible | 11 | 15 | 43 |
| Aggressive | 16 | 28 | 108 |

Transportation
 Residential
 Industrial
 Power plants

Natural gas sourcing could potentially be a challenge



Source: PESD estimates 2007, CNPC/Sinopec/CNOOC company reports 2007, ERI, IEA 2004, Chinese agencies: NDRC, China Energy Development Report 2003, CNPC, CNOOC, Western sources: BP, EIA/DOE 2003, AIE/WEO 2002