Mitigating Climate Change through Energy Efficiency: Implications of China's 20% Energy Intensity Reduction Target

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Overview

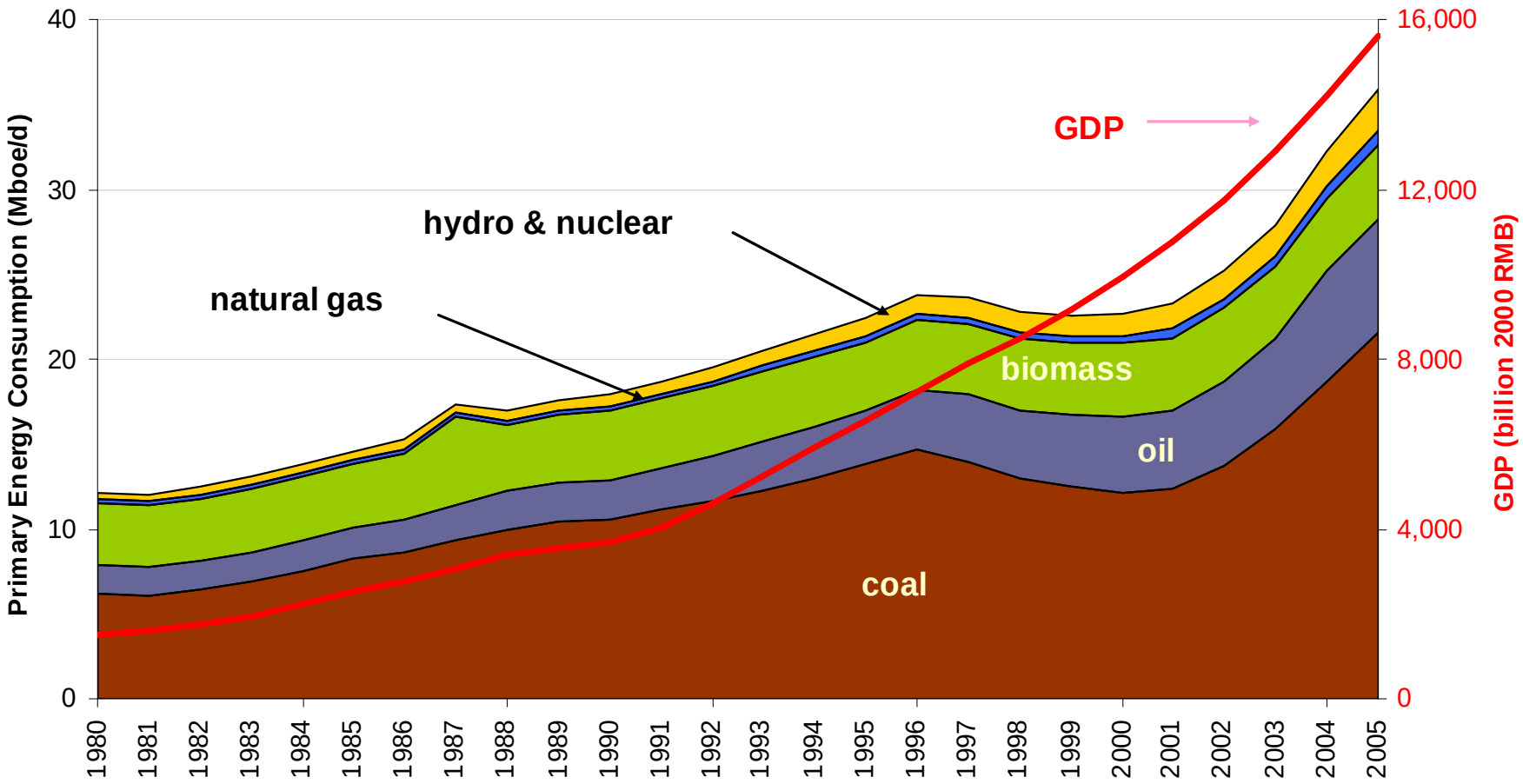
Background

Recent trends in energy and GDP growth

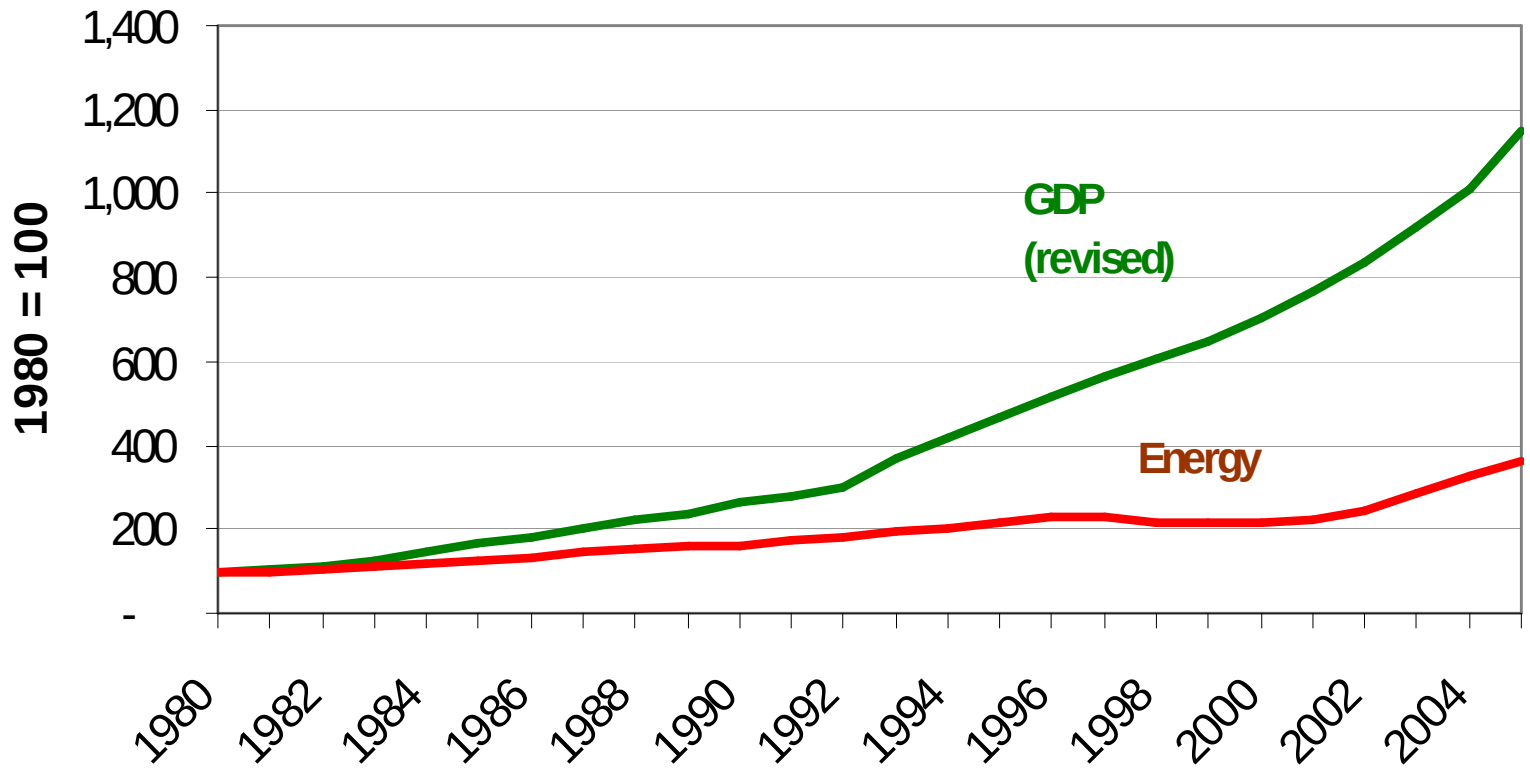
Possible scenarios for energy intensity reduction

Background

China's energy mix and GDP from 1980 to 2005: ~5X GDP, ~3X Energy, but little change in the mix

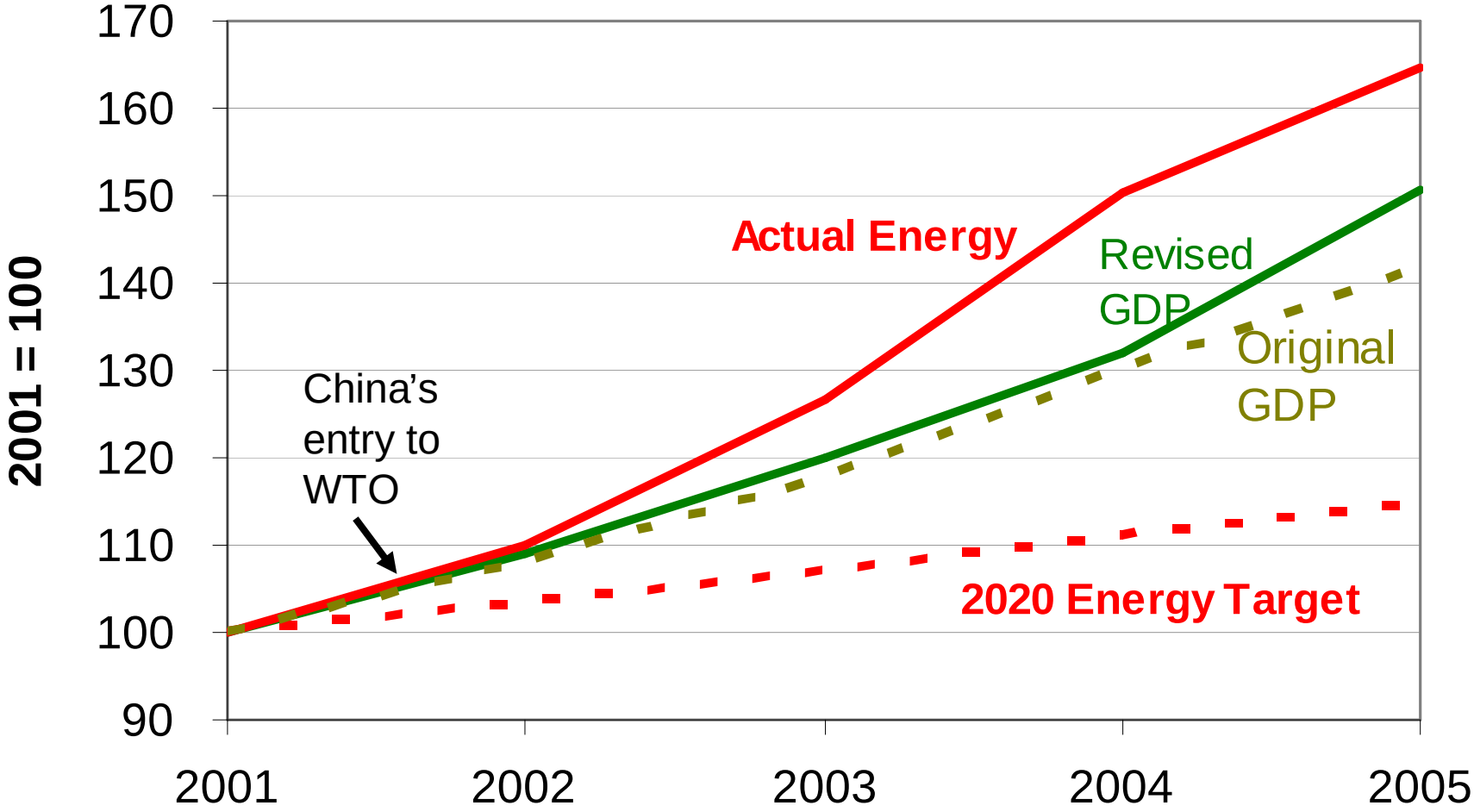


China's bold reform policies of the 1980's showed that energy and GDP growth can be decoupled



Source: NBS, China Statistical Yearbook, various years; China Statistical Abstract 2006.

Energy use has grown much faster than GDP since 2001



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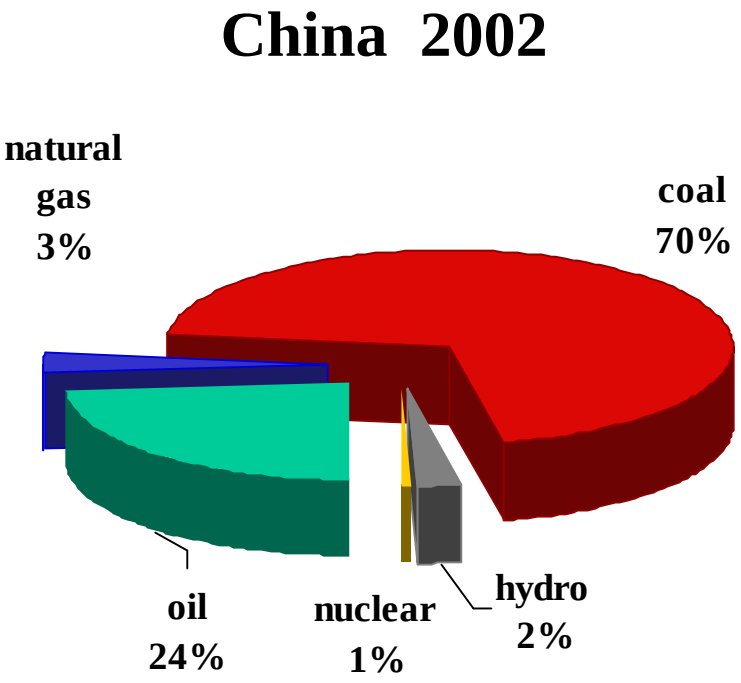
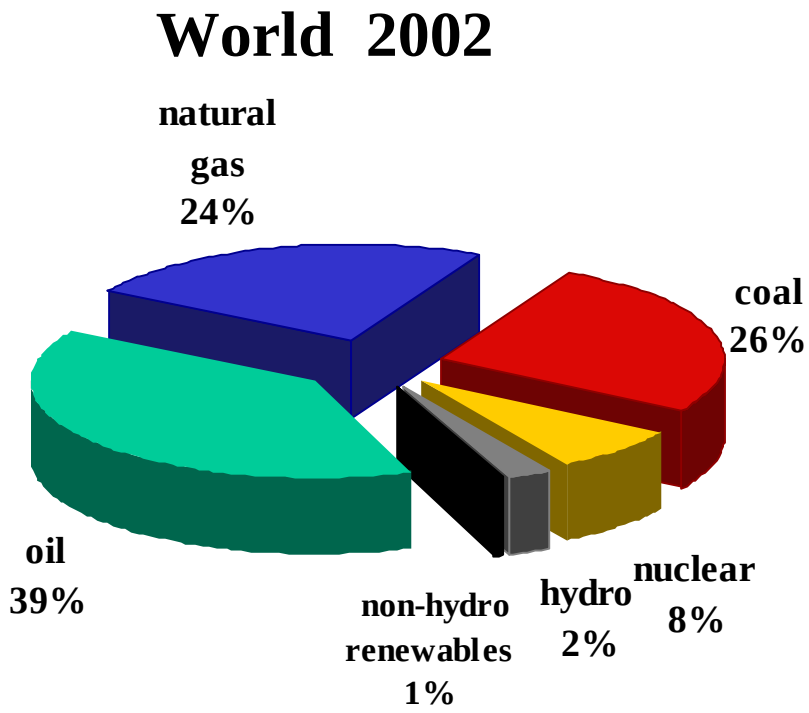
The Coal Problem in China





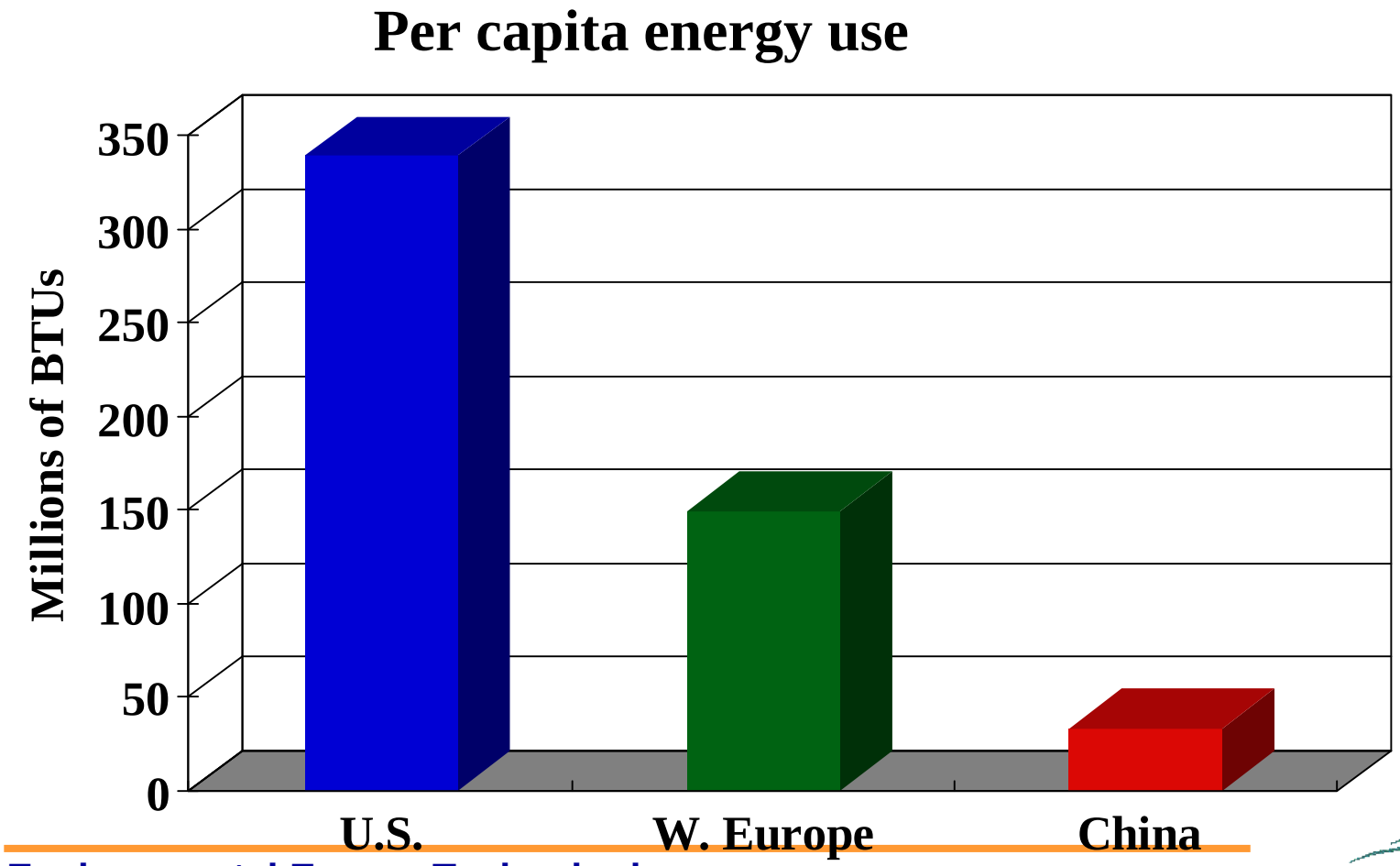
Source: IEA, 2004

The Coal Boom in China

Boom in power plant construction

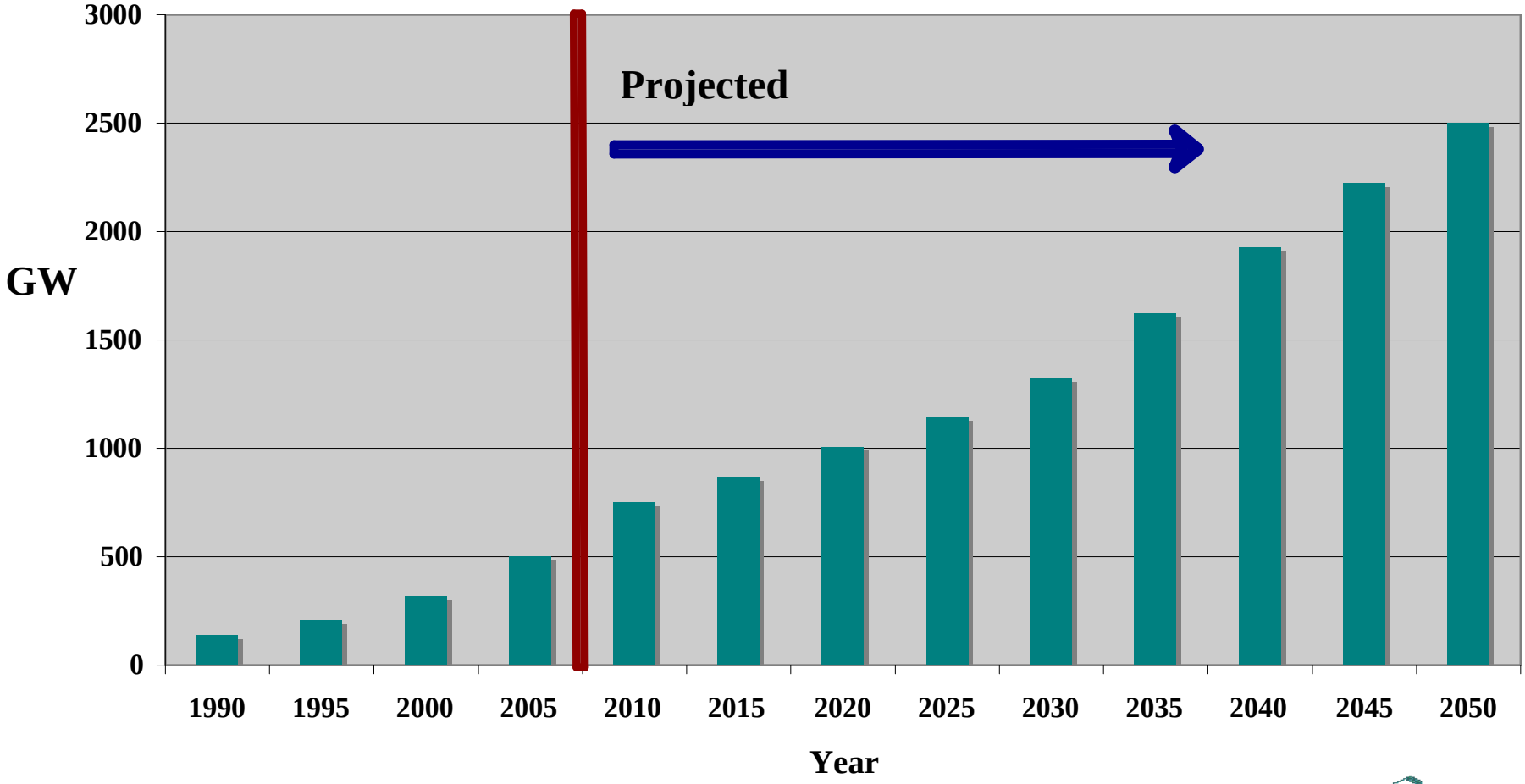
- **101 GW added in 2006**
- **92 GW coal-fired**
- **589 million tons of CO2/year**

China has a long way to grow…

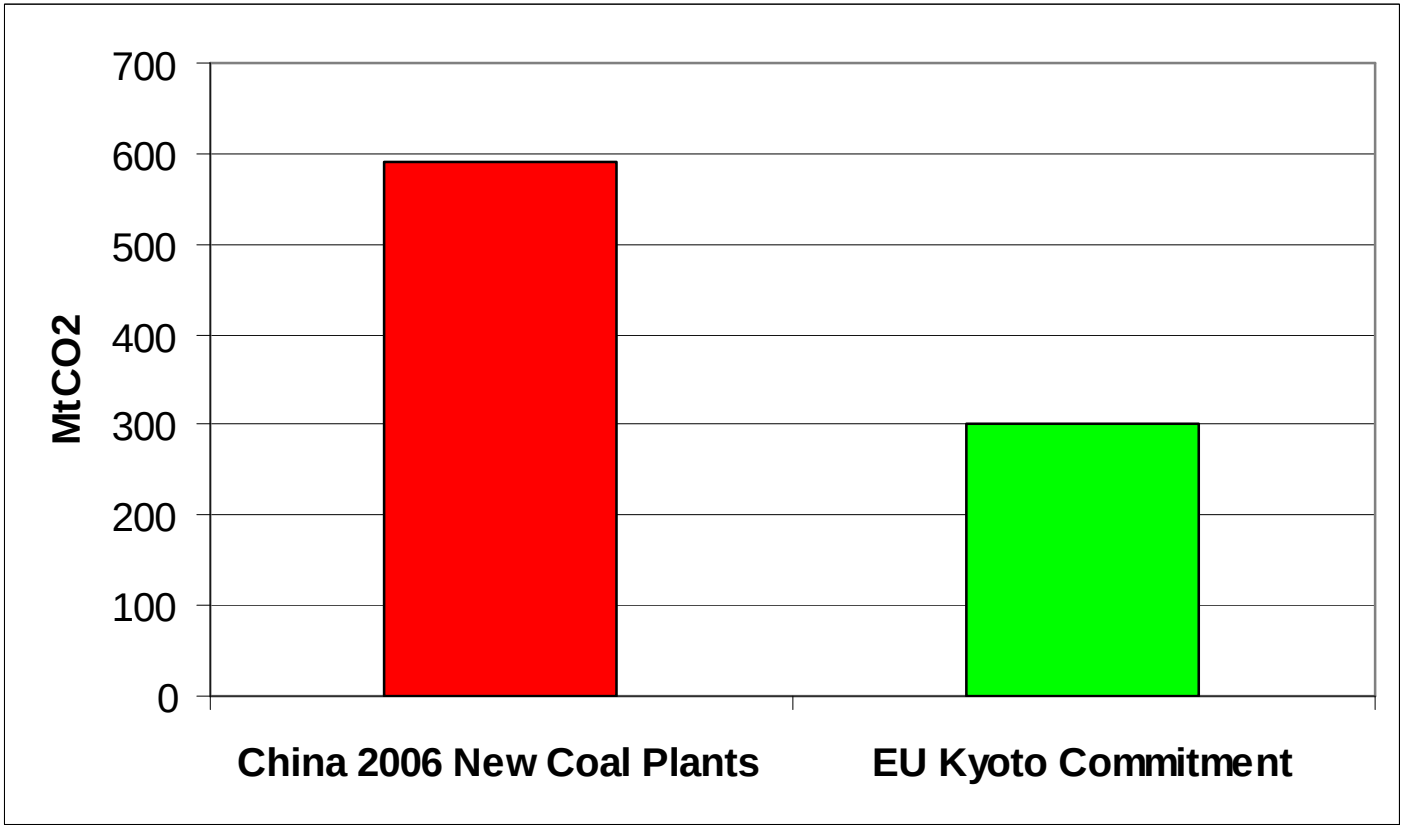


Source: Energy Information Administration, 2002

China's Electricity Growth 1990-2050

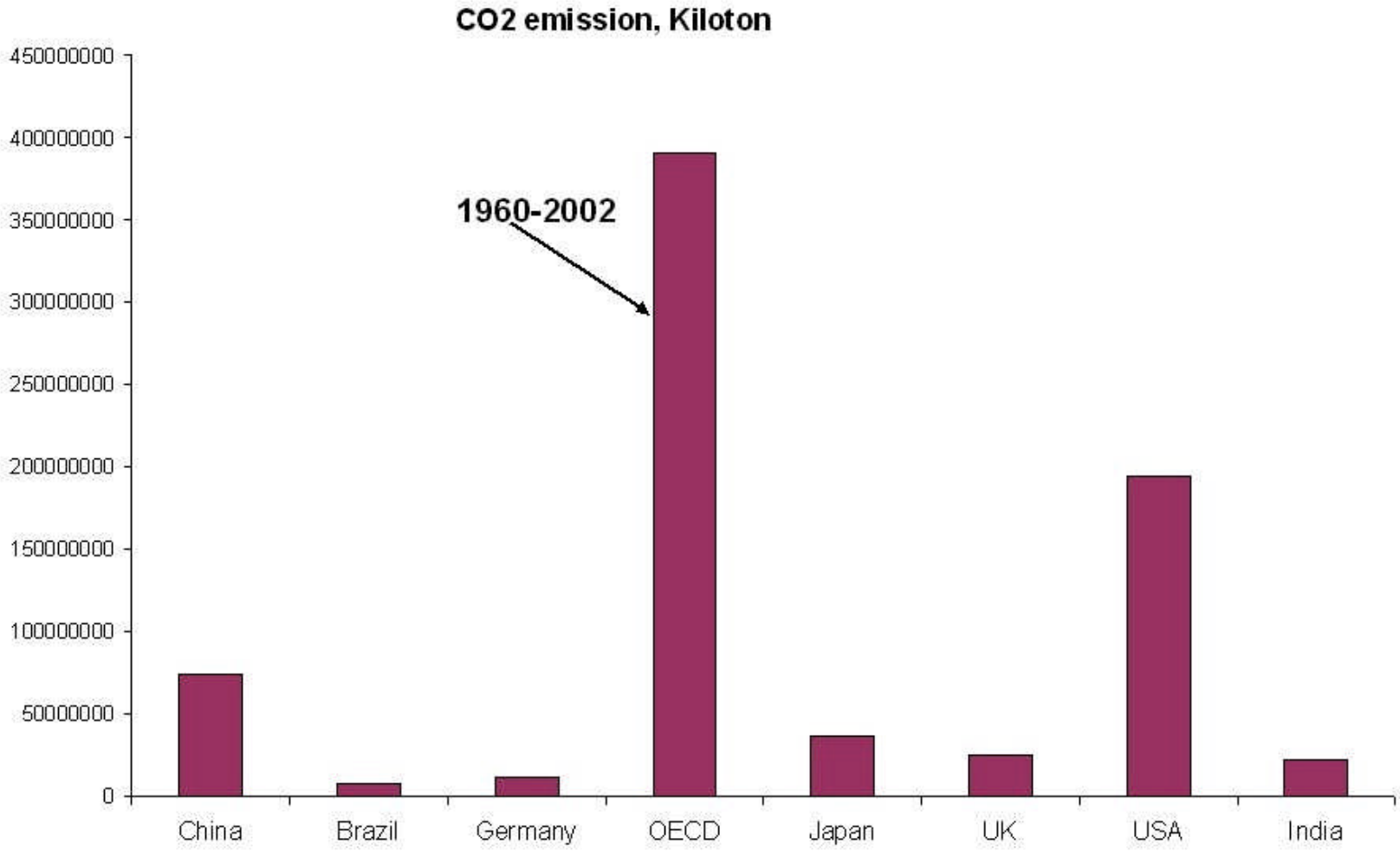


China's 2006 Coal Plants

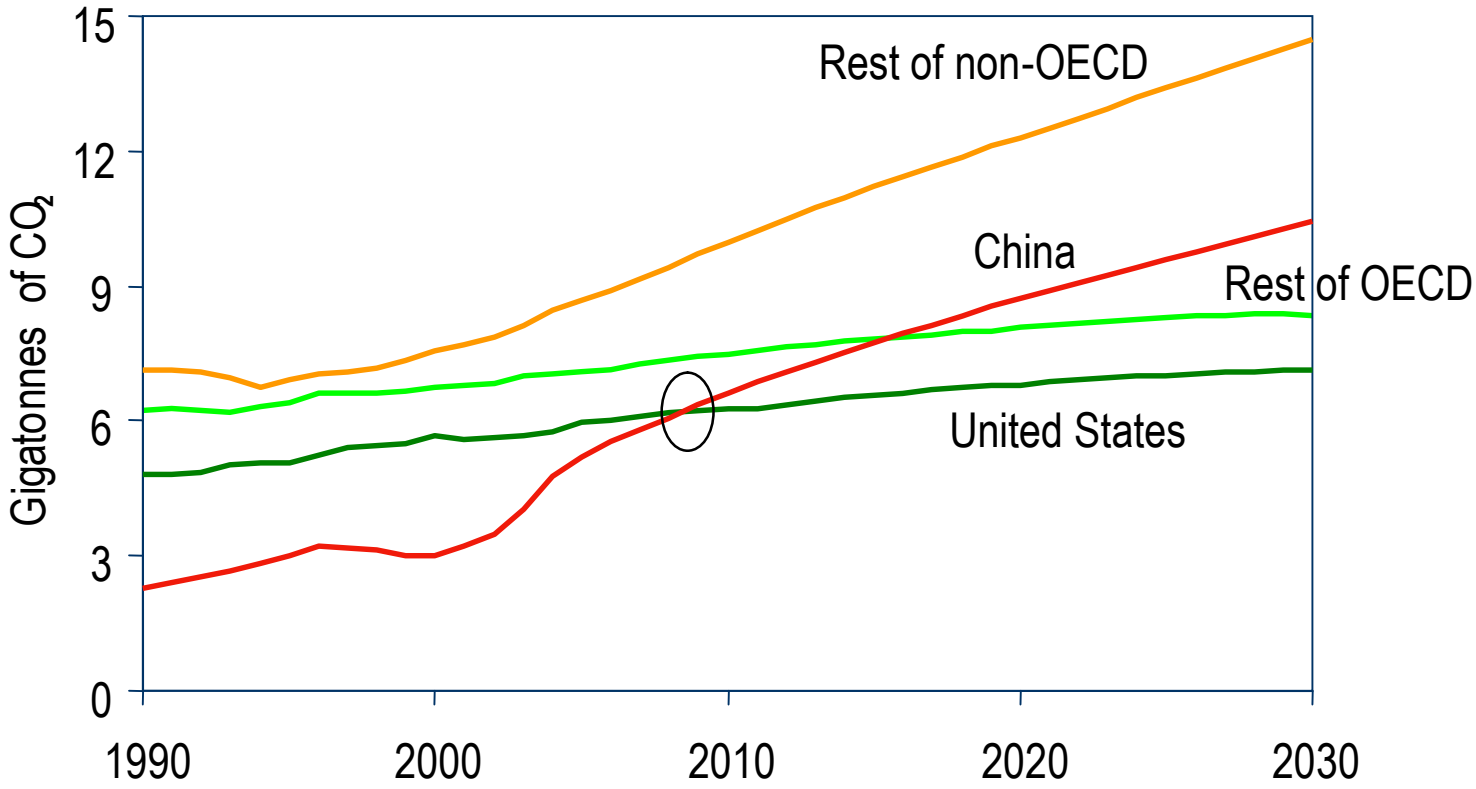


Cumulative CO_2 Emissions

China vs. OECD 1960-2002



Reference Scenario 参考情景
Energy-Related CO_2 emissions by Region
不同地区和能源相关的二氧化碳排放



China overtakes the US as the world's biggest emitter before 2010, though its per capita emissions reach just 60% of those of the OECD in 2030

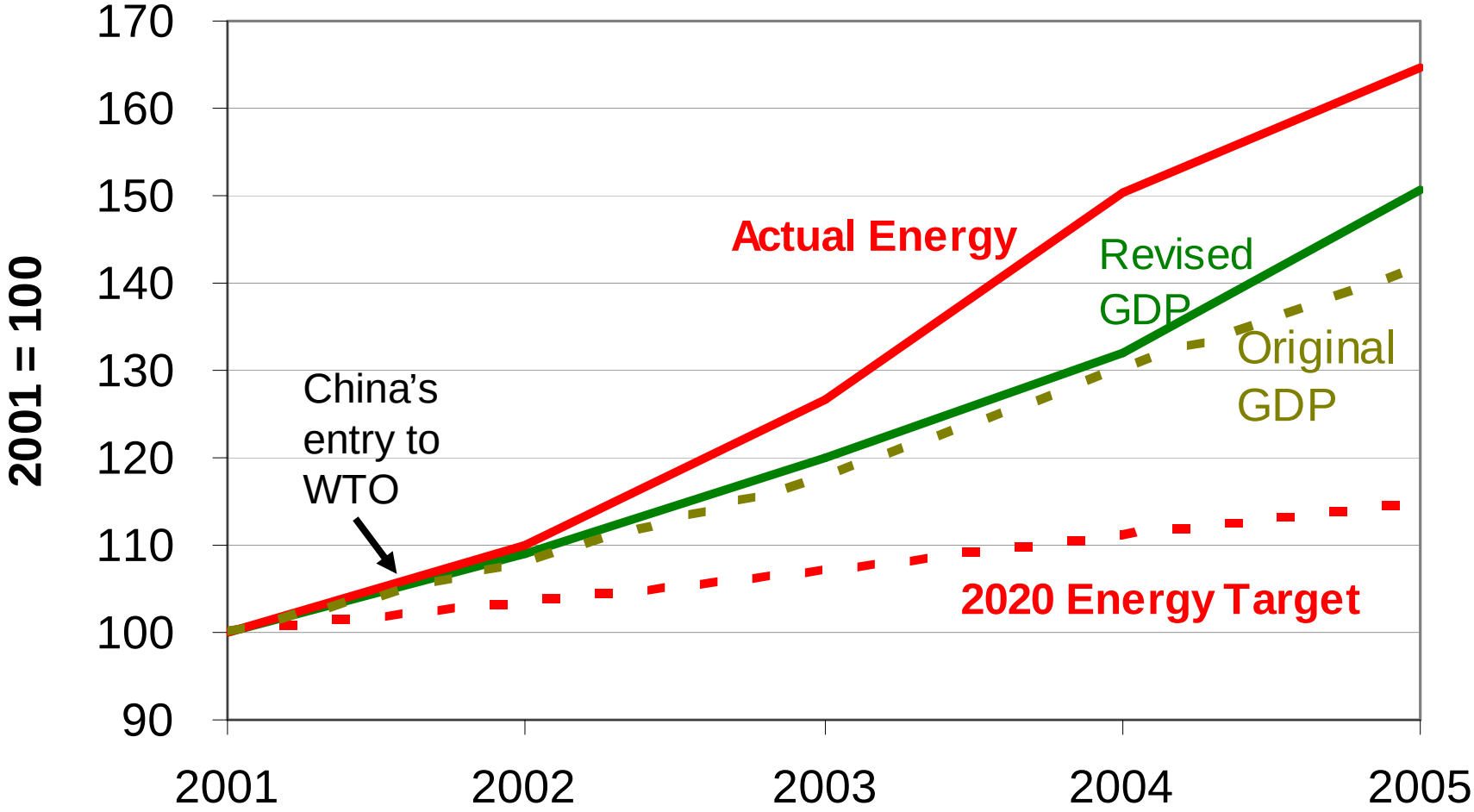
China's Development Goals in 11th FYP (2006-2010)

- GDP growth rate of +7.5% per year
- Energy intensity: -20% by 2010
- Air pollutants (SO2 and NOx): -10% by 2010

Implies

- CO2 emissions avoided: 1.5 billion tons/year
- Energy saved: 620 million tce/year

Energy use has grown much faster than GDP since 2001



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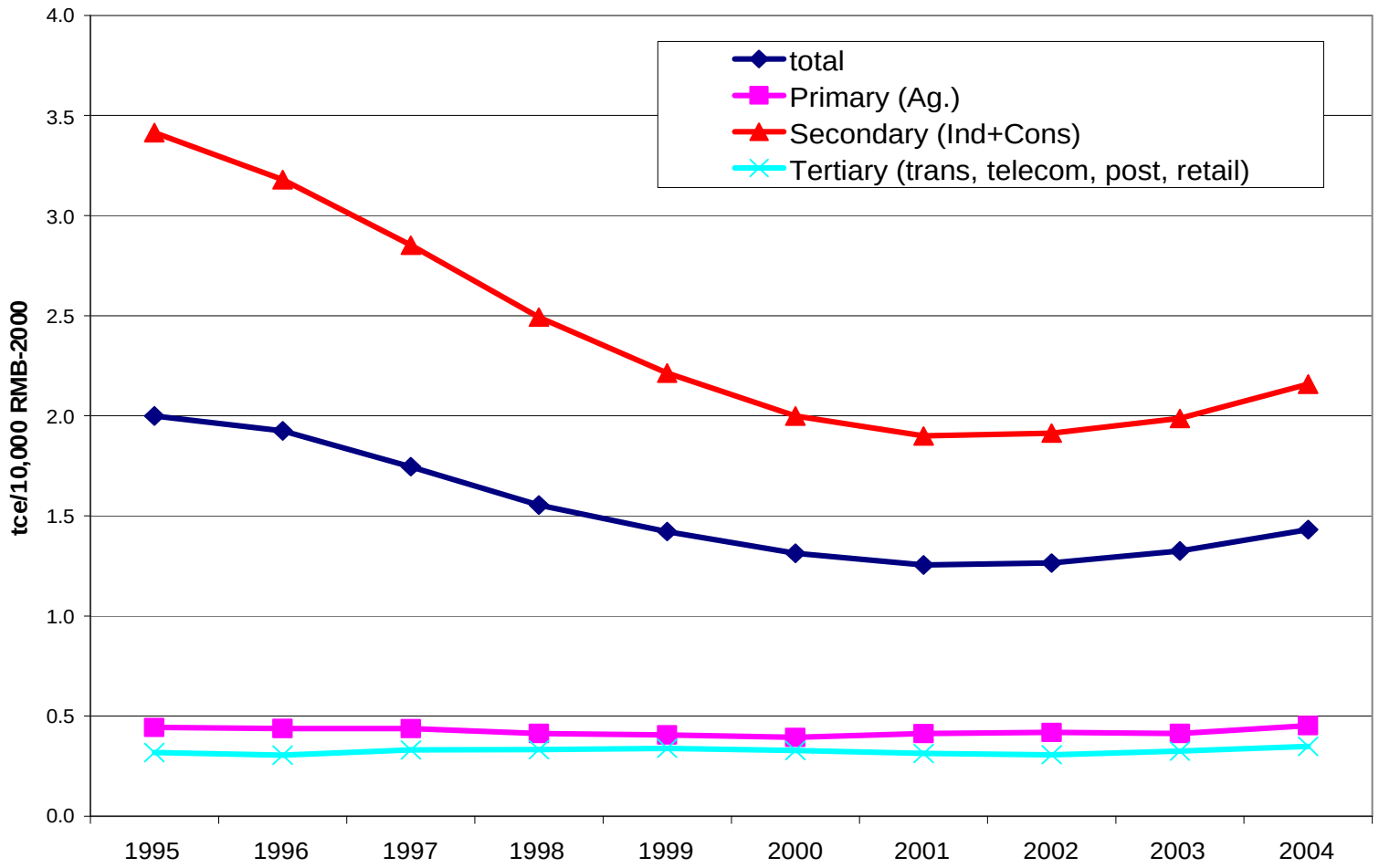
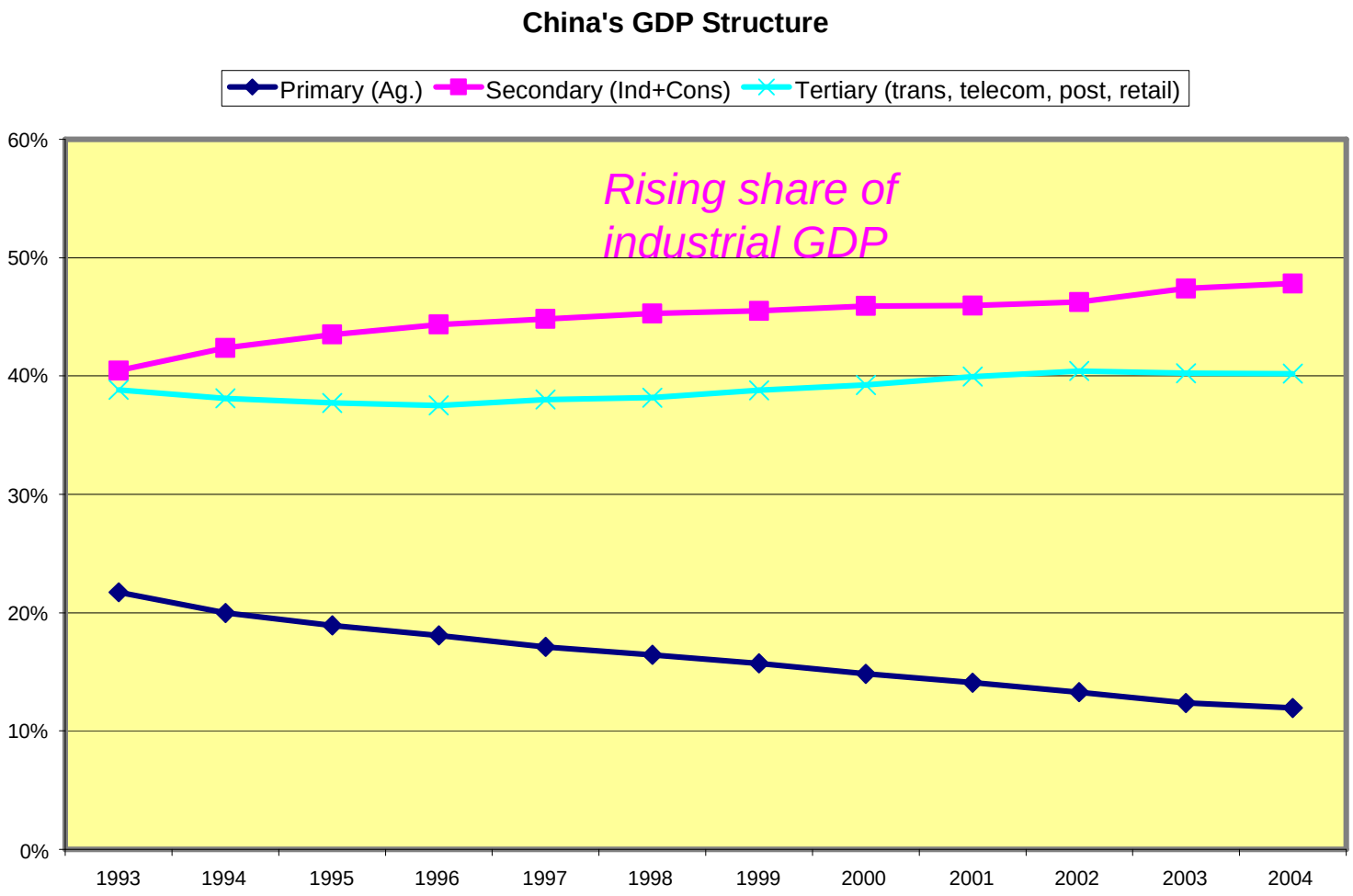
What happened to energy intensity over the last decade?

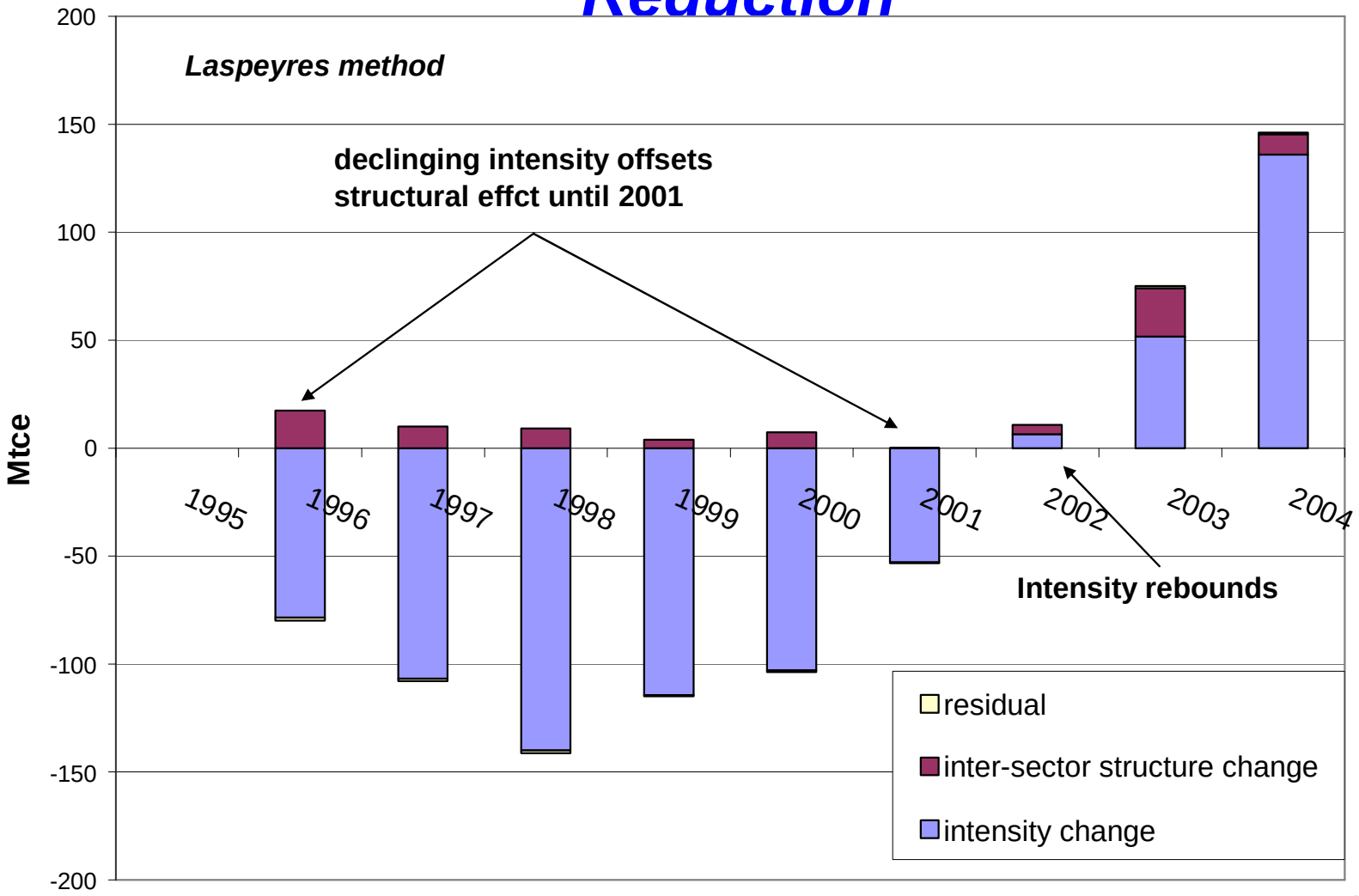
Up-and-down in Energy Intensity of GDP



“Heavy Industrialization”?



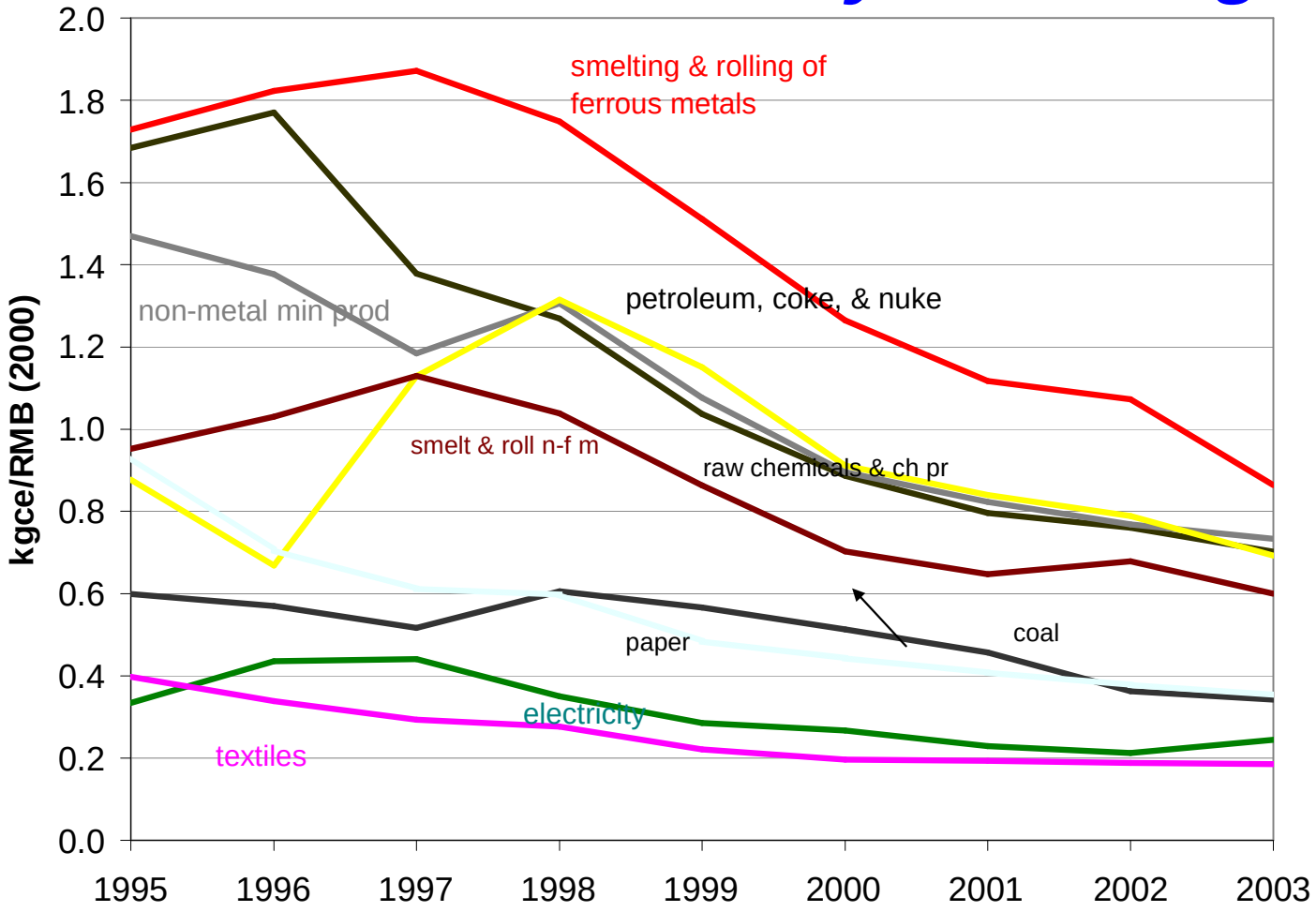
Inter-Sector Structural Change vs Intensity Reduction



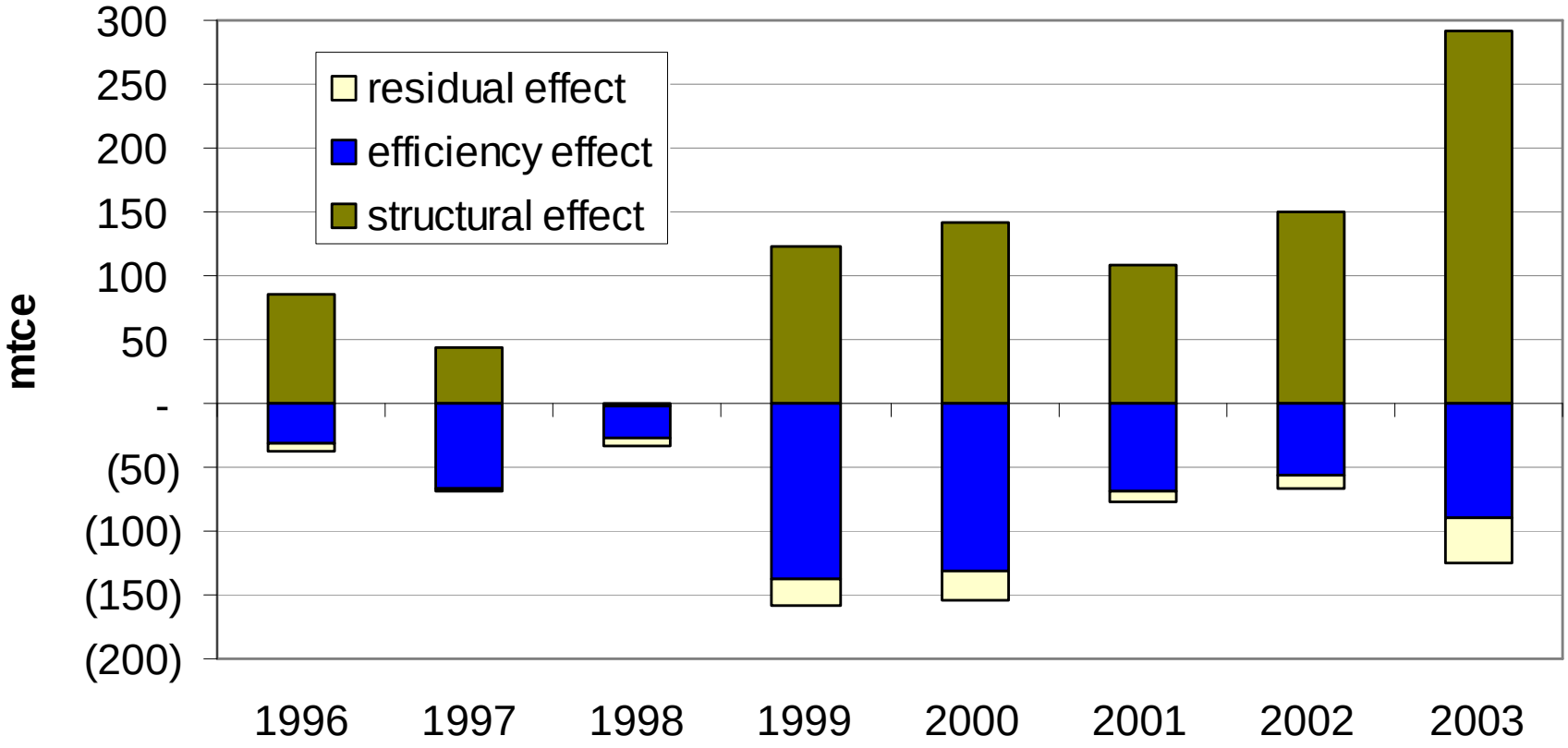
Why would industrial energy intensity rise?

- Energy intensity changes are caused by two factors
  - Changes in efficiency within a sub-sector (eg, Chemicals)
  - Relative growth in output of sub-sectors

Energy intensities within industrial sub-sectors are actually declining



Changes in the relative output of industrial sub-sectors are driving overall intensity higher



Summary: what happened to energy intensity

1. The largest factor in intensity growth is due to rapid growth in heavy industries (Iron and Steel, Chemicals, Cement)
2. The second largest factor is the overall growth of industries, relative to services and agriculture
3. Thirdly, this is partially offset by continuing energy efficiency gains

- However, since 2001 efficiency gains alone have not been nearly sufficient

Possible scenarios towards a 20% energy intensity reduction by 2010

Modeling Framework

LEAP-LBNL/China Energy Model

- **Bottom-up end-use energy demand model**
- **Built in 2005 using LEAP accounting framework**

Revision of the LBNL BAU Baseline

1. updated China baseline to reflect revised industrial sector output targets
2. built-in intensity improvement goals similar to those listed in China Energy Development Strategy 2004

Sector Efficiency Scenarios

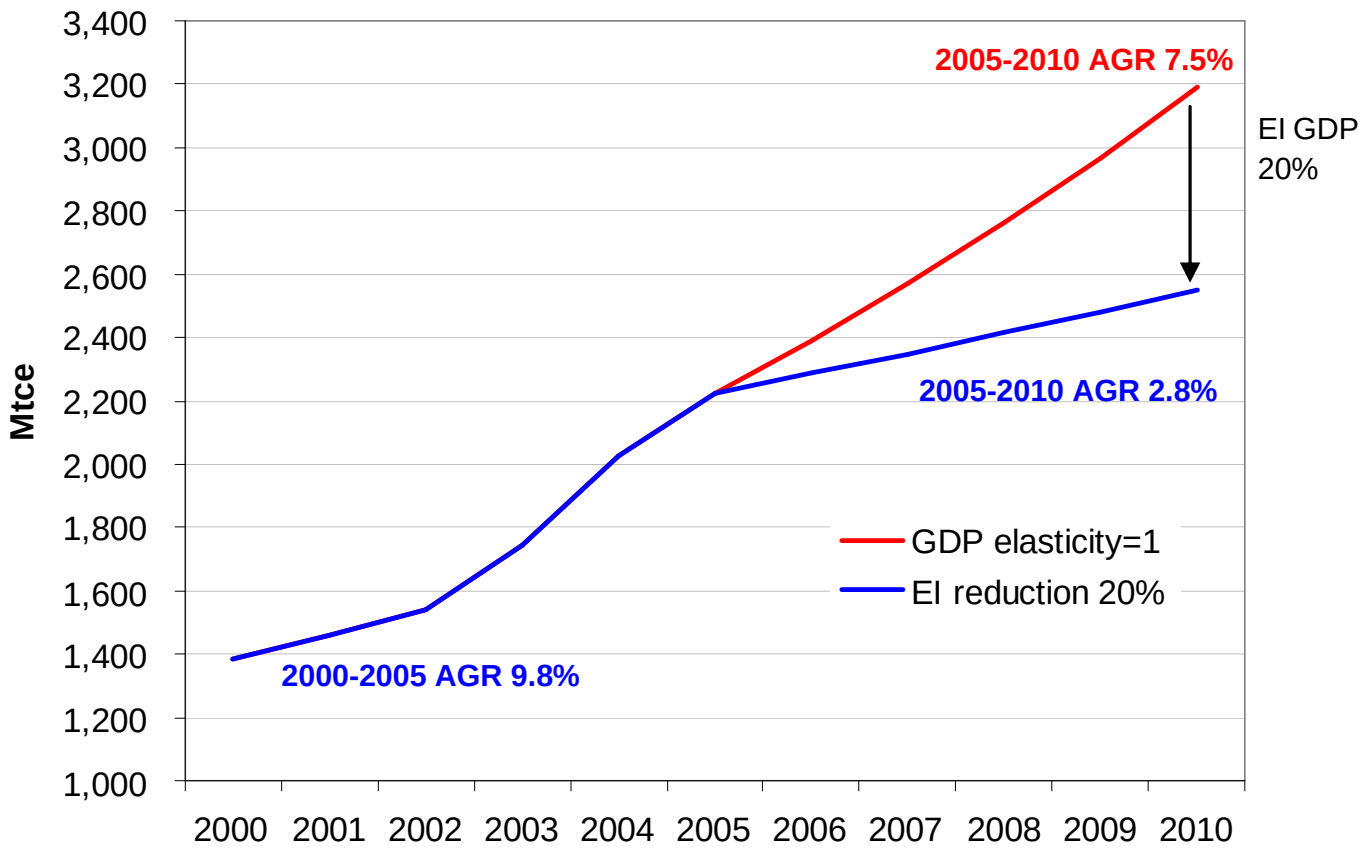
- **Best practices for industries**

  rapid physical intensity decline in heavy industrial sub-sectors (moving 2020 targets to 2010).
- **Appliance efficiency improvement**

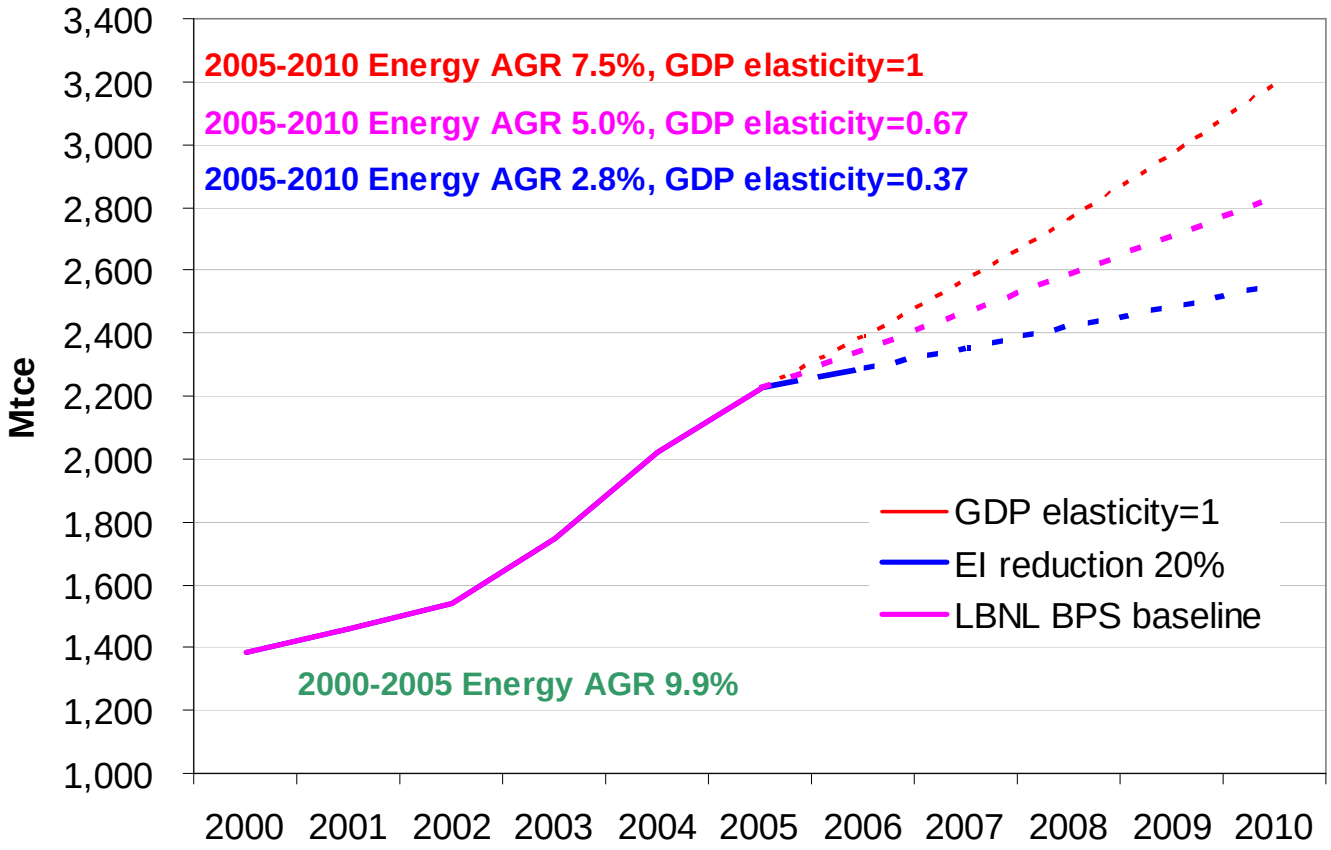
  accelerated efficiency improvement in appliances.
- **Energy efficiency improvement in power sector**

  Additional reduction in transmission and distribution losses and further thermal efficiency improvement.

Reducing energy intensity by 20% by 2010 implies an annual growth rate (AGR) of 2.8% in energy use



Our baseline scenario incorporates moderate energy efficiency improvement.



Key Energy Drivers for Major Industries

Industry Production Revision (million ton)

Production (million ton)

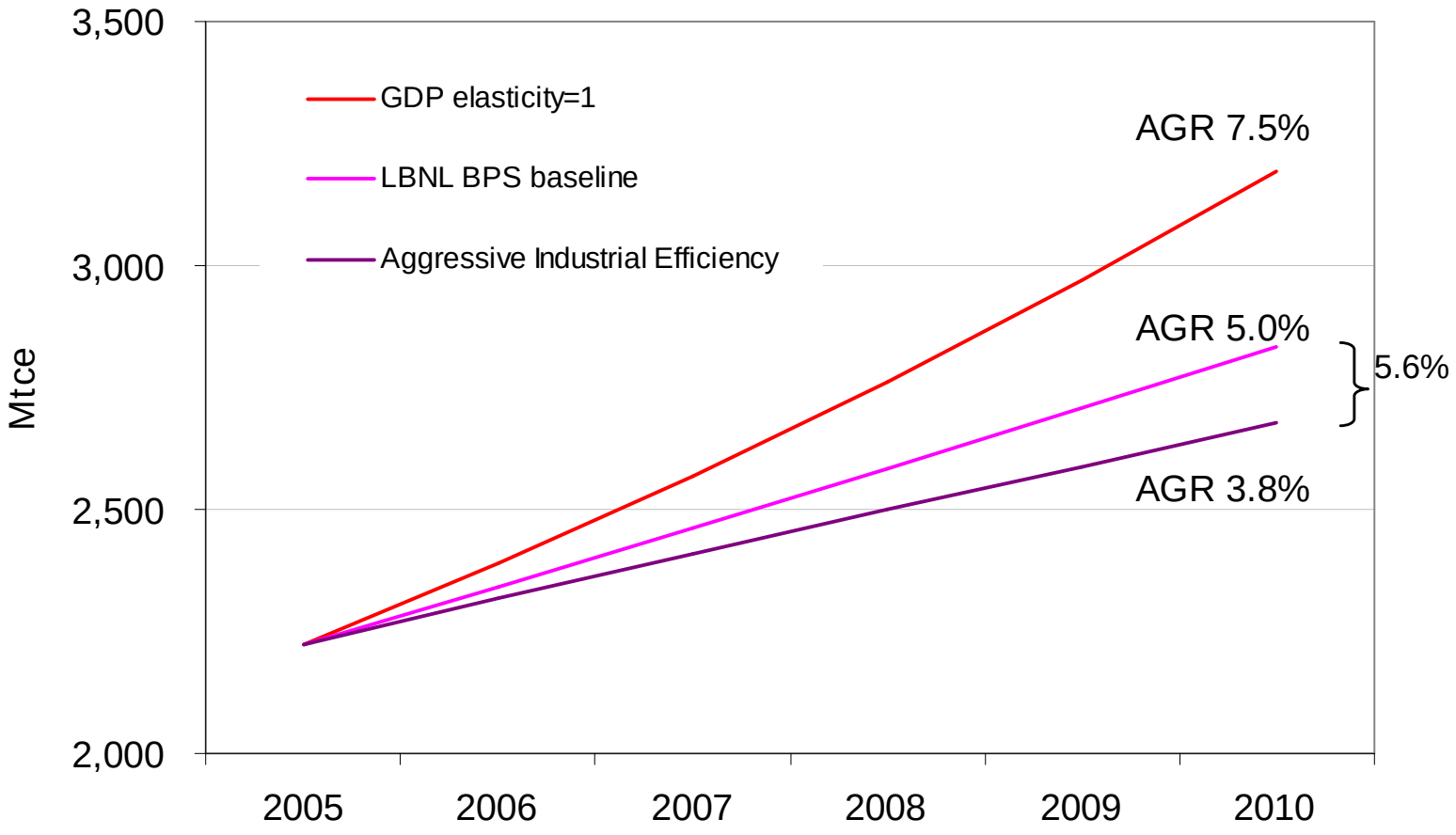
	2000	2005	2010	00-05	05-10
Glass previous	9.1	9.6	10.1	1.1%	1.0%
Glass revised	9.1	17.5	27.5	14.0%	9.5%
Ethylene previous	4.7	7.7	12.0	10.4%	9.3%
Ethylene revised	4.7	7.6	13.0	10.1%	11.3%
Ammonia previous	33.6	36.0	38.0	1.4%	1.1%
Ammonia revised	33.6	46.0	38.0	6.5%	-3.7%
Paper previous	30.5	40.0	50.0	5.6%	4.6%
Paper revised	30.5	52.6	68.0	11.5%	5.3%
Cement previous	597.0	680.0	790.7	2.6%	3.1%
Cement revised	597.0	1050.0	1310.0	12.0%	4.5%
Aluminium previous	3.0	4.0	4.6	6.0%	2.8%
Aluminium revised	3.0	7.7	11.2	20.7%	7.8%
Iron and Steel previou	128.5	250.0	300.0	14.2%	3.7%
Iron and Steel **revised**	128.5	349.4	440.0	22.1%	4.7%

Major Industry Sector Energy Intensity (tce/ton)

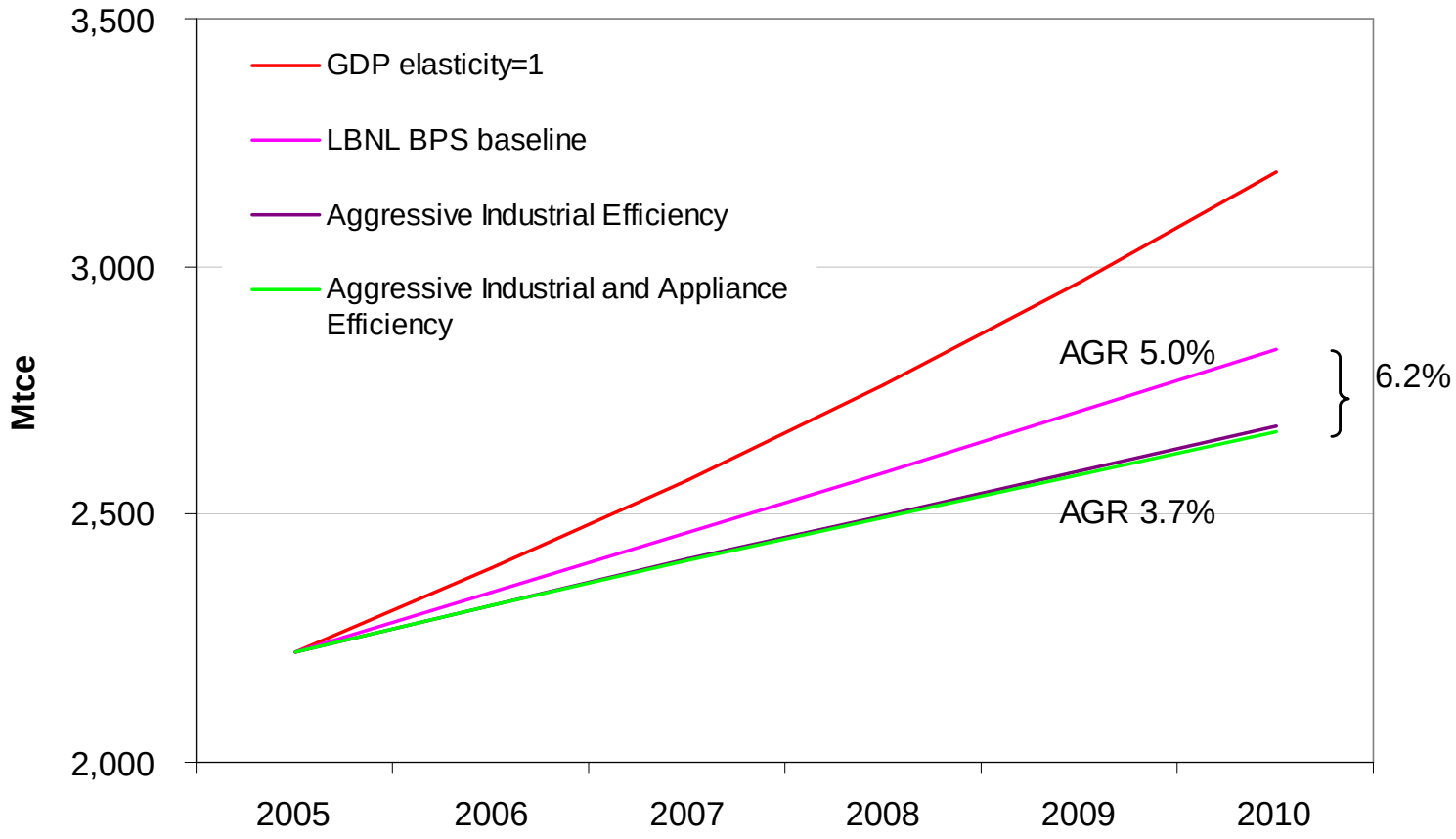
	2000	2005	2010	2020	00-05	05-10	10-20
Glass	0.50	0.46	0.40	0.36	-1.7%	-2.8%	-1.0%
Ethylene	1.21	1.00	0.93	0.86	-3.7%	-1.4%	-0.8%
Ammonia							
coal feed stock	1.17	1.10	1.05	0.95	-1.2%	-1.0%	-1.0%
NG feed stock (kWh)	1300	1229	1168	1055	-1.1%	-1.0%	-1.0%
fuel oil feedstock	0.13	0.12	0.12	0.11	-1.3%	-1.0%	-1.0%
Paper	0.86	0.84	0.79	0.71	-0.5%	-1.1%	-1.1%
Cement							
Rotary	0.19	0.17	0.16	0.13	-1.3%	-1.4%	-2.1%
Shaft	0.16	0.15	0.145	0.14	-0.7%	-0.7%	-0.7%
Aluminum	9.56	8.55	8.40	8.20	-2.2%	-0.4%	-0.2%
Iron and Steel*	0.78	0.71	0.67	0.61	-2.0%	-1.0%	-0.9%

*Comparable energy consumption

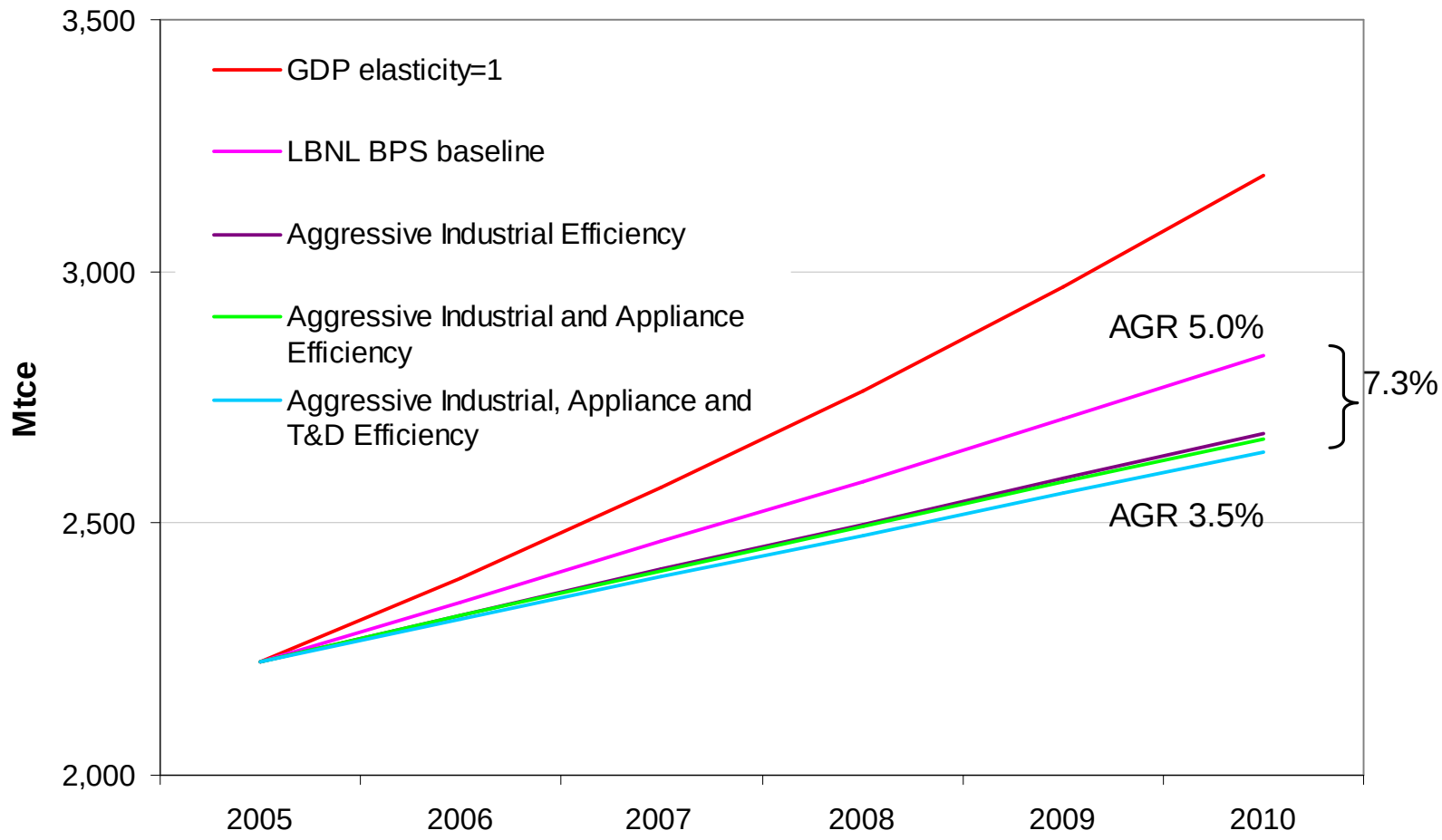
Achieving the 2020 targets for industrial energy intensities in 2010 would reduce energy growth rate from 5% to 3.8%



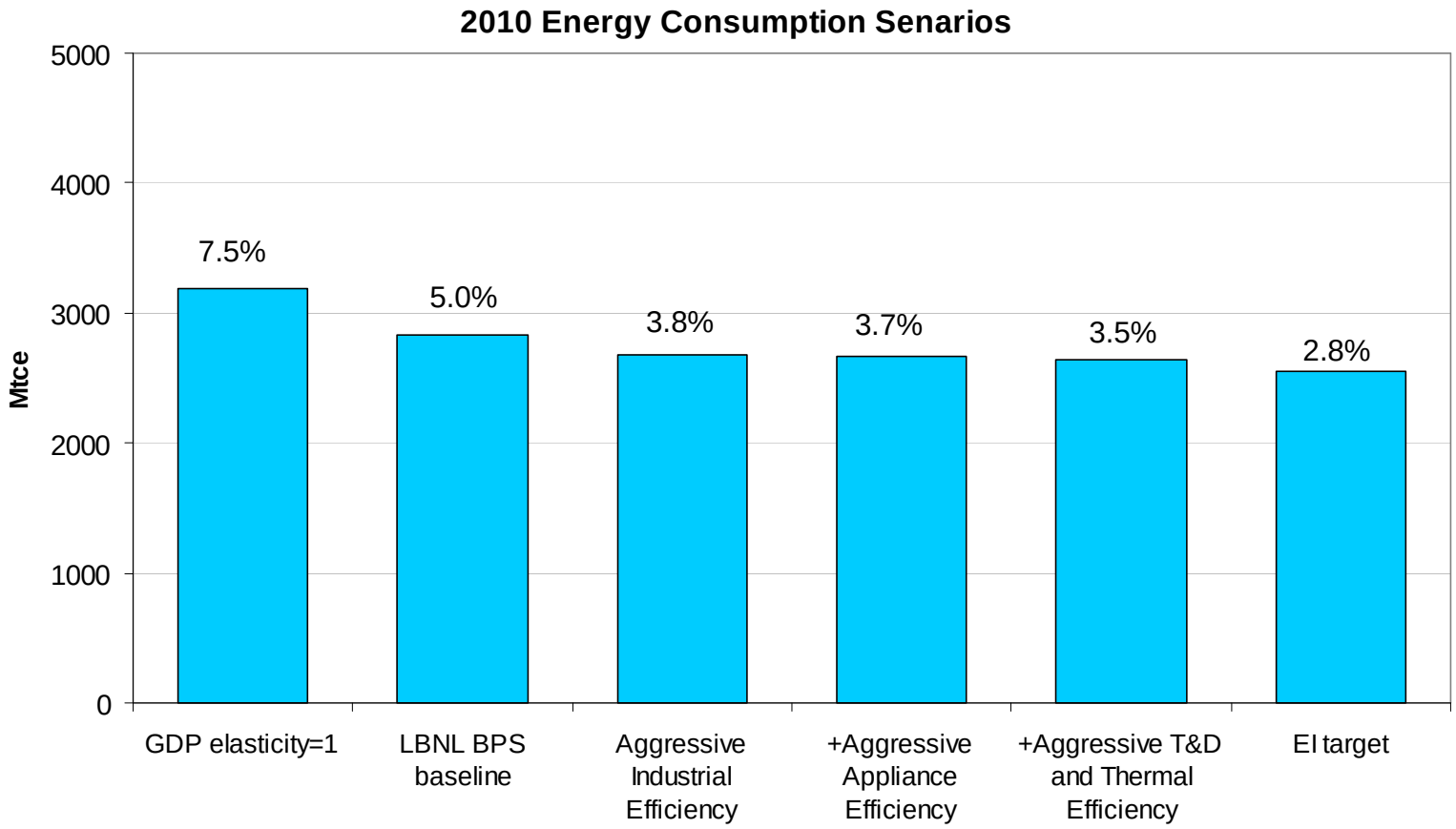
Additional appliance efficiency improvement brings the growth rate down to 3.7%



Another 1% increase in T&D and thermal efficiency would lead to an annual growth rate of 3.5%



Efficiency make a big difference, but . . .



A few observations…

- China's 20% EI target is one of the most significant initiative to reduce GHG emissions
- This target is very ambitious in light of recent trends in China's economic structure
- Without major incentives to support energy-efficiency and discourage wasteful practices, it is doubtful that the target will be met
- De-carbonizing coal use in China is critical to the global effort to reduce GHG emissions

"Crossing the River by Touching the Stones"

- **Energy Efficiency Policy**
  - targets for energy efficiency for industries, with strong incentives (carrots) and penalties (sticks)
    - Key supporting policies: information and technical guidance; strengthening local energy conservation service provider network; and subsidies directly connected to achieving industrial targets
  - enhanced enforcement of tighter building energy standards,
  - tighten and assure compliance with appliance efficiency standards,
  - strict enforcement and strengthening of auto fuel economy standards,
  - initiation of demand-side management programs of scale in several electric utilities, and
  - investment in mass transit alternatives.

Policies (cont)

- **Macroeconomic Policies**
  - Set energy prices to better reflect costs
  - Re-creation of successful approach of subsidizing investments in energy efficiency
  - Change taxes to better achieve social/political objectives (export promotion incentives, tax holiday for foreign investors)
  - Policies that result in additional closings of energy inefficient factories

Thank you

- For more information, please contact
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