China and India's Ravenous Appetite for Natural Resources— Their Potential Impact on the United States

Vince Matthews

Director
Colorado Geological Survey

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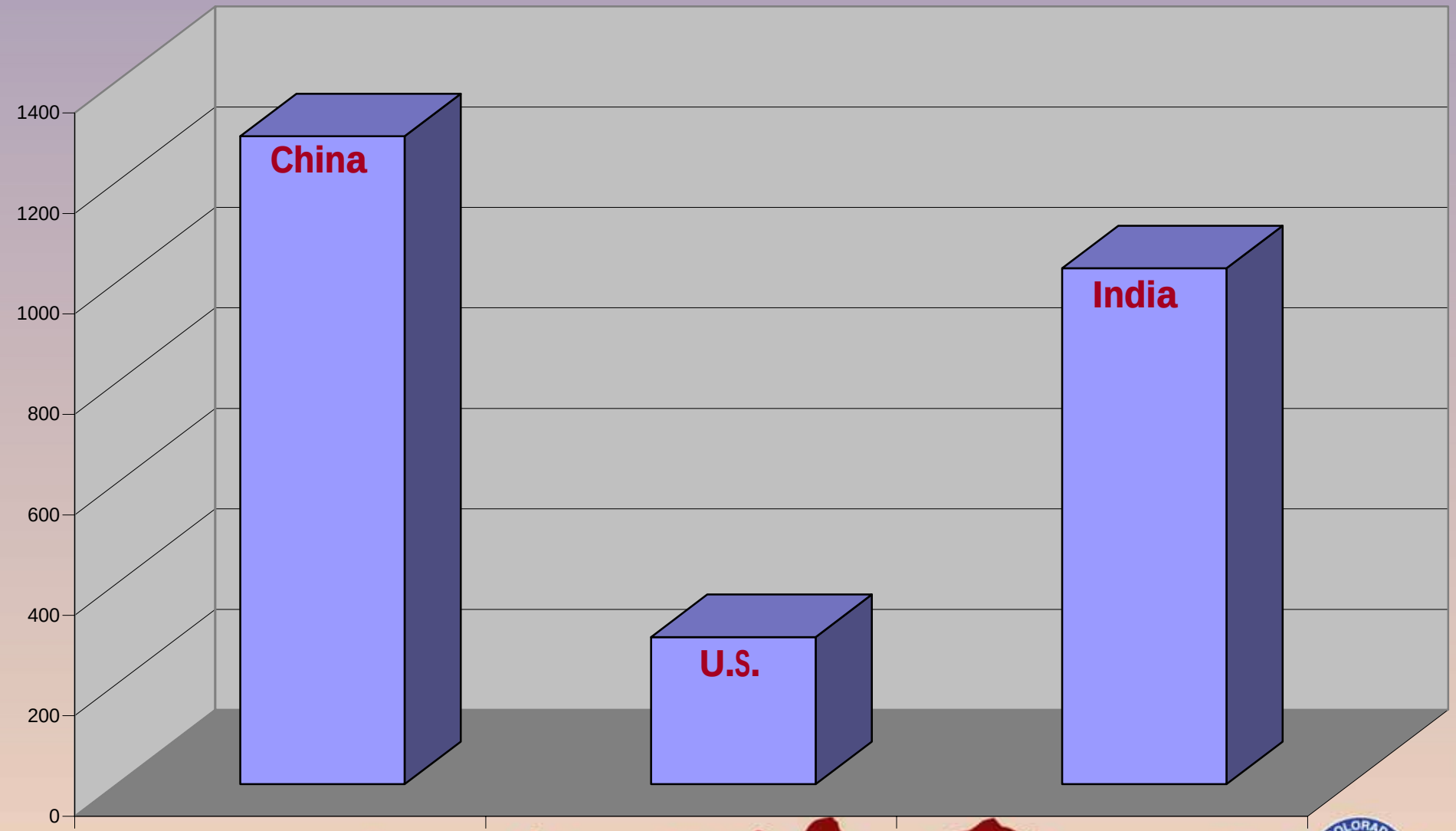
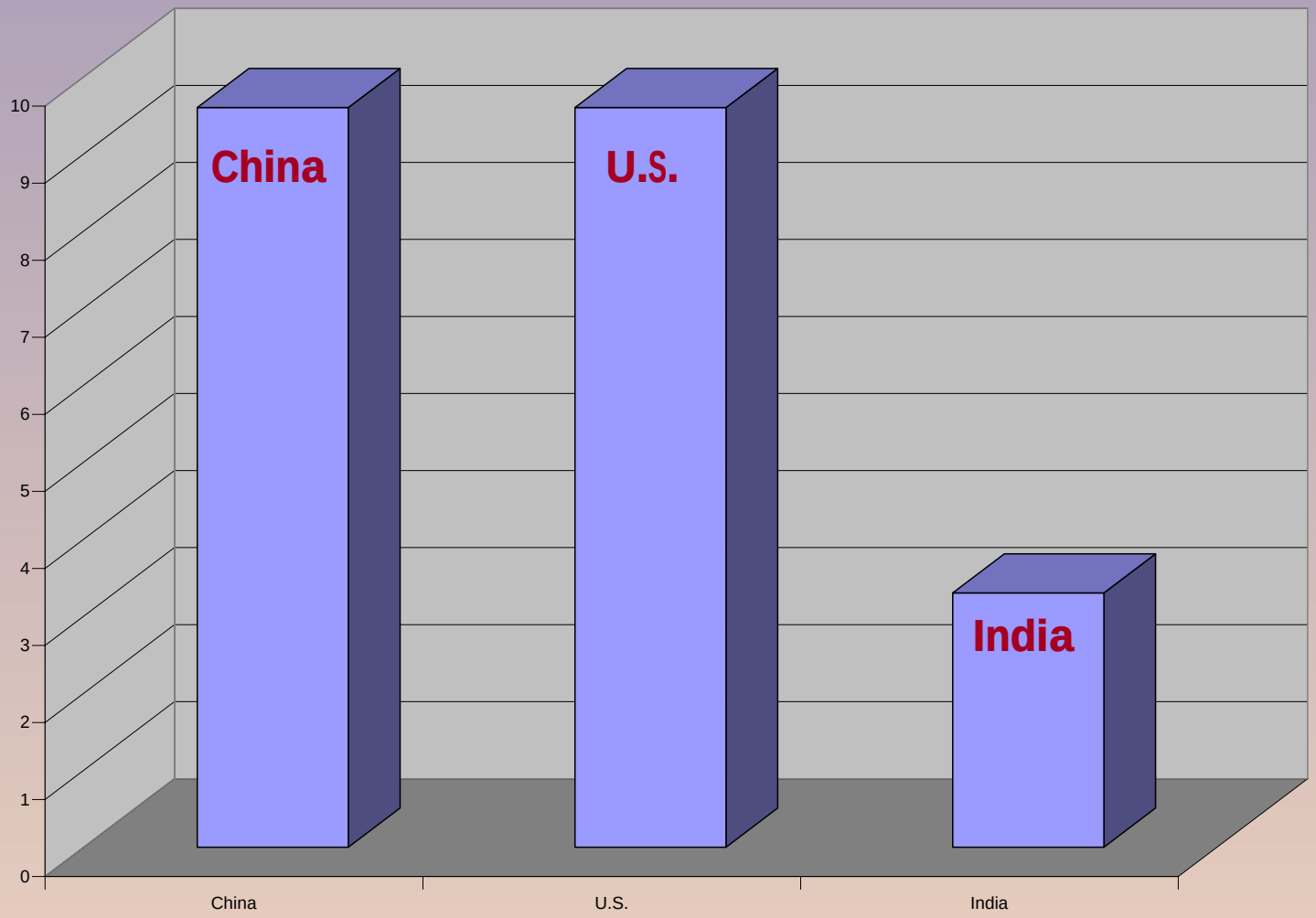
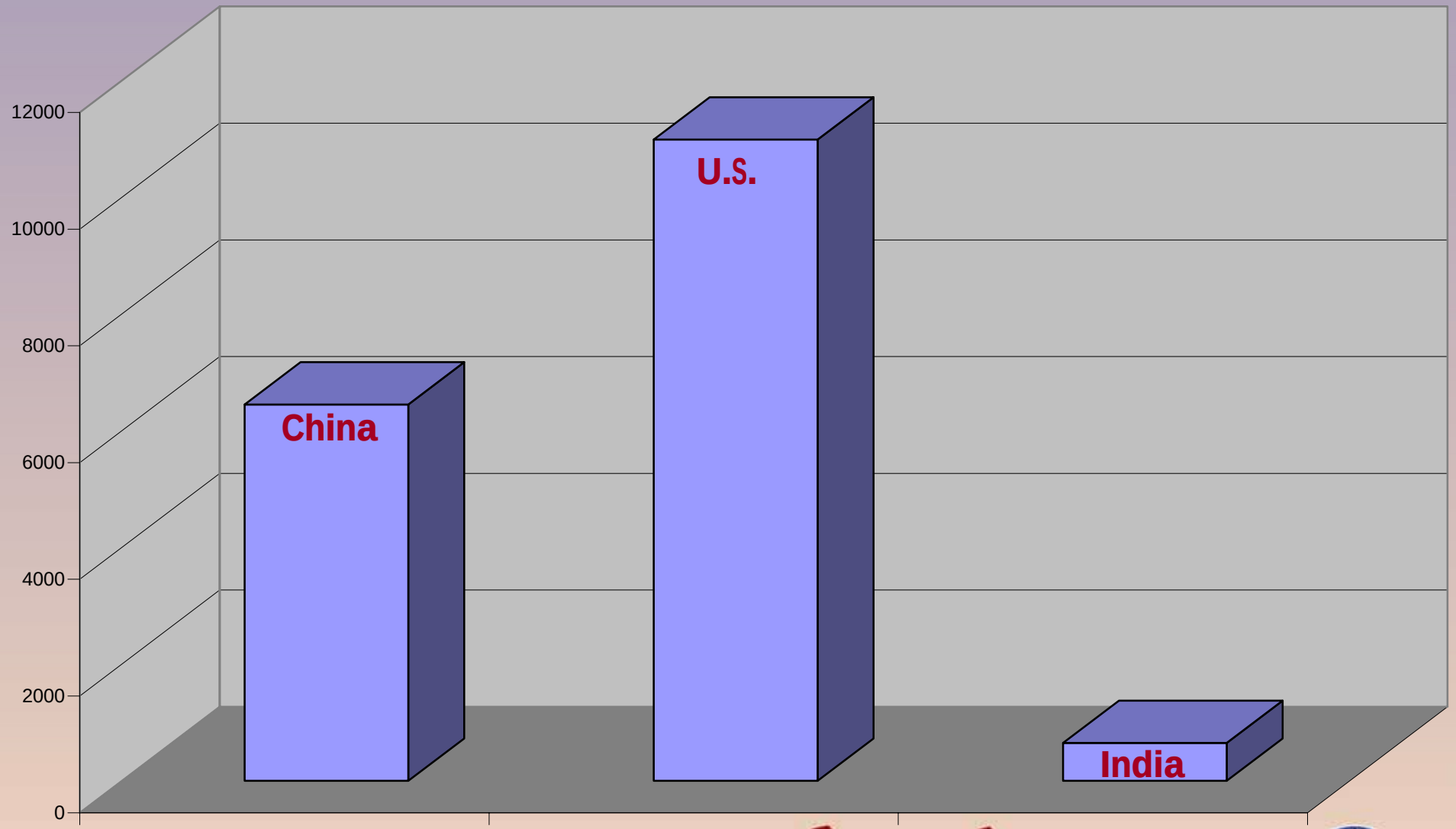
Population Comparison



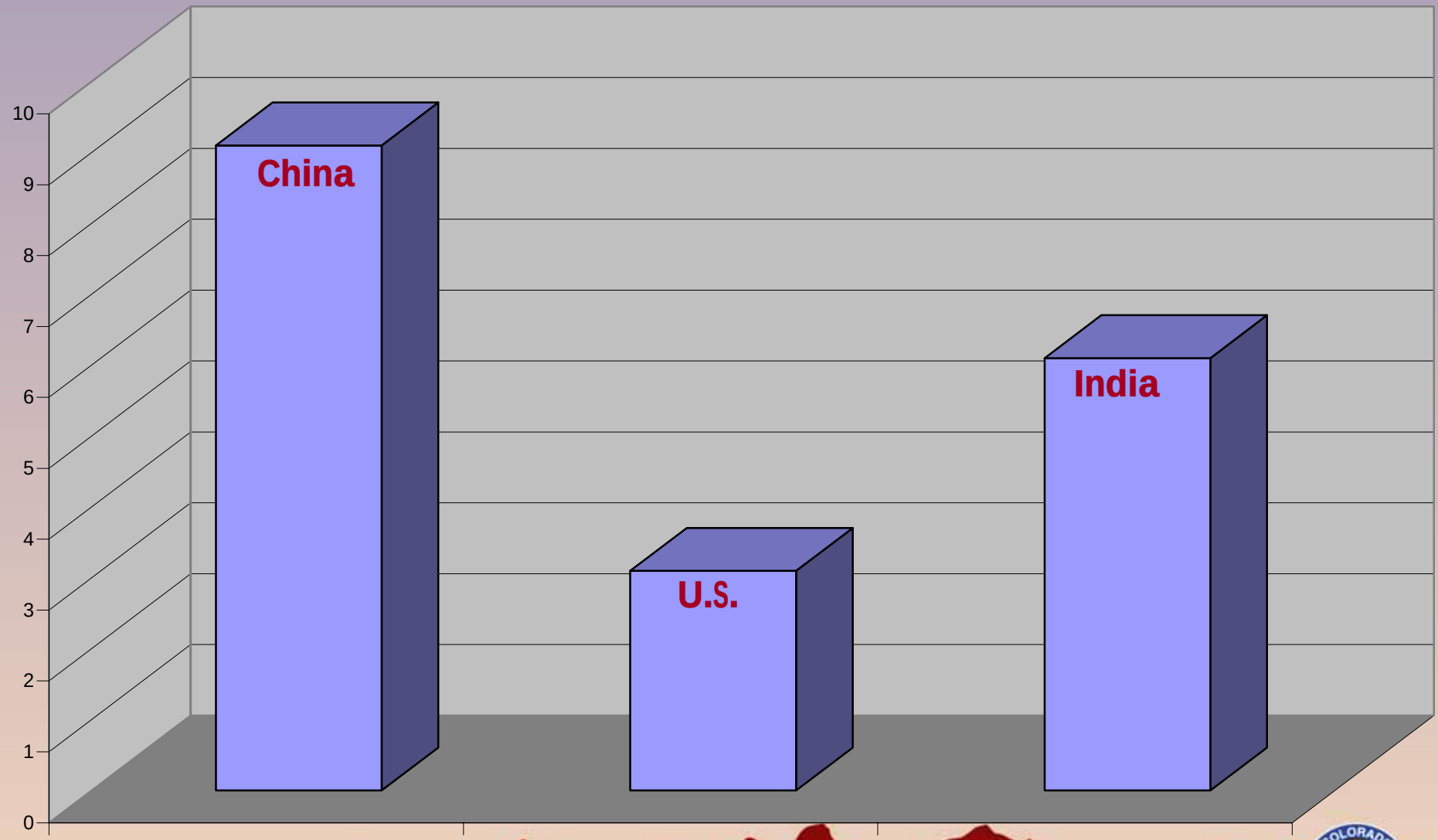
Land Area Comparison



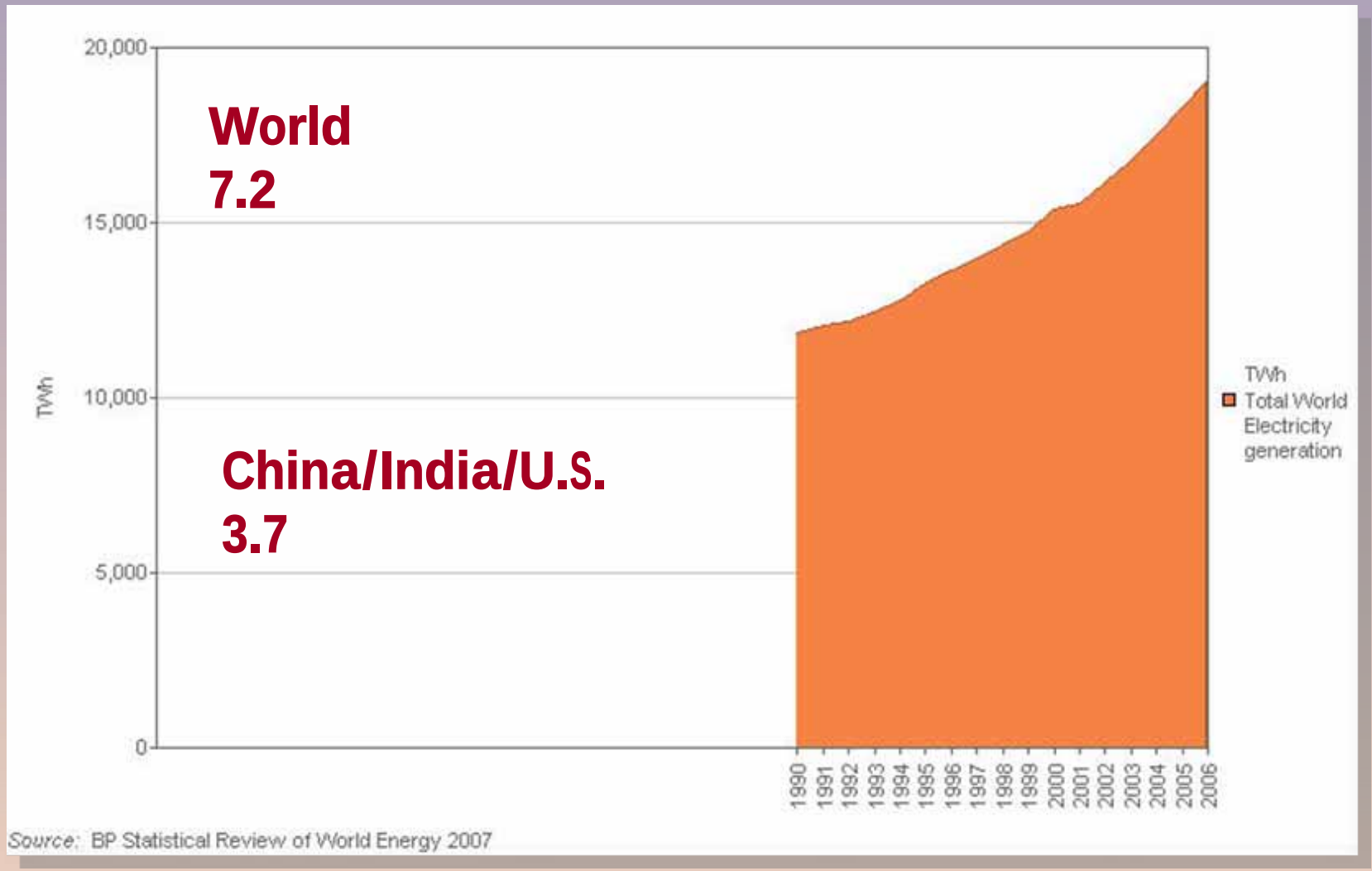
GDP Comparison



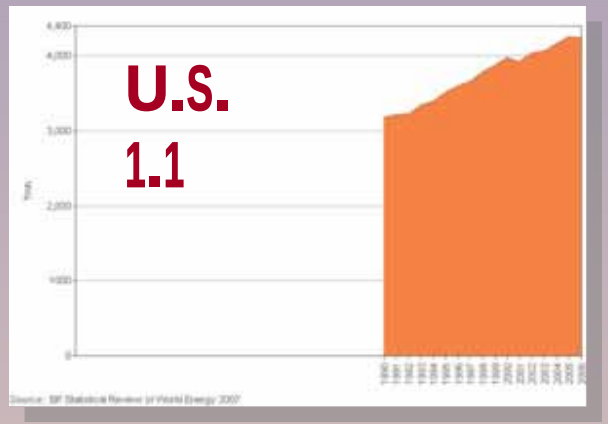
GDP Growth Comparison

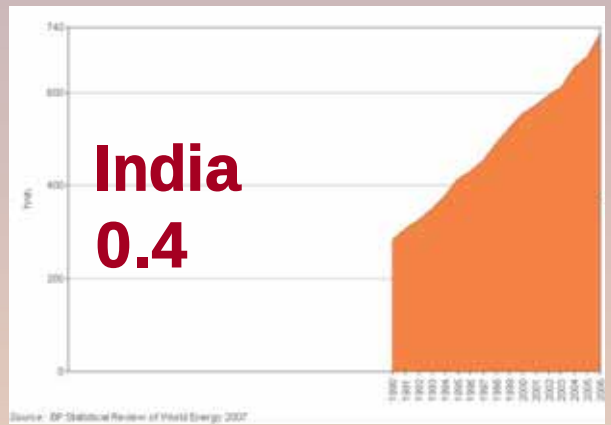


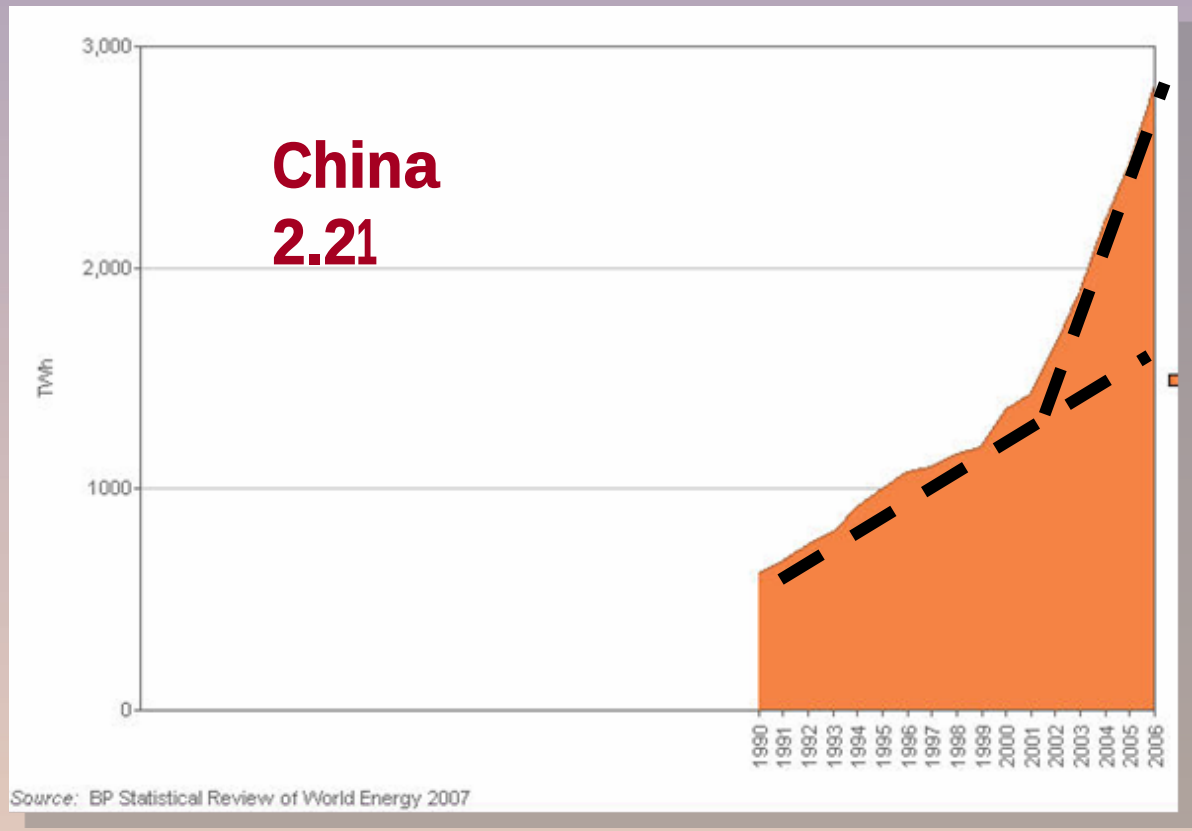
World Electrical Growth



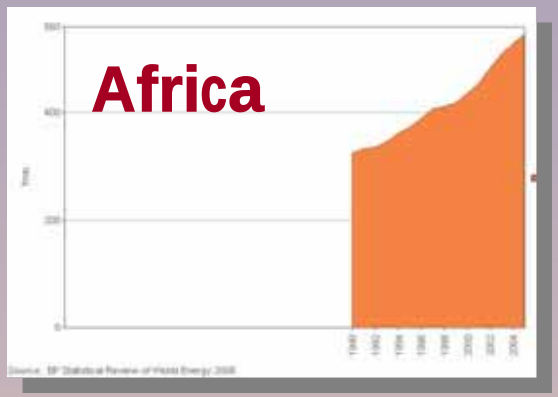
World Electrical Growth

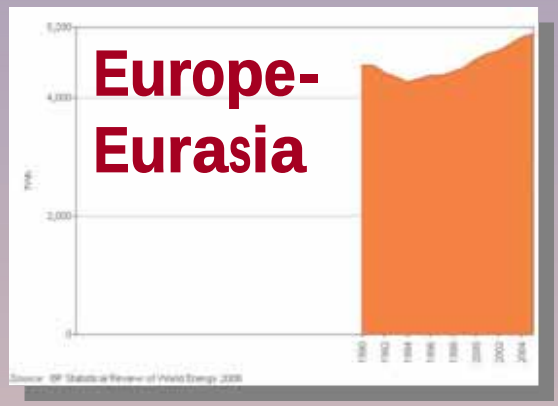


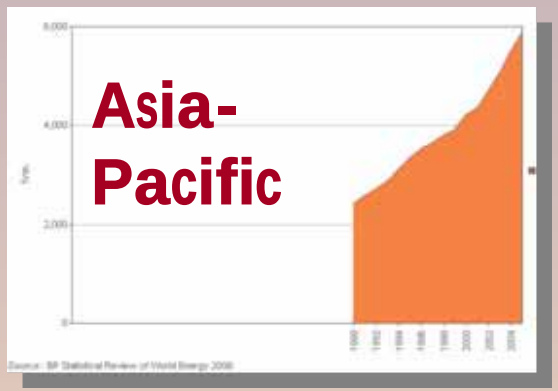


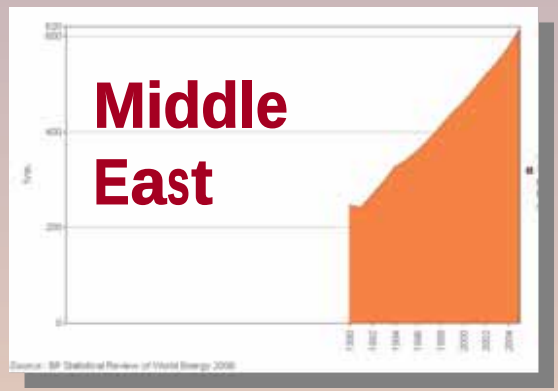


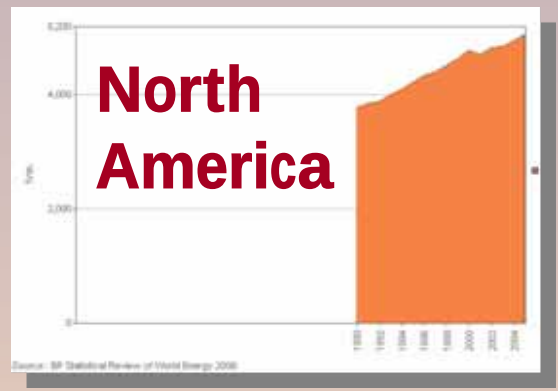
World Electrical Growth









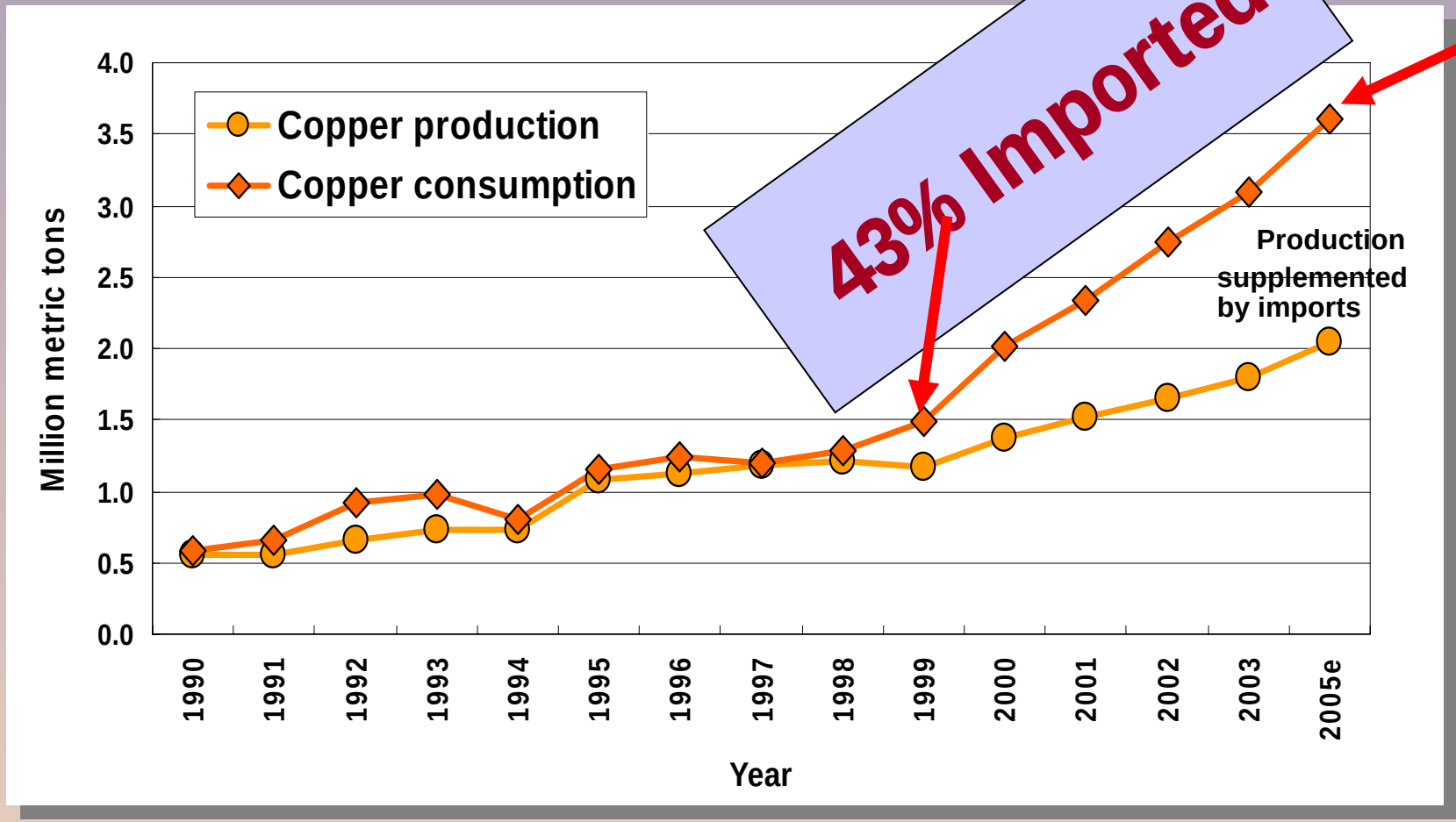


China's Share of World Mineral Production in 2003

Commodity	Percentage	Rank
Coal	45	1
Oil	4.7	6
Cement	42	1
Fluorspar	55	1
Rare earths	85	1
Aluminum	18	1
Antimony	89	1
Copper	12	2
Gold	8	4
Lead	18	2
Magnesium	45	1
Molybdenum	24	3
Silver	12	3
Steel, crude	23	1
Tin	32	1
Tungsten	83	1
Zinc	22	1

Source: USGS, Kenzie, et al

China's Production and Consumption of Copper



Source: USGS, Kenzie, et al

Colorado Impact

Difficulty in manufacturing of copper products

Increased copper thefts

Increased costs to the consumer

Copper mine reopening

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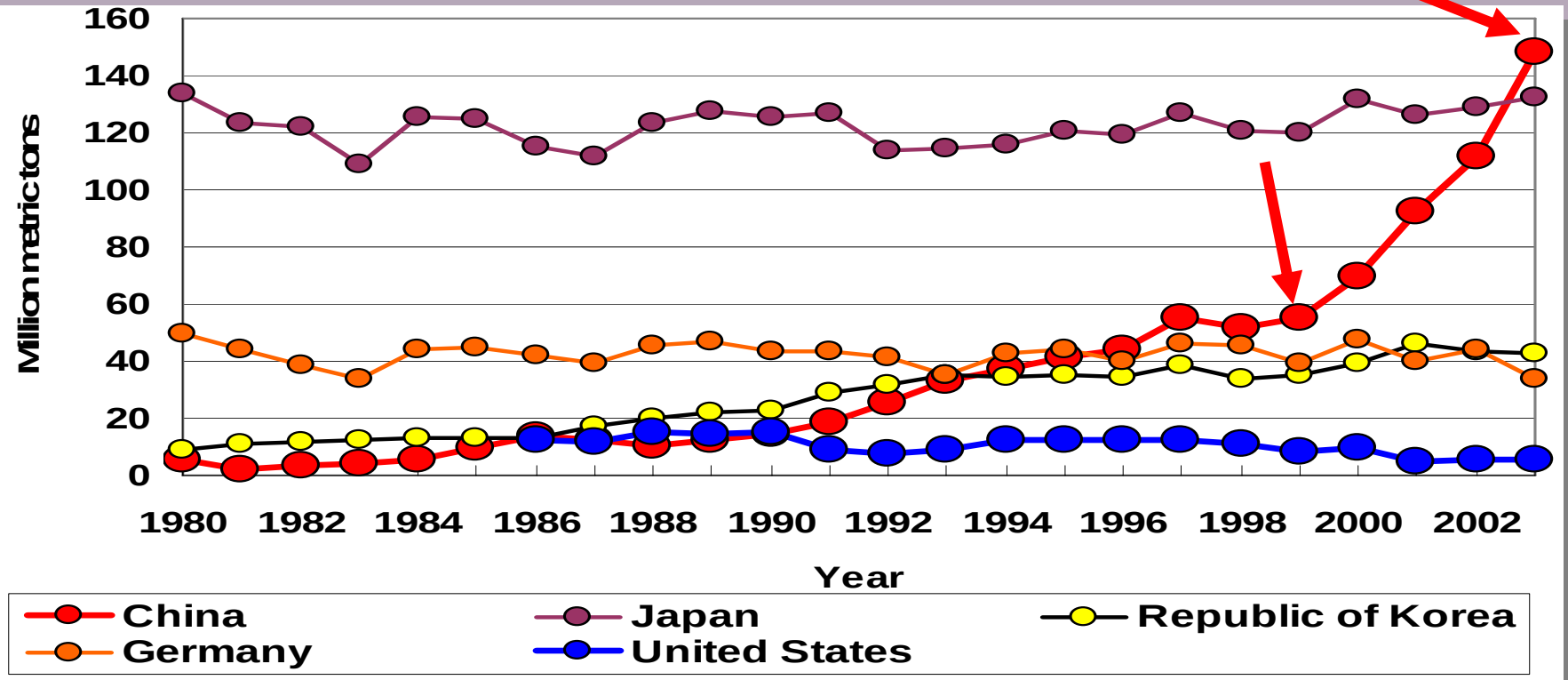
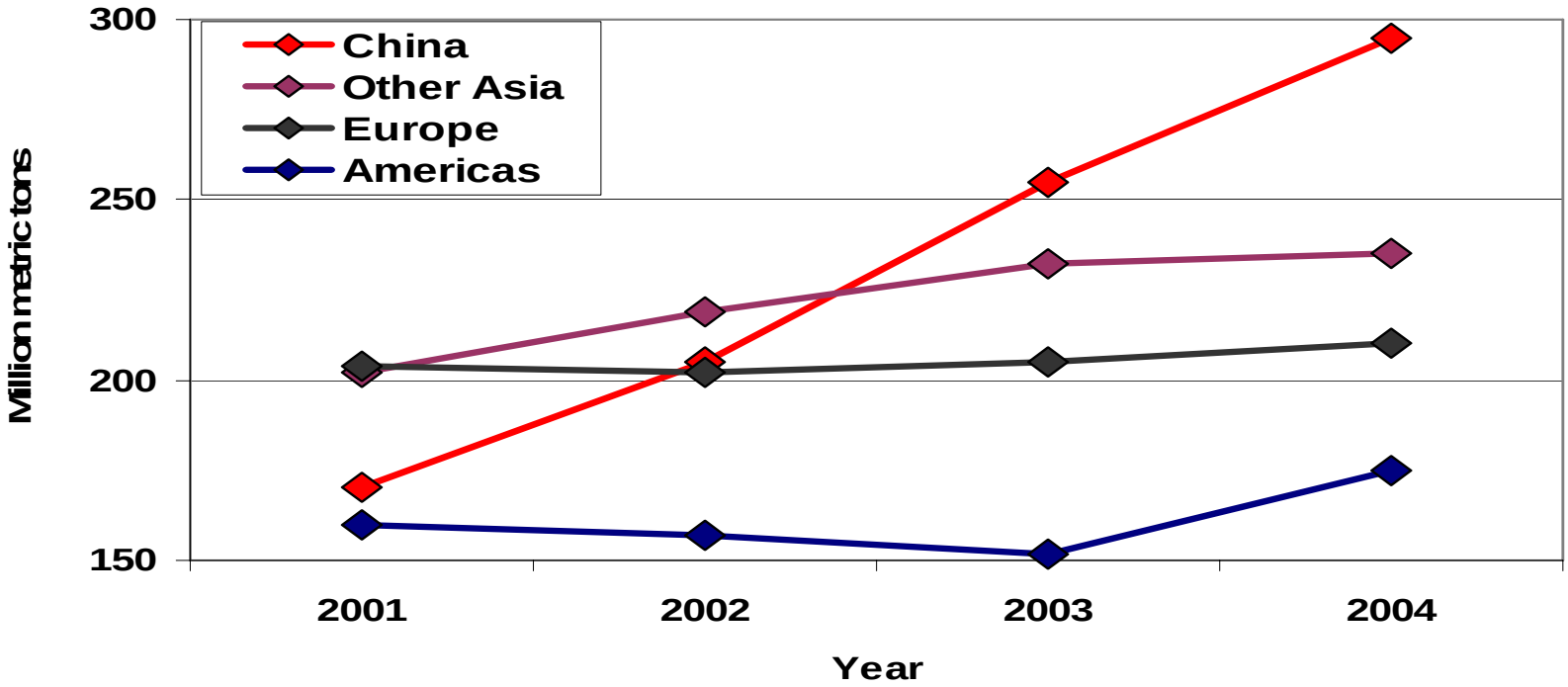
Source: USGS, Kenzie, et al

Leading Importers of Iron Ore—1980–2003



Sources: U.S. Geological Survey Minerals Yearbook; United Nations Conference on Trade and Development.

Trends in Demand for Steel



Source: International Iron and Steel Institute.

China

2005 – Opened 70,000 new supermarkets

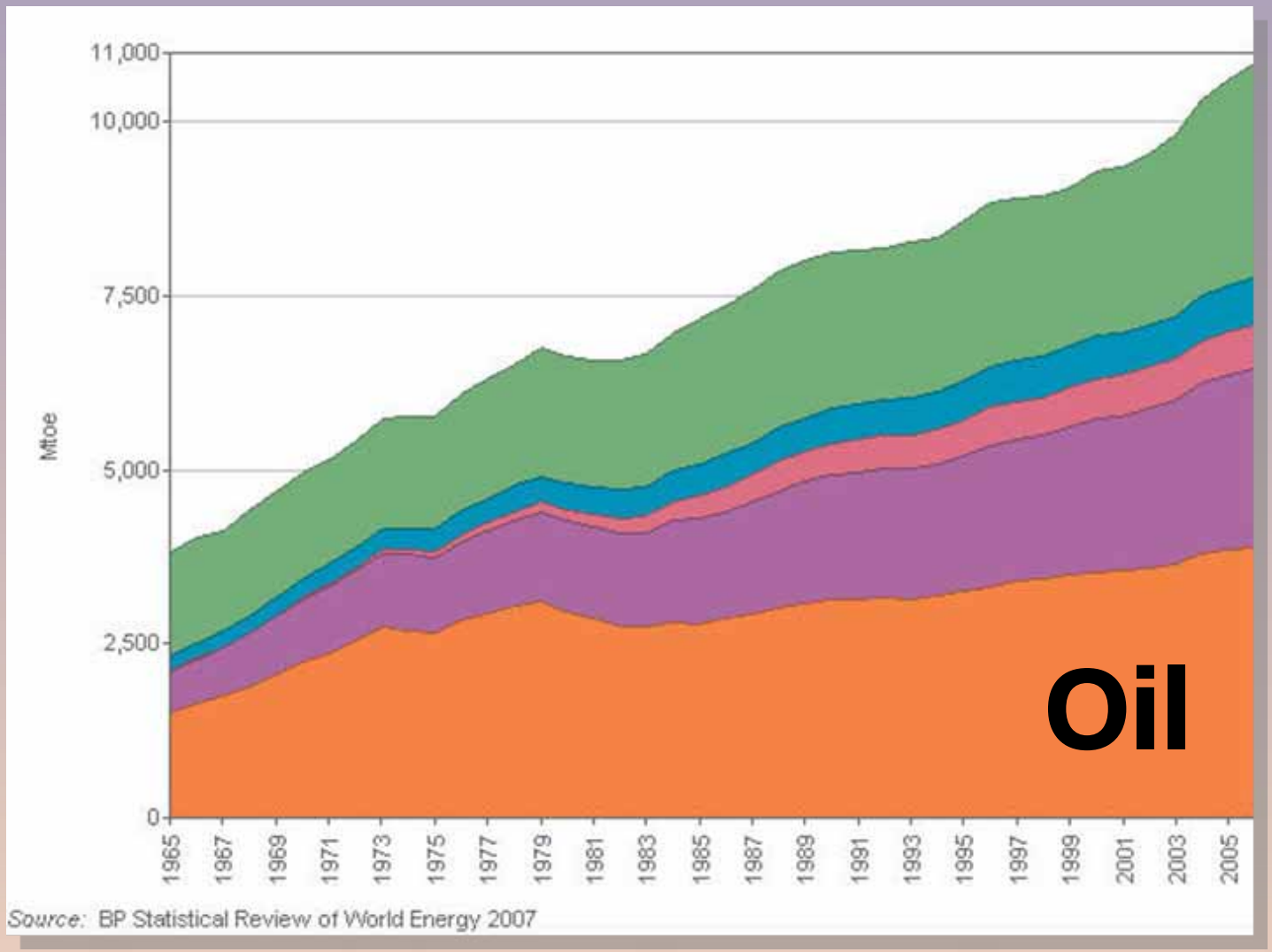
2006 – Became #3 car manufacturer

11th Five-year plan

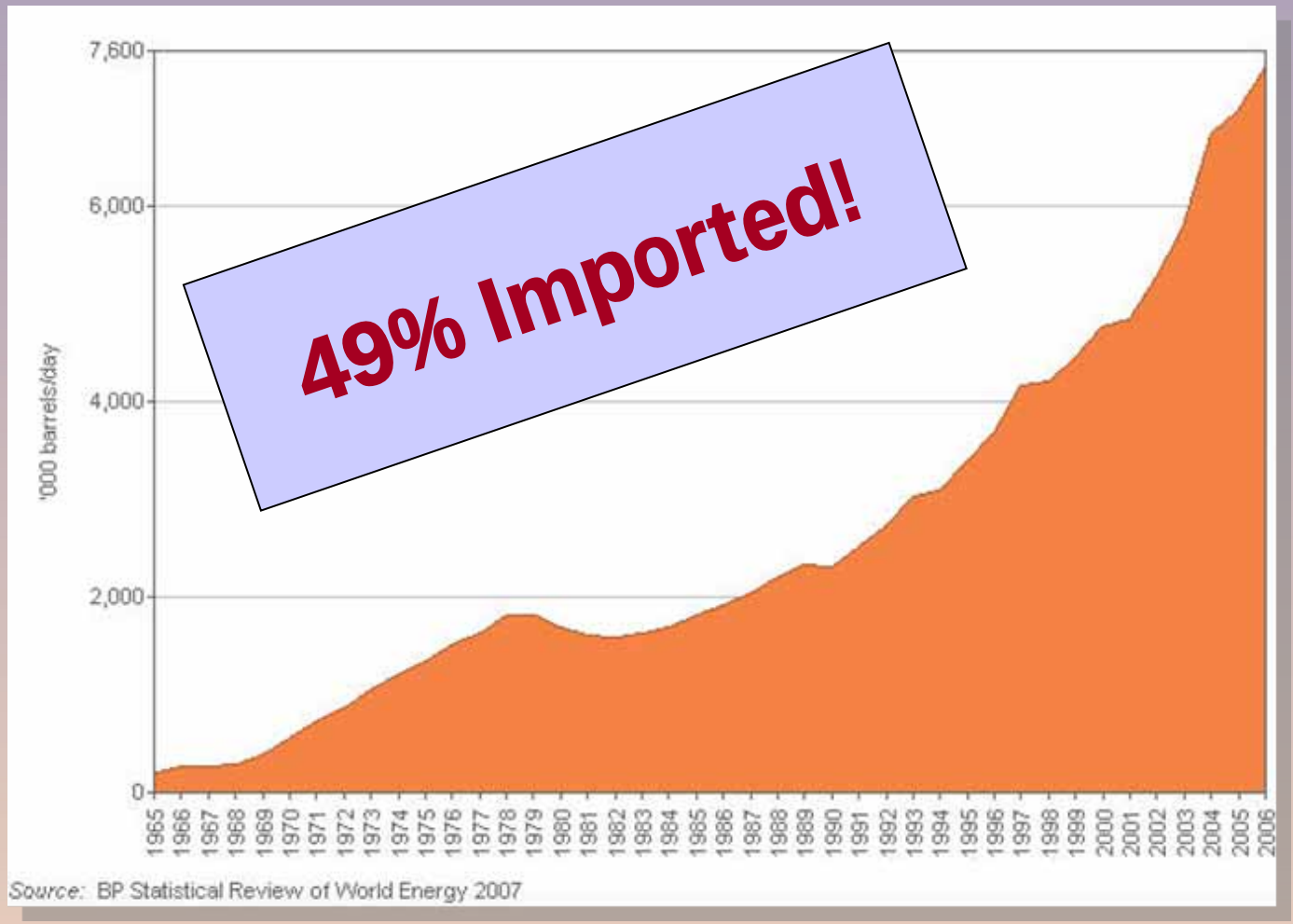
– 42% increase in capital investment

- Plan to build the equivalent of three Manhattan Islands

World Energy Consumption

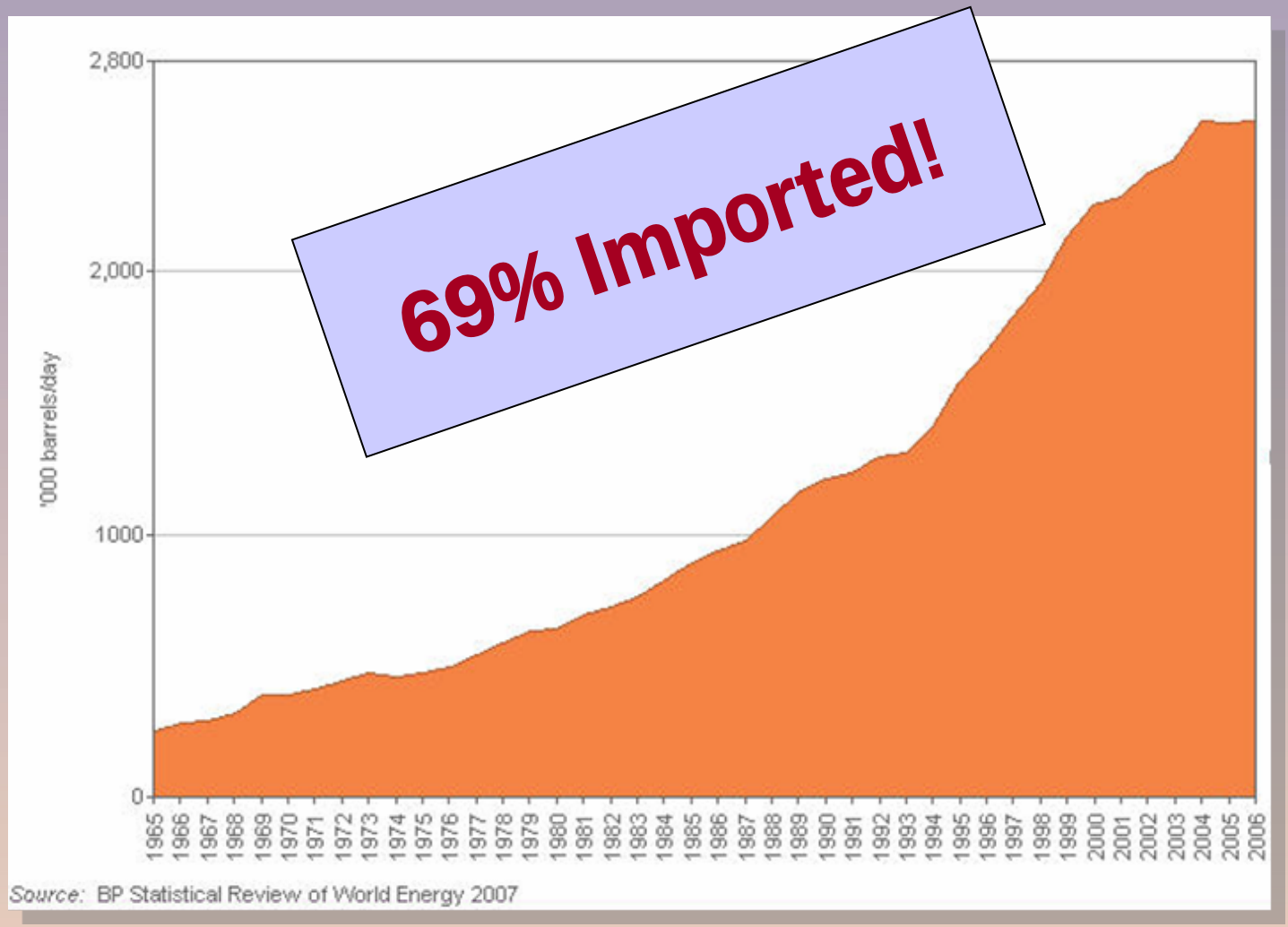


OIL CONSUMPTION- China



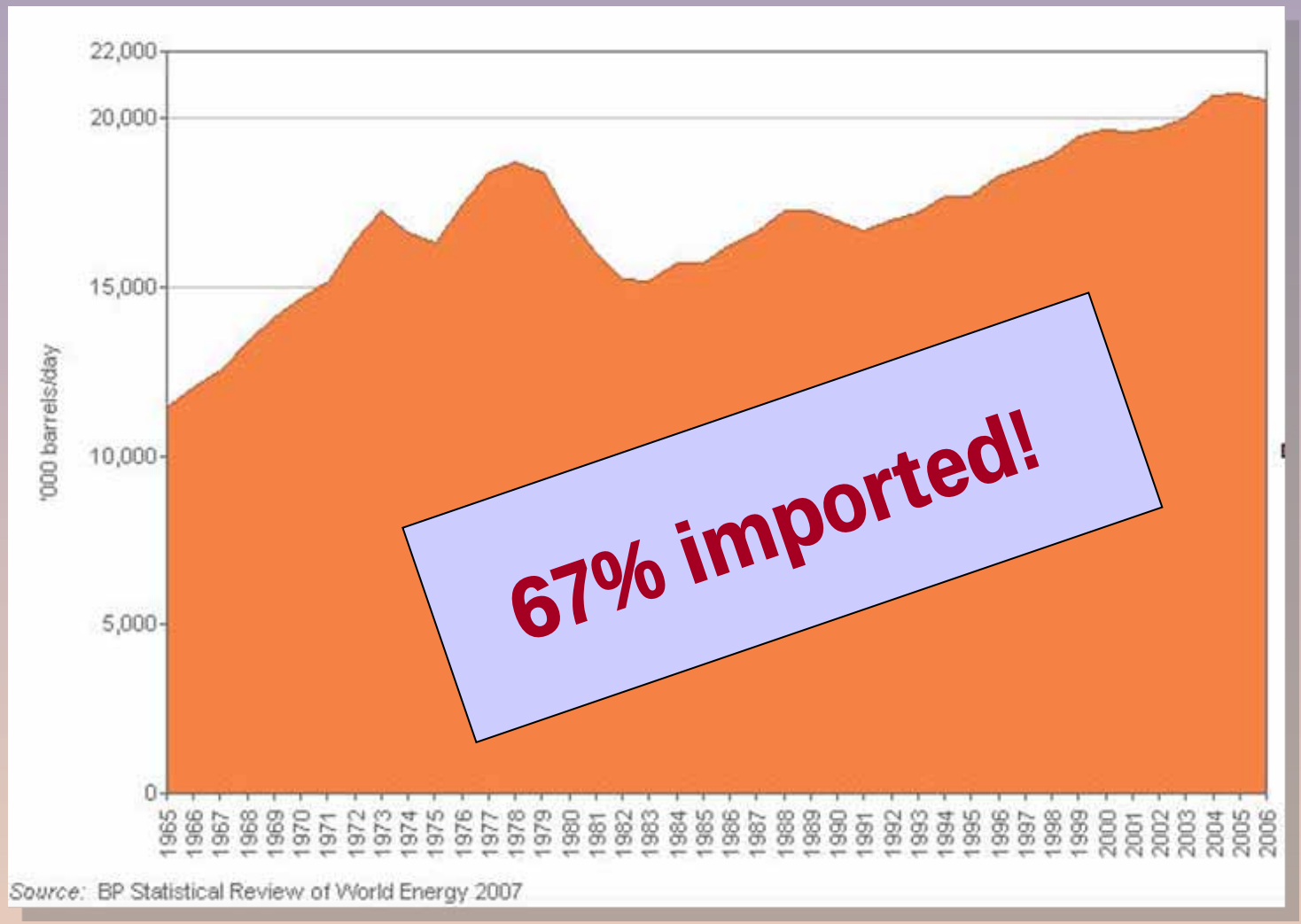
Source: BP

OIL- CONSUMPTION India

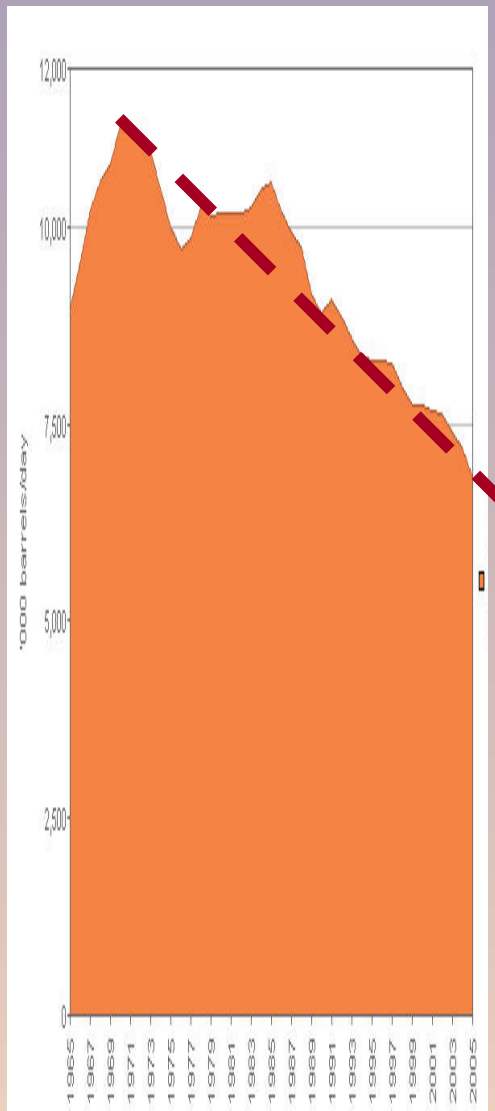


Source: BP

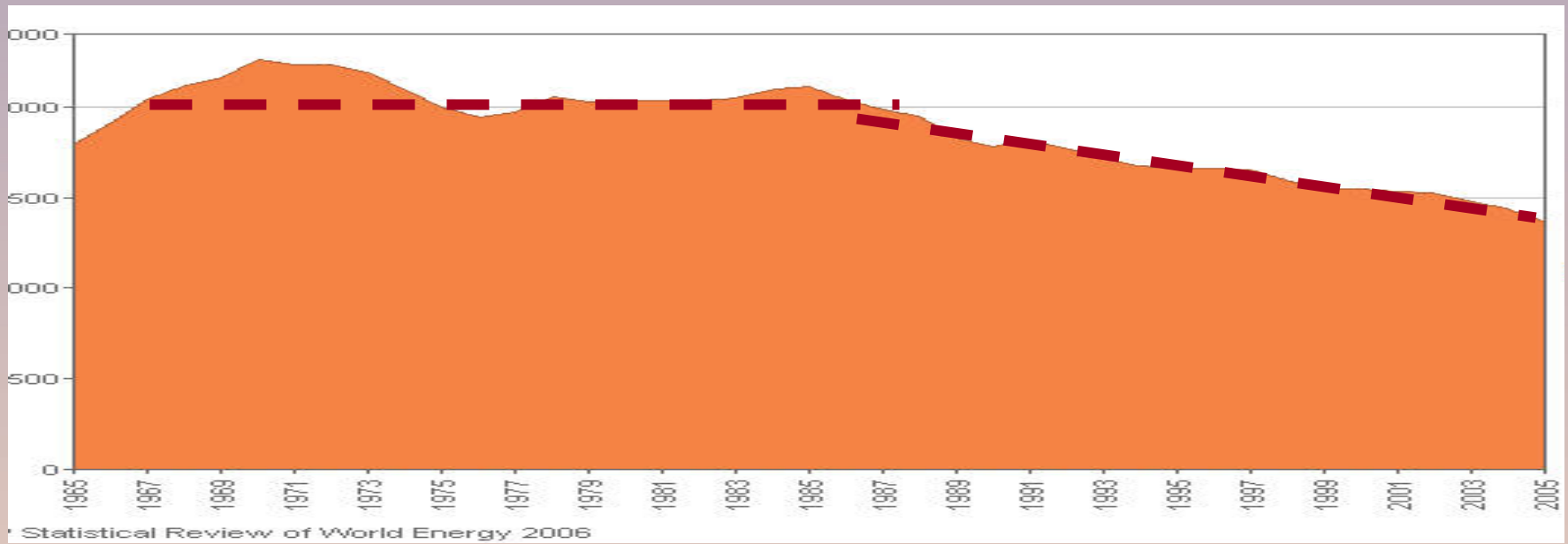
OIL- U.S. Consumption

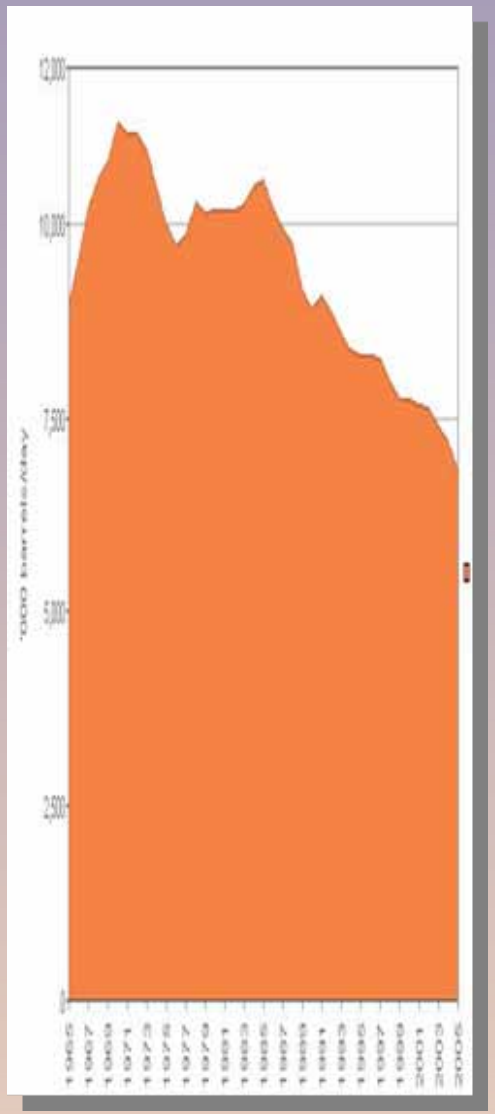


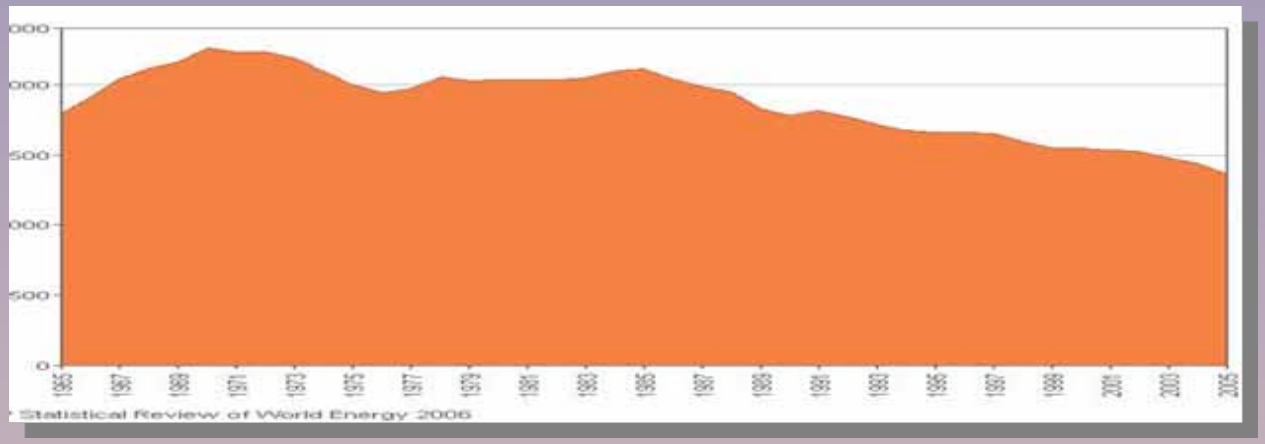
OIL- U.S. Production

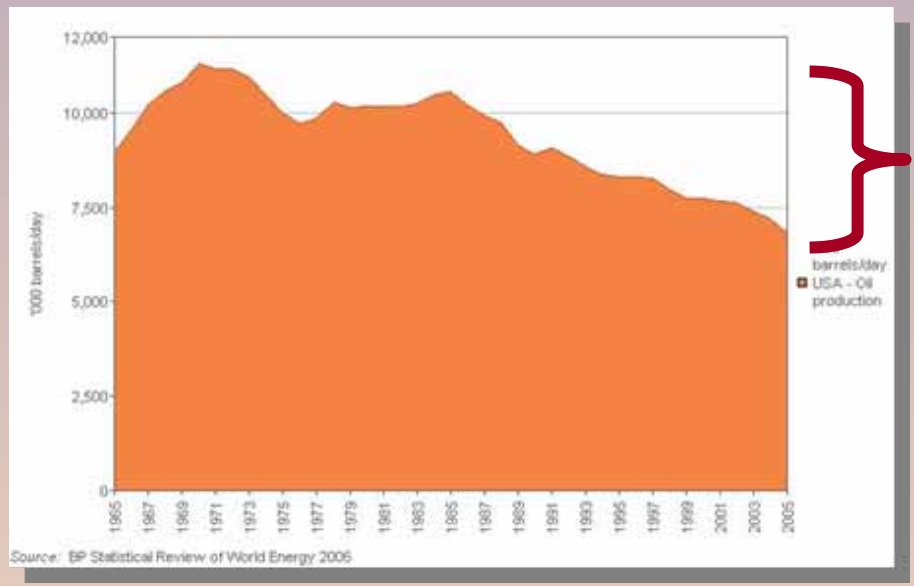


OIL- U.S. Production









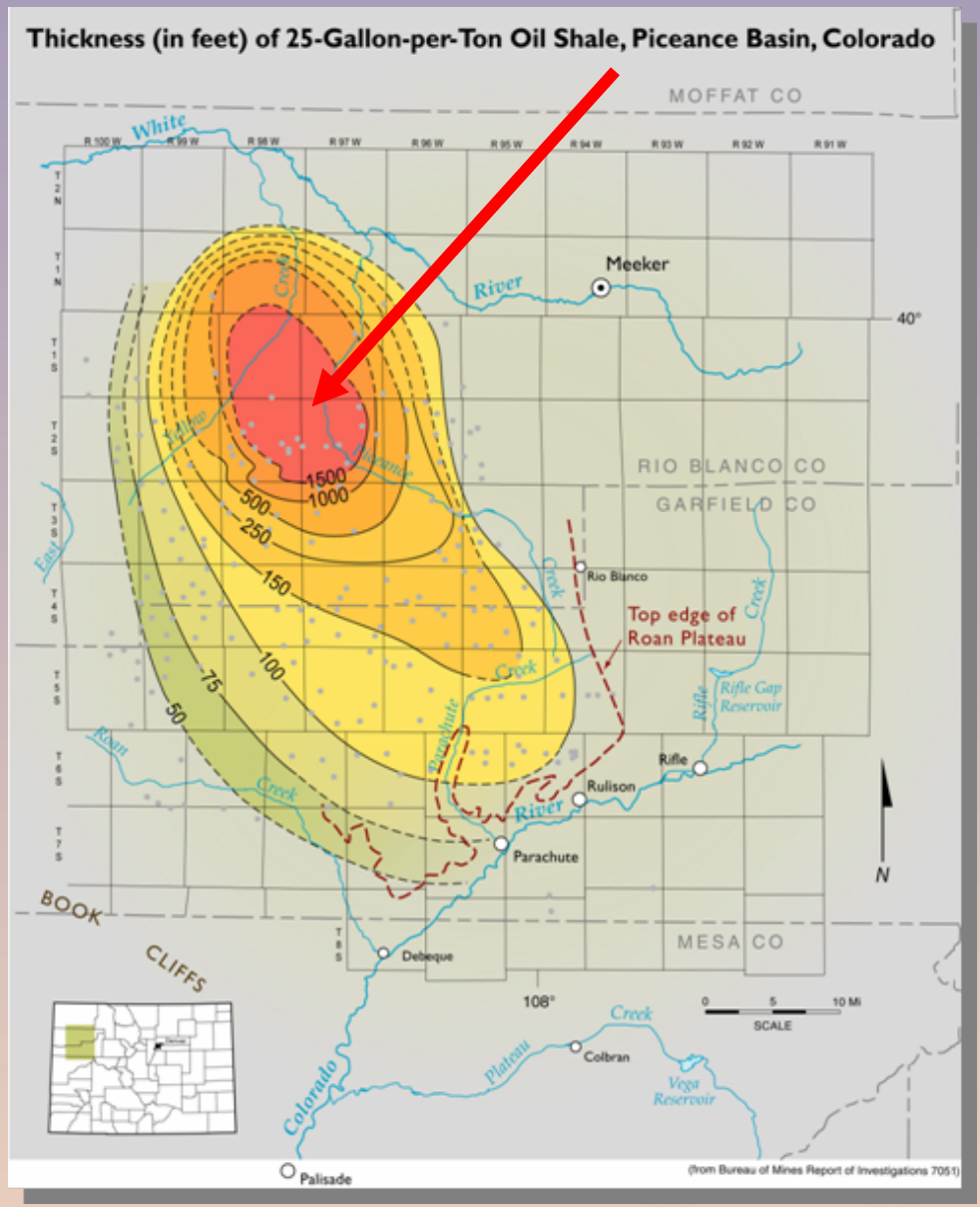
1.6 billion barrels

40% less

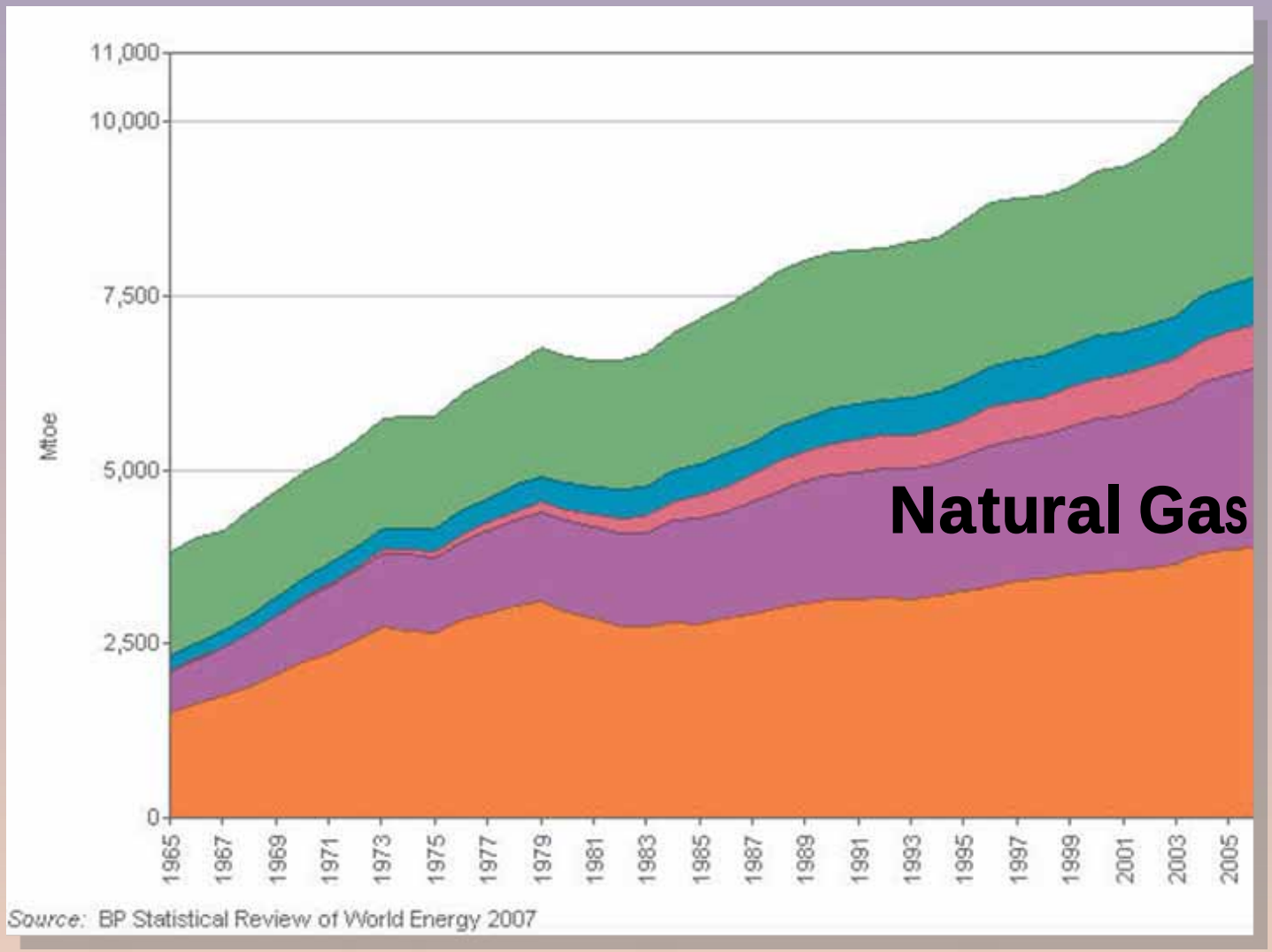
Technology Advances
post US peak oil & gas

- Bright spot technology
- Massive fracturing technology
- Coalbed methane technology
- 3D seismic technology
- Seismic workstations
- Horizontal drilling
- CO2 flooding technology
- Computer advances

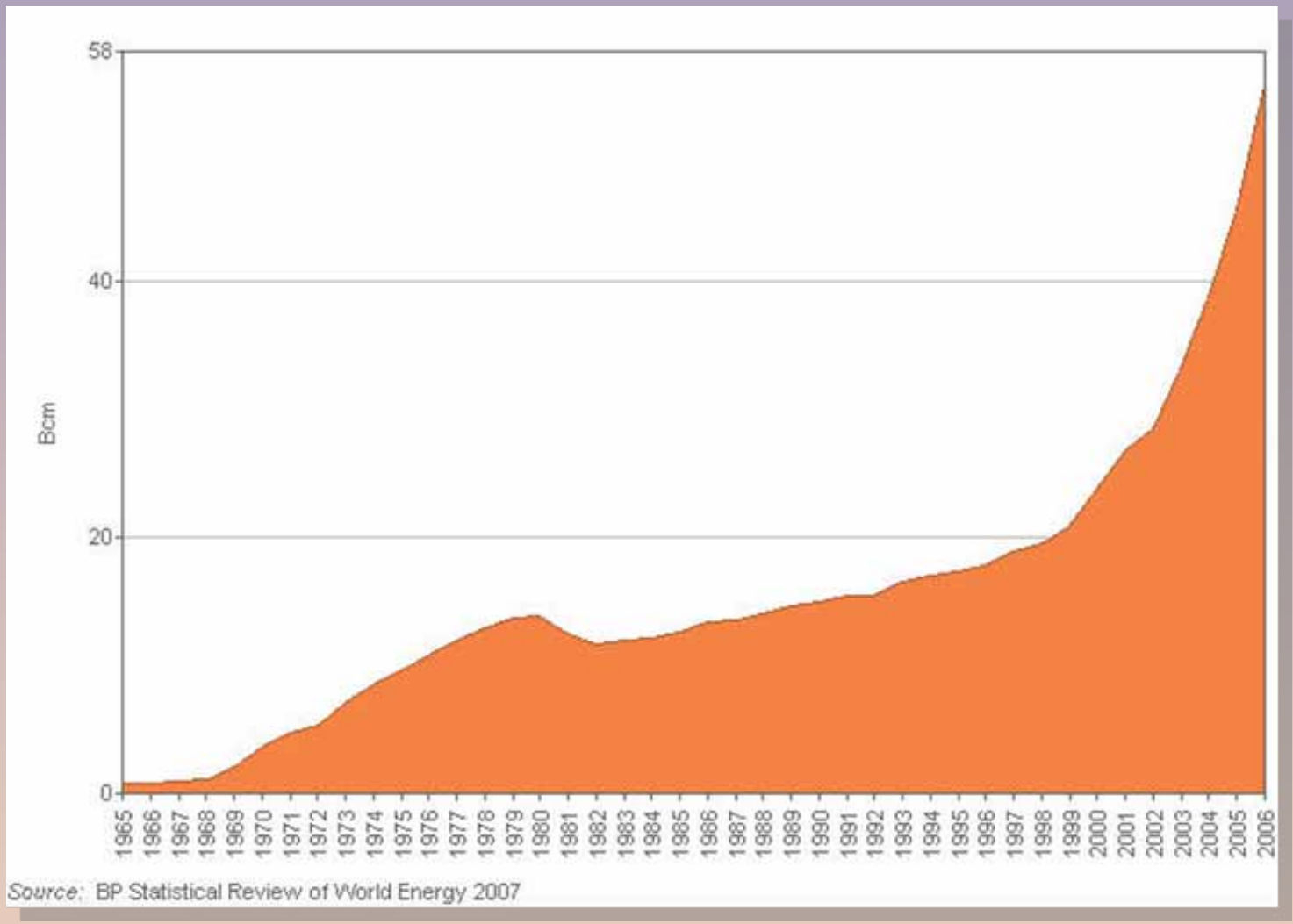
Oil shale is being seriously re-appraised.


Thickness (in feet) of 25-Gallon-per-Ton Oil Shale, Piceance Basin, Colorado
MOFFAT CO
RIO BLANCO CO
GARFIELD CO
MESA CO
Meeker
Rio Blanco
Rifle
Rulison
Parachute
Debeque
Colbran
Palisade
Top edge of Roan Plateau
1500
1000
500
250
150
100
75
50
40°
108°
N
SCALE
0 5 10 Mi
BOOK CLIFFS
White River
Yellow Creek
Piceance Creek
East Fork
Rio Blanco Creek
Rifle Creek
Rifle Gap Reservoir
Parachute Creek
Roan Creek
Colorado River
Plateau Creek
Vega Reservoir
(from Bureau of Mines Report of Investigations 7051)

World Energy Consumption

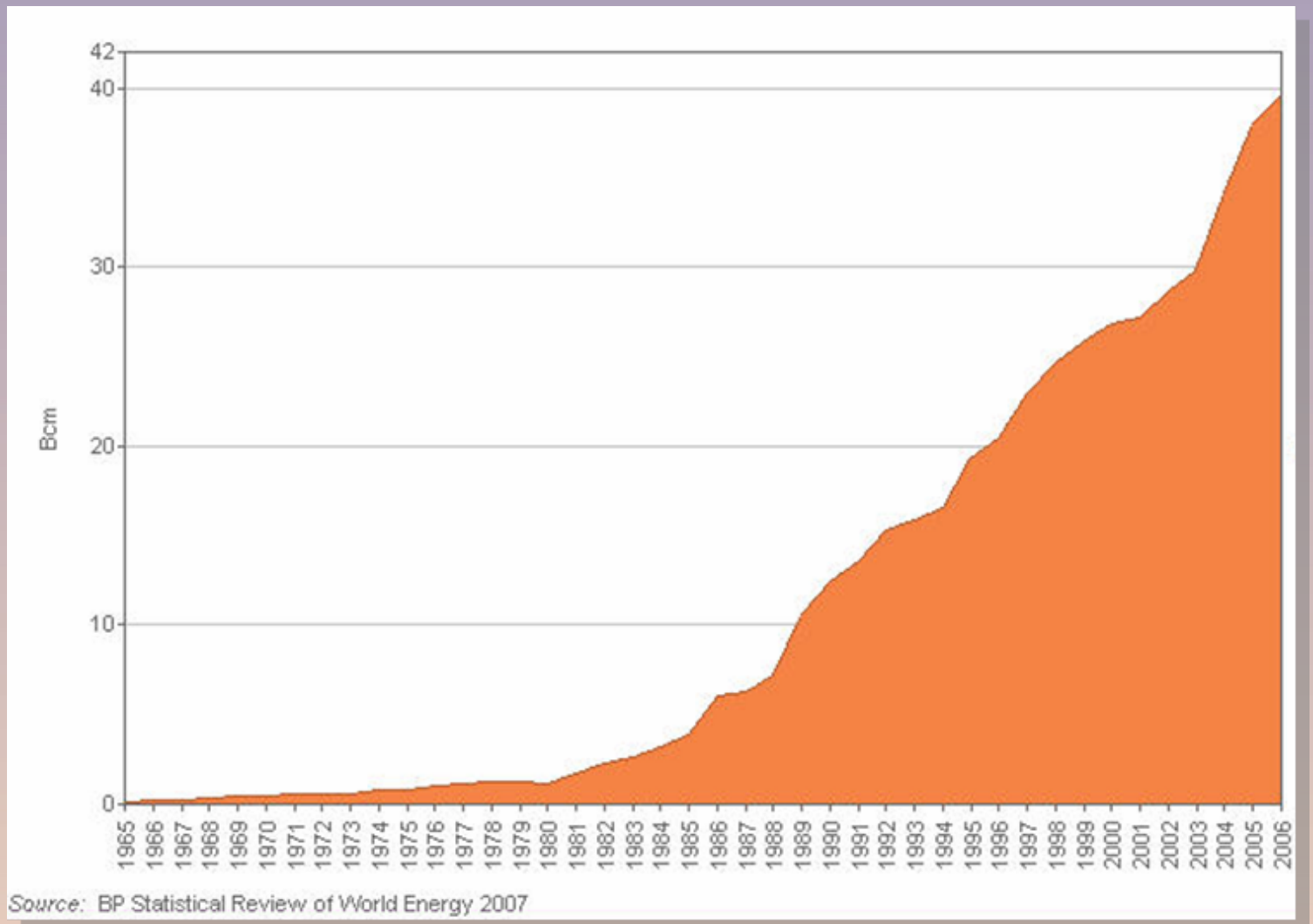


NATURAL GAS CONSUMPTION - China



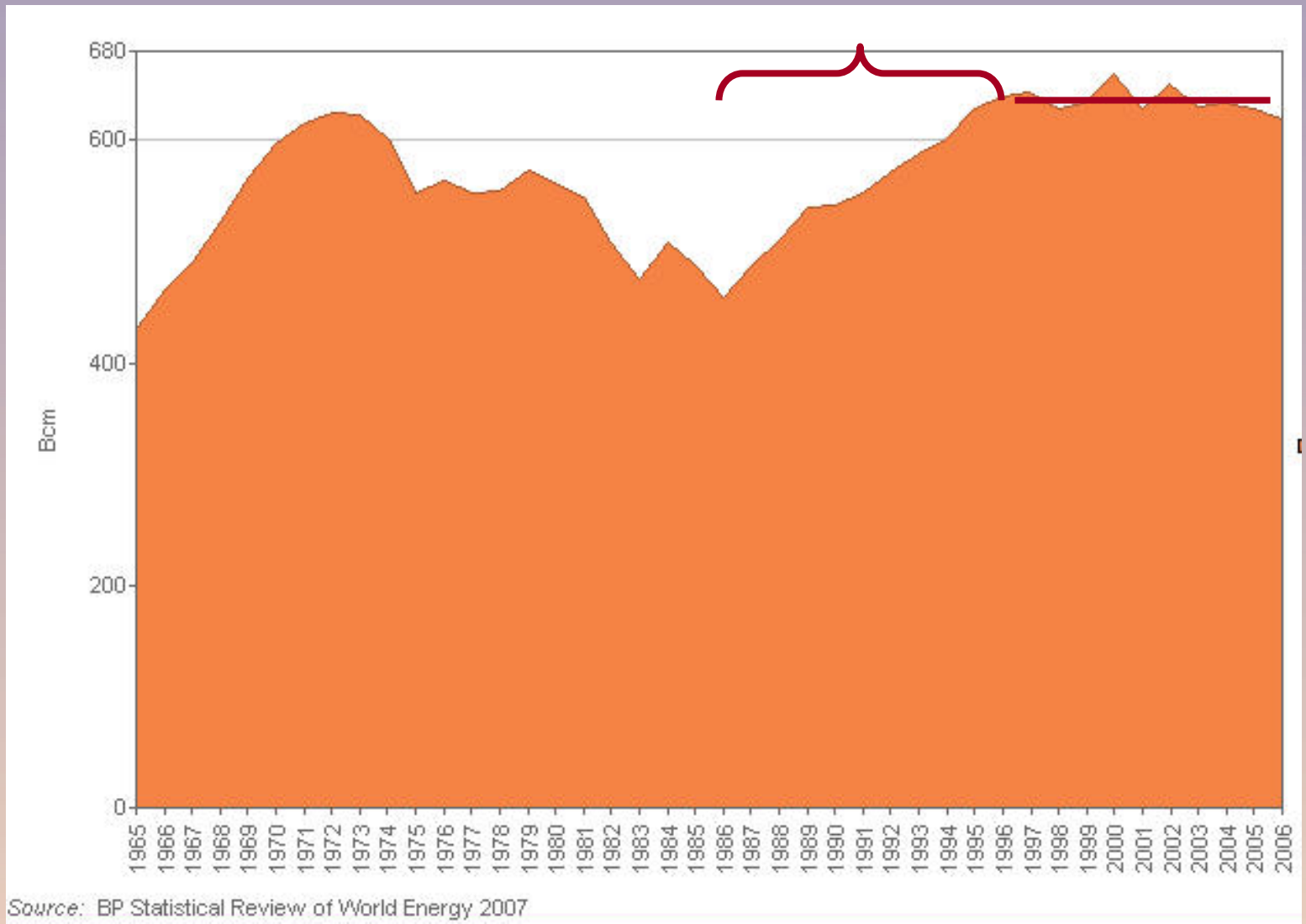
Source: BP Statistical Review of World Energy 2007

NATURAL GAS CONSUMPTION - India



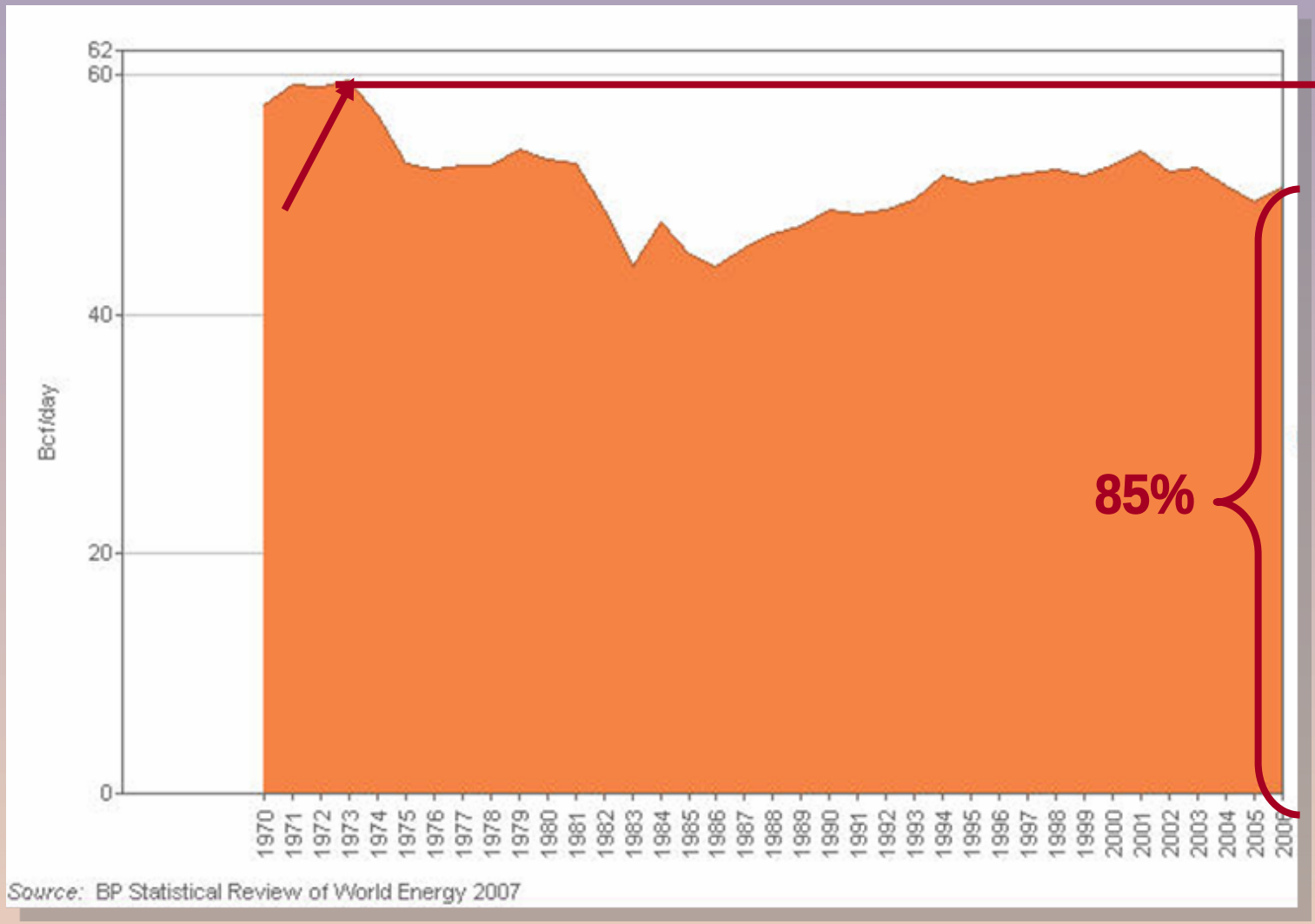
Source: BP Statistical Review of World Energy 2007

NATURAL GAS CONSUMPTION - U.S.

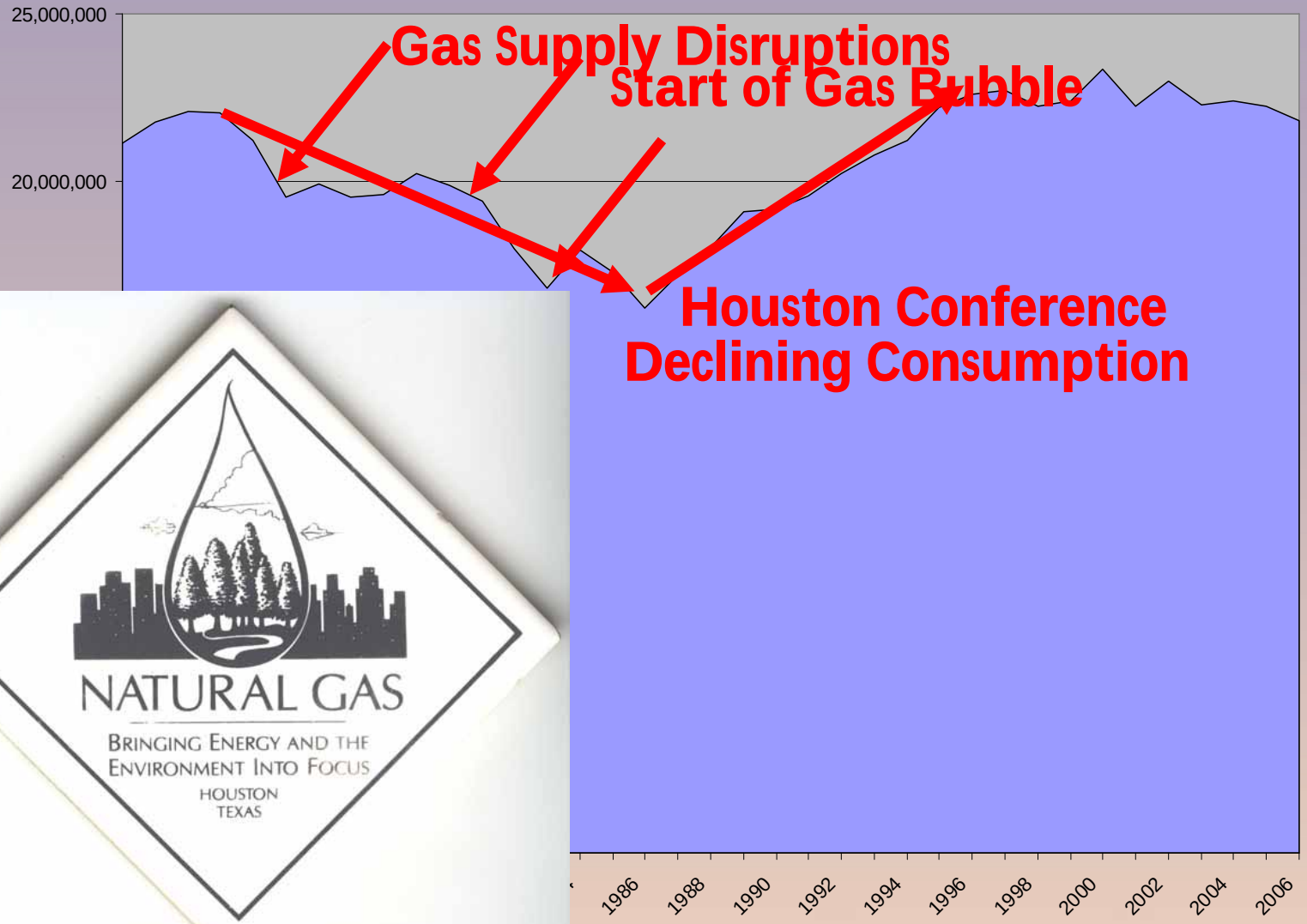


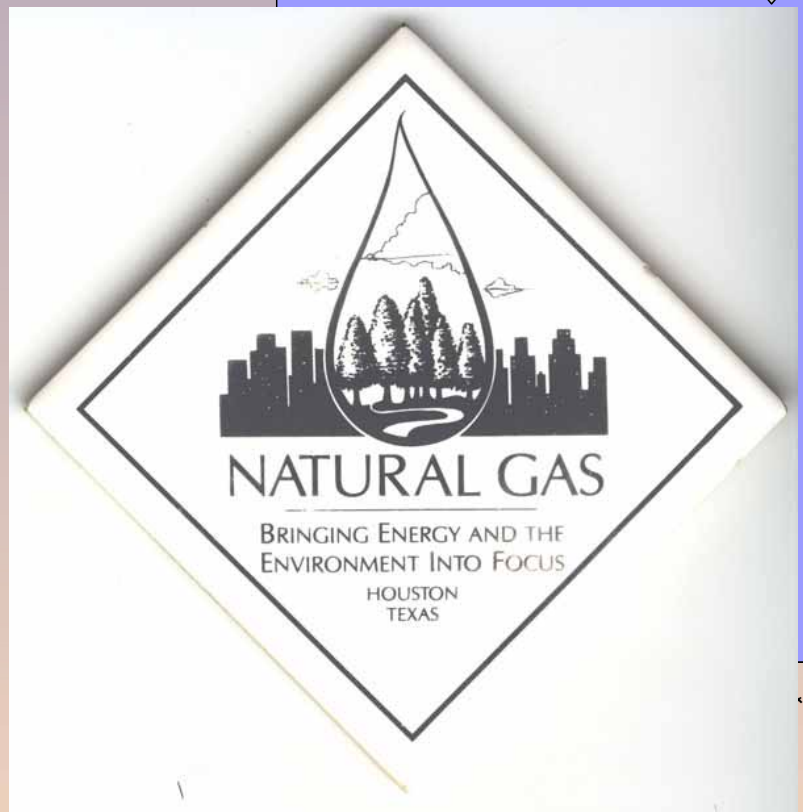
Source: BP Statistical Review of World Energy 2007

Natural Gas- U.S. (Production)

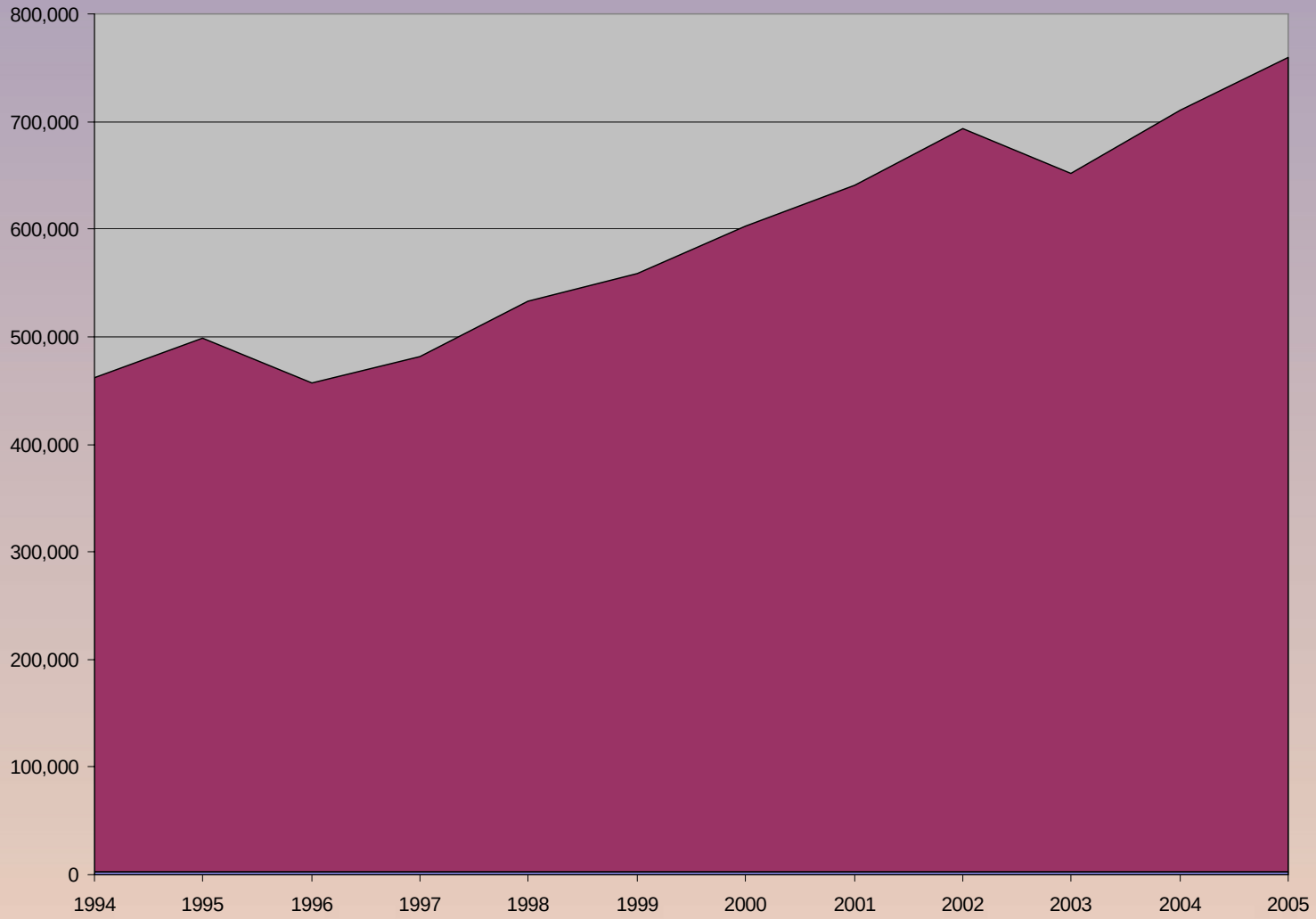


NATURAL GAS CONSUMPTION - U.S.

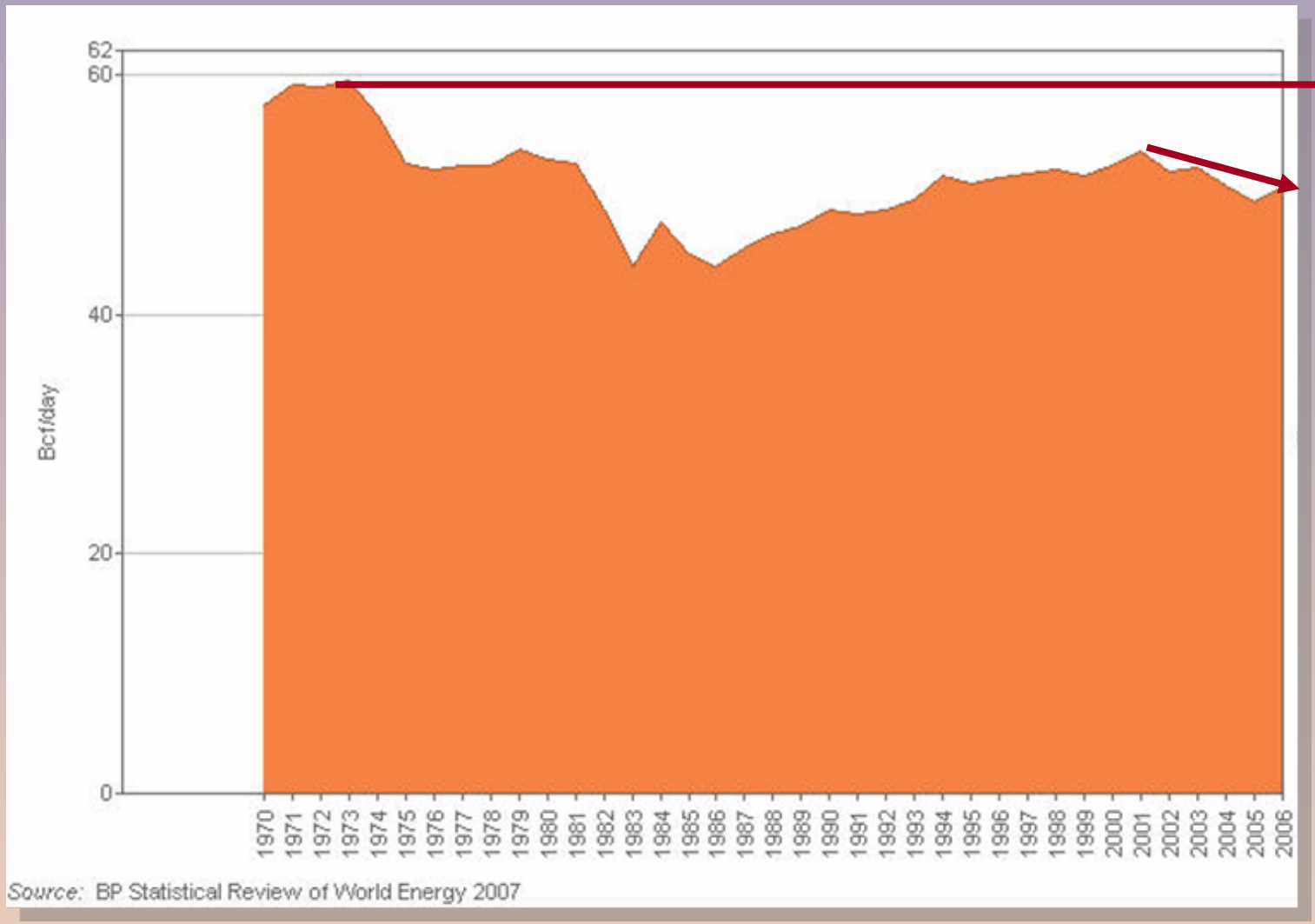




GAS FIRED ELECTRICITY - U.S.

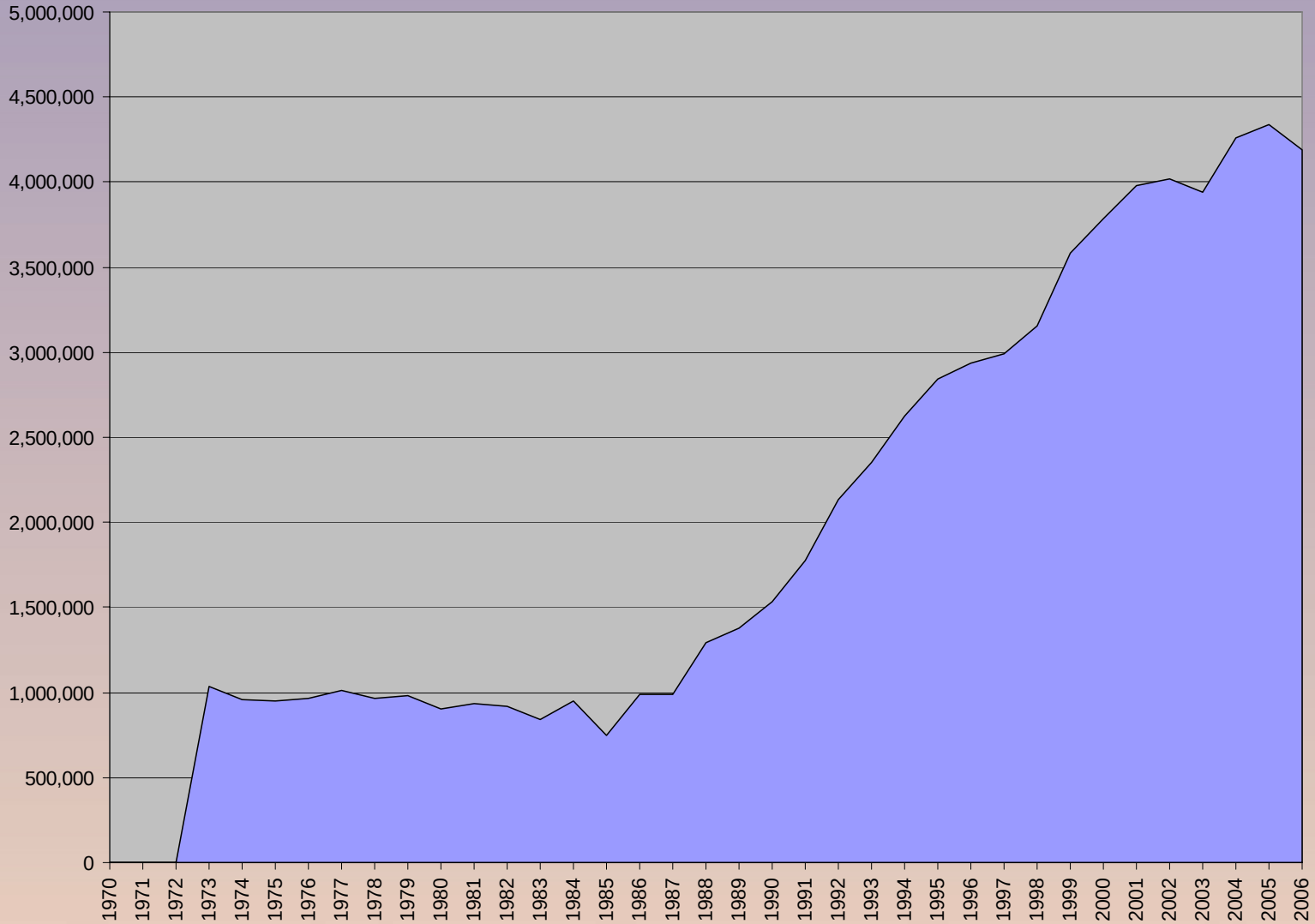


Natural Gas- U.S. (Production)

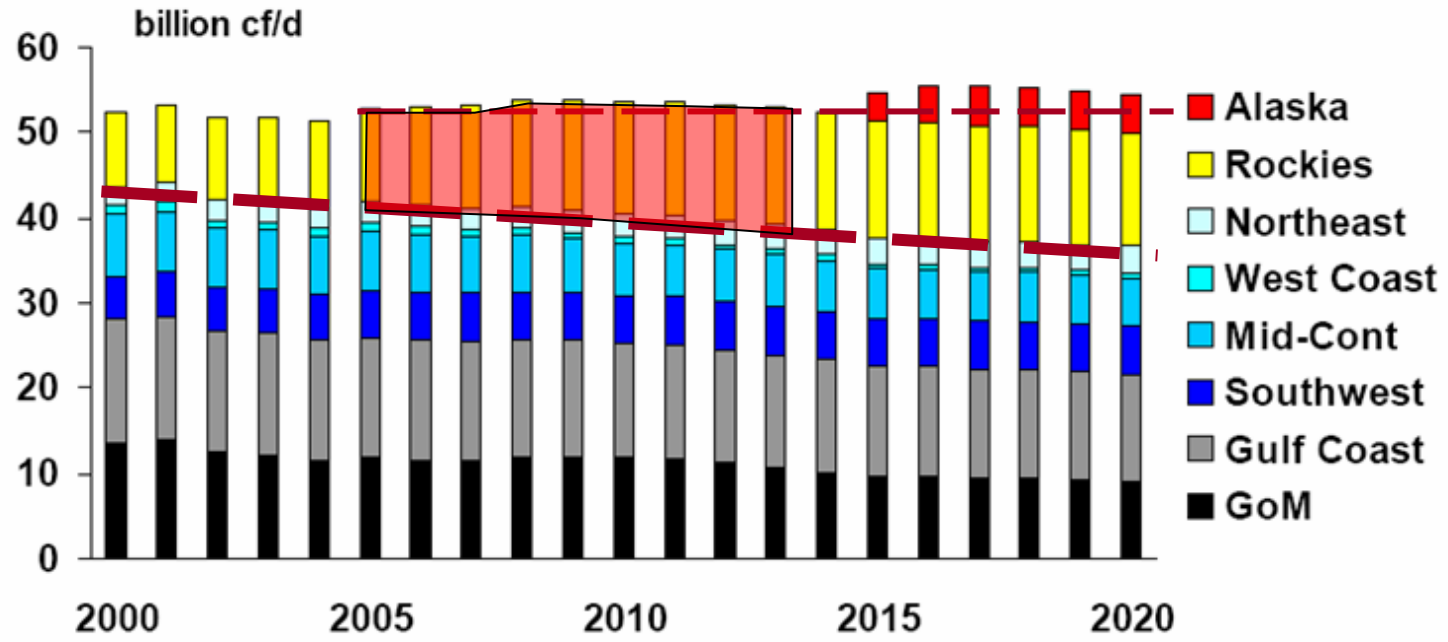


Source: BP Statistical Review of World Energy 2007

NATURAL GAS IMPORTS - U.S.

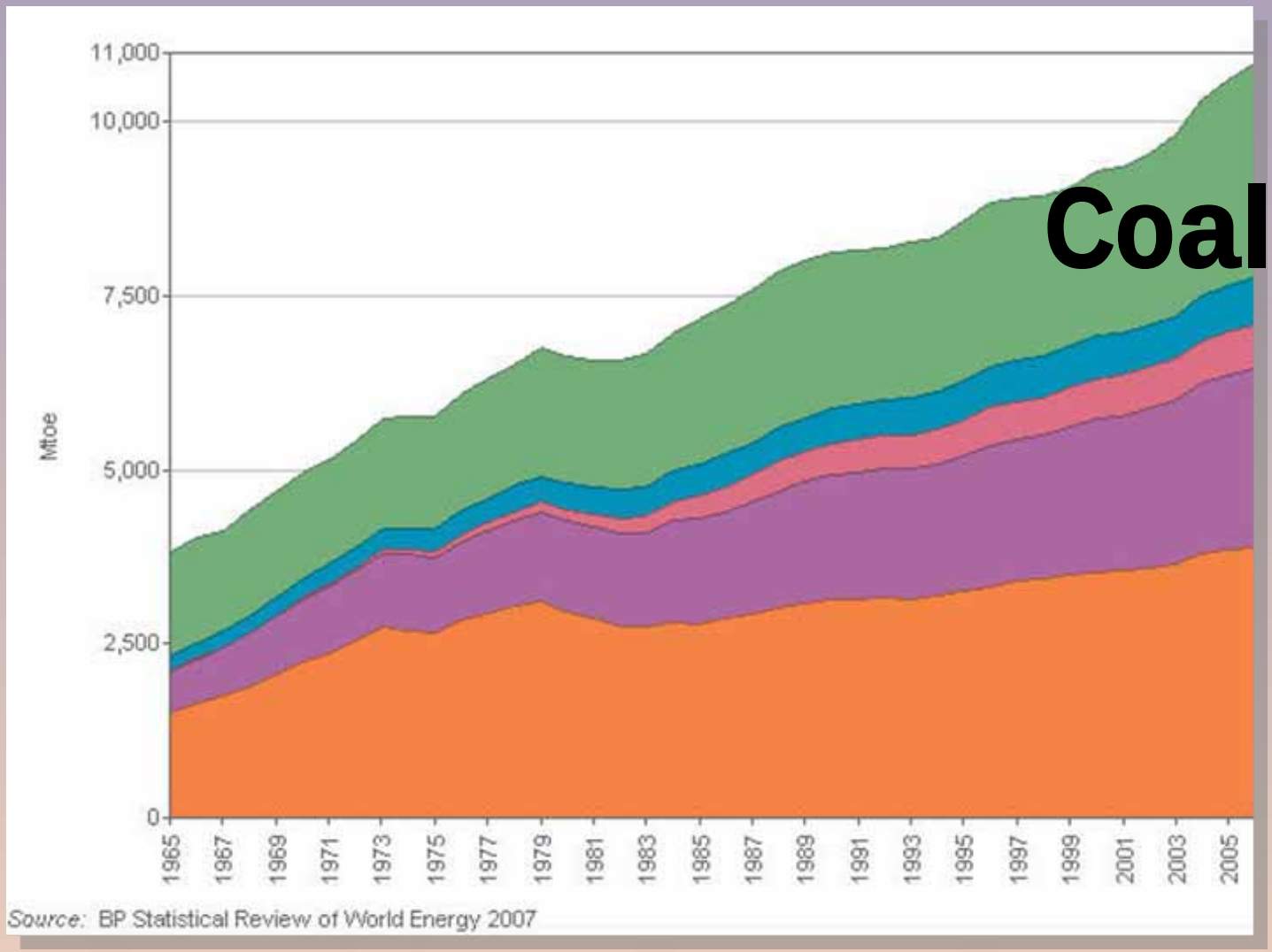


US gas supply is likely to be broadly flat despite more gas from the Rockies…

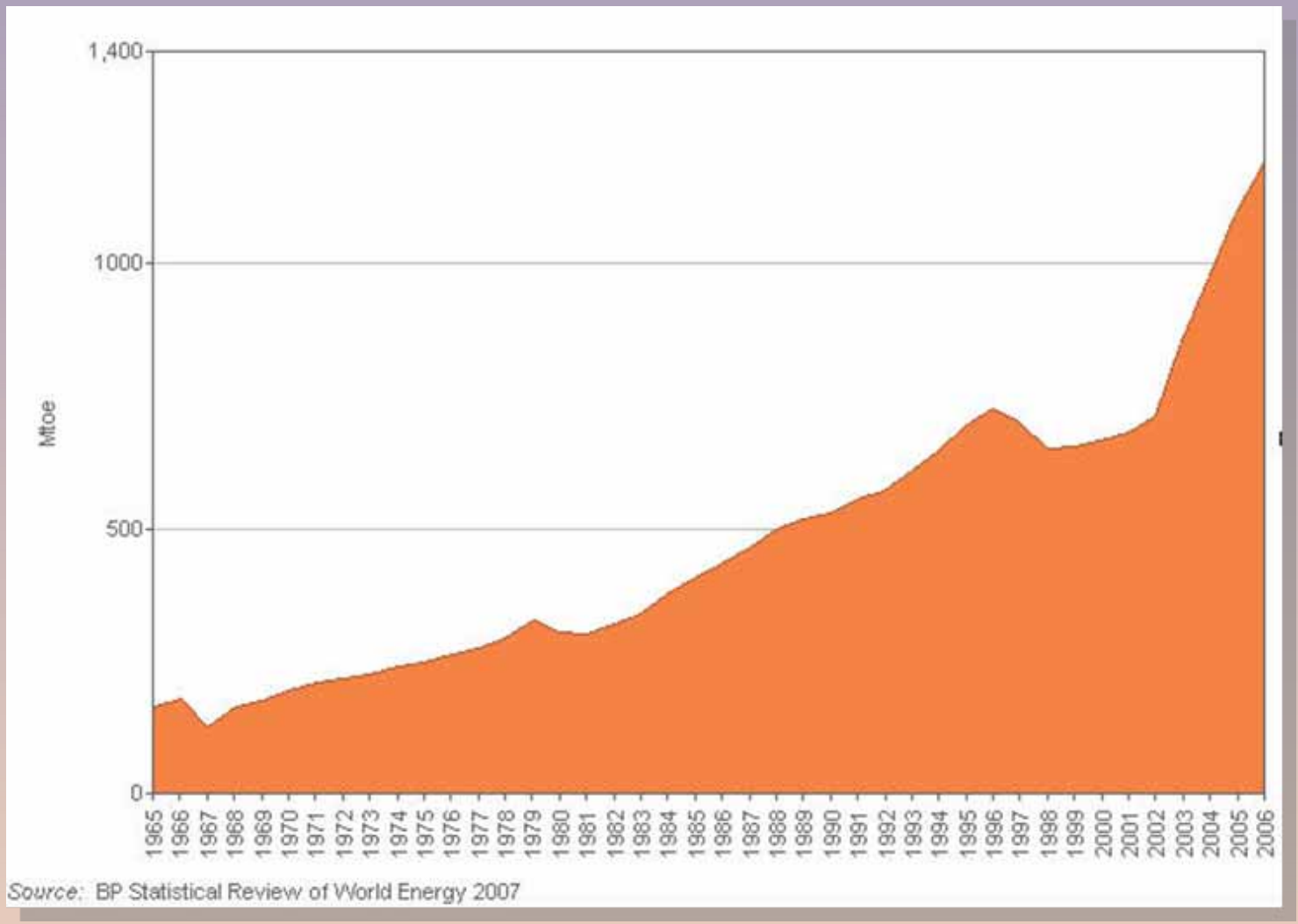


Wood Mackenzie

World Energy Consumption



COAL- China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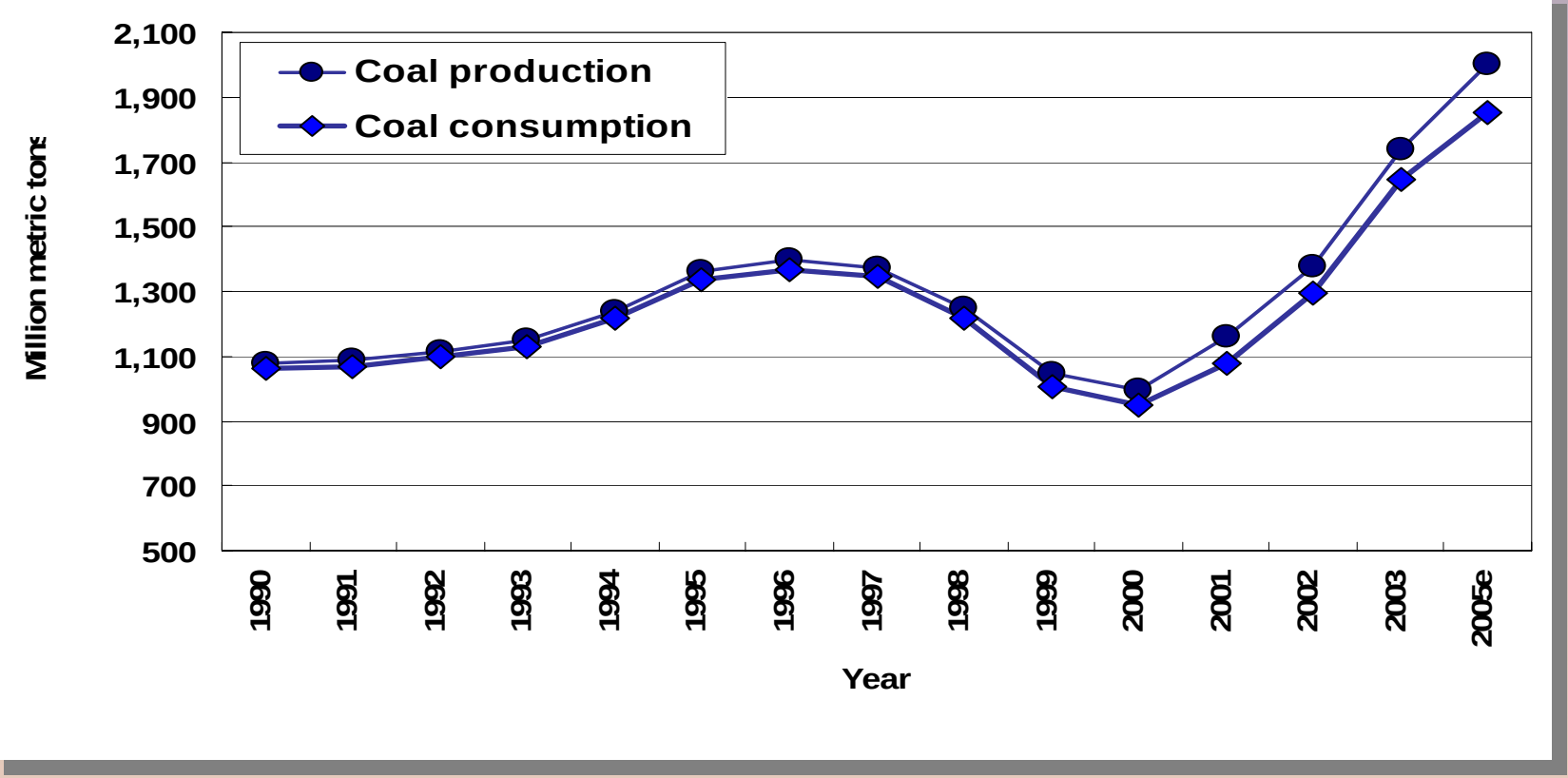
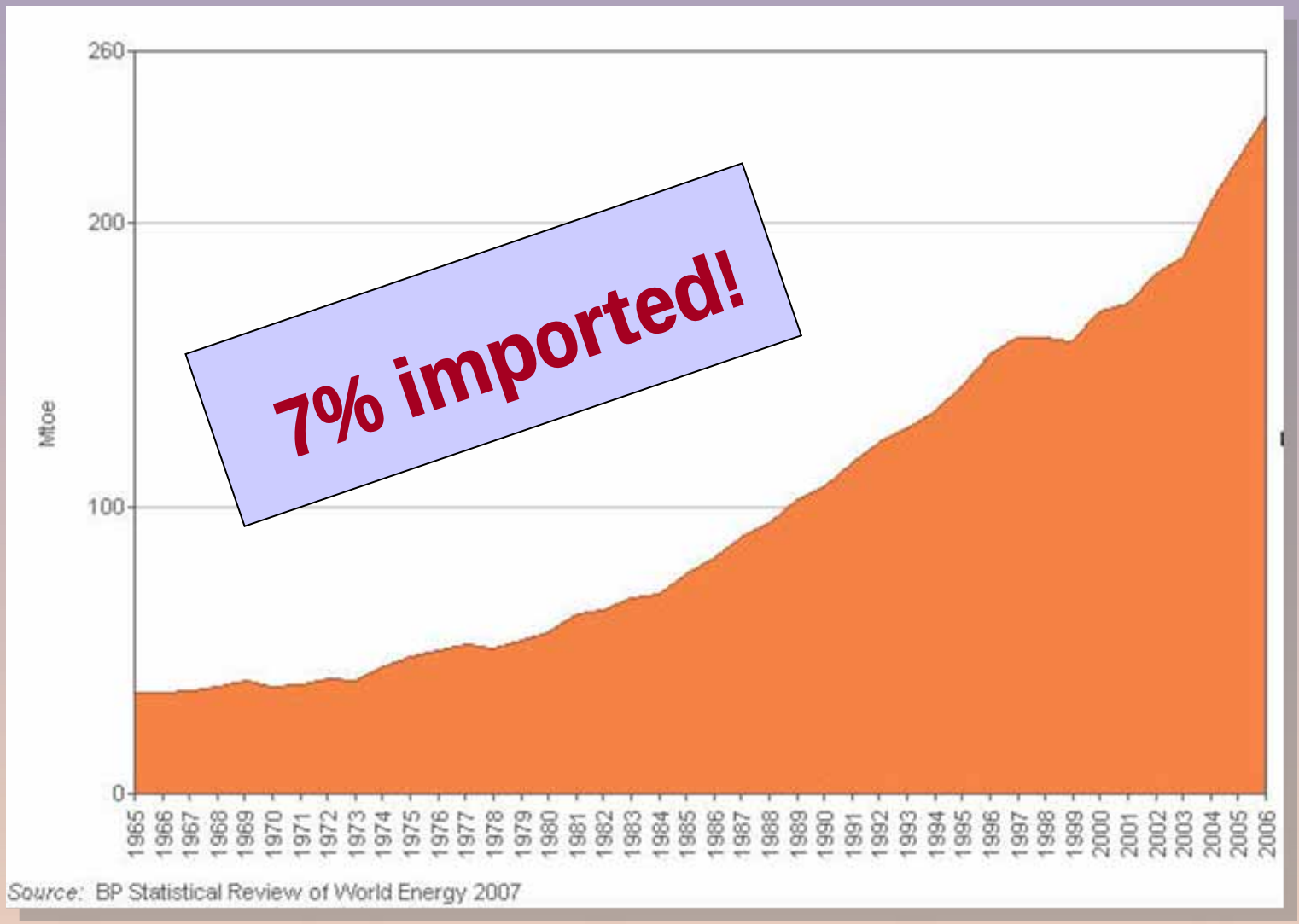
2006
Source: BP Statistical Review of World Energy 2007

China's Production and Consumption of Coal



In 2005 China built 117 government approved, coal-fired power plants

COAL- India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7% imported!
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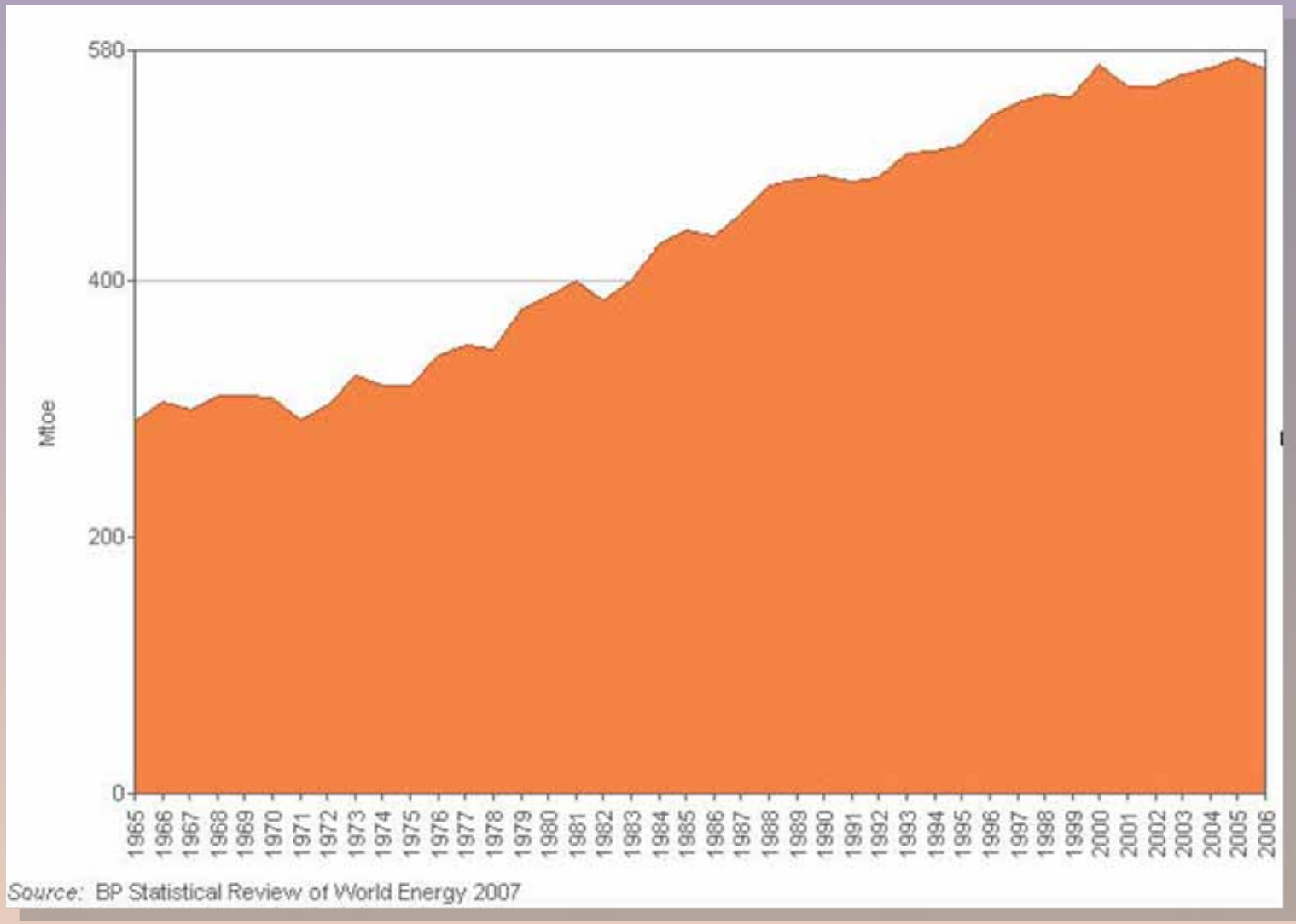
Source: BP Statistical Review of World Energy 2007

COAL U.S.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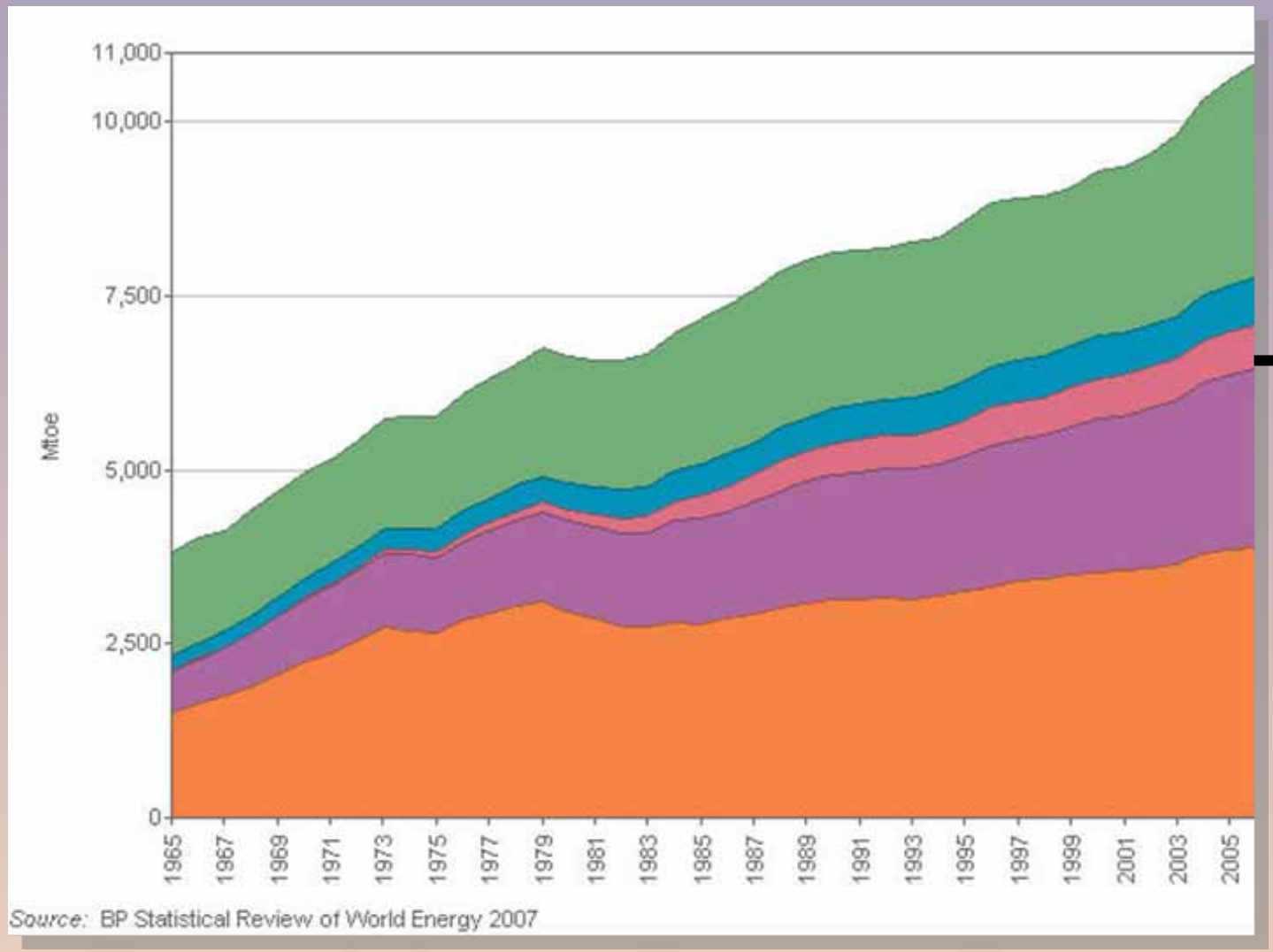
2006
Source: BP Statistical Review of World Energy 2007

China/U.S. Coal

54% of world production.

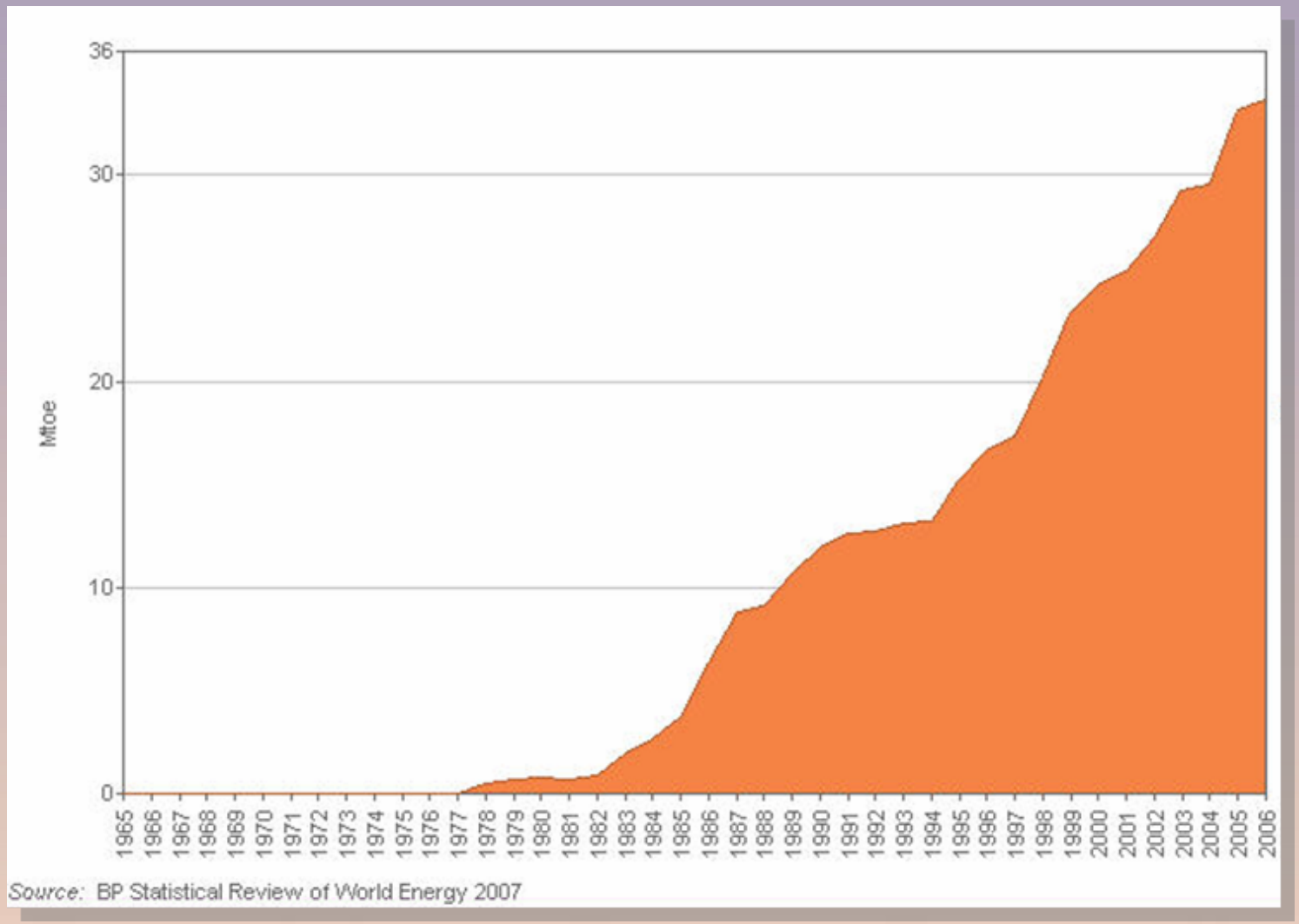
51% of world consumption.

World Energy Consumption

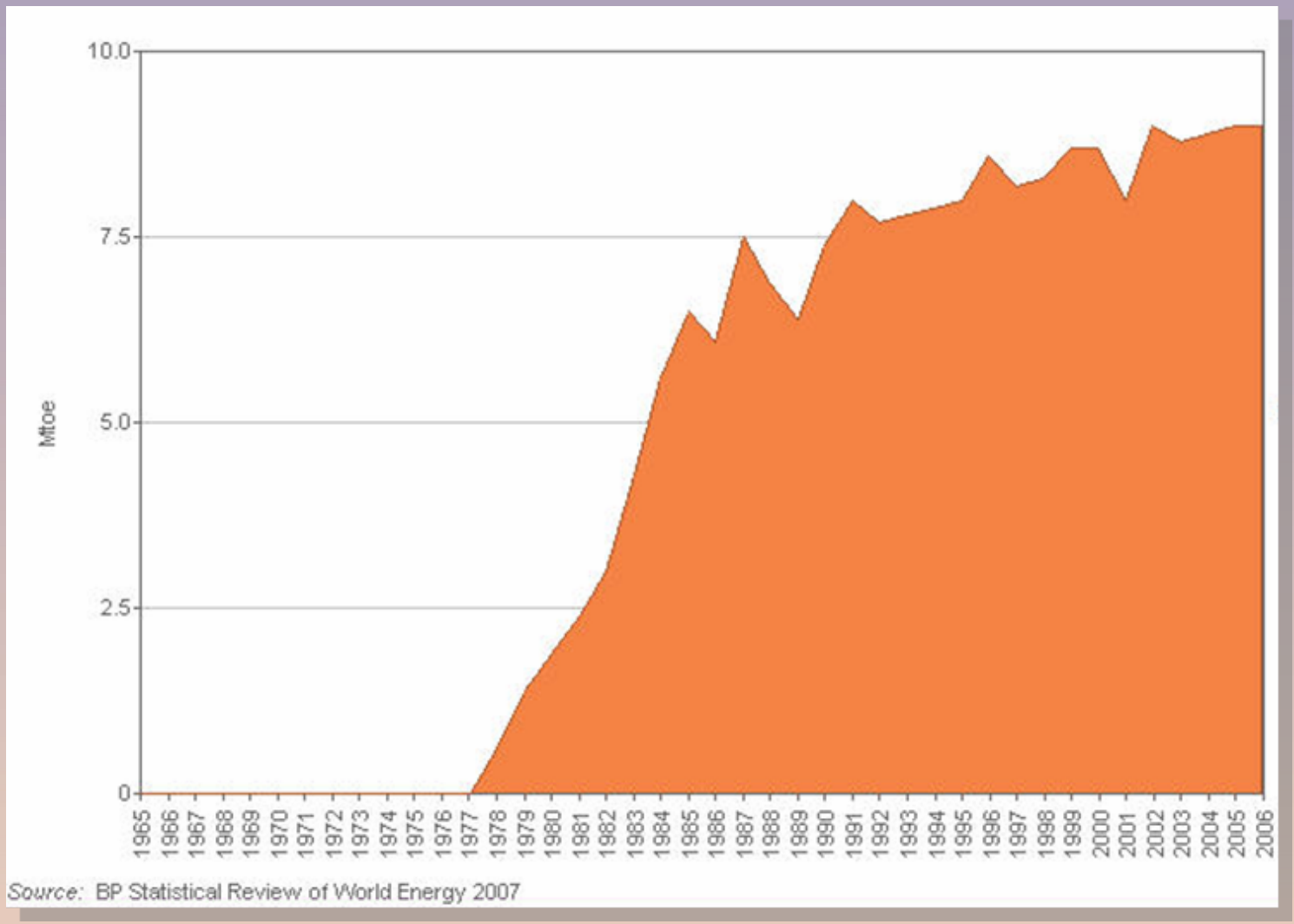


— Nuclear

NUCLEAR- China



NUCLEAR- India



Source: BP Statistical Review of World Energy 2007

China : 27 new plants by 2020

India: 17 new reactors by 2012

NUCLEAR- U.S.

The last nuclear power plant came on line in 1996

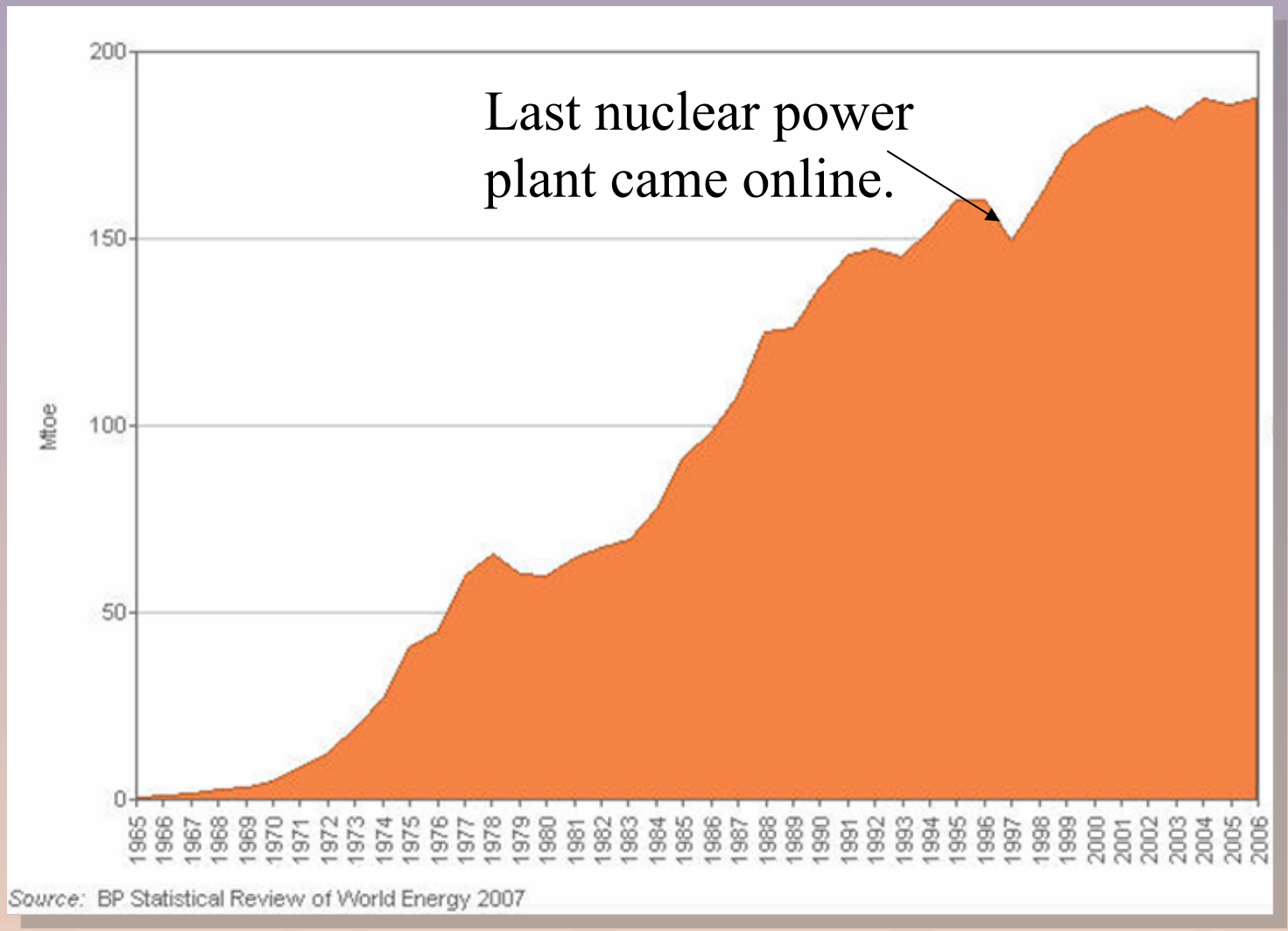
Since then has U.S. nuclear generation --

Increased?

Decreased?

Remained flat?

NUCLEAR- U.S.


Last nuclear power plant came online.
Mtoe
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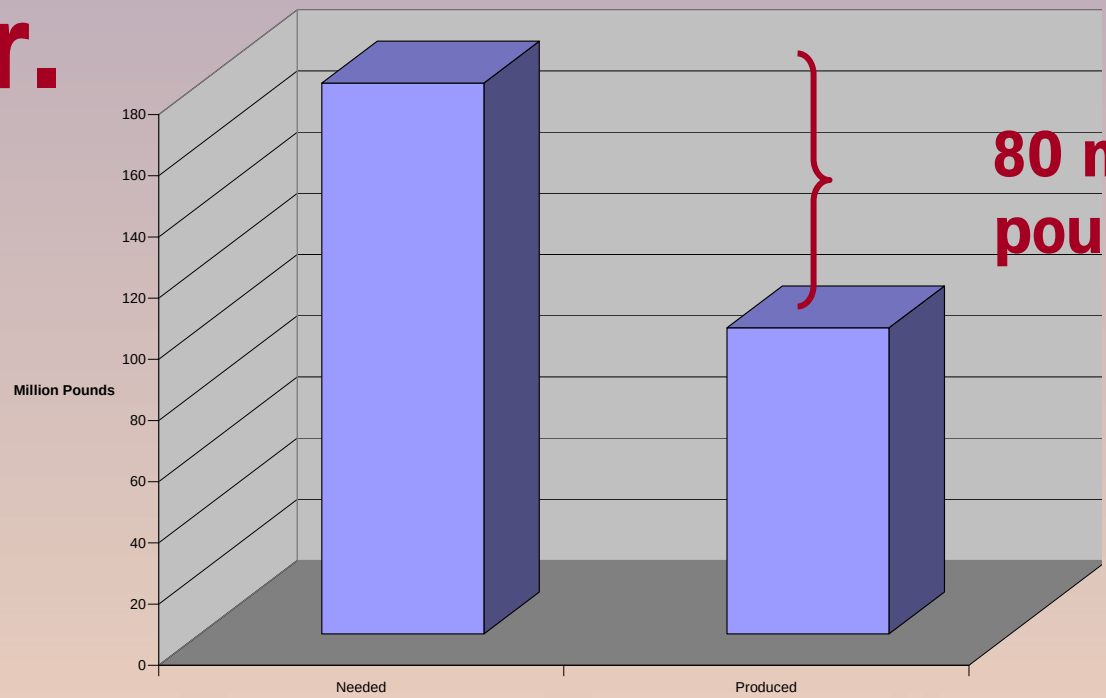
150
100
50
0
1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
Source: BP Statistical Review of World Energy 2007

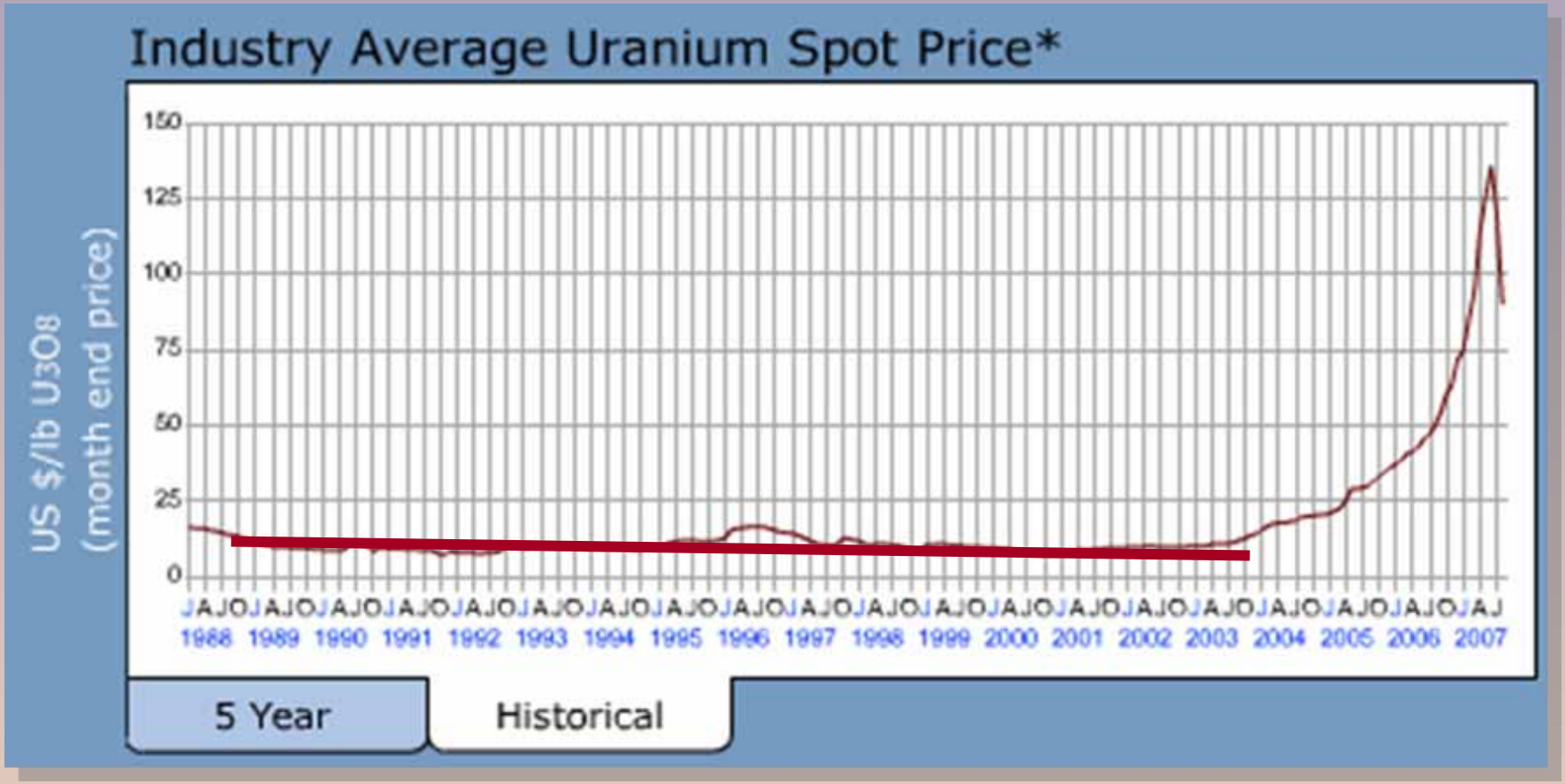
And, the largest nuclear power generator in the world?

The United States generates as much nuclear energy as France, Germany, Spain, Sweden, and the United Kingdom *combined*!

The world's existing 435 nuclear reactors currently need 180 million pounds of uranium each year.

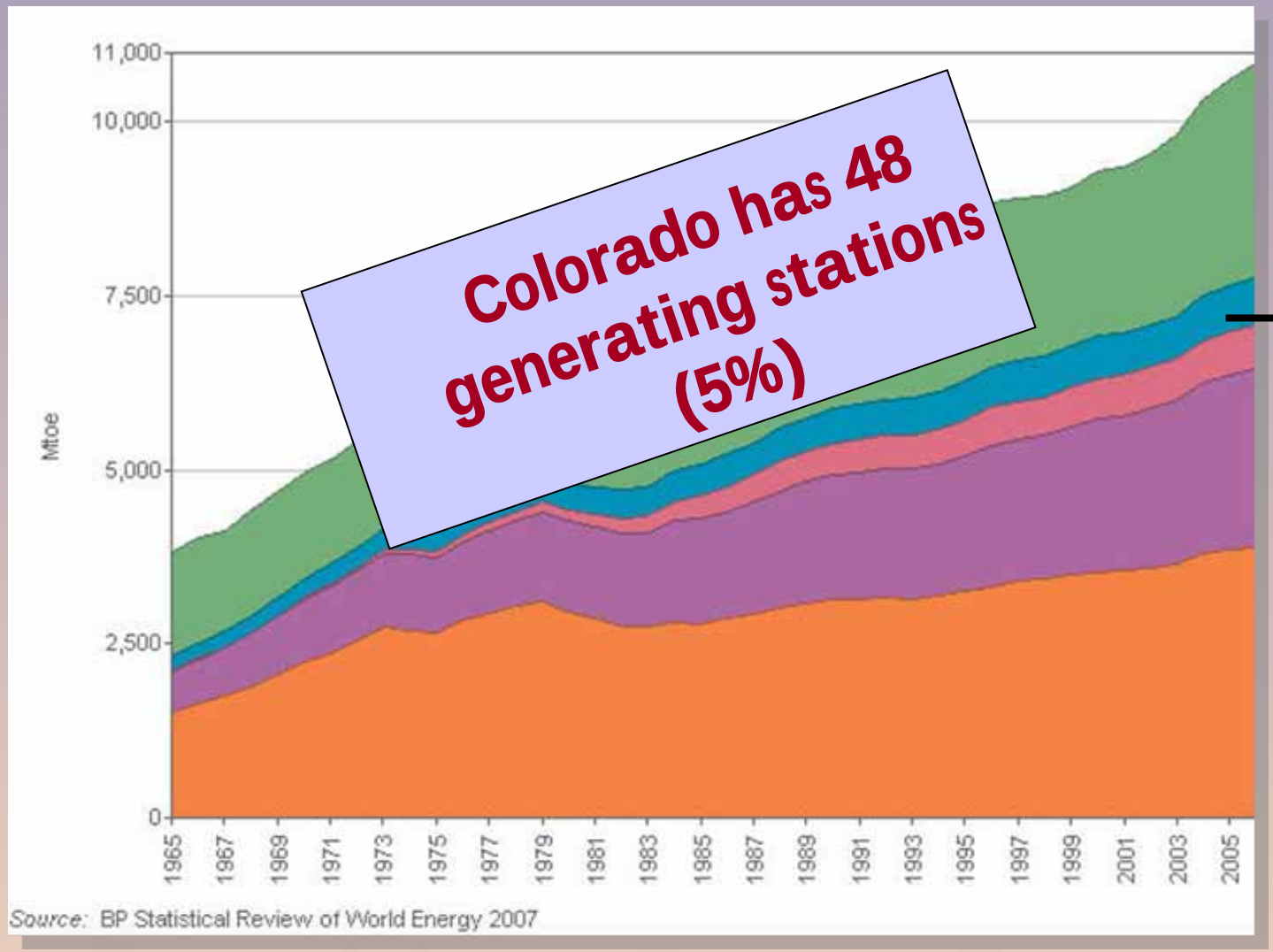


Uranium prices



Source: Cameco

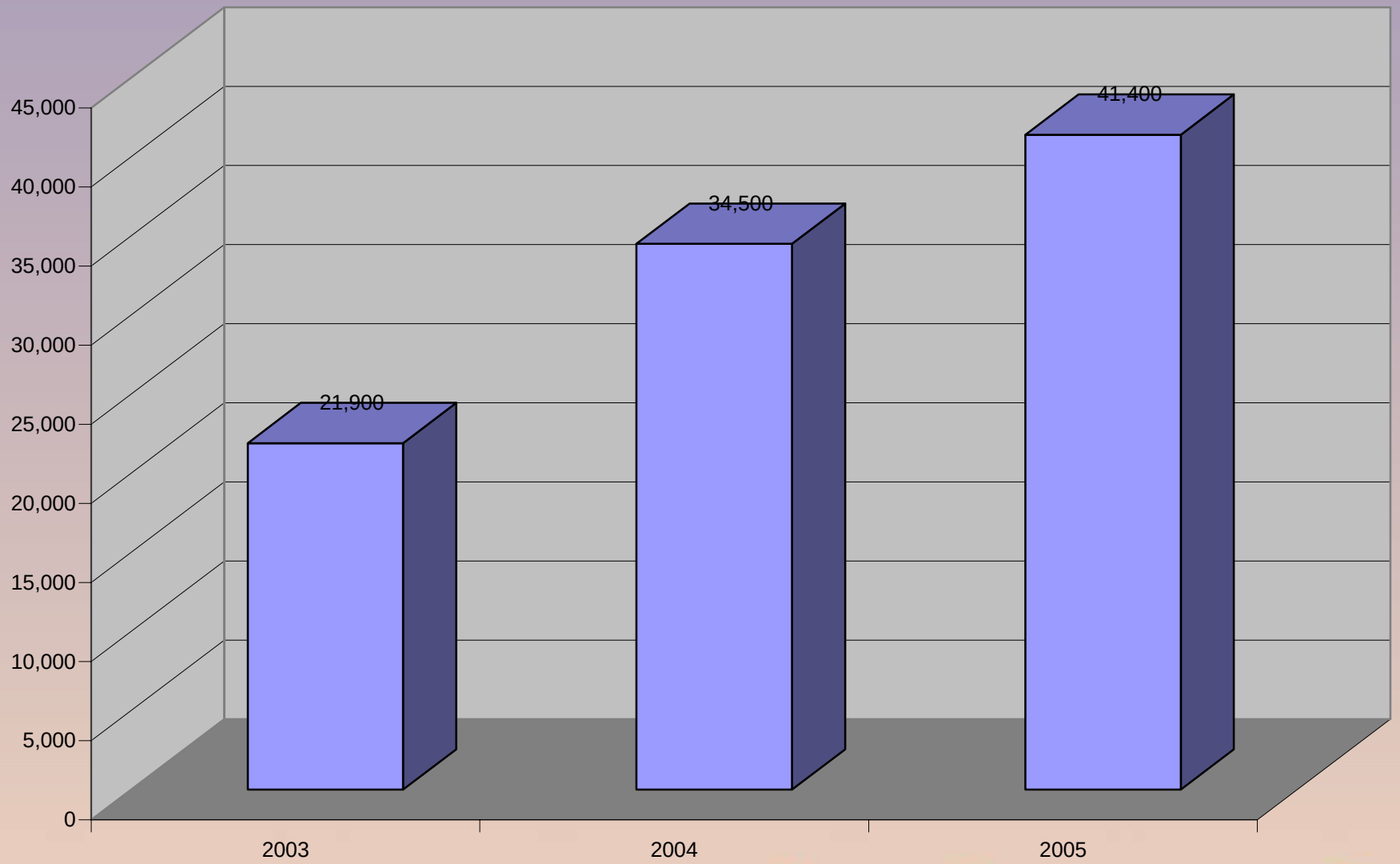
World Energy Consumption



Colorado has 48 generating stations (5%)

—**Hydro**

U.S. molybdenum exports



MOLYBDENUM Price

~ $2.00/lb in 2002

$40/lb in July, 2005!

Precious Metal Increases 01/03 - 10/07

Gold
128%

Silver
266%

Platinum
122%

Base Metal Increases 01/03 - 10/07

Nickel 630%

Copper 454%

Zinc 497%

Aluminum 144%

Lead 705%

Tin 198%

Antimony

Bismuth

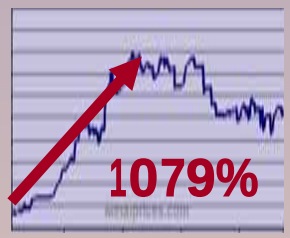
Cadmium

Chromium

Cobalt

Germanium

Indium



Magnesium

Manganese

Rhenium

Selenium

Tellurium

Titanium

Tungsten

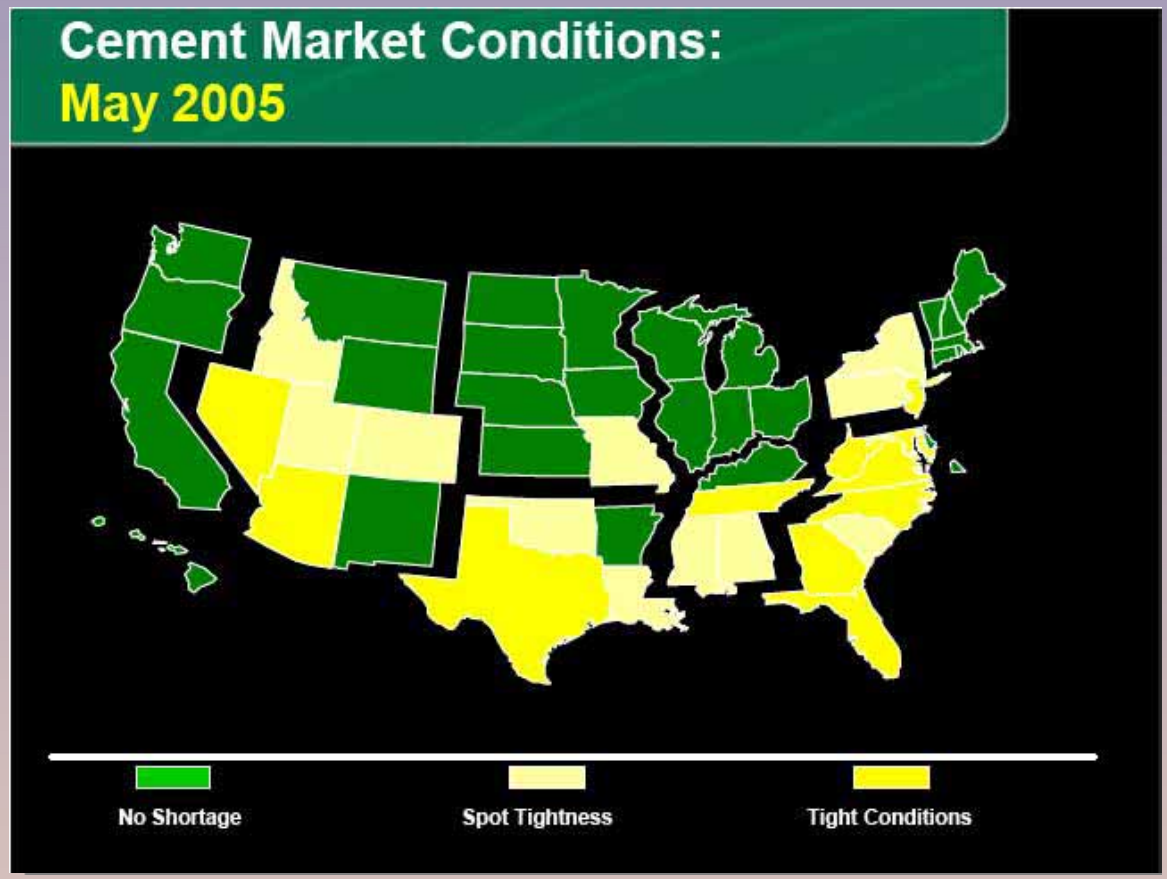
Vanadium

COLORADO GEOLOGICAL SURVEY

Cement producers

1. China
2. India
3. U.S.

22% Imported



China Consumes ½ of all the concrete in the world

U.S. cement manufacturing is 81% foreign owned

“Chinese companies and their rivals are scouring the globe from Australia to Africa for access to the raw materials needed to sustain the Asian nation’s growth as commodity prices surge.”

--June 23, 2006 (*Bloomberg*)

Strategic and Critical Materials with uses in Alternative Energy applications for which the U.S. is dependent on imports for 50% or more of consumption

Commodity	**Primary Sources**	***Applications in Alternative Energy***
Antimony	China	Thermoelectric/paraelectric materials
Barium	China	Thermoelectric/paraelectric materials
Bismuth	China, Mexico	Thermoelectric/paraelectric materials
Cobalt	Kinshasa,Australia	Photovoltaics (solar cells)
Gallium	China	Photovoltaics, paraelectric materials
Germanium	Belgium,Canada	Photovoltaics (solar cells)
Indium	China, Canada	Solar cells, thermo/paraelectric materials
Manganese	Gabon, S. Africa	Photovoltaics
Nickel	Canada	Fuel cells
Platinum group	South Africa	Fuel cells, para/thermoelectric mtrls
Rare Earths	China	Fuel cells, para/thermoelectric mtrls
Scandium	China, Russia	Thermoelectric/paraelectric materials
Selenium	Canada	Solar cells, thermoelectric materials
Strontium	Mexico	Thermoelectric/paraelectric materials
Tantalum	Brazil	Thermoelectric/paraelectric materials
Tellurium	Belgium, Germany	Solar cells, thermoelectric metrls, semiconductors
Tin	Peru	Thermoelectric materials
Titanium	Australia, S. Africa	Solar cells
Vanadium	Czech Rep., S. Africa	Fuel cells
Zinc	Canada, Mexico	Photovoltaics, fuel cells, thermoelectric mtrls

Overall Impacts

We will suffer from effects of inflation

We may see increasing shortages of critical raw materials

Pressures will mount to develop more of the West's natural resources

Conflicts may arise with multi-national corporations operating in the U. S.

The End!

Of the talk, that is.

2007 Houston World Oil Conference

Proceedings

- Conference Program
- Conference DVD
- Video Highlights
- Peak Oil Review
- ASPO-USA