The Rise of Oil

3 February 2005

Out of Gas

- *Over the past century, we have developed a civilization firmly rooted in the promise of an endless supply of cheap oil. That promise is about to be broken, much sooner than most people realize, possibly within this decade. Anyone who remembers the temporary, artificial oil shortage of 1973 can guess what will happen when the oil really starts to run out.*

- *The world will soon start to run out of conventionally produced, cheap oil… By the time we have burned up all that fuel, we may well have rendered the planet unfit for human life. Even if human life does go on, civilization as we know it will not survive, unless we can find a way to live without fossil fuels.*

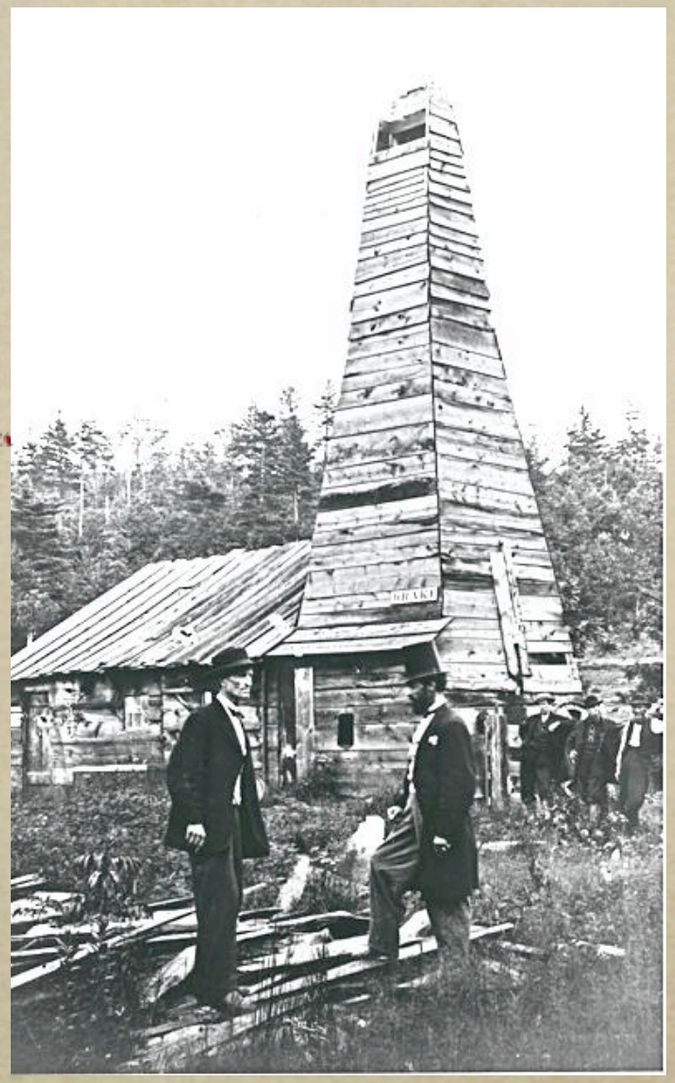
Cover flap, *Out of Gas*, David Goodstein 2004

History

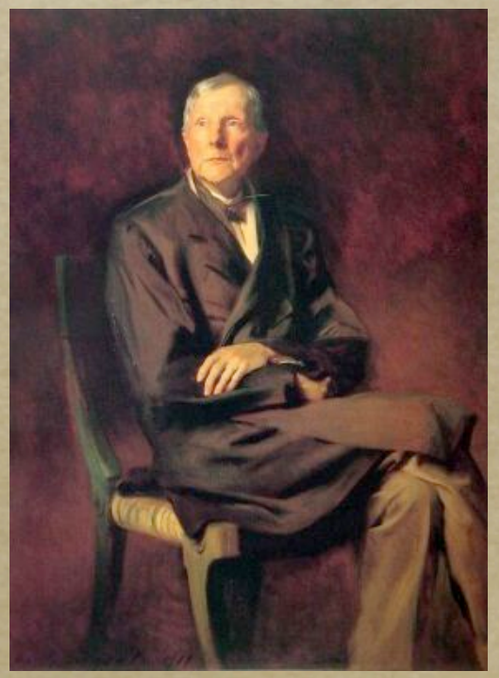
- *Organisms deposited on ocean floor are decomposed by bacteria, compressed by sediments and overlying rock.*
- *Most commercially exploited deposits are less than 250 My old.*
- *Production takes thousands of years*

History, Part II

- *More than 2600 years ago, people already knew the value of … "fire water." During the siege of Persia in 331 BC, Alexander the Great's tent was lit by fire vessels made of clay and filled with oil taken from inhabitants living near the Caspian seaside.*
- *1859 – Edwin L. Drake drills first oil well near Titusville, northwest Pennsylvania*
- *1861 – Nikolaus Otto invents gasoline-burning engine*
- *1862 – John D. Rockefeller invests in his first oil refinery*
- *1870 – Rockefeller founds Standard Oil*
- *1901 – Rockefeller worth $900 million*
- *1933 – First Saudi Arabian oil concession to American company*
- *1956 – M. King Hubbert, geophysicist working for Shell Oil, predicts peak in American oil production in 1970*
- *1970 – Peak in American oil production*
- *2005 – Peak in **world** oil production?*

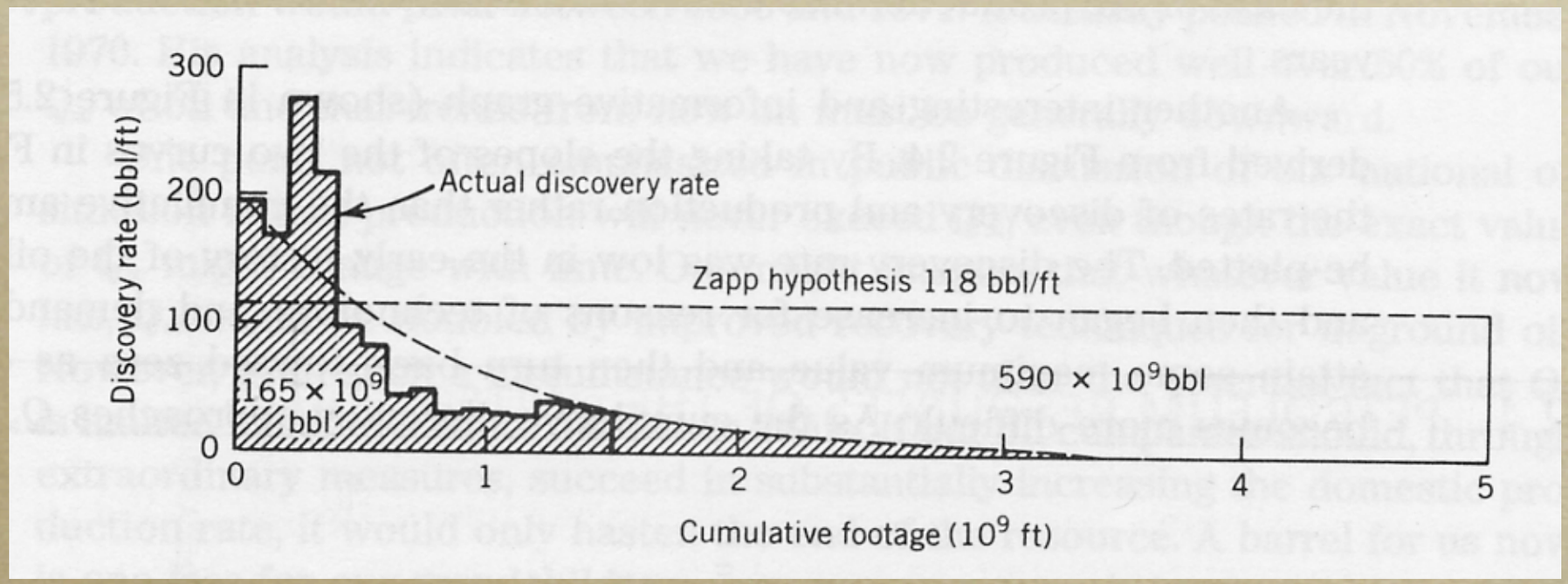


http://www.drilshop.com/hallfame/wellsite.html



John Davison Rockefeller, by John Singer Sargent

Zapp Hypothesis (1962)



Oil discovery per foot of drilling will remain constant until we have one well per two square miles.

Hubbert's Peak

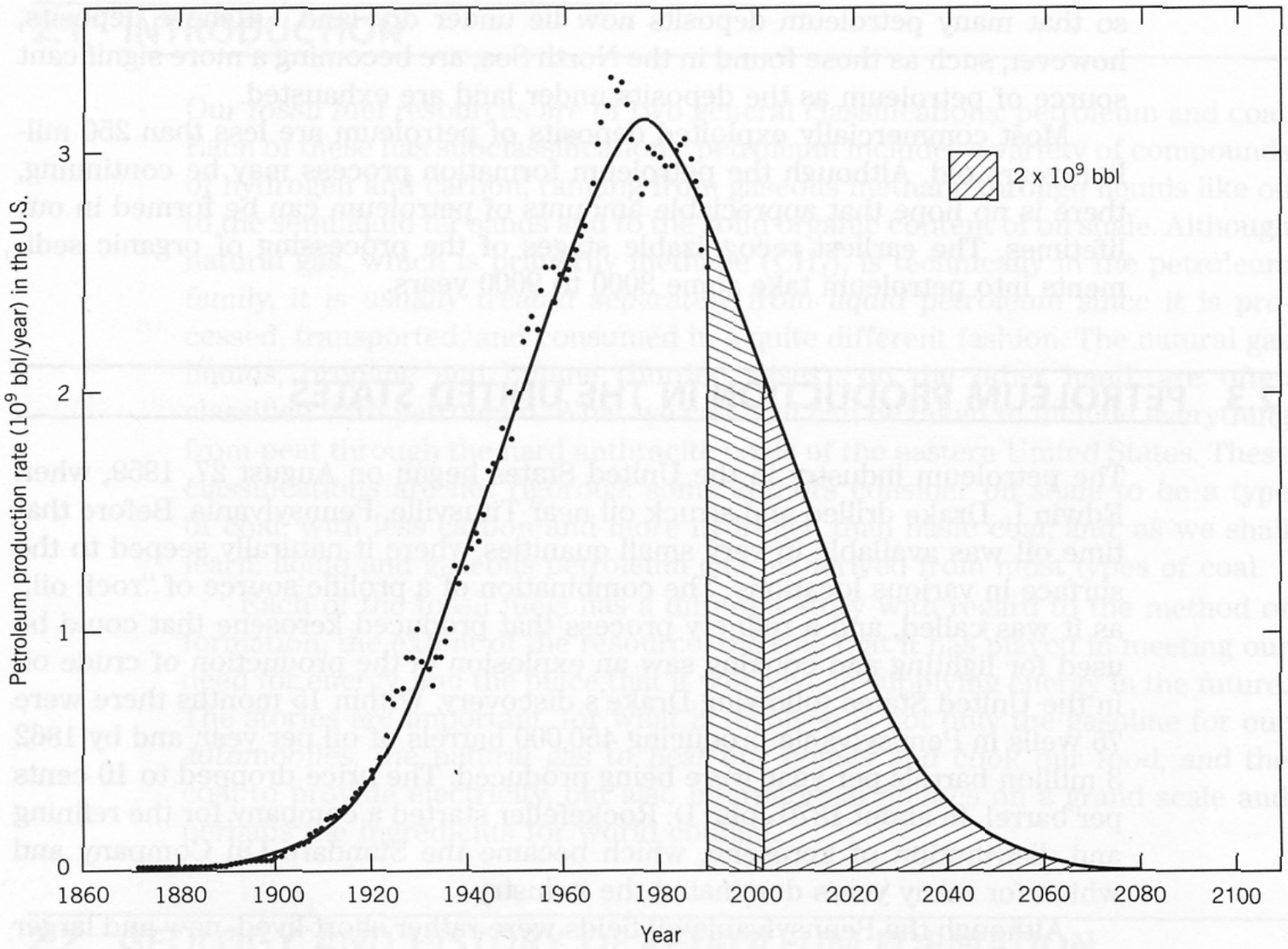
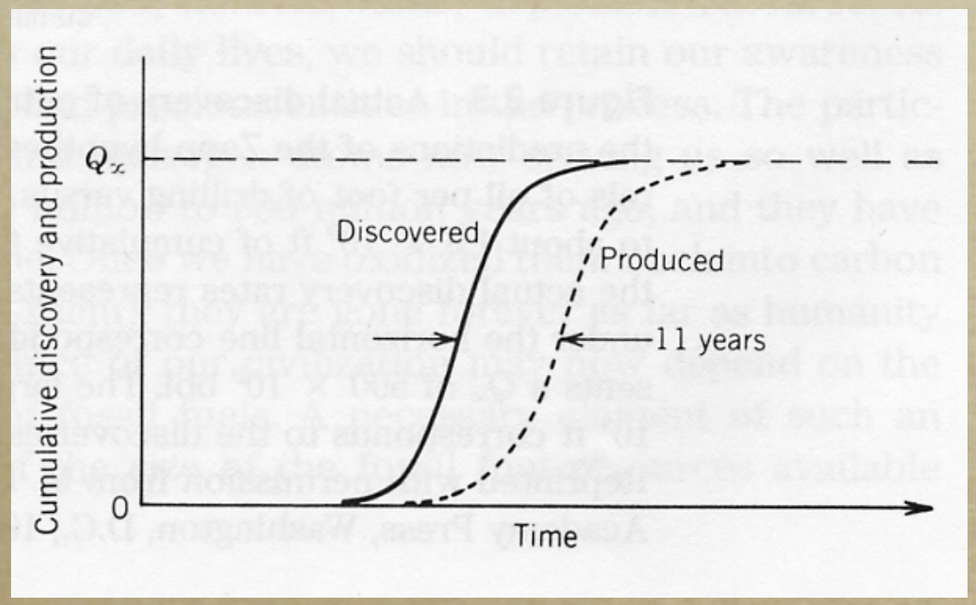


Figure 2.2 Petroleum production in the United States, including Alaska, since 1860. The smooth curve on the right side of the figure is drawn to reflect the shape of the actual production curve on the left. The significance of the shaded areas is discussed in Section 2.4 of the text. (Data from: *Basic Petroleum Data Book*, Vol. XII, Washington, D.C.: American Petroleum Institute, Jan. 1992.)

- *1 barrel = 42 gallons ≈ 1.7 MWh*
- *Daily U.S. oil consumption = 20 Mbbl; annual = 7.3 Gbbl/y*

Kraushaar & Ristinen, 1993

Production Lag



Discovery to production lag = 11 years

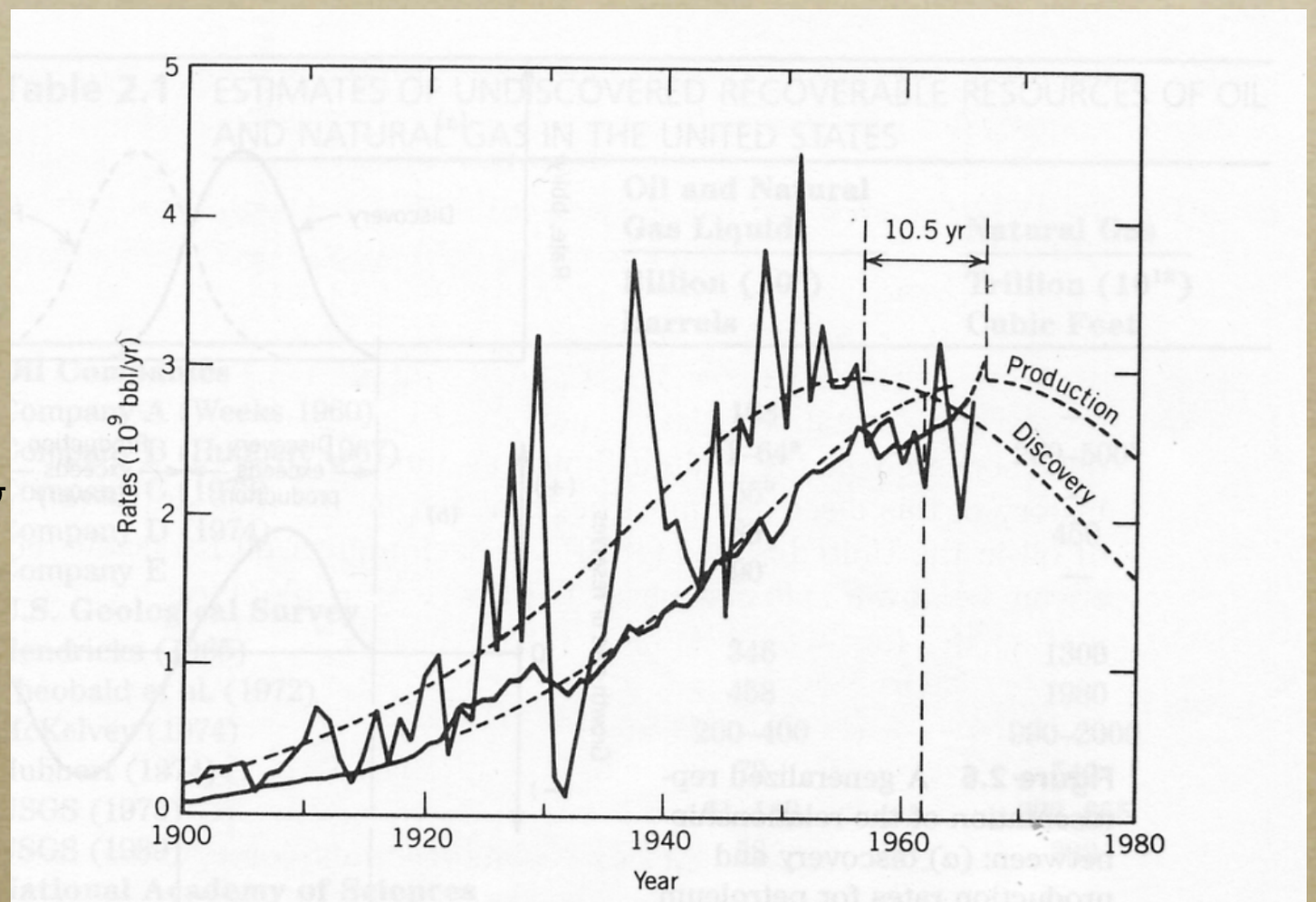
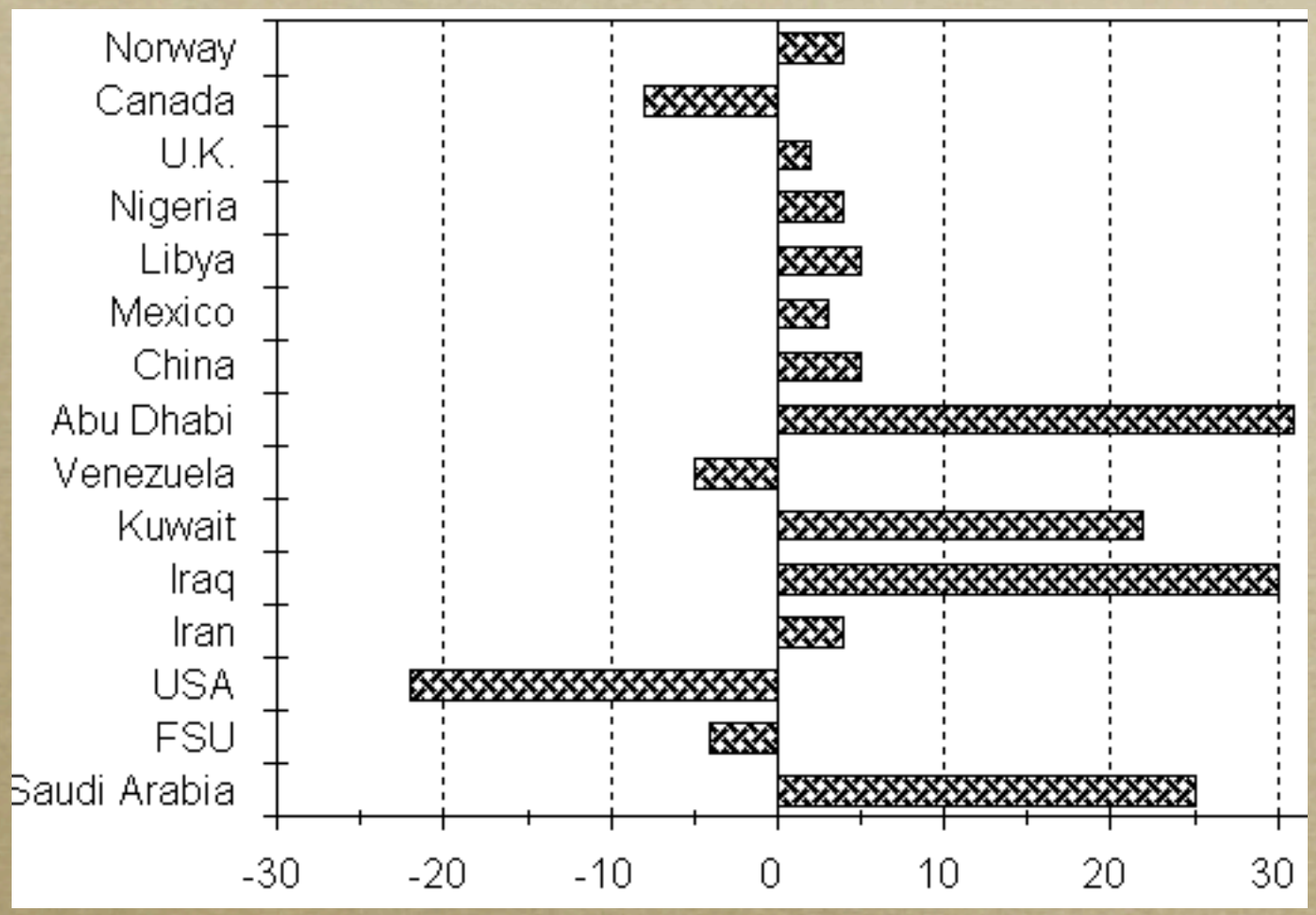


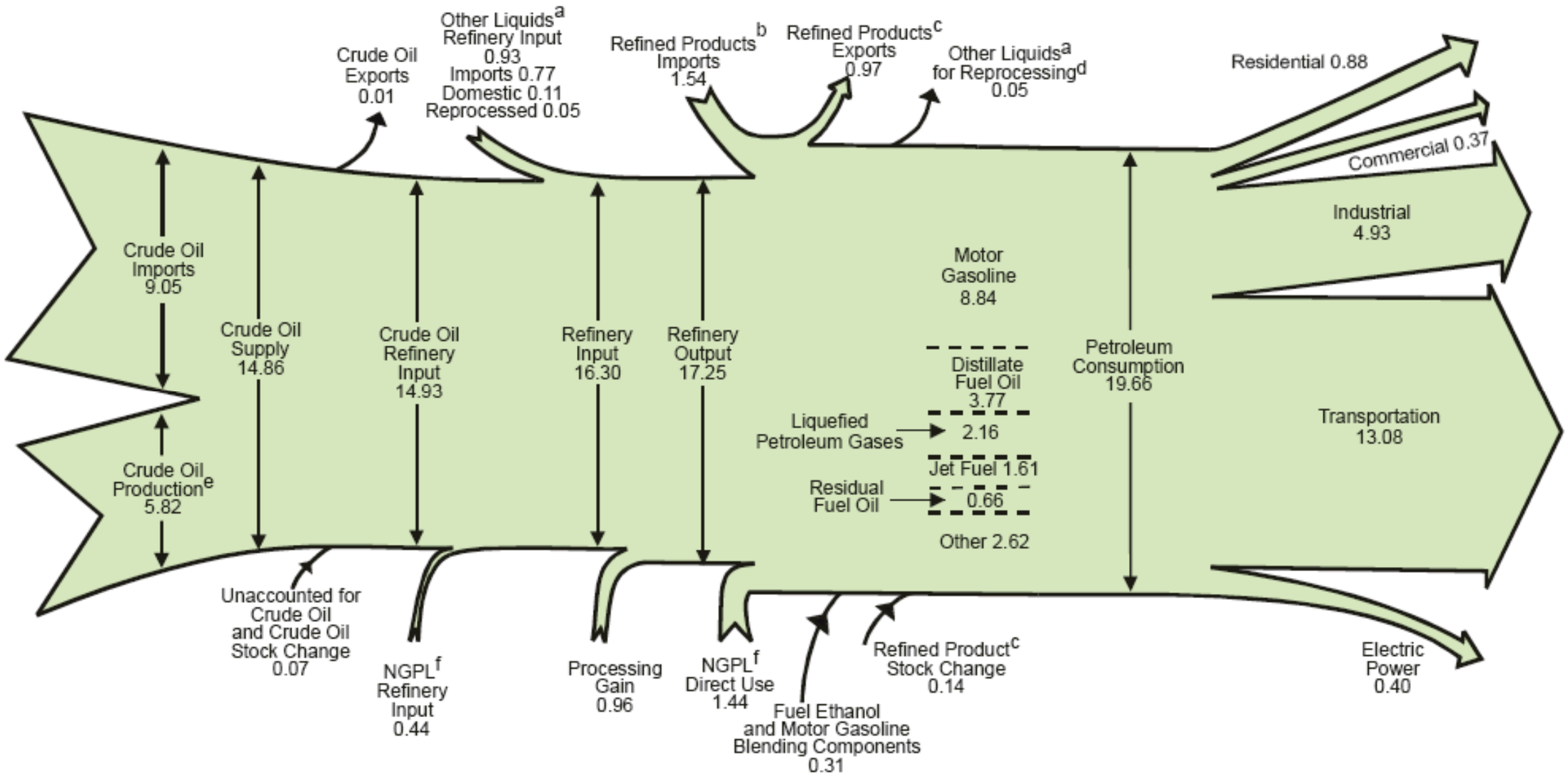
Figure 2.5 Actual discovery and production rates for oil in the United States are shown by solid lines. The smooth dashed lines represent average trends for these quantities. (Source: Reprinted with permission from M. K. Hubbert, *Resources and Man,* National Academy Press, Washington, D.C., 1969.)

Time to Production Midpoint



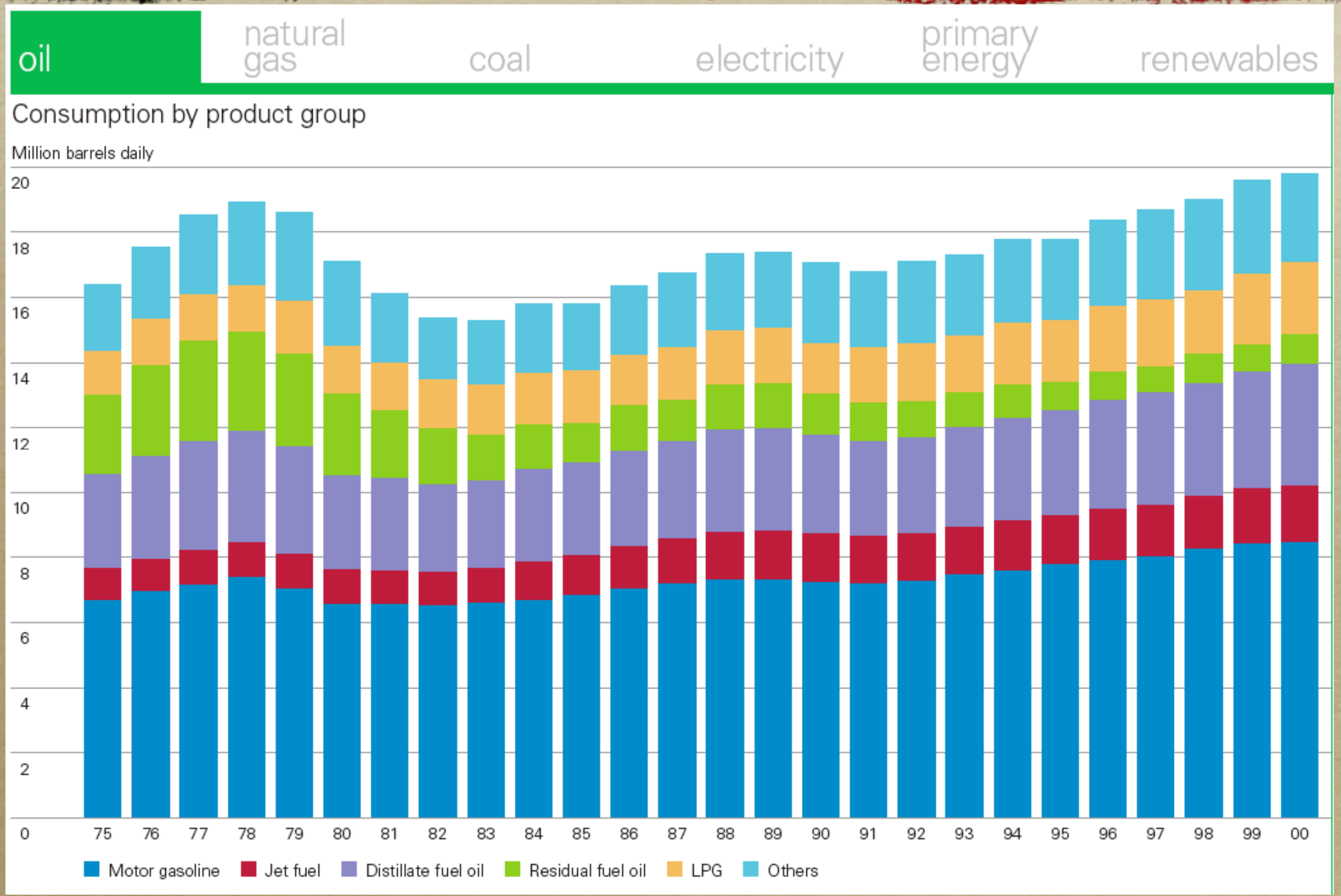
http://www.hubbertpeak.com/summary.htm

Diagram 2. Petroleum Flow, 2002
(Million Barrels per Day)

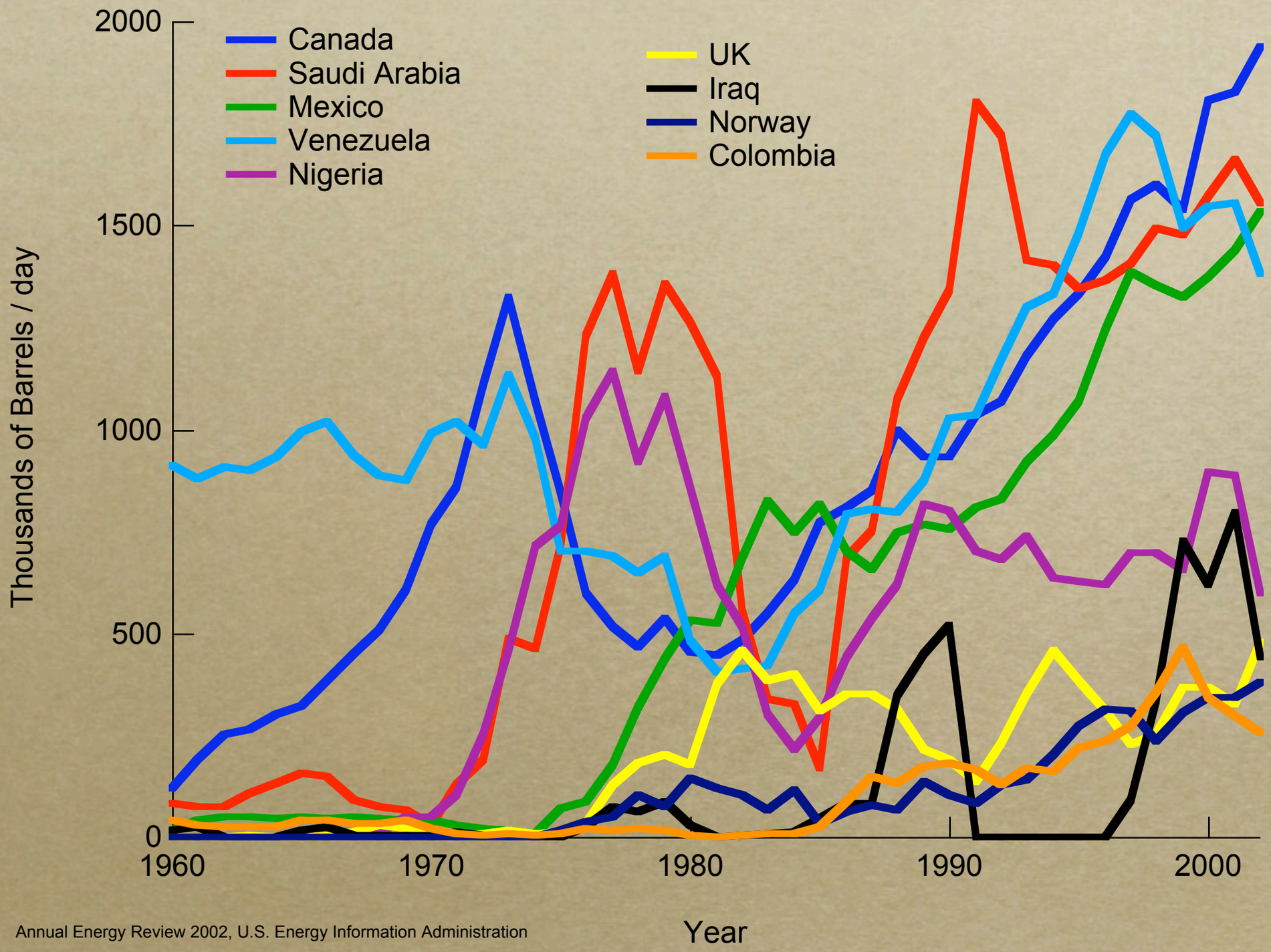


[a] Unfinished oils, motor gasoline blending components, aviation gasoline blending components, and other hydrocarbons and oxygenates.
[b] Finished petroleum products, liquefied petroleum gases, and pentanes plus.
[c] Finished petroleum products, liquefied petroleum gases, pentanes plus, and other liquids.
[d] Unfinished oils requiring further refinery processing, and aviation blending components.
[e] Includes lease condensate.
[f] Natural gas plant liquids.
Notes: • Data are preliminary. • Totals may not equal sum of components due to independent rounding.
Sources: Tables 5.1, 5.3, 5.5, 5.8, 5.11, 5.12a-5.12d, 5.14, and *Petroleum Supply Monthly*, February 2003, Table 3.

U.S. Oil Consumption

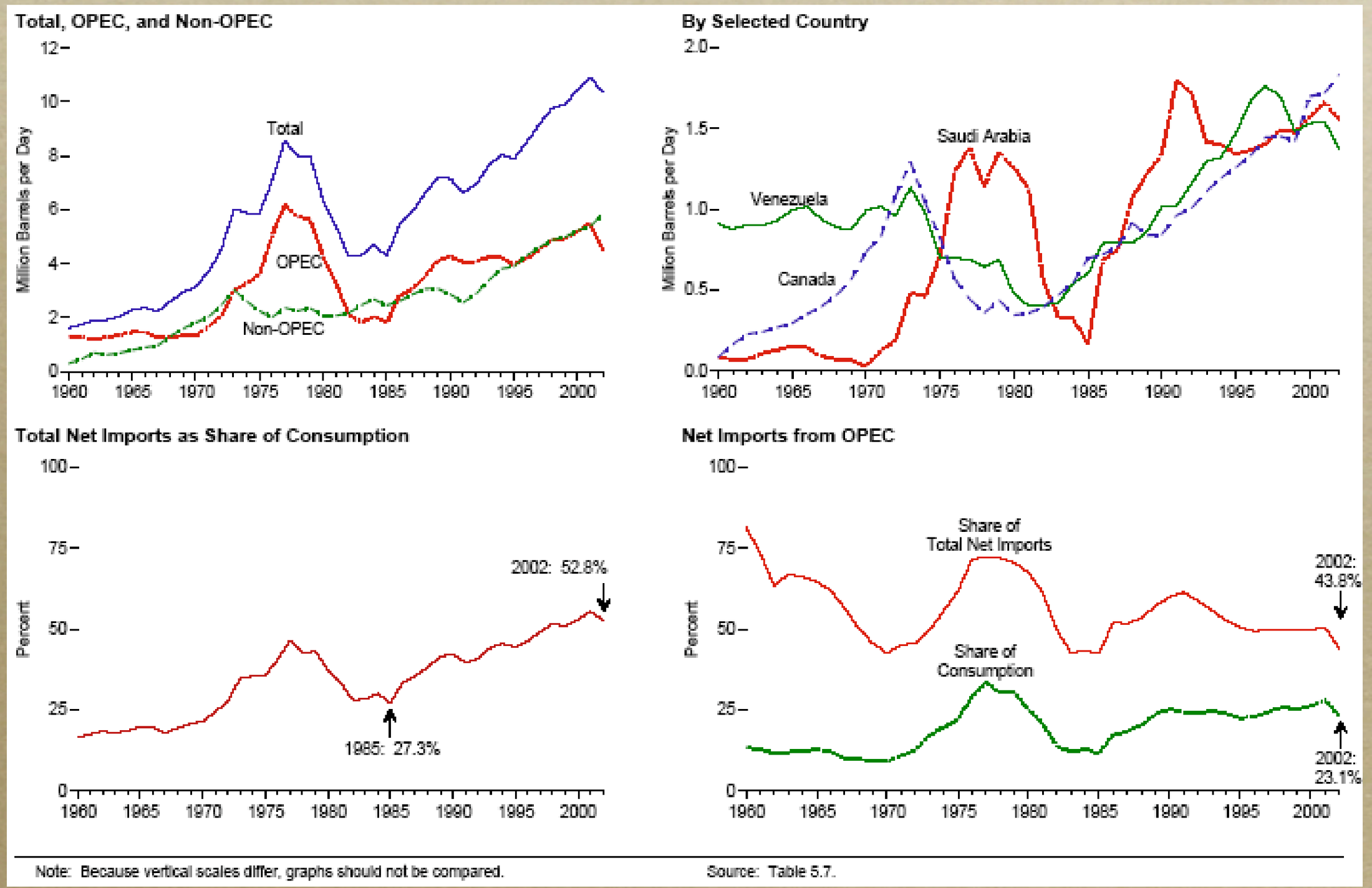


Sources of Imported Oil



Annual Energy Review 2002, U.S. Energy Information Administration

Net Petroleum Imports



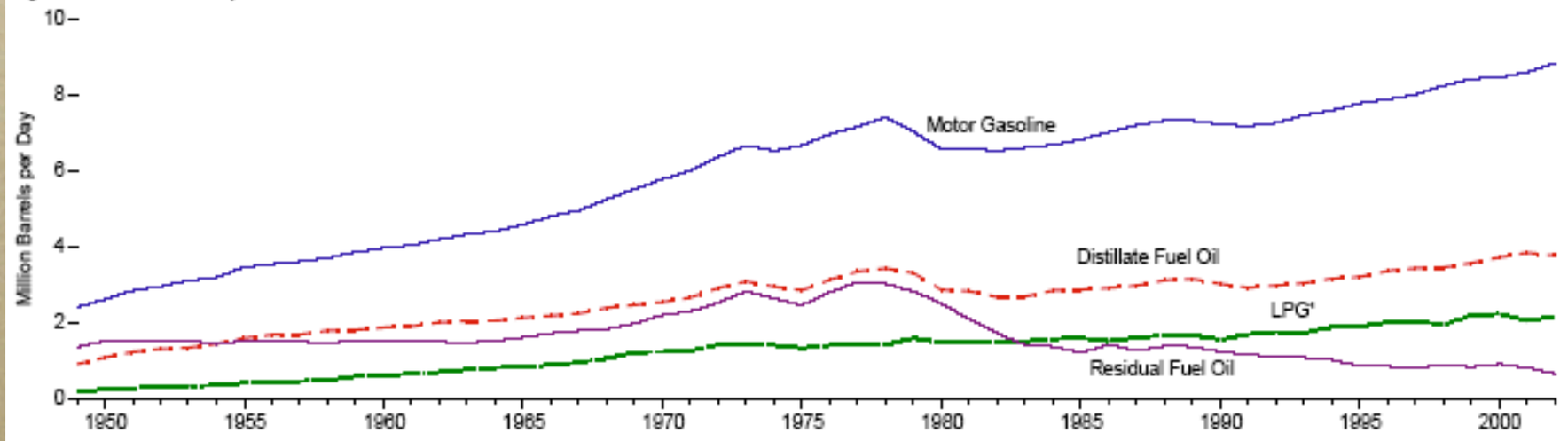
Note: Because vertical scales differ, graphs should not be compared.

Source: Table 5.7.

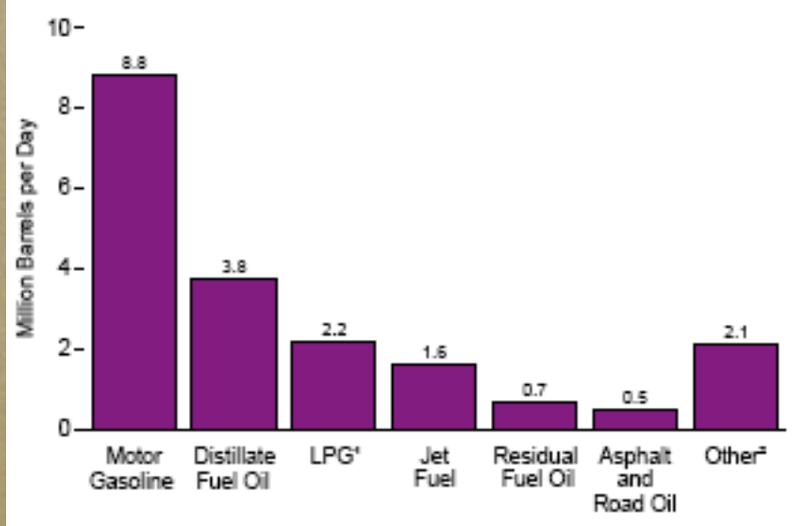
Mix of Petroleum Products

Figure 5.11 Petroleum Products Supplied by Type

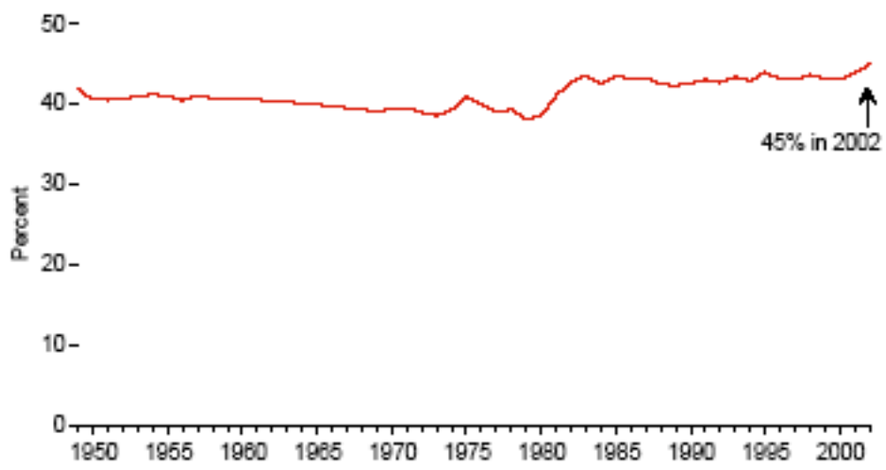
By Selected Product, 1949-2002



By Product, 2002



Motor Gasoline's Share of Total Petroleum Products Supplied, 1949-2002



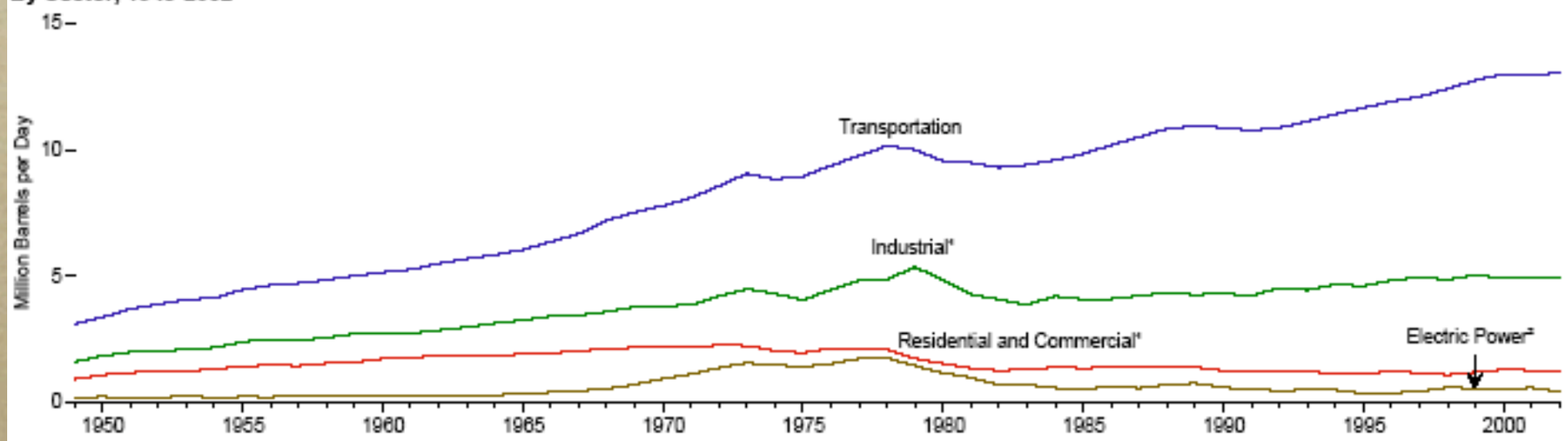
[1] Liquefied petroleum gases.
[2] Aviation gasoline, kerosene, lubricants, petroleum coke, still gas (refinery gas), petrochemical feedstocks, waxes, natural gasoline, pentanes plus, and miscellaneous products.

Source: 5.11.

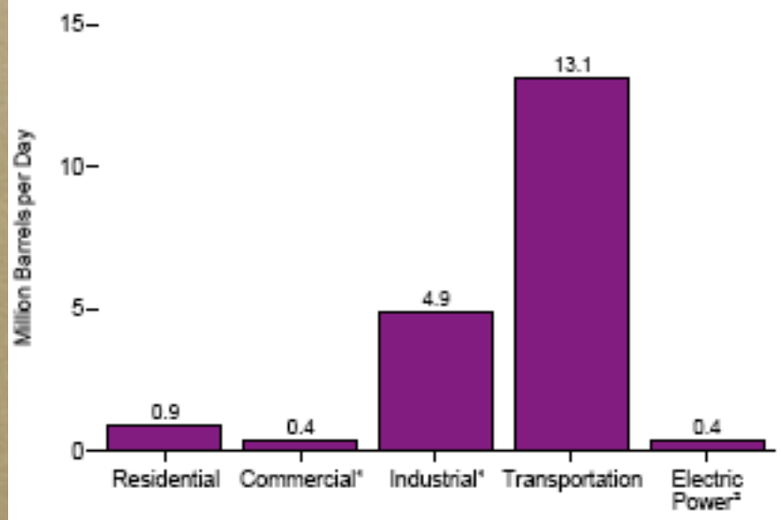
Consumption by Sector

Figure 5.12a Petroleum Consumption by Sector

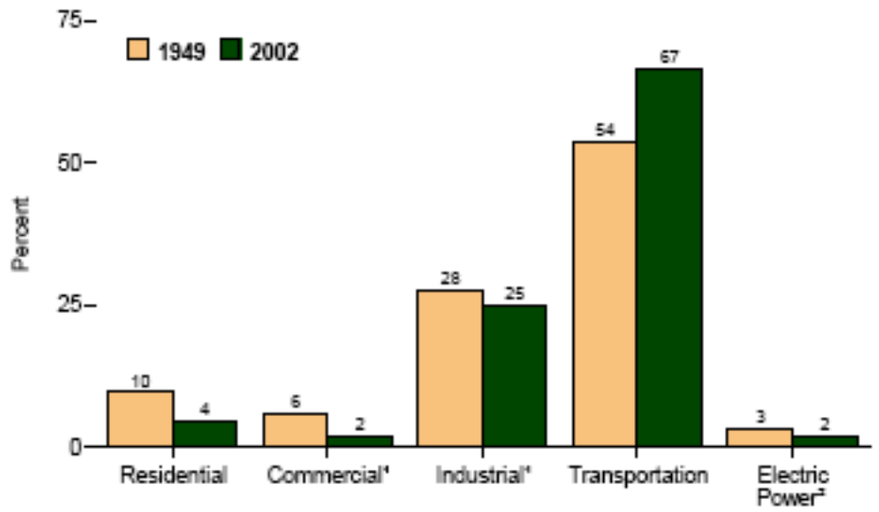
By Sector, 1949-2002



By Sector, 2002



End Use and Electric Power Shares, 1949 and 2002

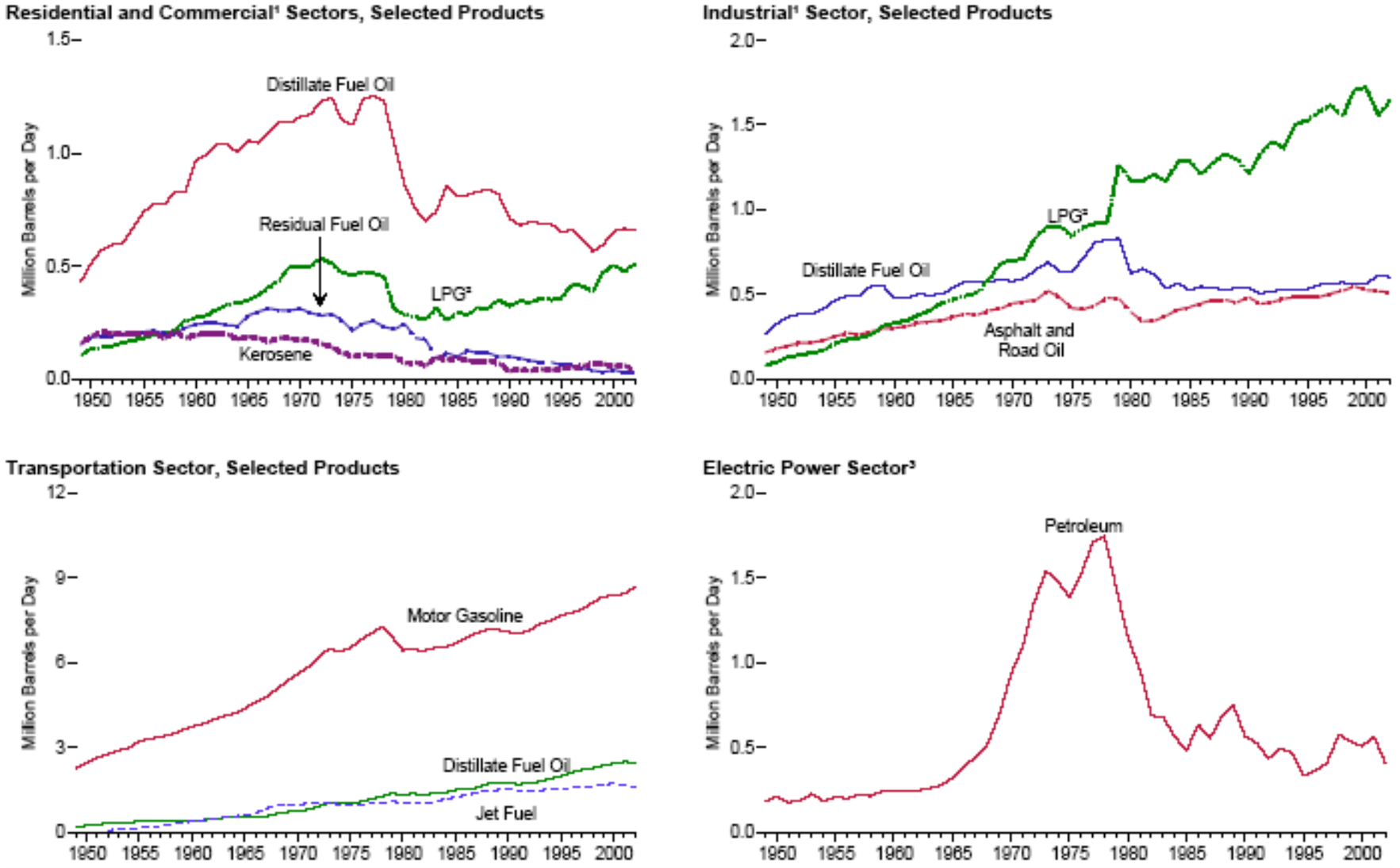


[1] Includes combined-heat-and-power plants and a small number of electricity-only plants.
[2] Electricity-only and combined-heat-and-power plants whose primary business is to sell electricity, or electricity and heat, to the public.

Note: See related Figure 5.12b.
Sources: Tables 5.12a–5.12d.

Consumption by Product/Sector

Figure 5.12b Petroleum Consumption by Product by Sector, 1949-2002

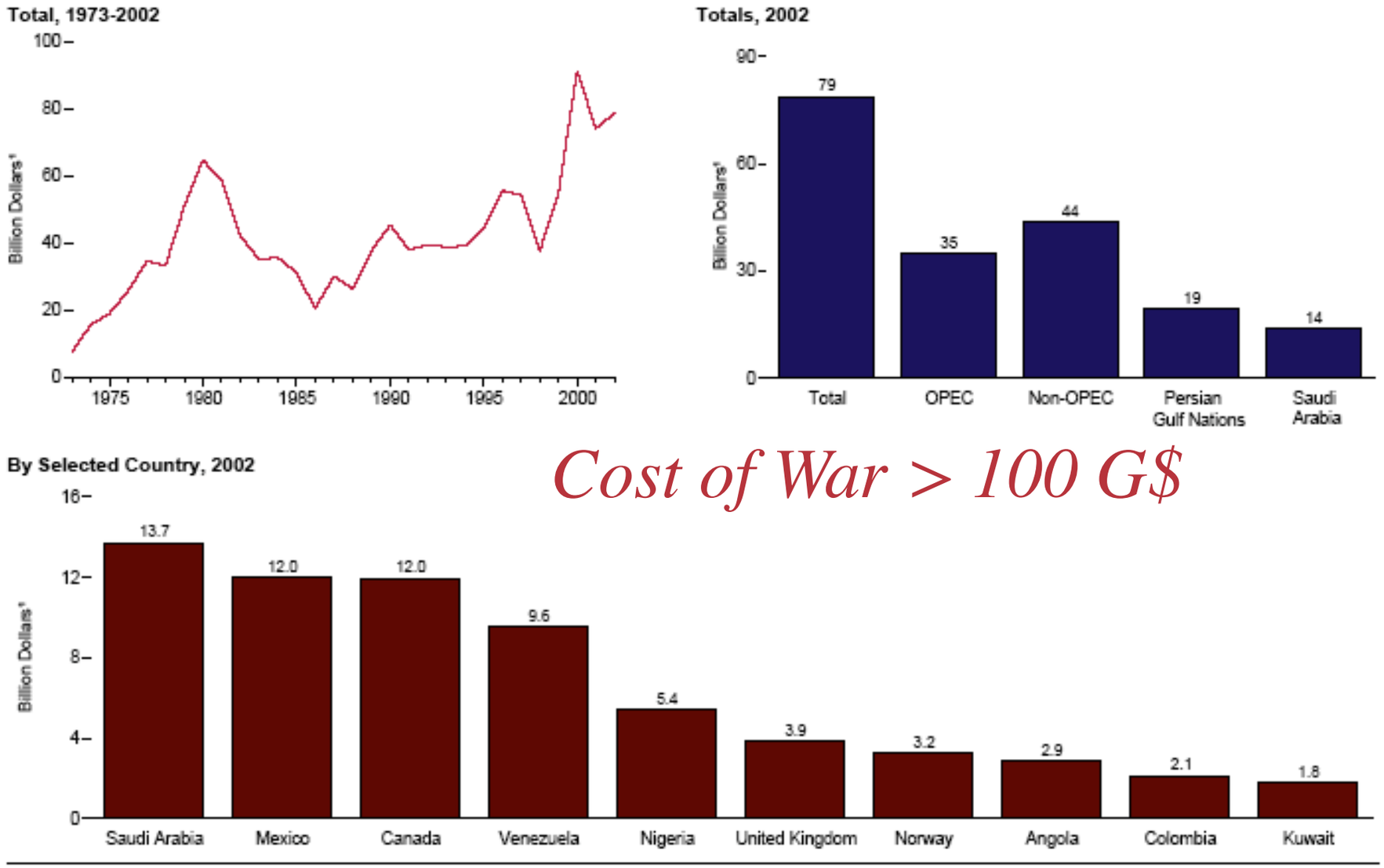


[1] Includes combined-heat-and-power plants and a small number of electricity-only plants.
[2] Liquefied petroleum gases.
[3] Electricity-only and combined-heat-and-power plants whose primary business is to sell electricity, or electricity and heat, to the public.

Notes: • See related Figure 5.12a. • Because vertical scales differ, graphs should not be compared.
Sources: Tables 5.12a–5.12d.

Value of Crude Oil Imports

Figure 5.18 Value of Crude Oil Imports



Cost of War > 100 G$

¹ Nominal dollars.

Notes: • OPEC=Organization of Petroleum Exporting Countries. • Because vertical scales differ, graphs should not be compared.

Source: Table 5.18.

Recent Headlines

February 24, 2004

Forecast of Rising Oil Demand Challenges Tired Saudi Fields
By JEFF GERTH

March 25, 2004

Say Bye-Bye to Cheap Oil

Surplus capacity is history. The jolts will start with $3 gas pump prices.

Paul Roberts, Los Angeles Times

April 4, 2004

Imagining a $7-a-Gallon Future

By DANIEL YERGIN

An Oil Enigma: Production Falls Even as Reserves Rise

June 12, 2004
By ALEX BERENSON