

Natural Gas in the United States

A brief overview of natural gas production, transportation, and consumption in the United States.

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Background: key energy units

- British Thermal Unit (Btu)
 - ⇒ *1 Btu = 1 match tip*
 - ⇒ *1 peanut butter sandwich = 1,250 Btu*
 - ⇒ *1 million Btu (10^6) = 8 gal gasoline*
 - ⇒ *1 barrel of oil = 5.80 MBtu*
- Quadrillion BTU (Quad)
 - ⇒ *10^{15} Btu*
 - ⇒ *45 million tons of coal (3.7 sq mi, 10 ft high)*
 - ⇒ *170 million barrels of crude oil*
 - ⇒ *Annual US consumption is about 100 quads*
 - ⇒ *Annual world consumption is about 400 quads*
 - ⇒ *About 1 quad every 22 hours*

Energy units, continued

- Joule
 - ⇒ *Metric unit of energy*
 - ⇒ *Roughly 1/1000 of a Btu*
- Exajoule (EJ)
 - ⇒ $10^{18} J$
 - ⇒ *1 EJ is about equal to 1 quad*
- Kilowatt hour (kWh)
 - ⇒ *Electricity rather than heat*
 - ⇒ *100% efficient conversion, 3412 Btu per kWh*
 - ⇒ *Actual conversion efficiency roughly 33%*
 - ⇒ *Approx 10,000 Btu of fossil fuel per 1 kWh*
 - ⇒ $1 \text{ GWyr} = 1 \text{ GW for } 8,760 \text{ hr/yr} = 8.76 \times 10^6 \text{ kWh}$

Energy units, continued

- Weight or mass
 - 2000 lb = 1 US ton
 - 1000 kg = 1 metric ton (tonne)
- Energy conversions
 - 1 Btu = 1055.06 J
 - 1 kWh = 3.6×10^6 J
 - 1 kWh = 3412 Btu
 - 1 quad = 1.055 EJ
 - 1 quad primary energy = 11 GWyr
- Metric prefixes
 - Mega (M), million, 10^6
 - Giga (G), billion, 10^9
 - Tera (T), trillion, 10^{12}
 - Peta (P), quadrillion, 10^{15}
 - Exa (E), quintillion, 10^{18}

Basic facts

- Primarily methane, CH₄
- Sources
 - ⇒ *Gas fields*
 - ⇒ *Associated gas from oil fields*
 - ⇒ *Landfills, agriculture*
- Transportation and storage
 - ⇒ *Pipelines*
 - ⇒ *Liquefied natural gas (LNG) tankers*
 - Four onshore terminals in US: GA, MD, MA, LA
 - One offshore in GOM
 - One in PR
 - ⇒ *Compressed natural gas (CNG)*

Basic facts, continued

- Significant greenhouse gas
 - ⇒ *Atmospheric lifetime 12 years*
 - ⇒ *Per unit, 23x the impact of CO₂*
 - ⇒ *However, much less emitted: 9% of overall effect*

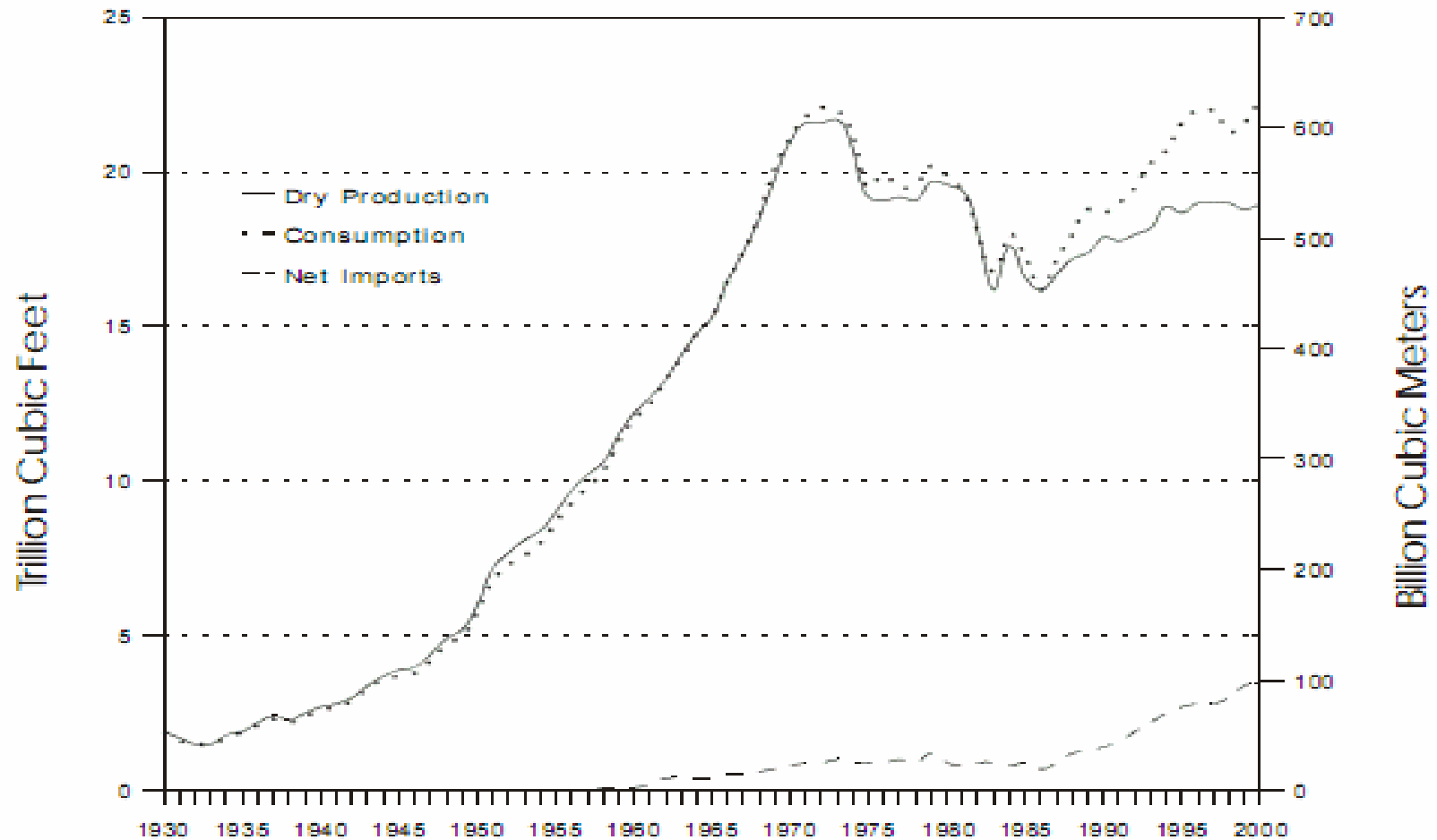
Units and energy content of gas

- Units of mass and volume
 - ⇒ *ft³ in US*
 - ⇒ *m³ in metric*
 - ⇒ *1 mcf is 10³ ft³*
 - ⇒ *Tcf = 10¹² ft³*
- Energy content
 - ⇒ *1 ft³ produces about 1000 BTU*
 - ⇒ *1 mcf = 1 million BTU, approx 1 GJ*
 - ⇒ *1 therm = 100,000 BTU*

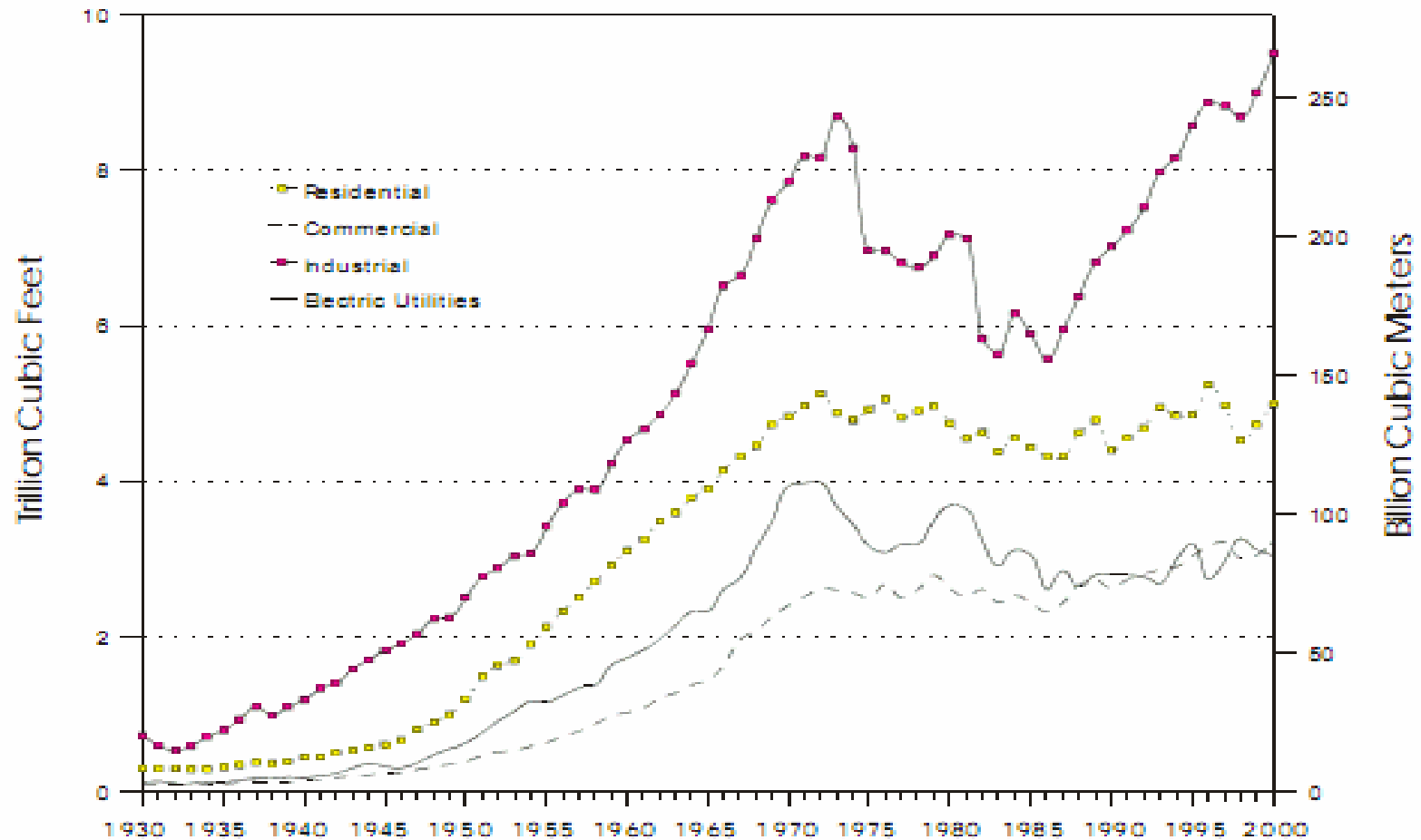
Supply and disposition

- See handout

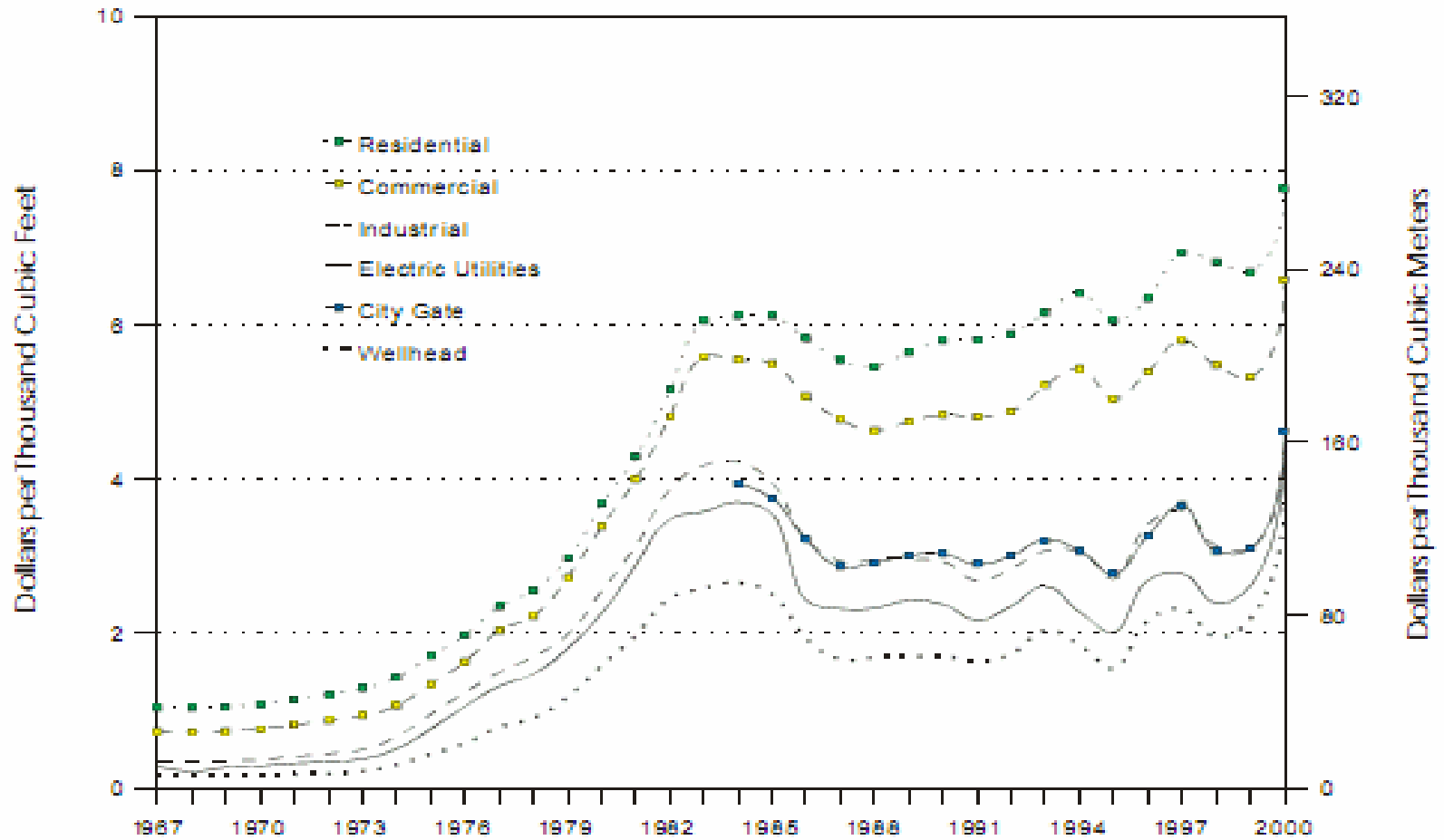
Historical production and consumption



Natural gas consumption



Gas prices



Regional production and consumption

- See handouts.

Market issues and history

- Concerns regarding residential heating supplies
- Take-or-pay contracts
- Futures trading
- Enron

Regulation

- Aspects
 - ⇒ *Wellhead*
 - ⇒ *Imports and exports*
 - ⇒ *Pipeline*
 - ⇒ *Retail or local distribution*
- Authorities:
 - ⇒ *DOE*
Imports and exports (mostly promotion)
 - ⇒ *Federal Energy Regulatory Commission (FERC)*
Interstate pipelines
 - ⇒ *Public Utility Commissions (PUCs)*

Evolution of regulation

- See handout.
- Wellhead deregulation in 1978
- Pipeline deregulation 1984-1992
- Retail unbundling occurring now at the state level
 - ⇒ *Gas supply*
 - ⇒ *Delivery*

Useful references

- US Energy Information Administration
 - ⇒ Annual Energy Review
 - ⇒ www.eia.doe.gov
- US Department of Energy, Office of Fossil Energy
 - ⇒ www.fossil.energy.gov
- NaturalGas.org
 - ⇒ www.naturalgas.org
- American Physical Society
 - ⇒ Energy Units.
 - ⇒ www.aps.org
- Wikipedia
 - ⇒ Natural gas