

SuperGrid 2 Conference

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Big Ways to Decarbonize the Energy System

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Bankside Power Station, London

Opened for power generation in 1953, became Tate Gallery in 2000

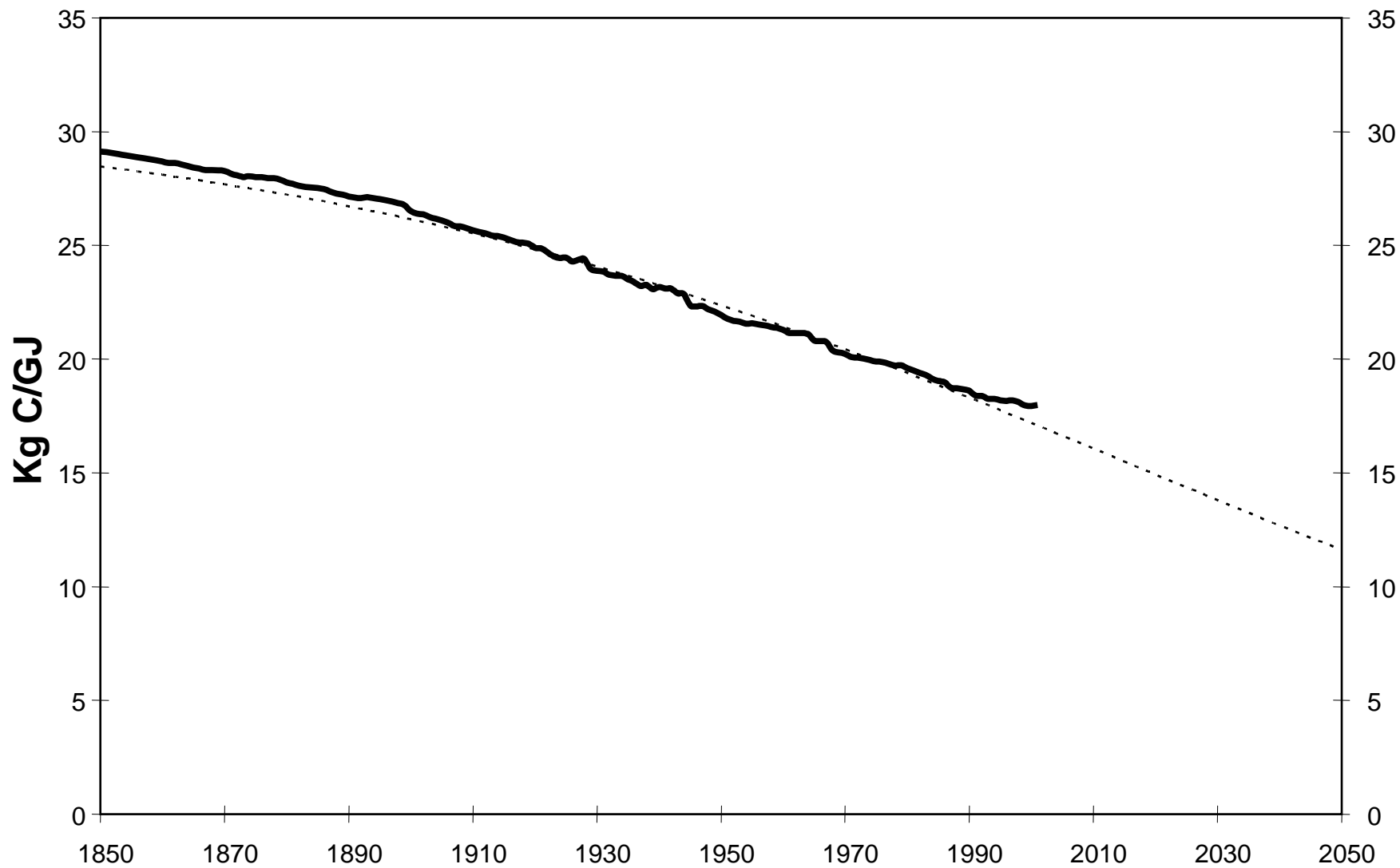
100m tall



**“Footprint”
covers 3.5
hectares**

**Comparably powerful plant built today
could fit in 1/10th the space**

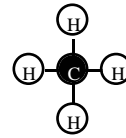
Falling Global Carbon Intensity of Primary Energy



Data sources: IIASA, BP (1965-2001), CDIAC http://cdiac.esd.ornl.gov/trends/emis/em_cont.htm

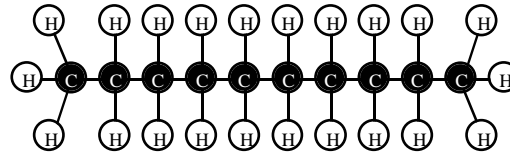
Carbon-Hydrogen Composition of Fossil Fuels

Methane Gas



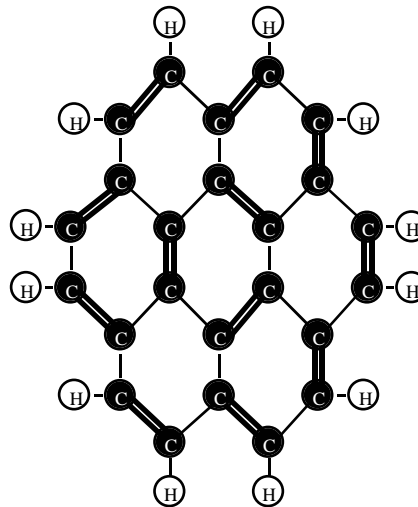
C:H = 1:4

Typical Oil



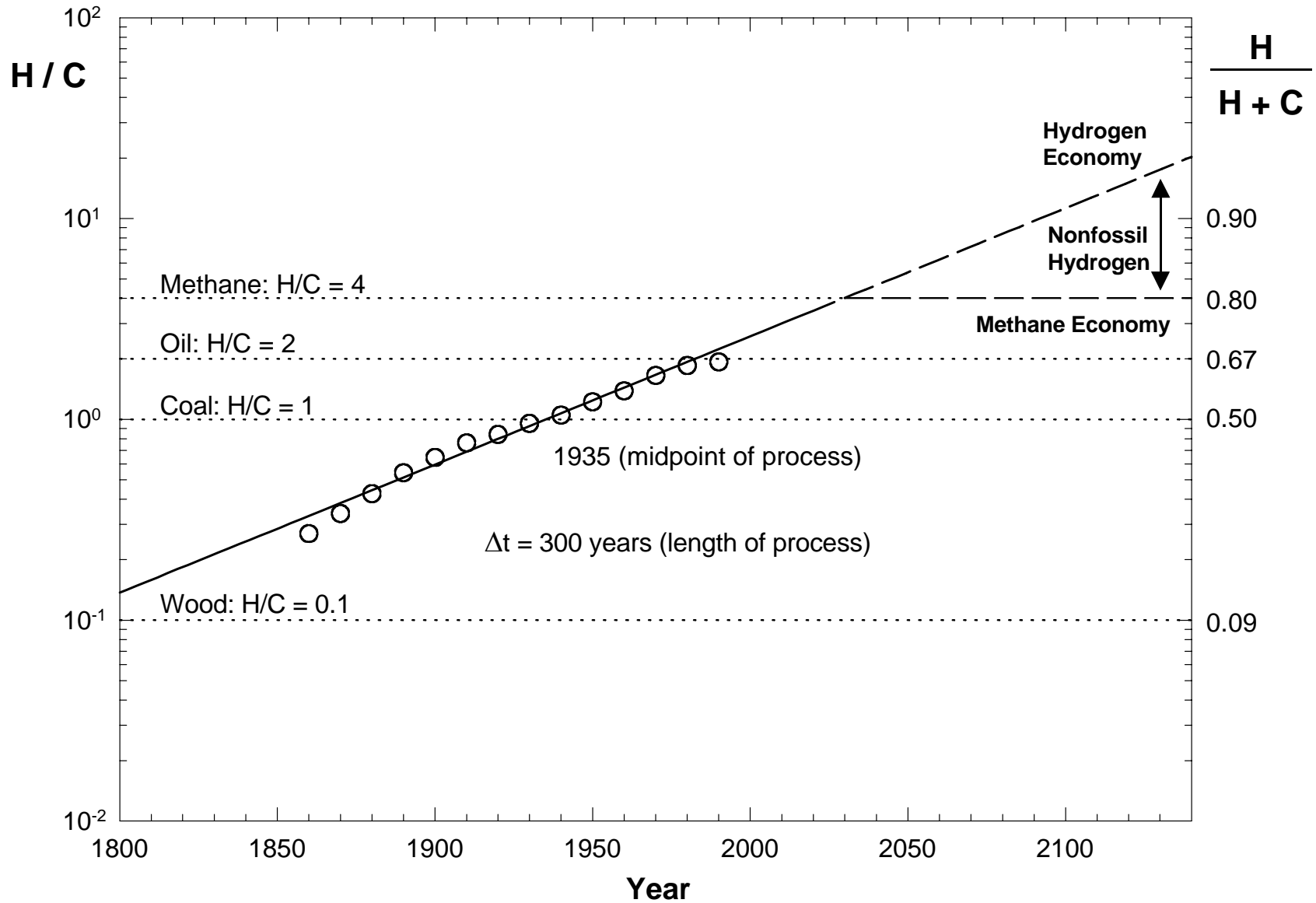
C:H = 1:2

Typical Coal



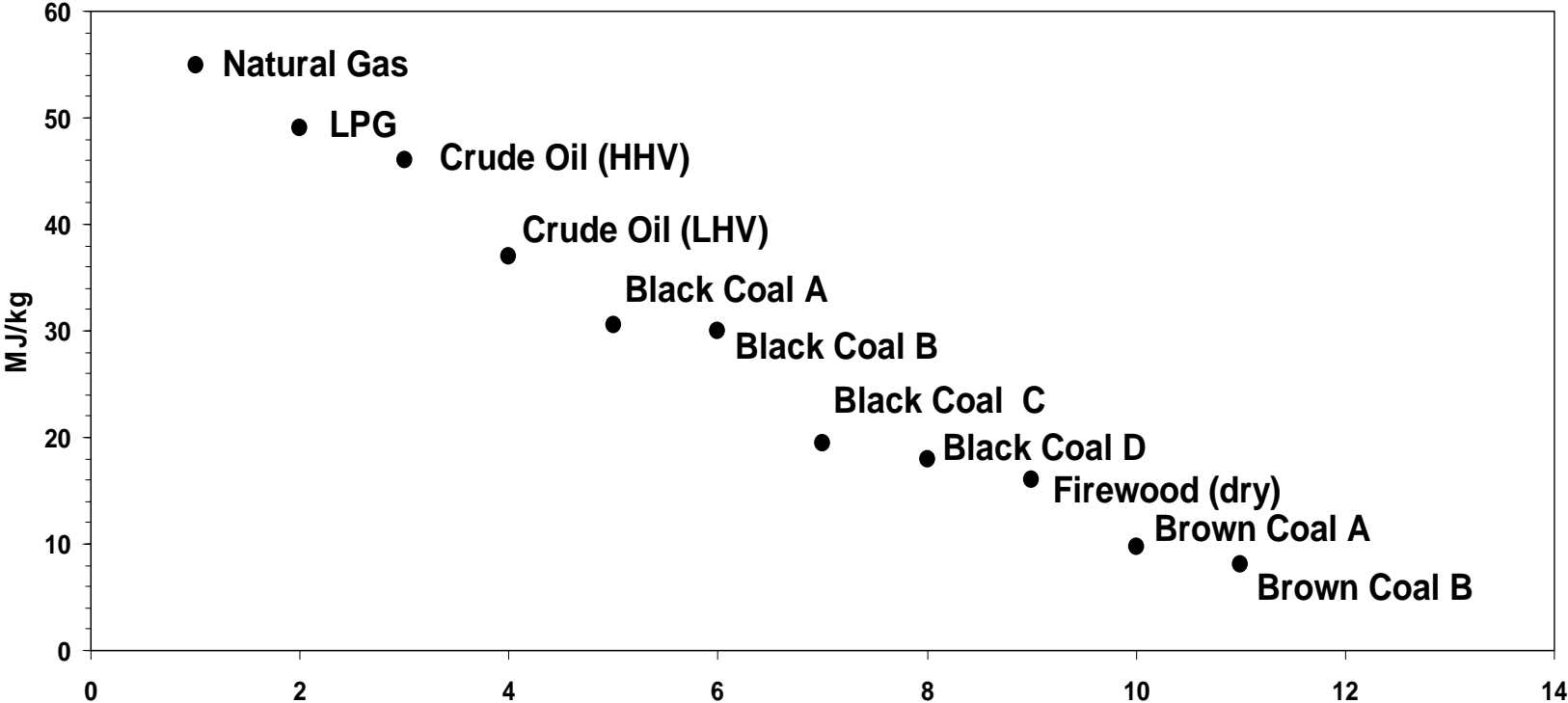
C:H = 2:1

Decarbonization: Evolution of the Ratio of Hydrogen (H) to Carbon (C) in the World Primary Fuel Mix



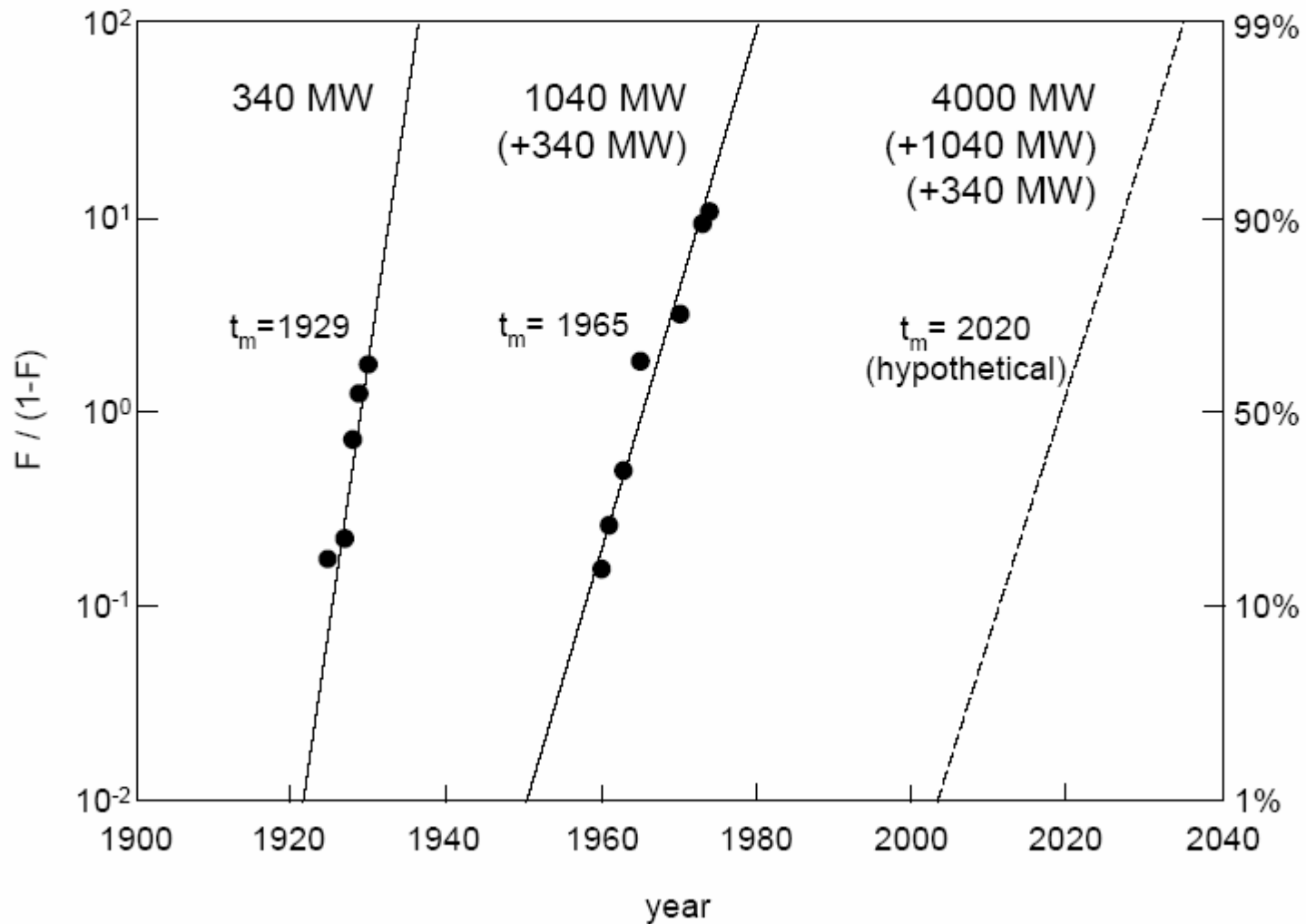
Source: Ausubel, 1996, after Marchetti, 1985

Hydrocarbon fuels ranked by heat value



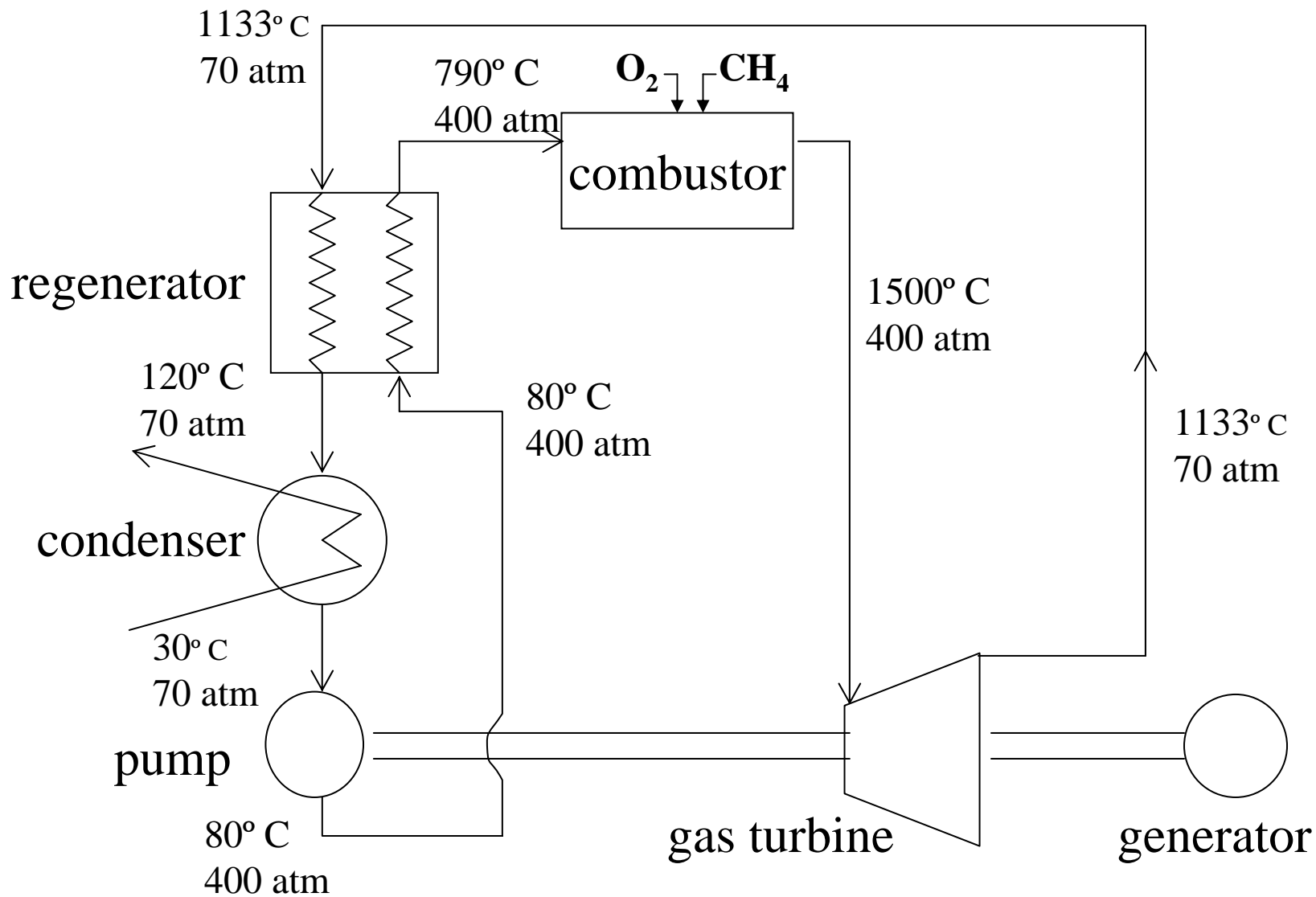
Source: N. Victor & J. Ausubel, 2003

Growth pulses of maximum size of power plants



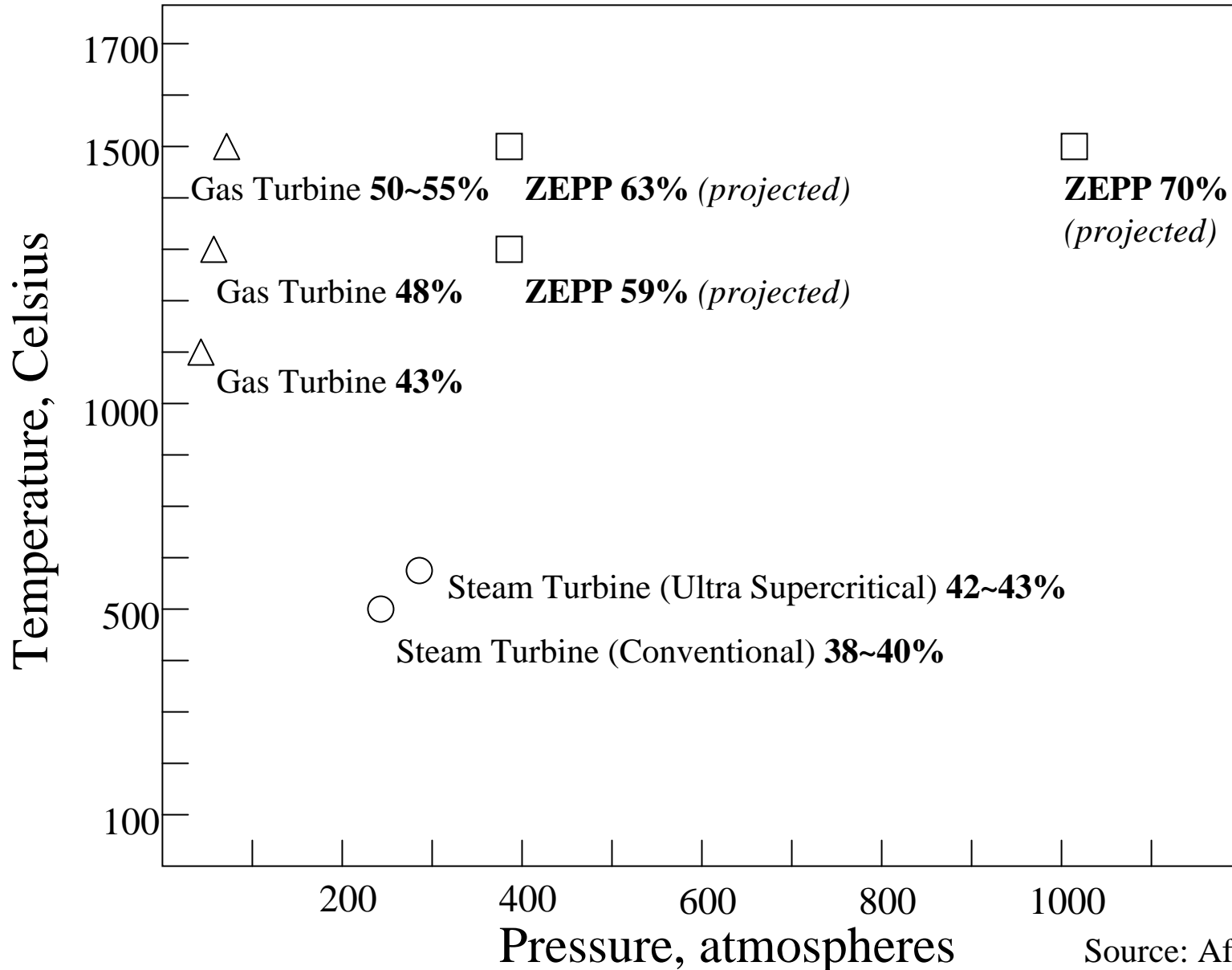
Source: Ausubel, 2001

Basic ZEPP configuration, 400 atm case

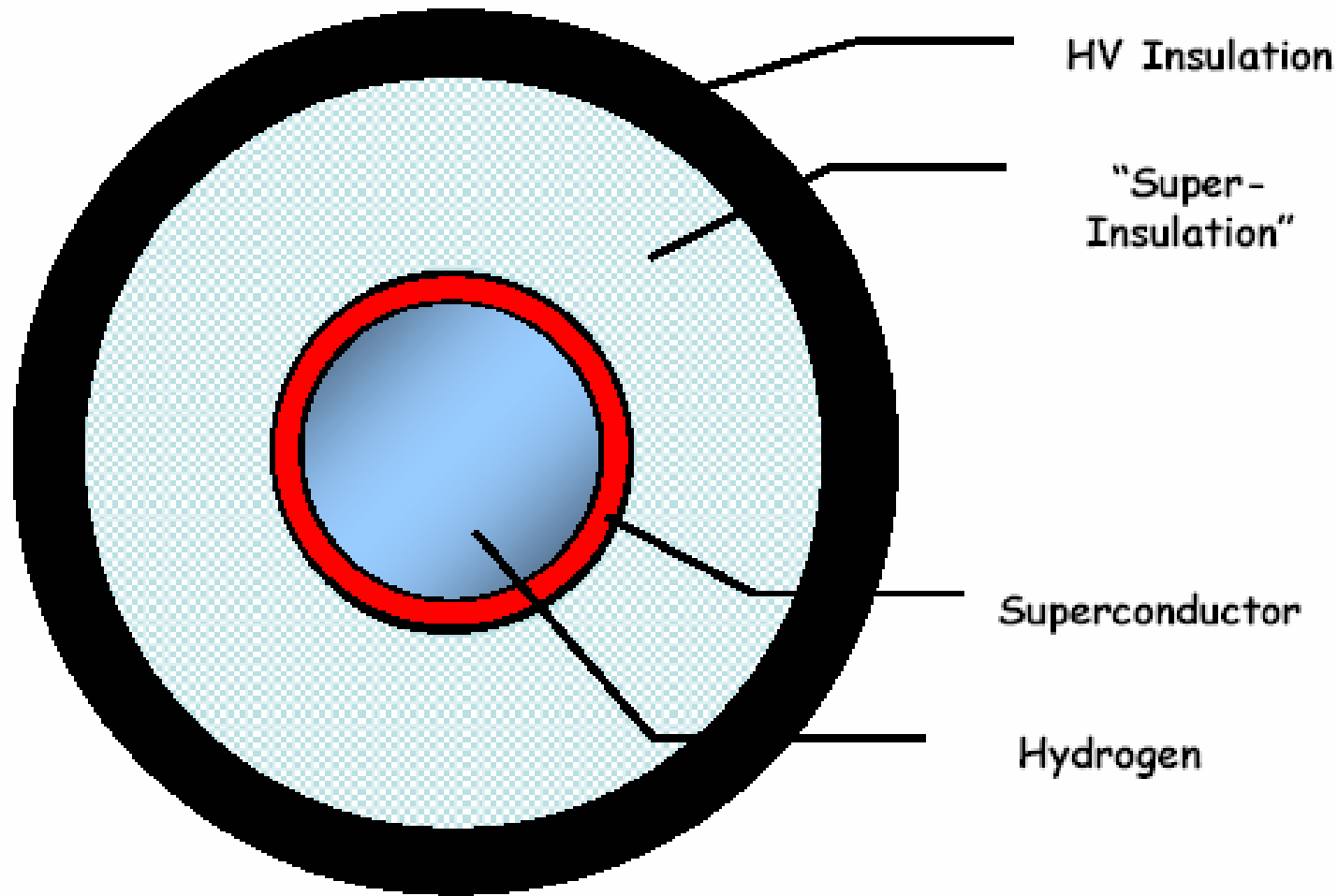


Efficiency increases with higher pressure and temperature.

Power Generation Efficiencies for Power Plants

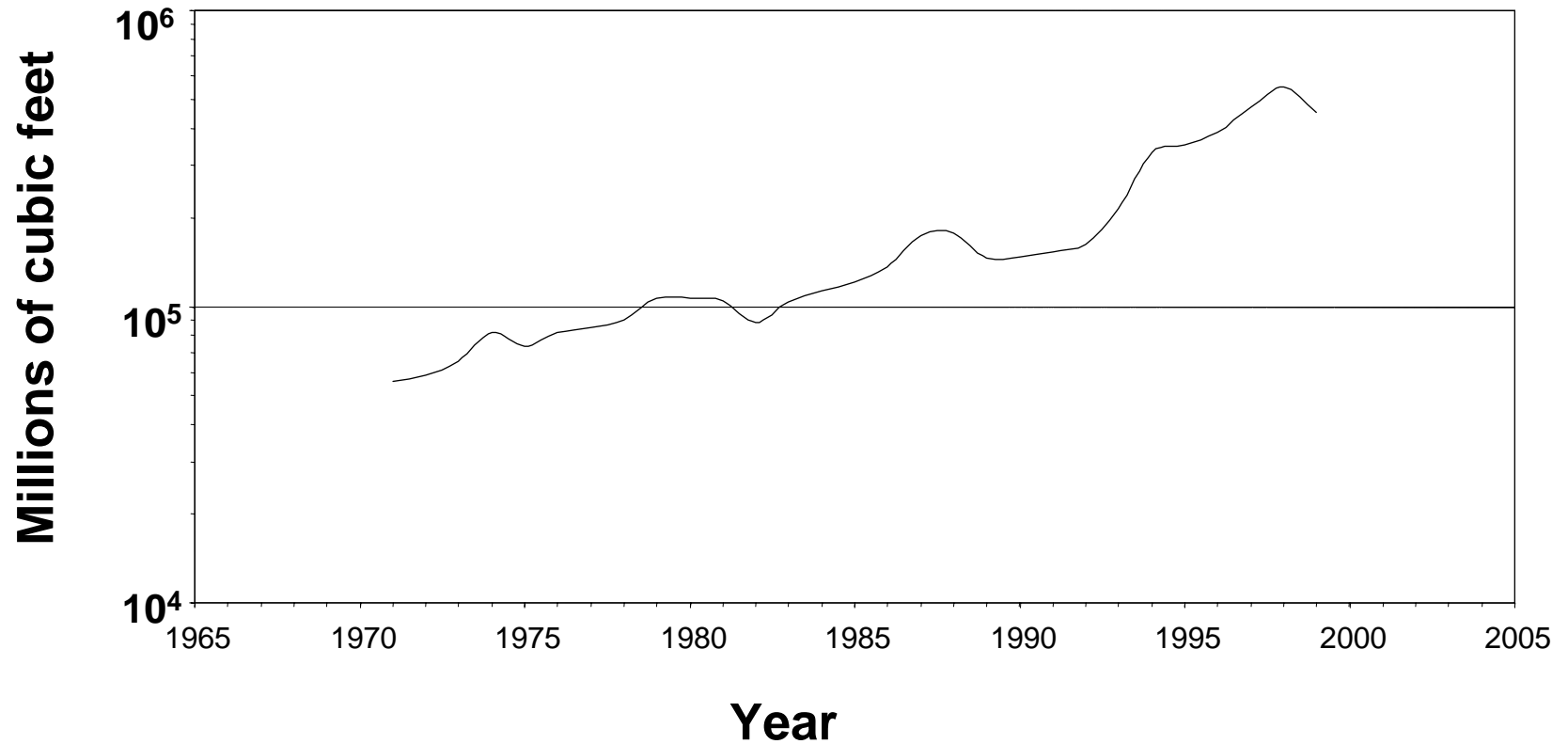


SuperCable Cross-Section

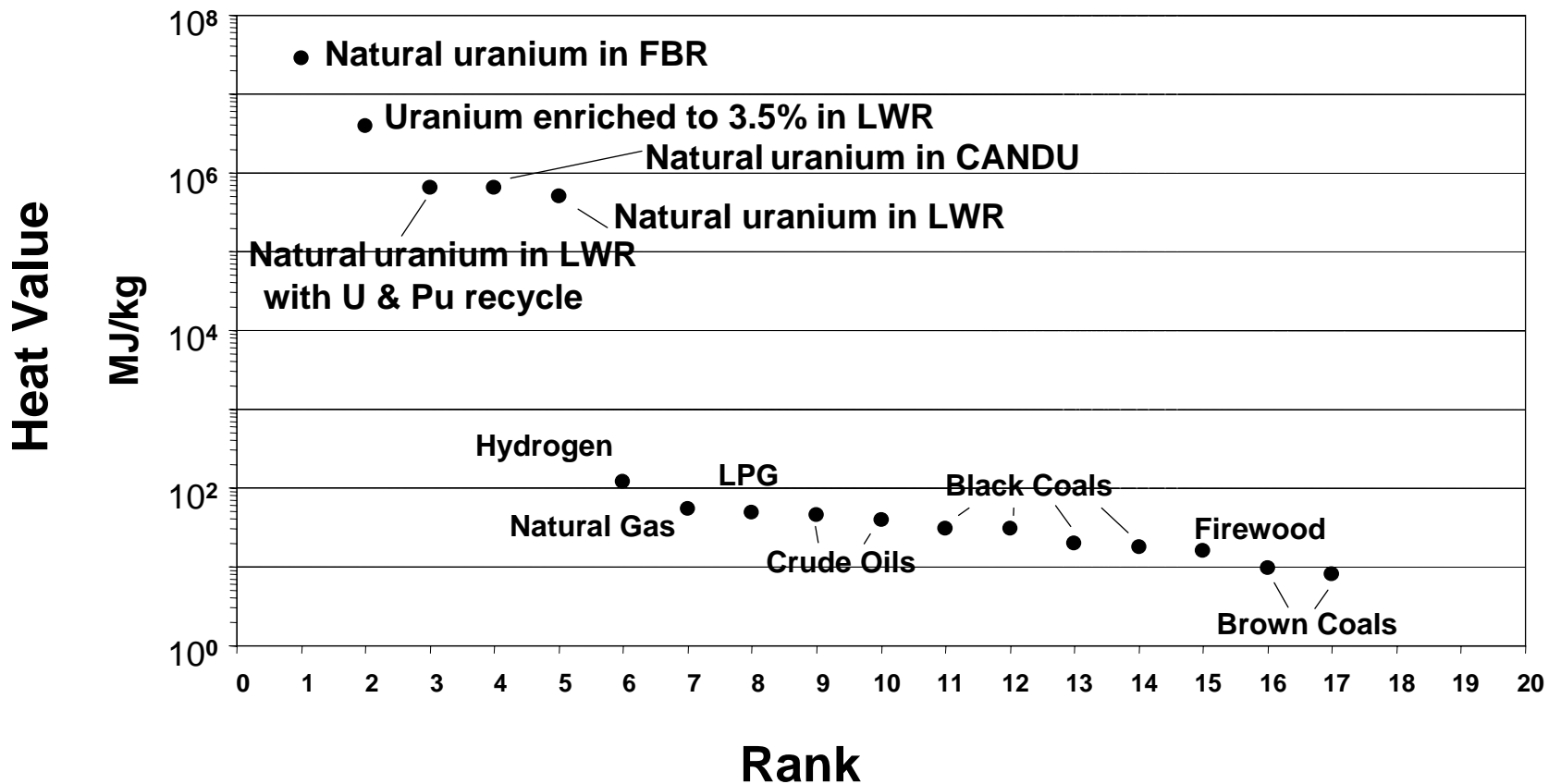


USA: Hydrogen production, 1971-1999

semi-log scale

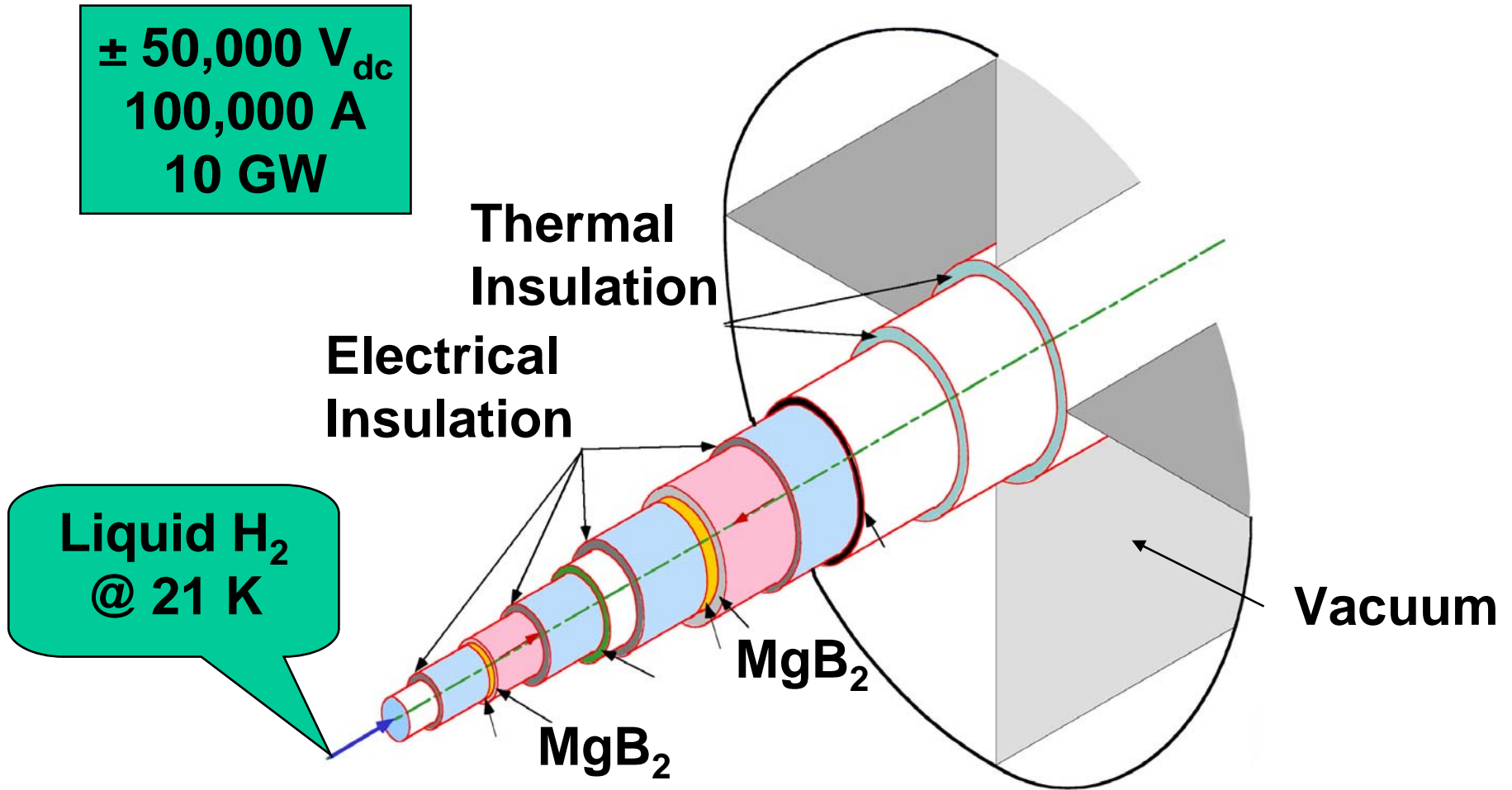


Major fuels ranked by heat value

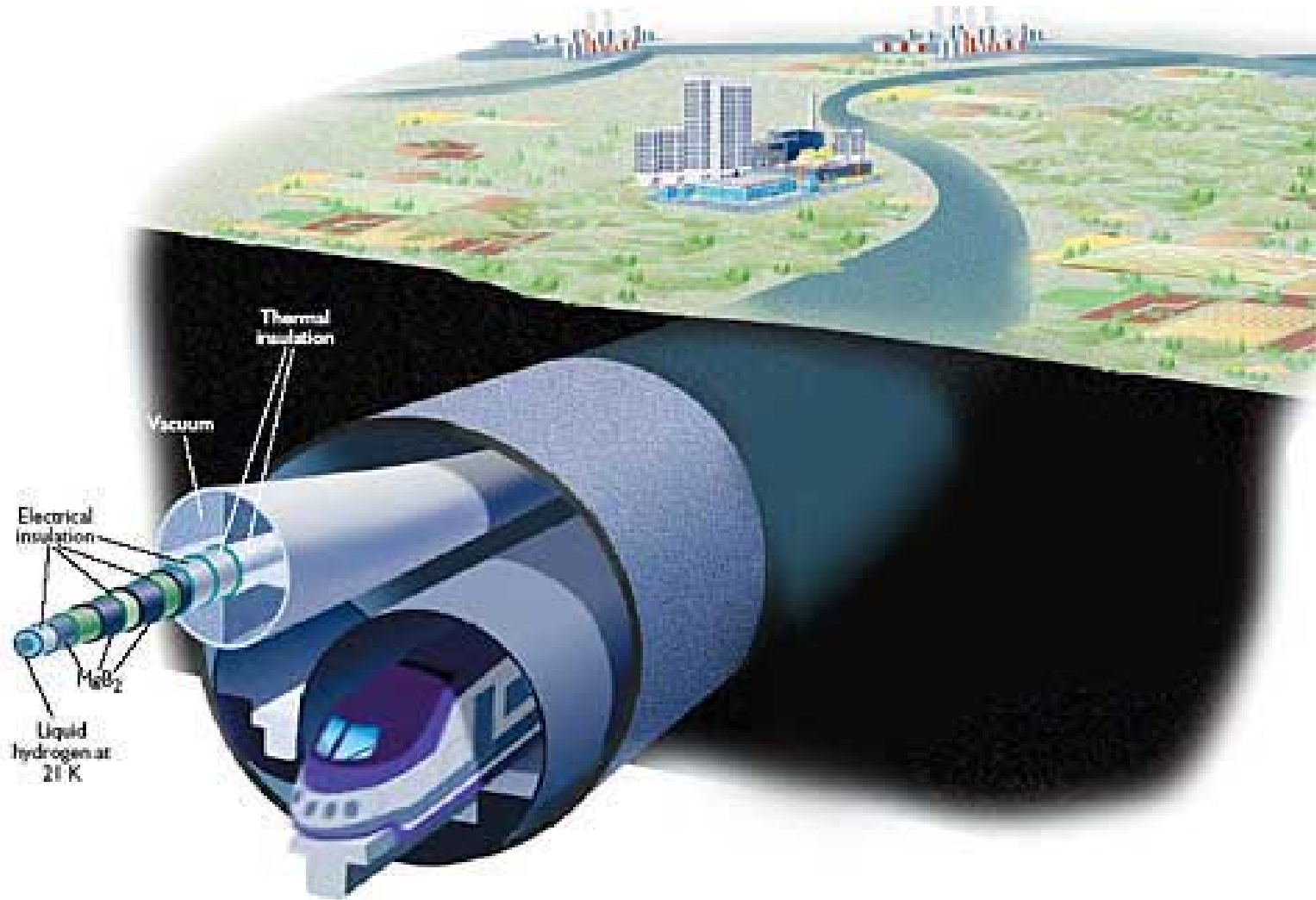


Hypothetical SuperGrid energy pipe

$\pm 50,000 \text{ V}_{\text{dc}}$
100,000 A
10 GW

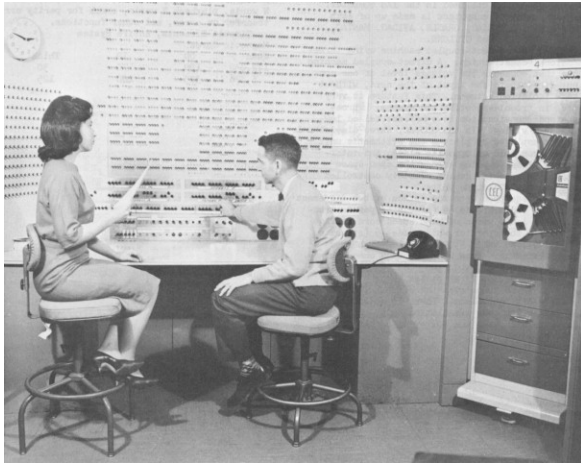


Supercable transporting hydrogen and electricity
Sharing tunnel with magnetically levitated train in low pressure tube



Source: Ausubel, 2004

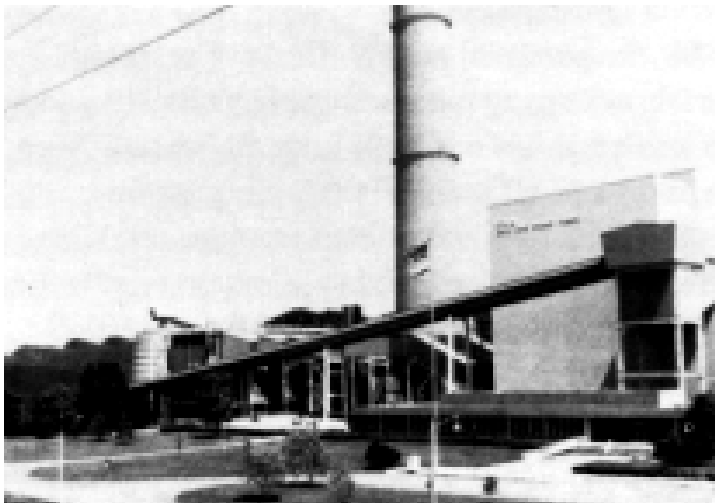
Like computers that comprise the Internet, power plants become more powerful AND SMALLER



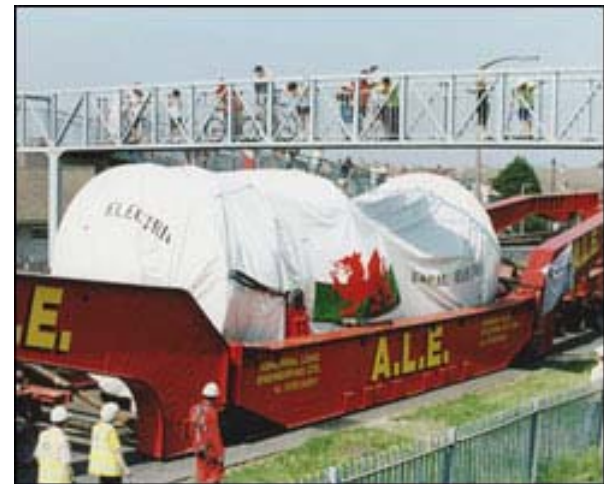
US Ballistic Research Lab computer, mid 1950s



Dell laptop, 2004



Tennessee Valley Authority coal plant
(date unknown)



Delivery of General Electric
480 MW natural gas turbine, 2000

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