

Alvin M. Weinberg Lecture

Oak Ridge National Laboratory

5 June 2003

Decarbonization: The Next 100 Years

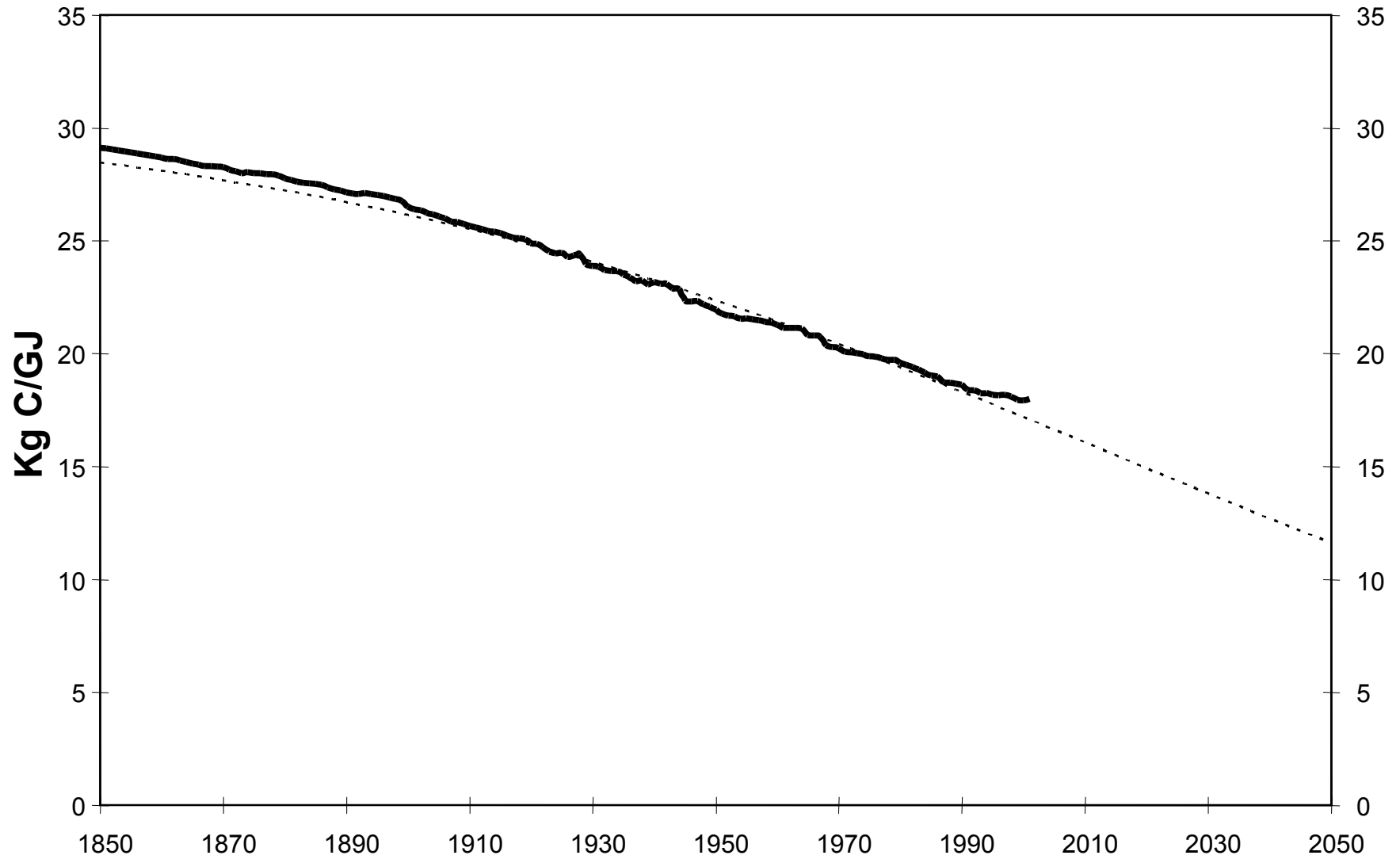
Jesse H. Ausubel

Program for the Human Environment

The Rockefeller University

<http://phe.rockefeller.edu>

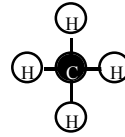
Falling Global Carbon Intensity of Primary Energy



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

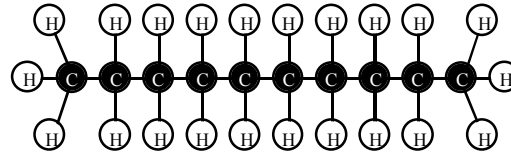
Hydrogen-Carbon Composition of Fossil Fuels

Methane Gas



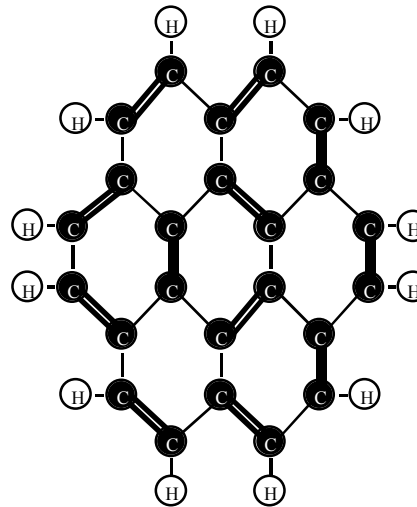
H:C = 4:1

Typical Oil



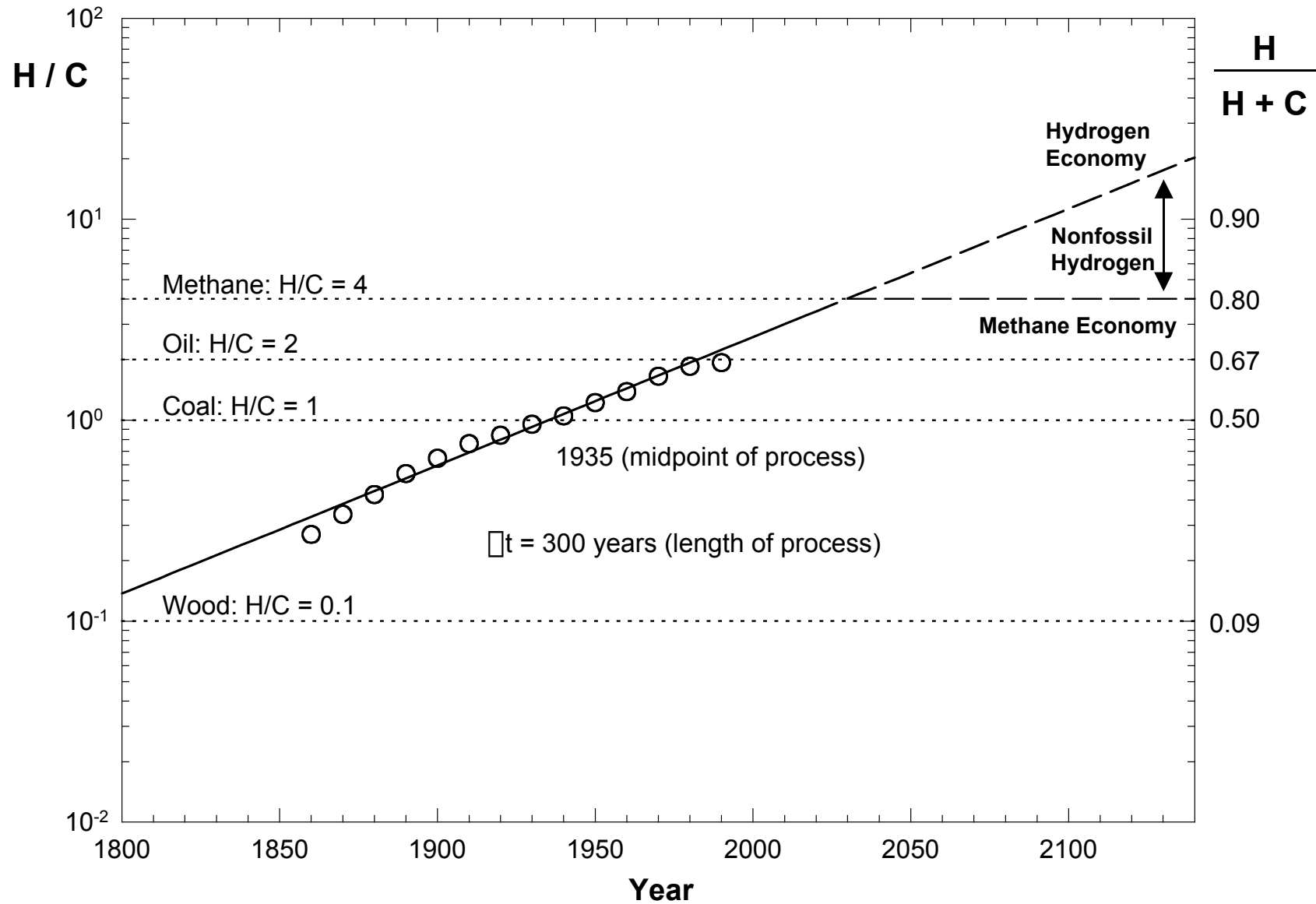
H:C = 2:1

Typical Coal



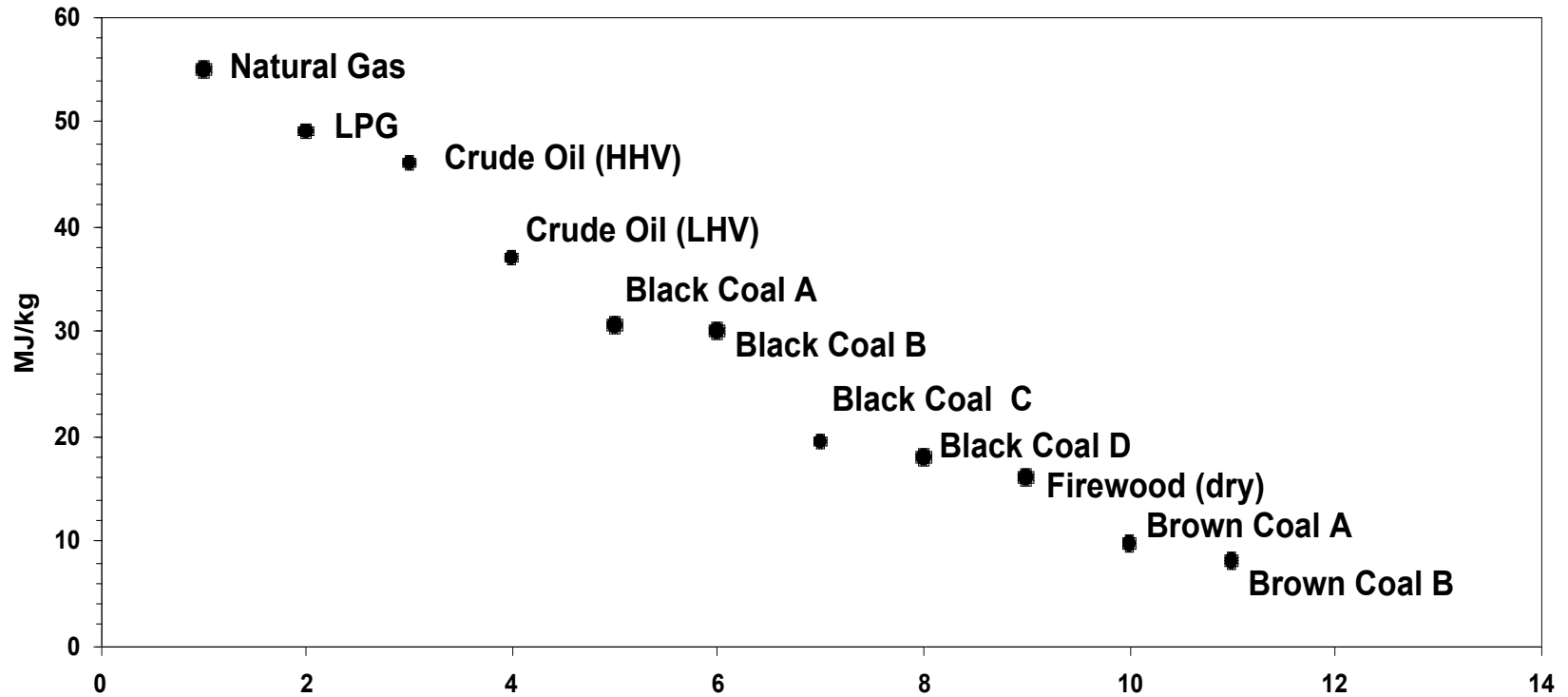
H:C = 0.5:1

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



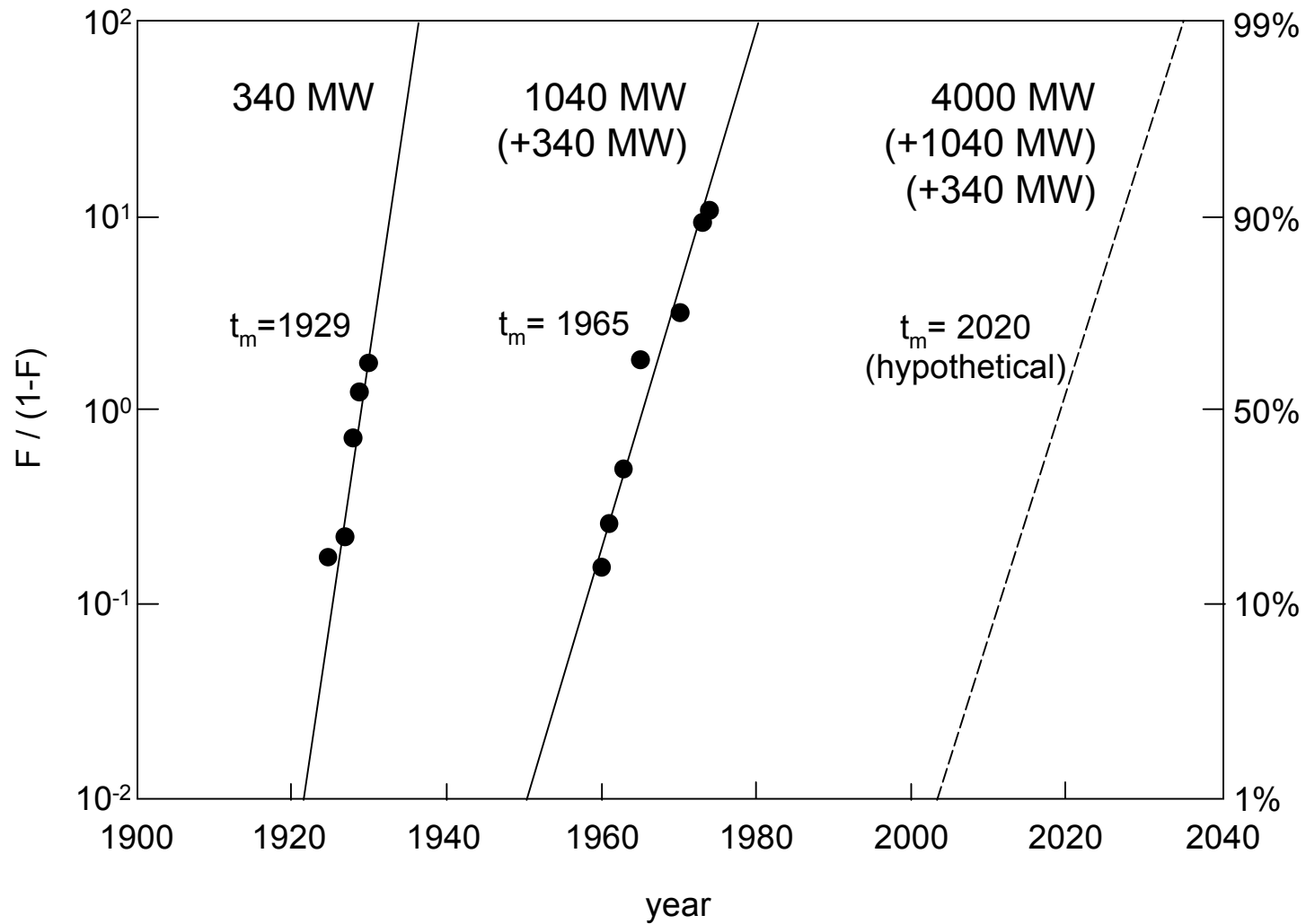
Source: Ausubel, 1996, after Marchetti, 1985

Hydrocarbon fuels ranked by heat value



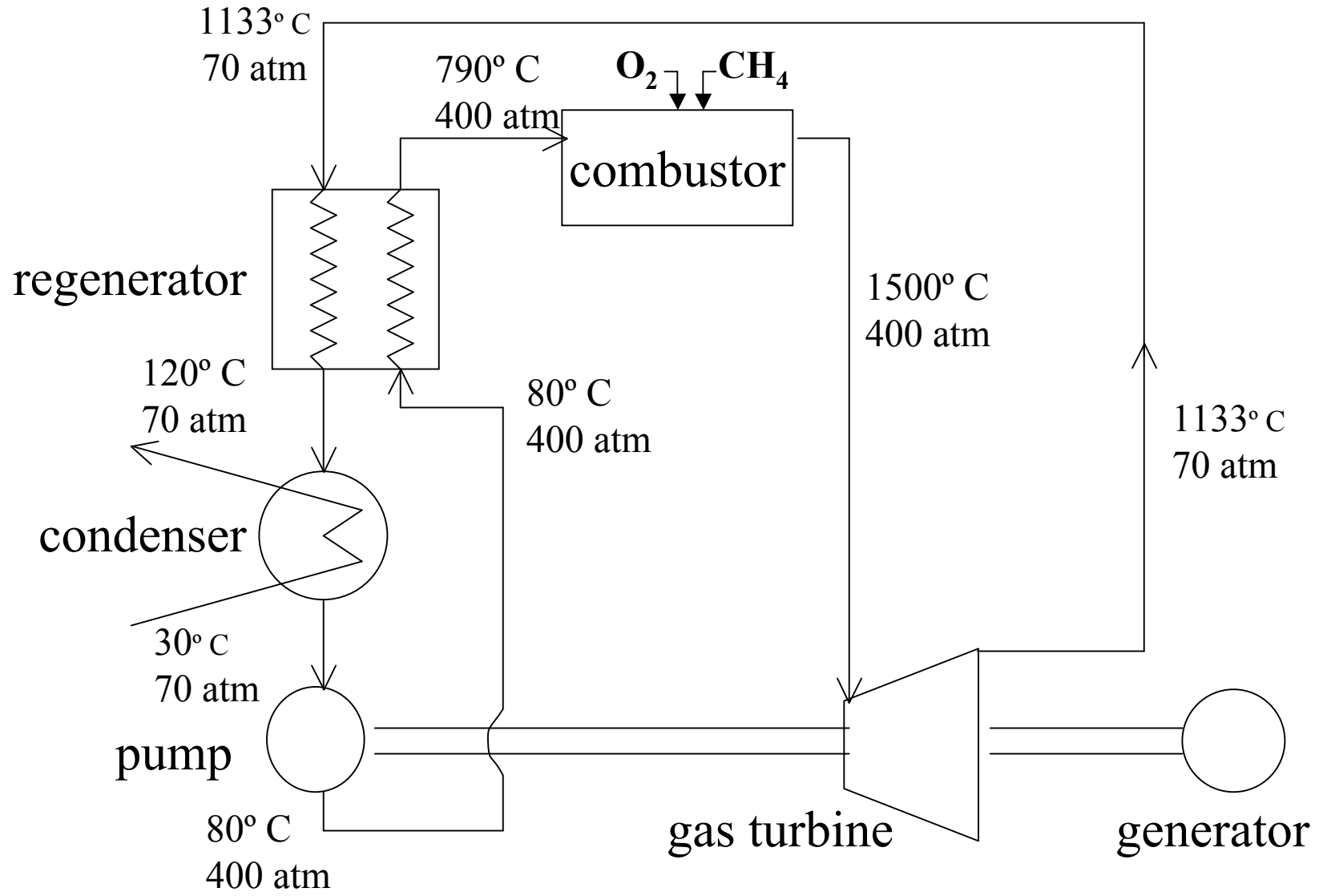
Source: N. Victor & J. Ausubel, 2003

Growth pulses of maximum size of power plants



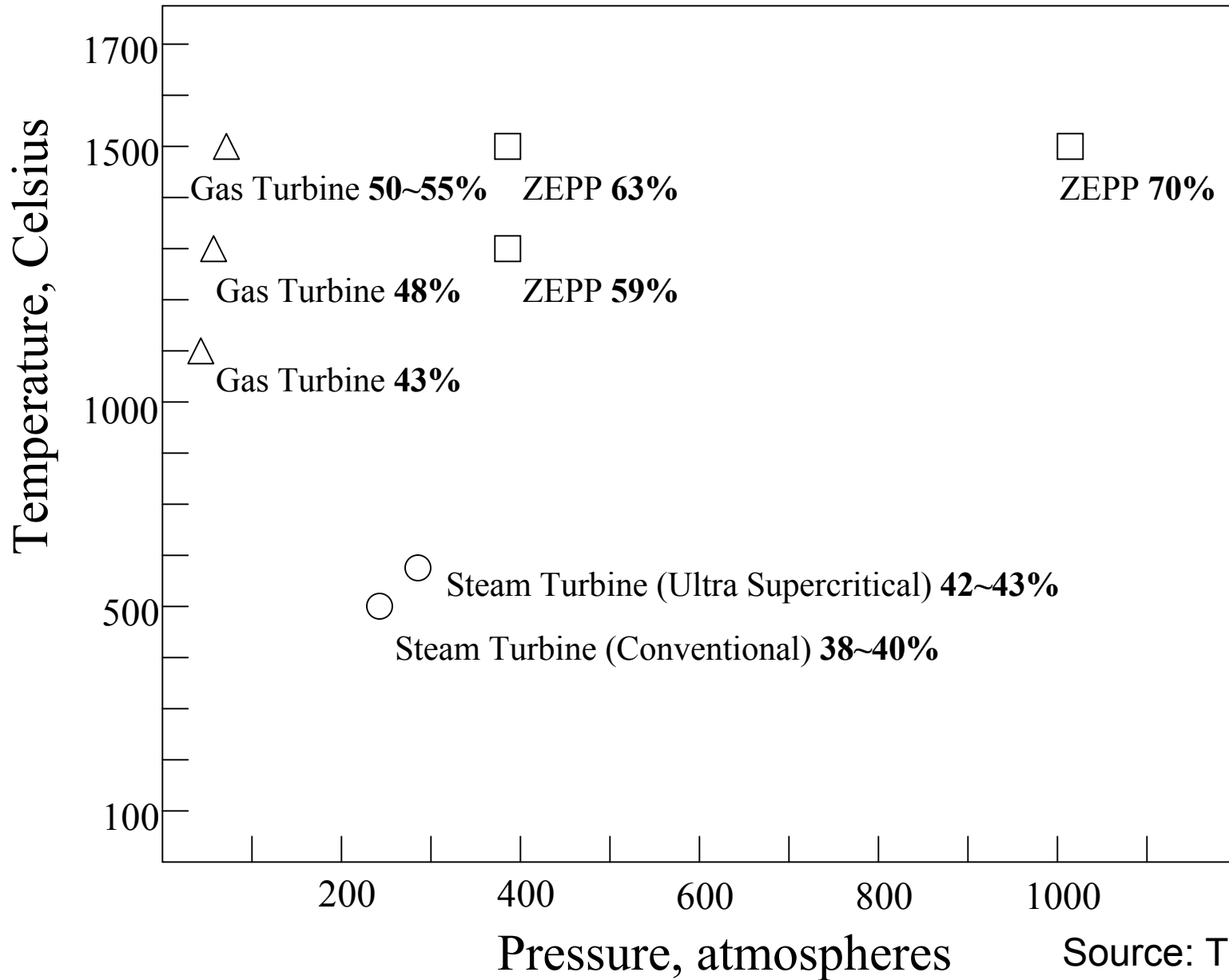
Source: Ausubel, 2001

Basic ZEPP Configuration, 400 atm case



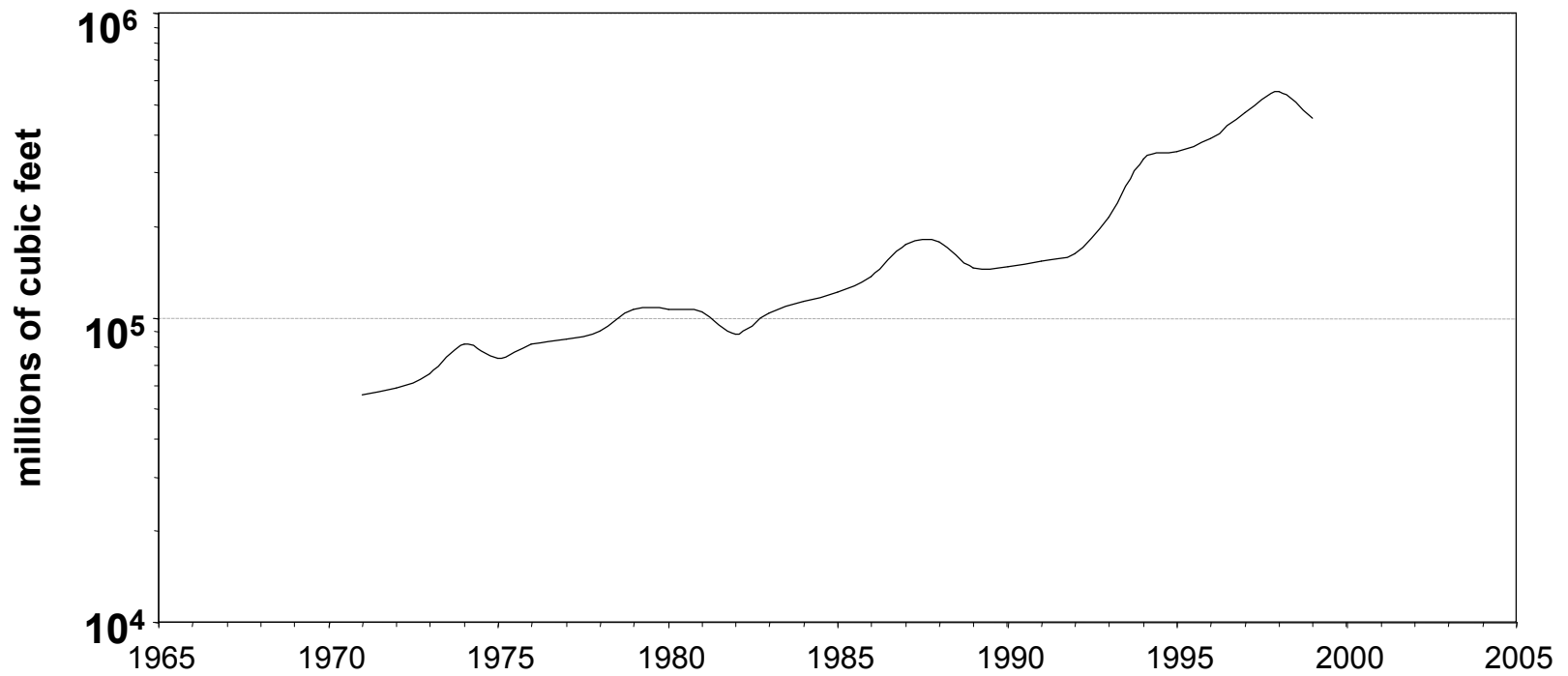
Source: After Ichihara, Tokyo Electric Power

Carnot Efficiencies for Power Plants



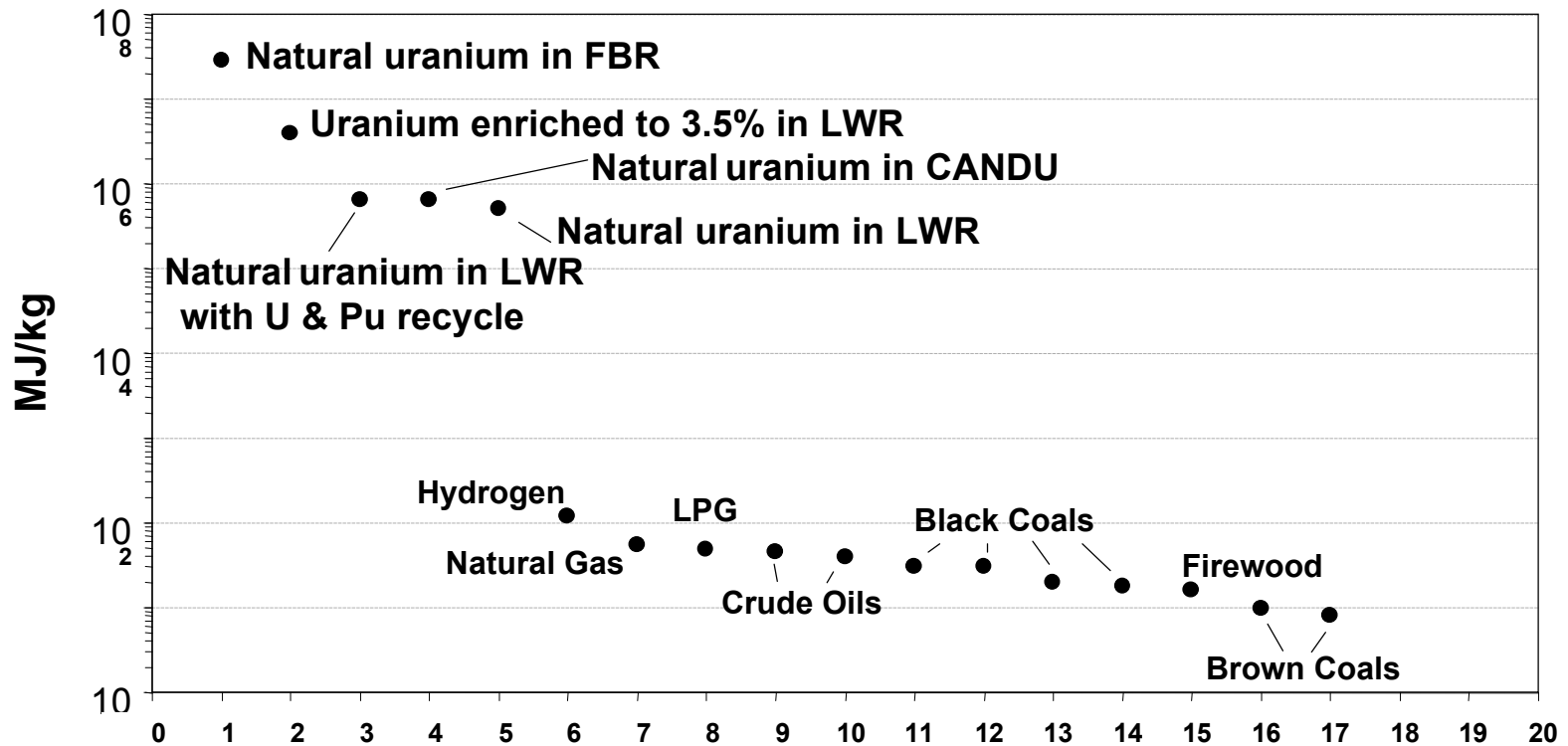
Source: TEPCO

USA: Hydrogen Production, 1971-1999



Source: N. M. Victor and J.H. Ausubel, 2002

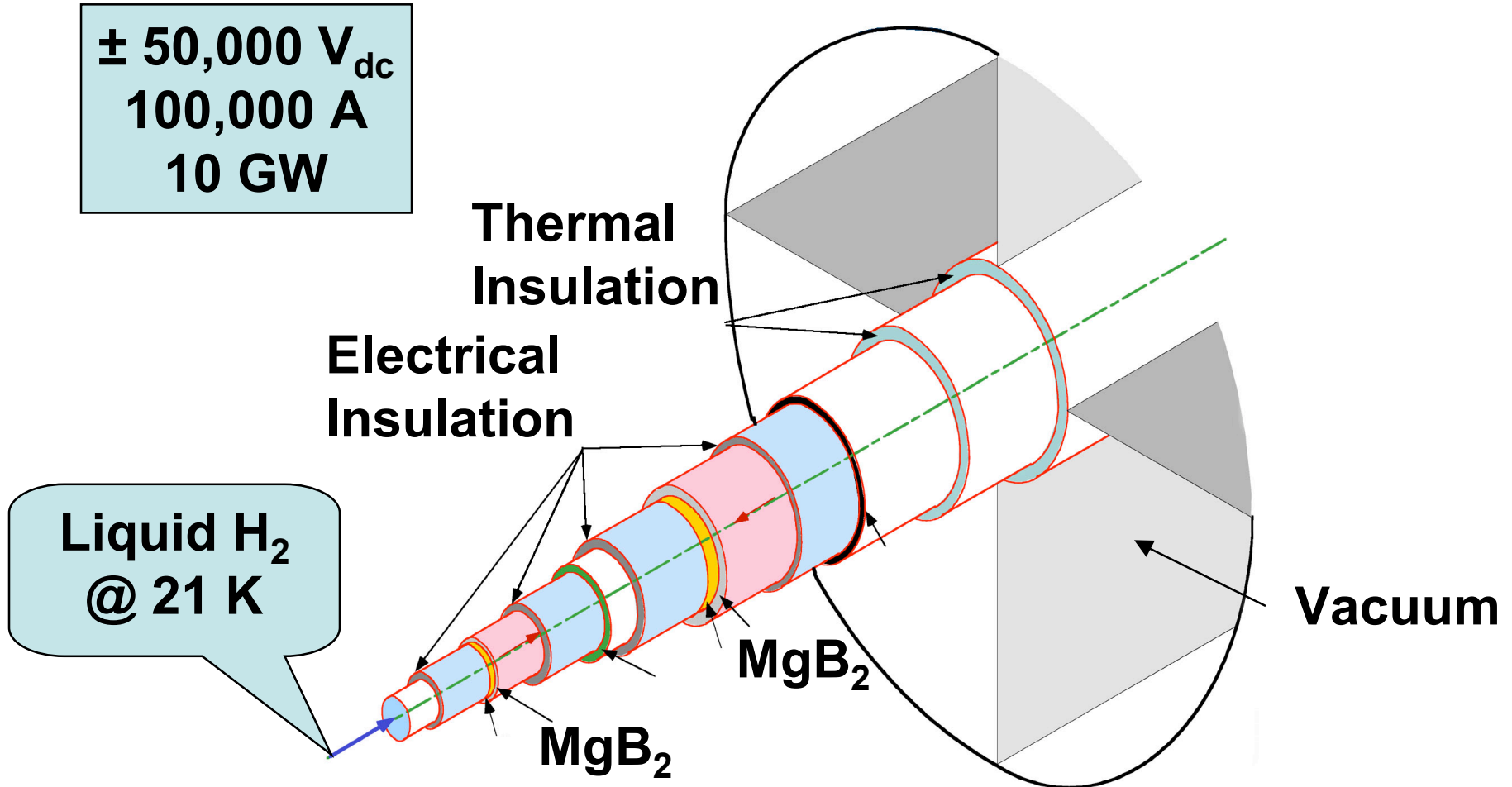
Major fuels ranked by heat value



Source: N. Victor and J. Ausubel, 2003

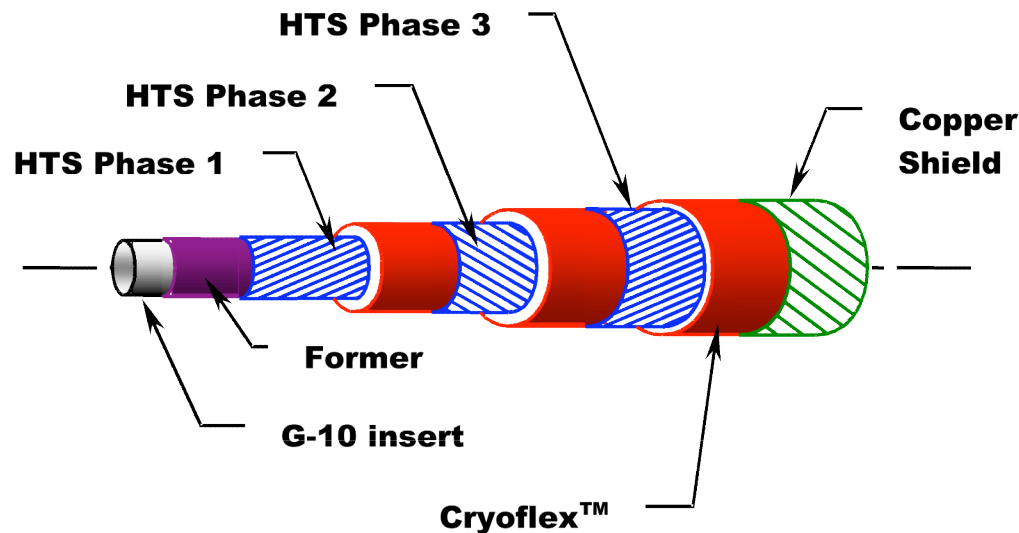
Supergrid Energy Pipeline

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



Source: P. Grant, EPRI

ORNL 1.5 m HTS Triaxial Cable

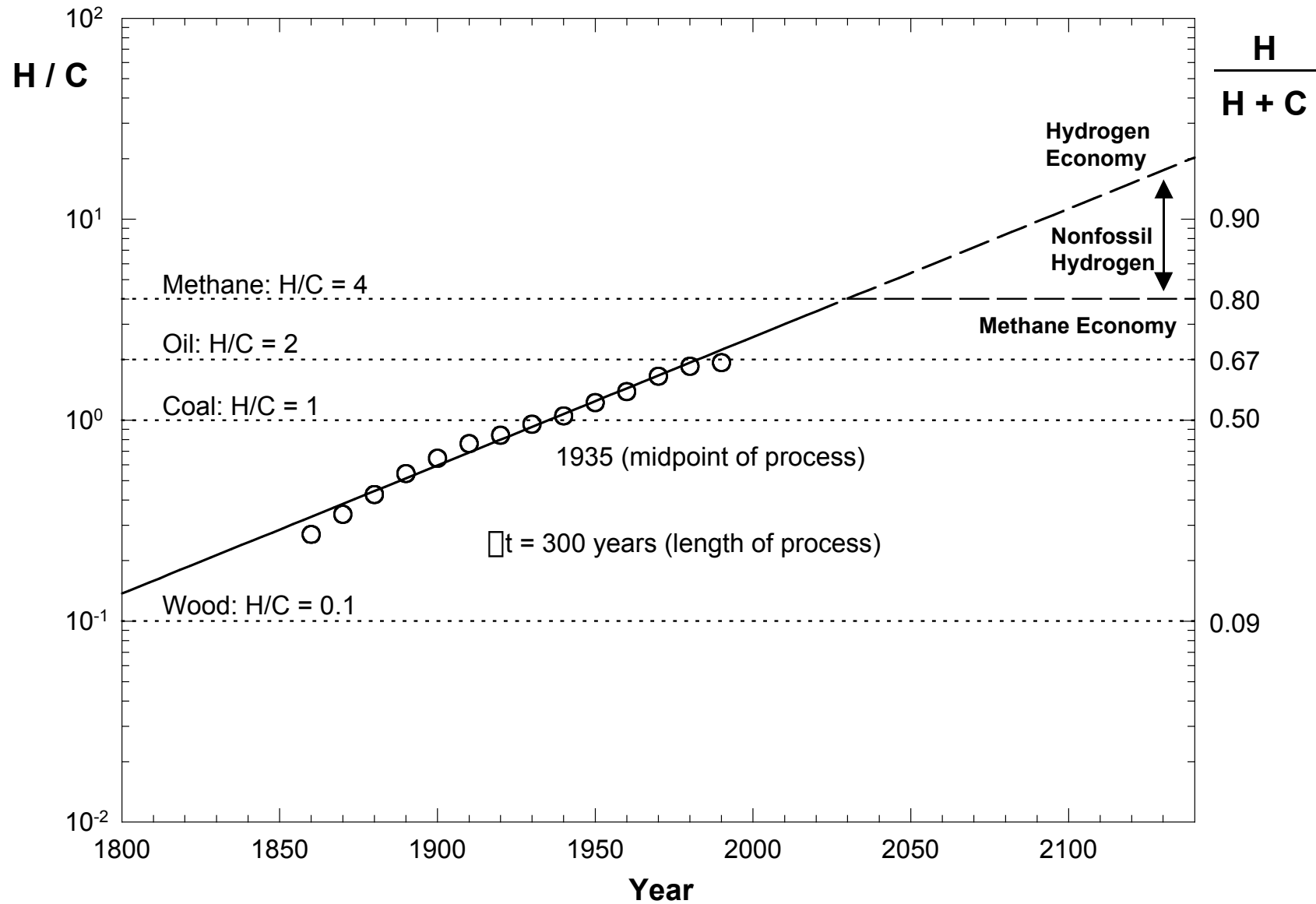


- Prototype fabricated to evaluate superconducting properties
- Each phase consists of two layers of BSCCO-2223 HTS tapes
- G-10 insert with thermocouples attached used for calorimetric measurement of AC losses

ELECTRICAL TESTS OF A TRIAXIAL HTS CABLE PROTOTYPE

J. W. Lue, J. A. Demko, J. C. Tolbert, U. K. Sinha, R. Grabovickic, G. C. Barber, M. J. Gouge, D. Lindsay, and R. L. Hughey, presented at CEC/ICMC 2001, to be published in Advances in Cryogenic Engineering.

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



Source: Ausubel, 1996, after Marchetti, 1985