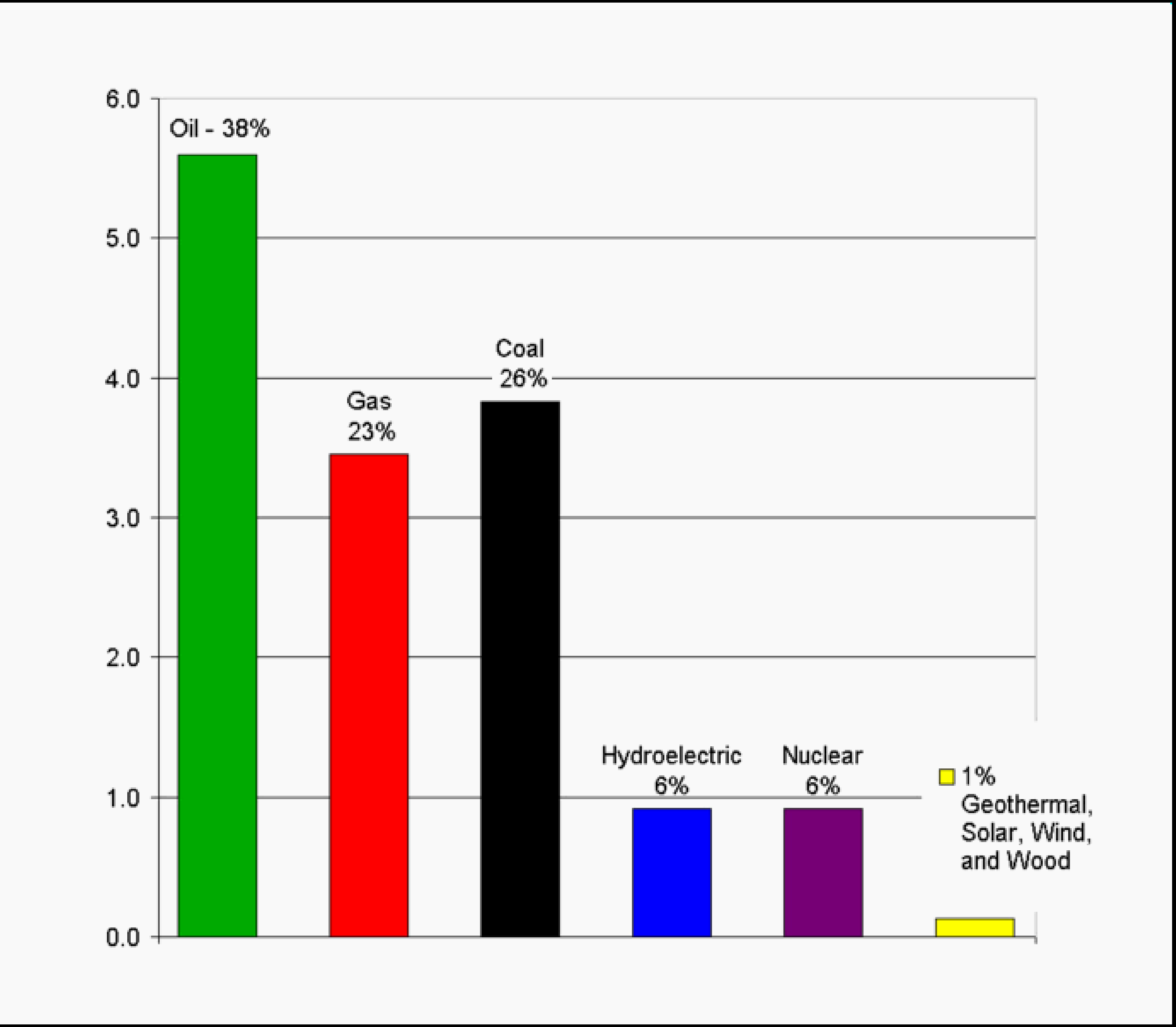

Western civilisation's
"energy normality illusion"
How many "energy slaves" are taking care of your lifestyle?

A civilization based on hydrocarbon use

60% of the world's primary energy is derived from oil and gas

1000 barrels of oil per second

Other energy sources:



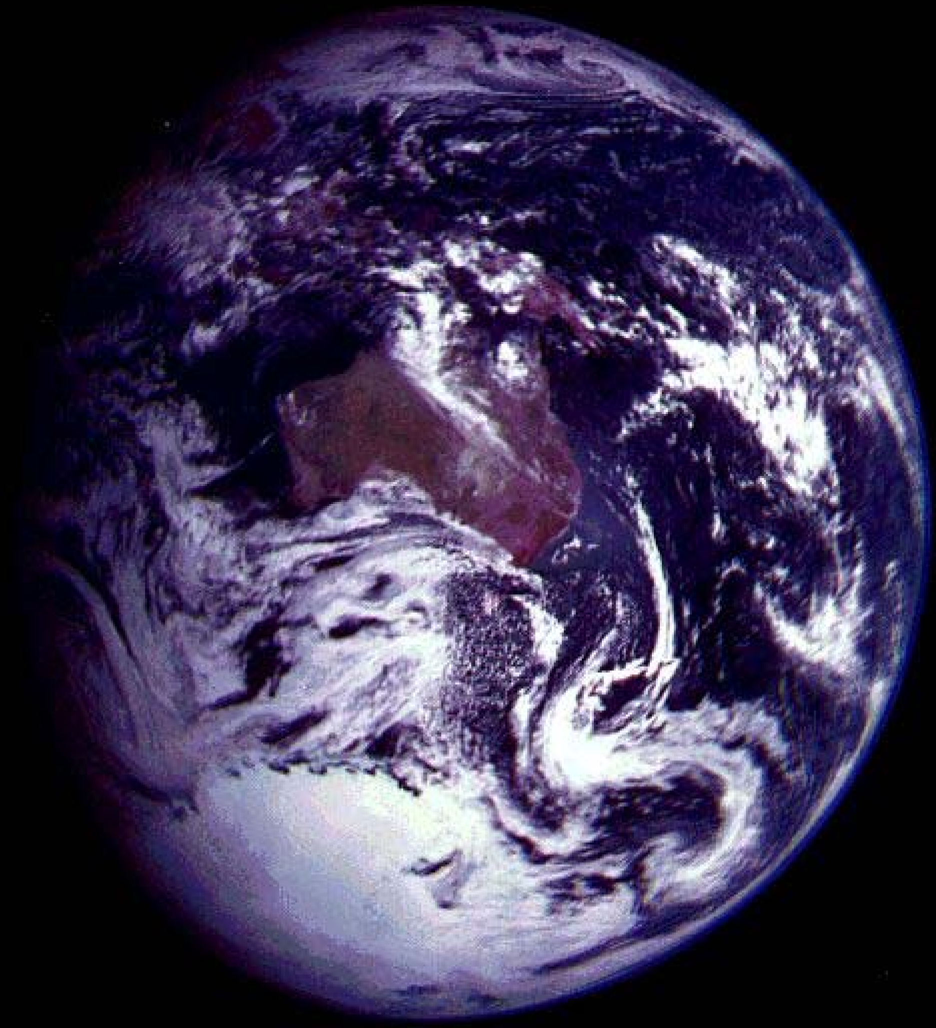
26% is coal

13% from other sources

So 87% of our energy comes from fossil fuels

90% of transport fuel comes from oil !

Globalisation is based on cheap transport



Cheap transport is based on cheap oil

Oil is the feedstock for most plastics and pharmaceuticals

1 kg of oil is needed to produce every kg of food !

“In the United States, 400 gallons of oil equivalents [~ 9.5 barrels or 1,500 litres] are expended annually to feed each American (as of data provided in 1994).”

This is only the energy used ON THE FARM!

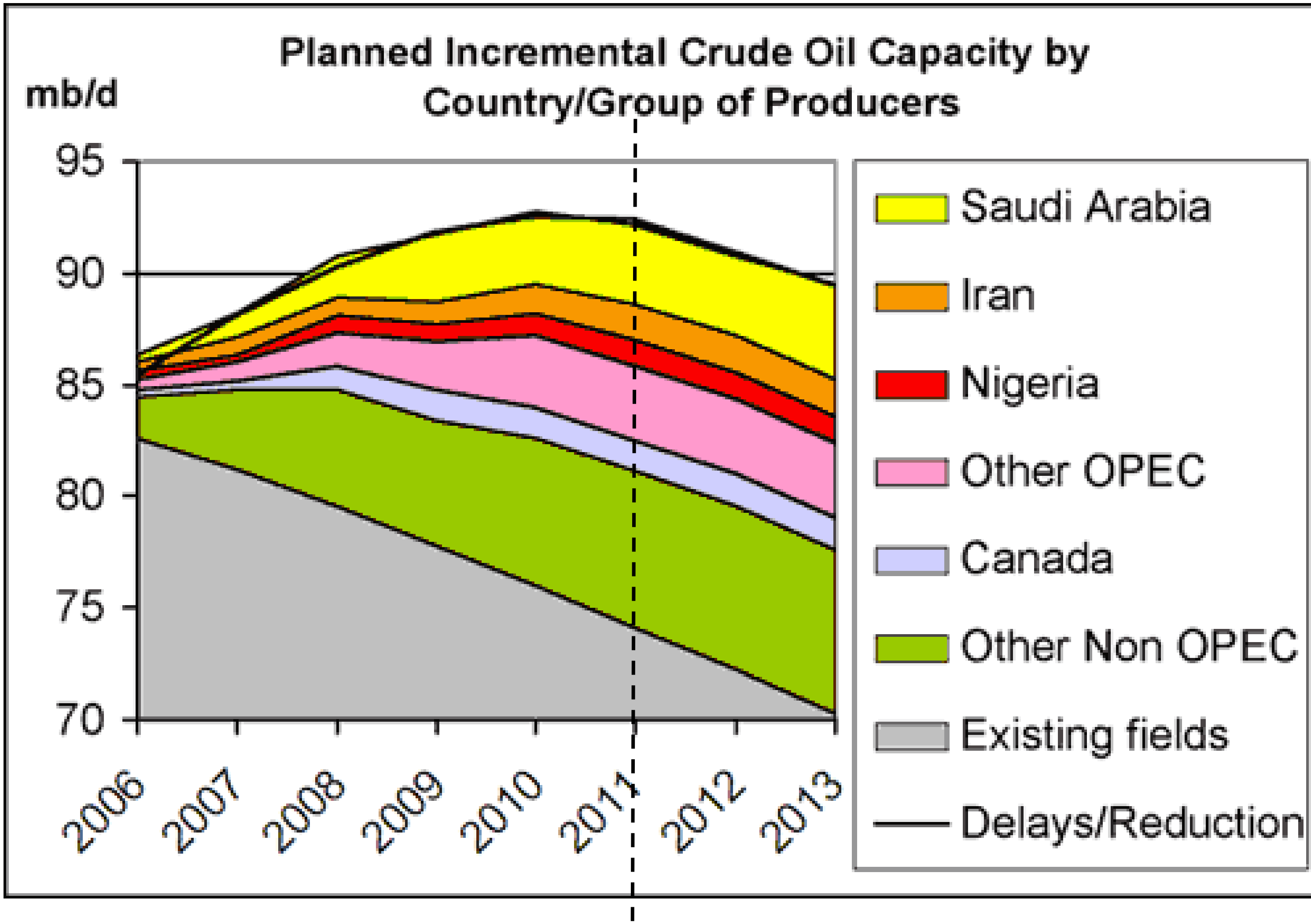
(From “Eating Fossil Fuels”, by Dale Allen Pfeiffer Dale © Copyright 2004, From The Wilderness Publications, www.copvcia.com)

Four lines of evidence for an imminent decrease in available oil:

- New projects minus depletion analysis (aka "Megaprojects", Best case) **2011**
- Oil available to export **2006**
- World oil production computer models **2007**
- Examining reserves
  - Oil + Nat. Gas **2011**
  - Conventional oil **2005**

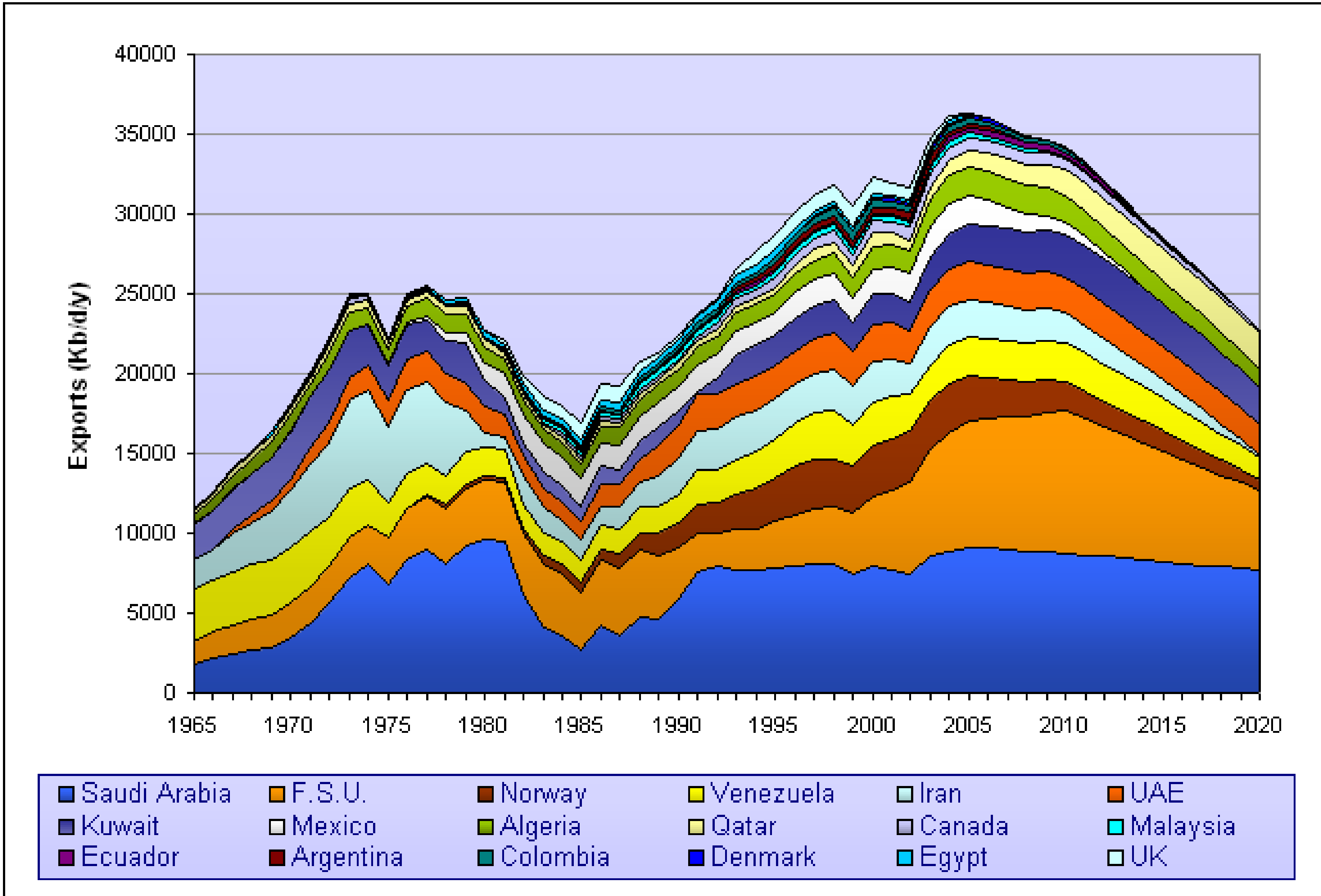
New projects minus depletion analysis

Skrebowski's Megaprojects analysis (no adverse natural/political events)

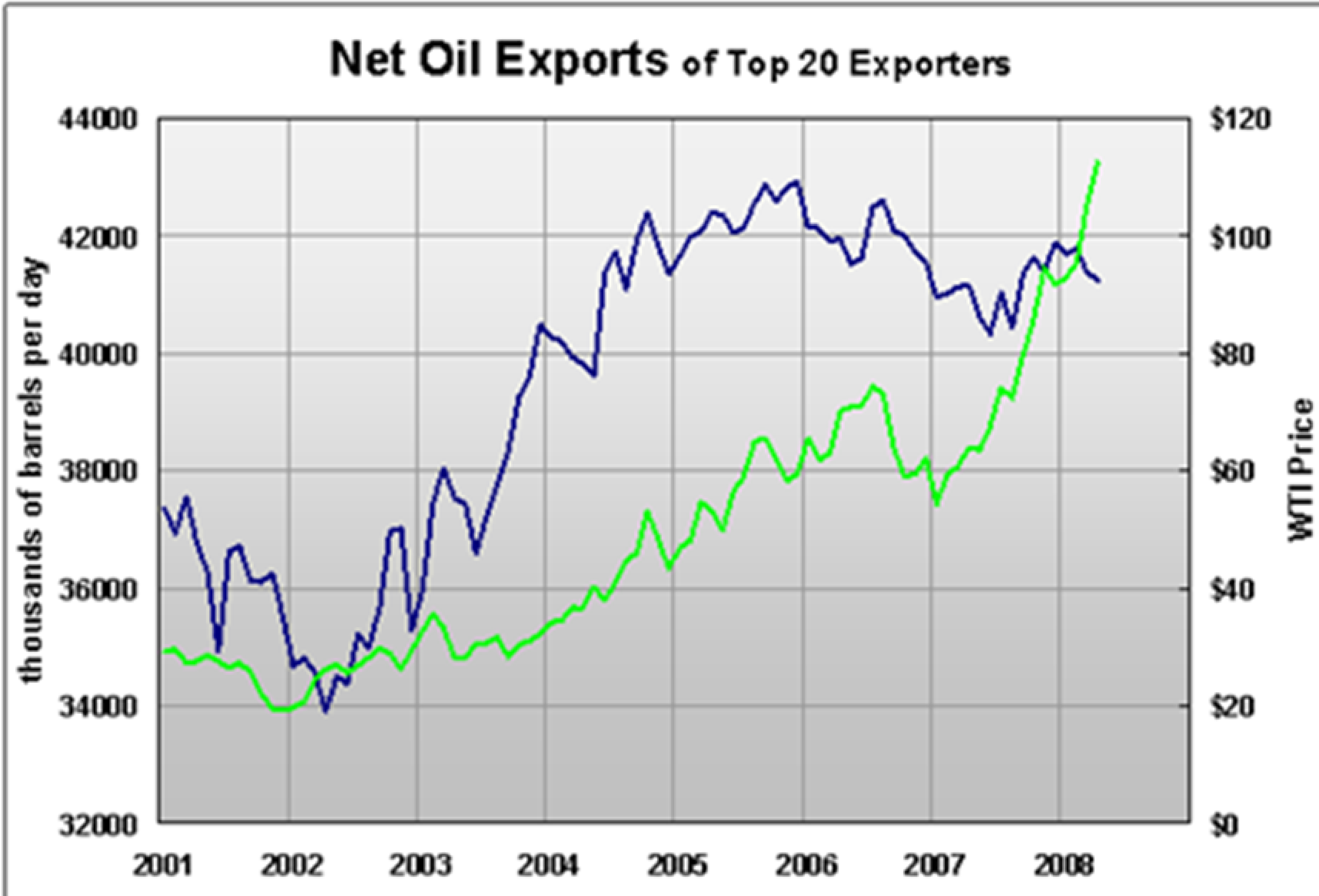


(Matt Mushalik)

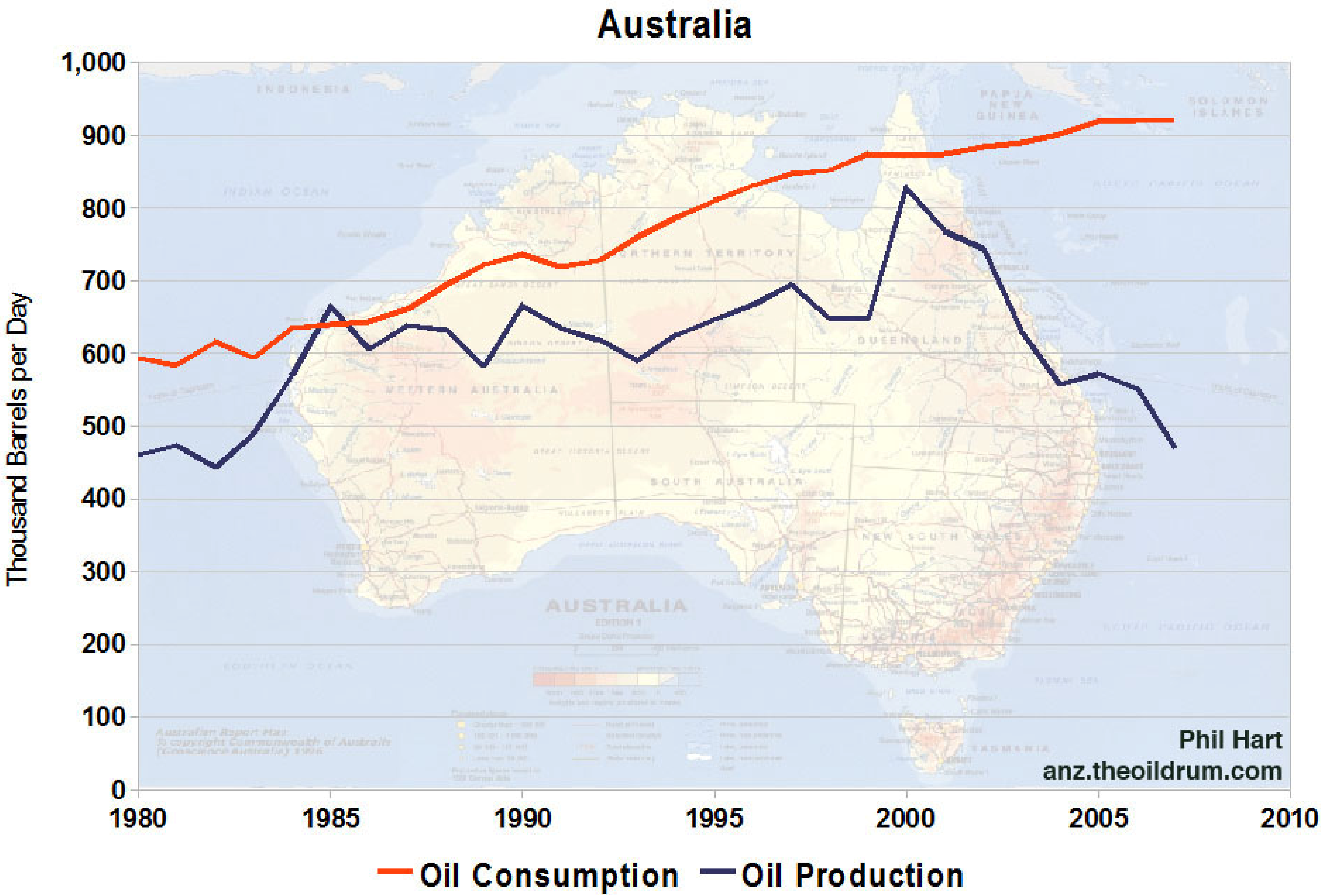
World oil exports prediction



http://www.theoildrum.com/story/2006/10/5/215316/408



Net Oil Exports of Top 20 Exporters
thousands of barrels per day
WTI Price
44000
42000
40000
38000
36000
34000
32000
$120
$100
$80
$60
$40
$20
$0
2001
2002
2003
2004
2005
2006
2007
2008



Australia
Thousand Barrels per Day
1,000
900
800
700
600
500
400
300
200
100
0
1980
1985
1990
1995
2000
2005
2010
Oil Consumption
Oil Production
Phil Hart
anz.theoildrum.com

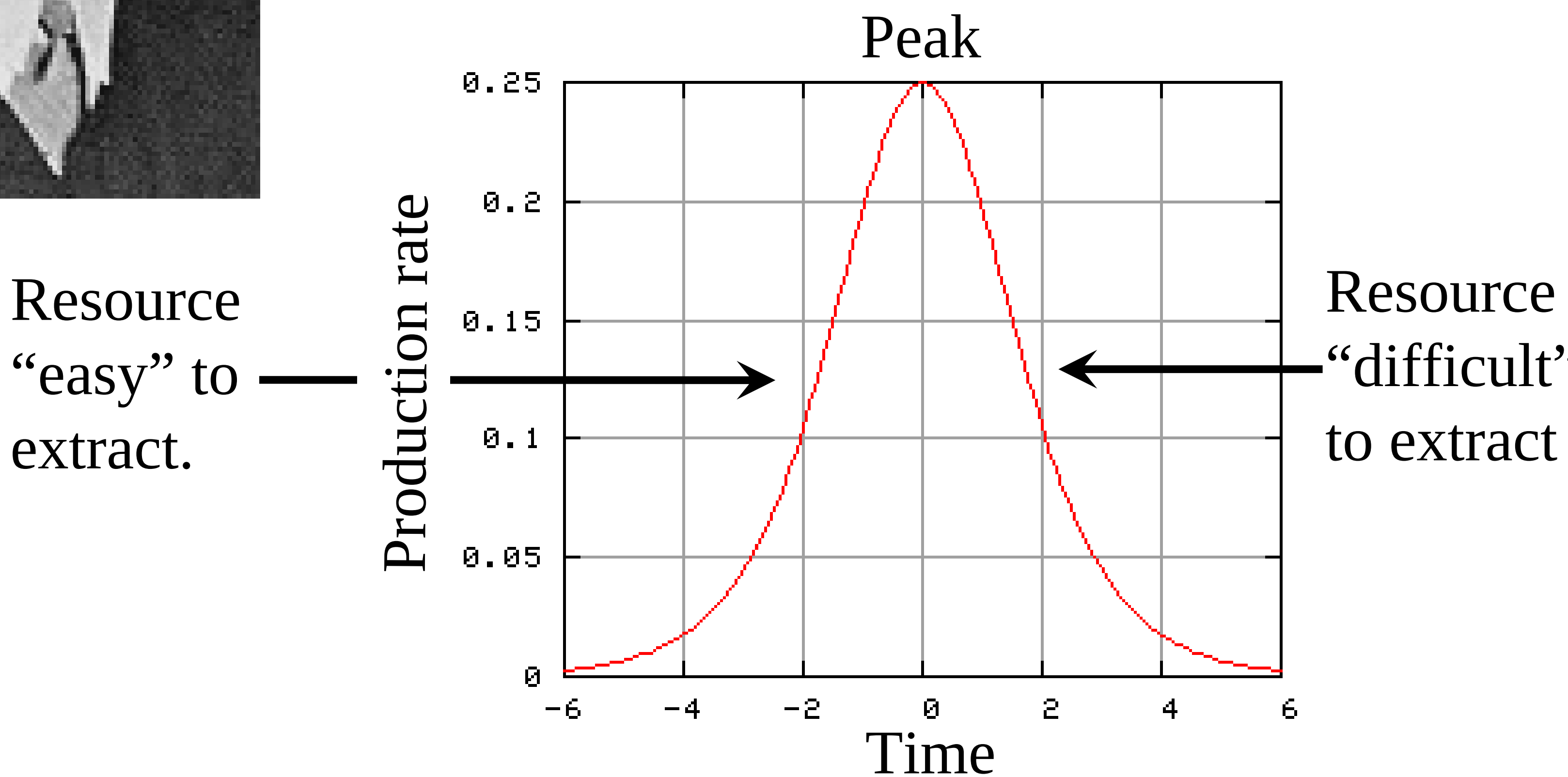
M. King Hubbert 1903-1989
Geophysicist for Shell and the
US Geological Survey

A temperamental genius:

“That Hubbert is a bastard,
but at least he’s *our* bastard!”

(Shell colleagues)

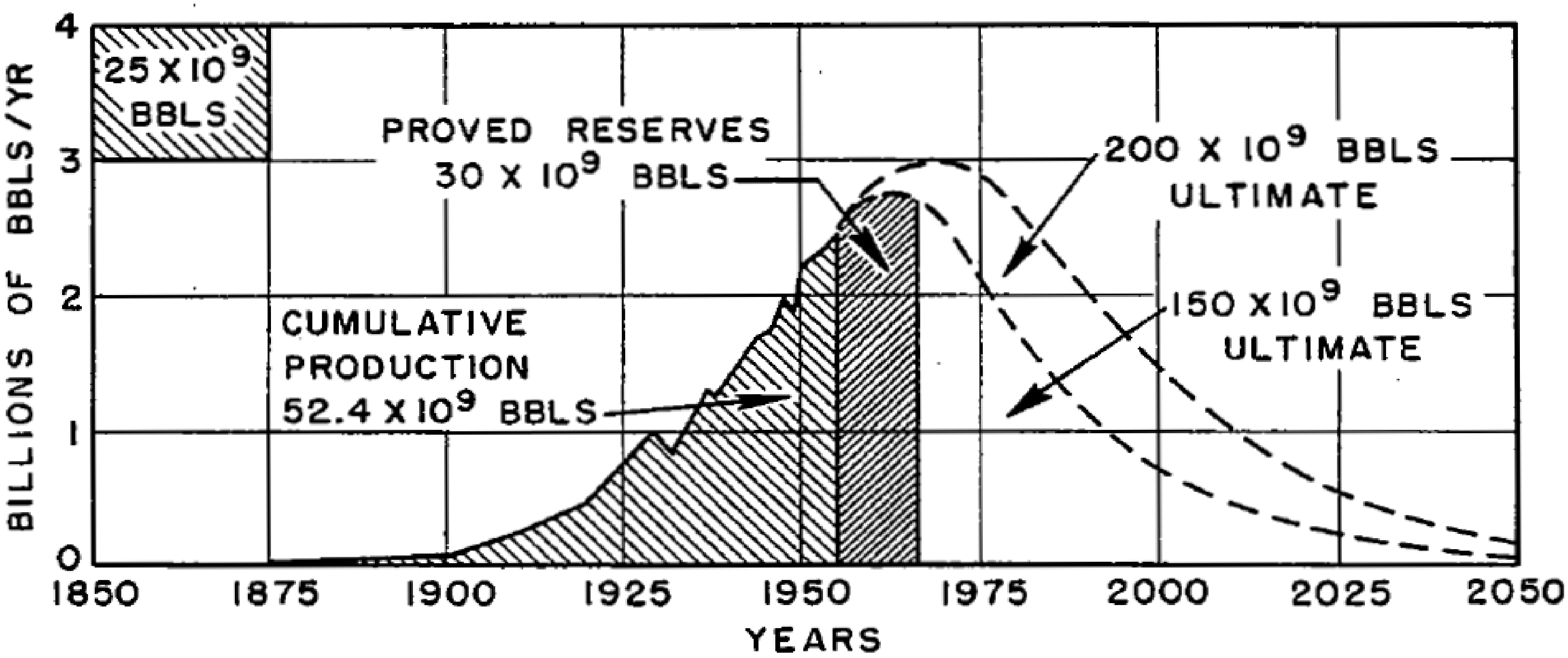
Hubbert’s great insight – the rate of utilization of a resource approximates a bell-shaped curve. This can be used to predict the moment of peak production and the final amount recoverable.



Modified from Rutledge Presentation

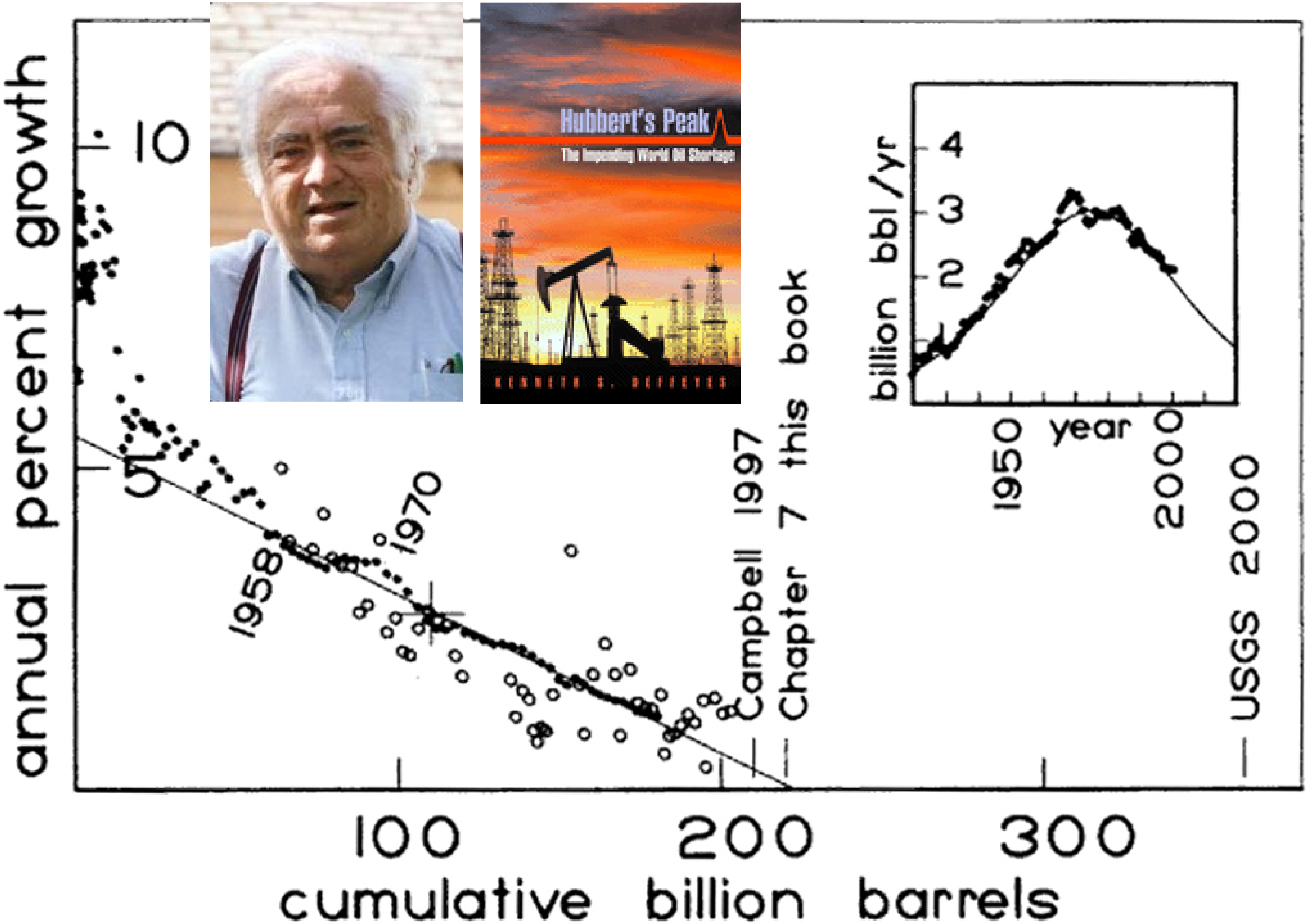
Hubbert's Peak

(US excluding Alaska, Hawaii and Gulf of Mexico)

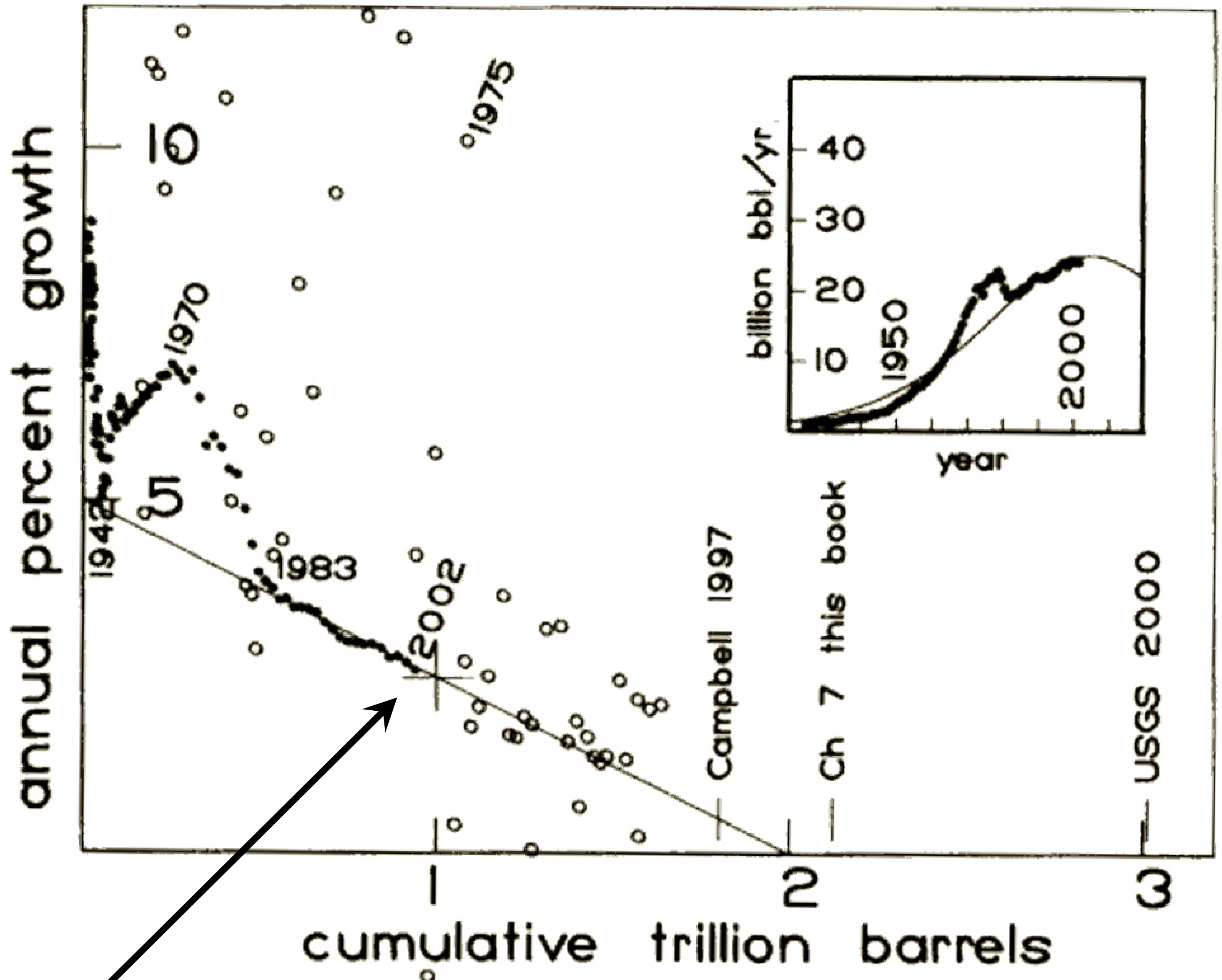


- BBLS = barrels
- CUMULATIVE PRODUCTION = past production
- ULTIMATE = cumulative production plus future production

Huge additional volumes only shift the peak marginally!



From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage



We have produced nearly 1 trillion barrels = half = time for peak!

What about Coal?

Kjell Aleklett
Professor of Physics
Uppsala University, Sweden

Head of the Uppsala Hydrocarbon Depletion Study Group

President of ASPO

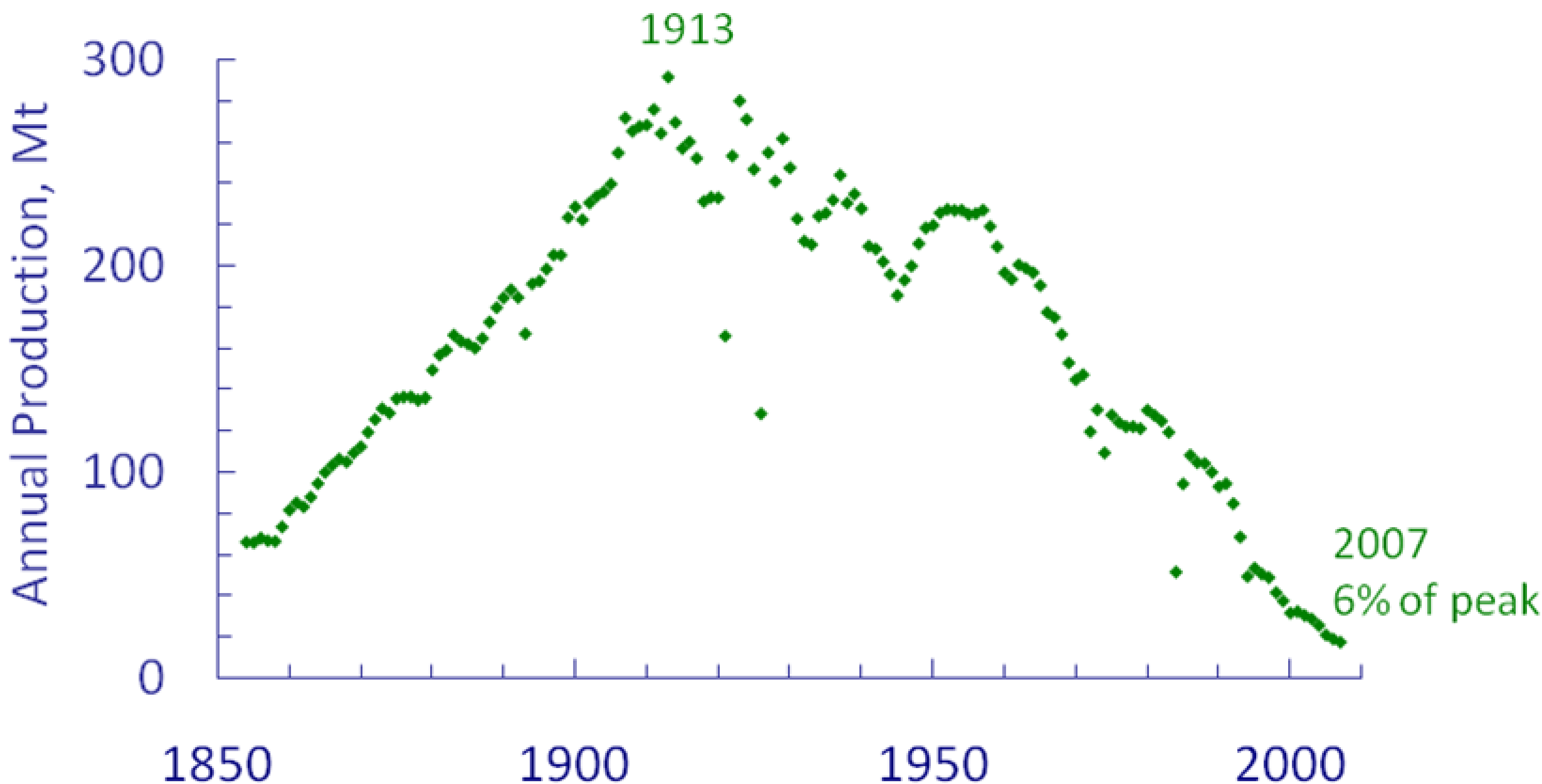
David B. Rutledge
Kiyo and Eiko Tomiyasu Professor of Electrical Engineering
Caltech, USA

Chair of the Division of Engineering and Applied Science

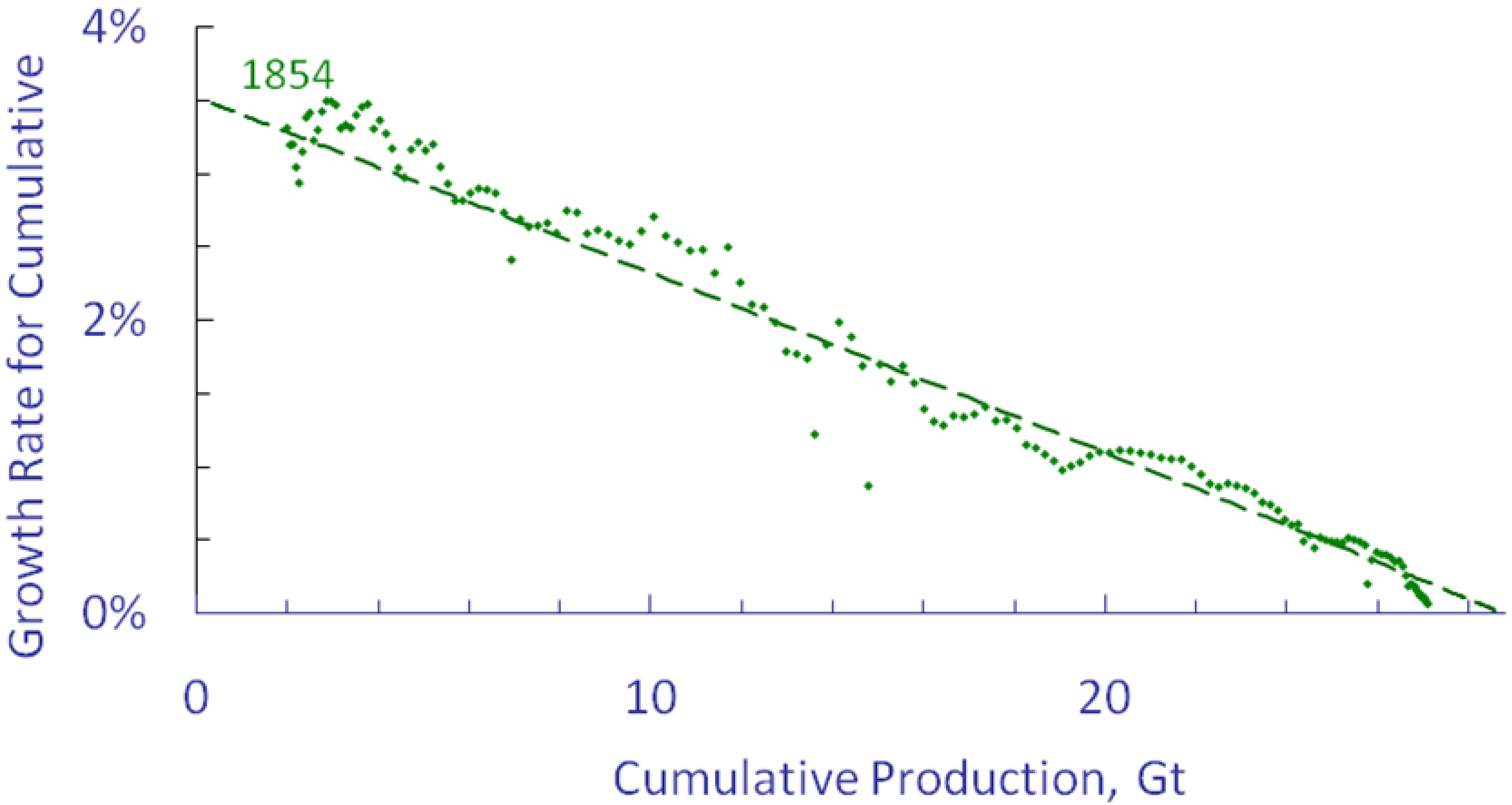
Watch his excellent 1 hour lecture on future coal production at: http://rutledge.caltech.edu/ or read report at: www.theoildrum.com/node/2697

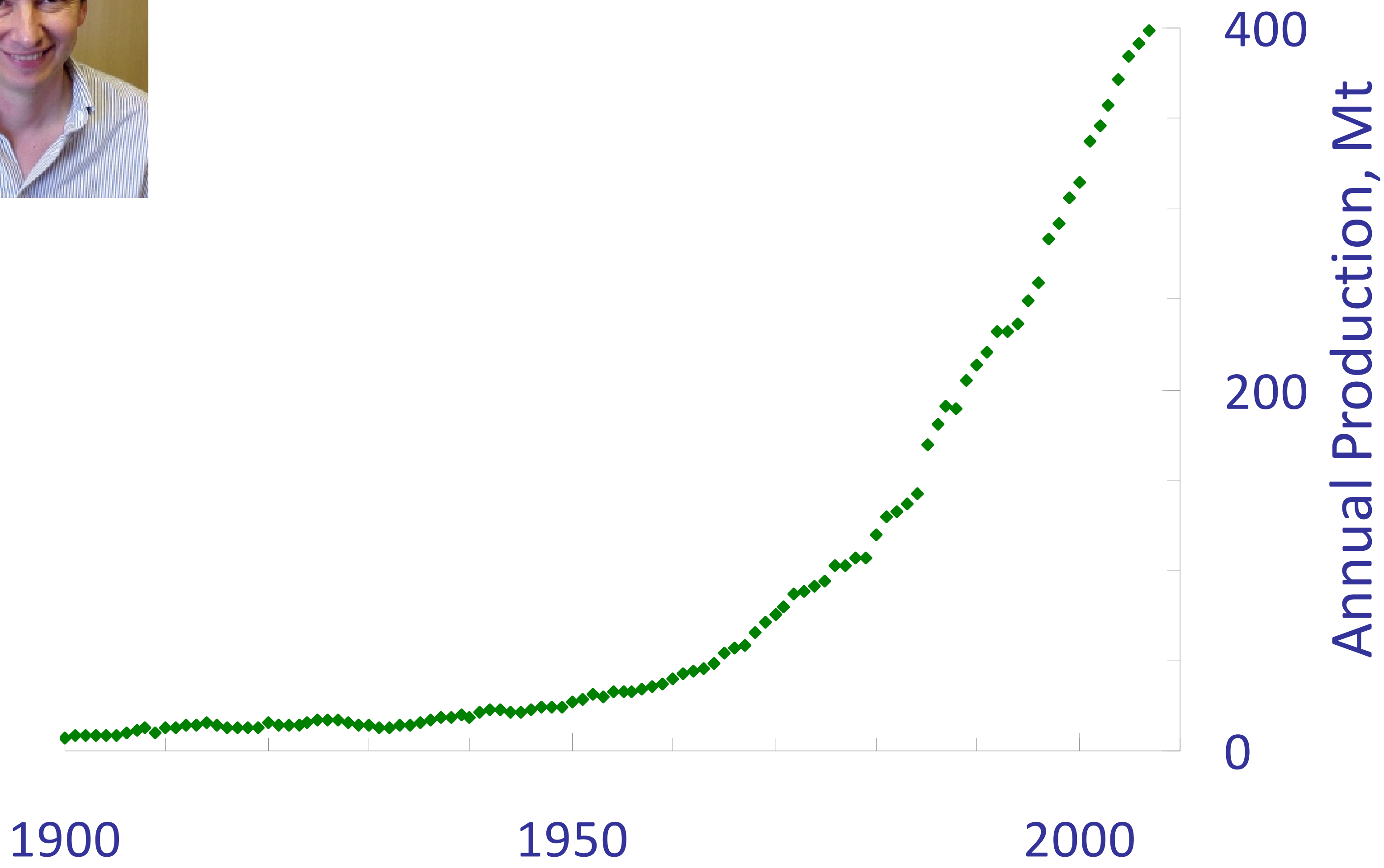
British Coal Production

Mt = millions of metric tons

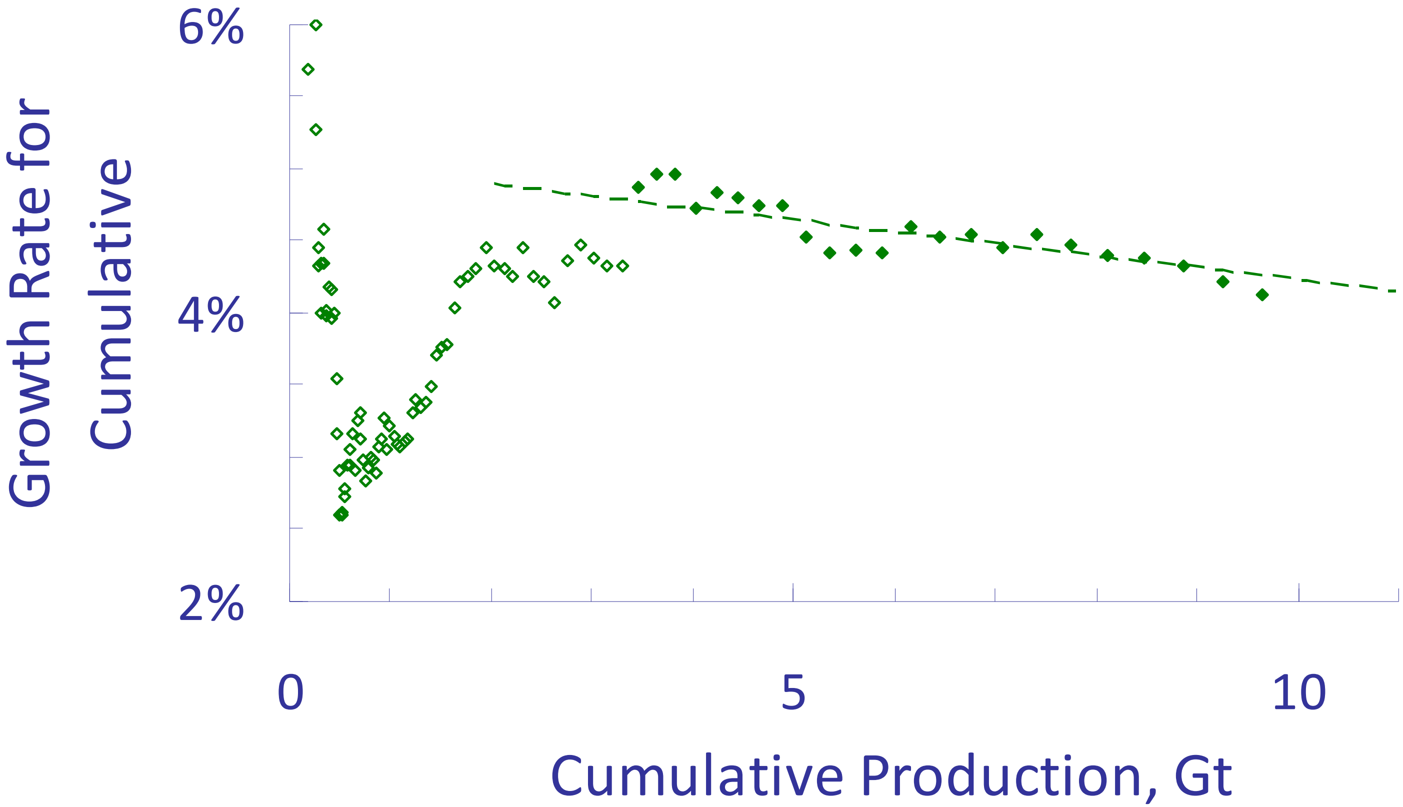


Hubbert Linearisation for British Coal





From Rutledge’s spreadsheet:
Australia and New Zealand Coal Production History

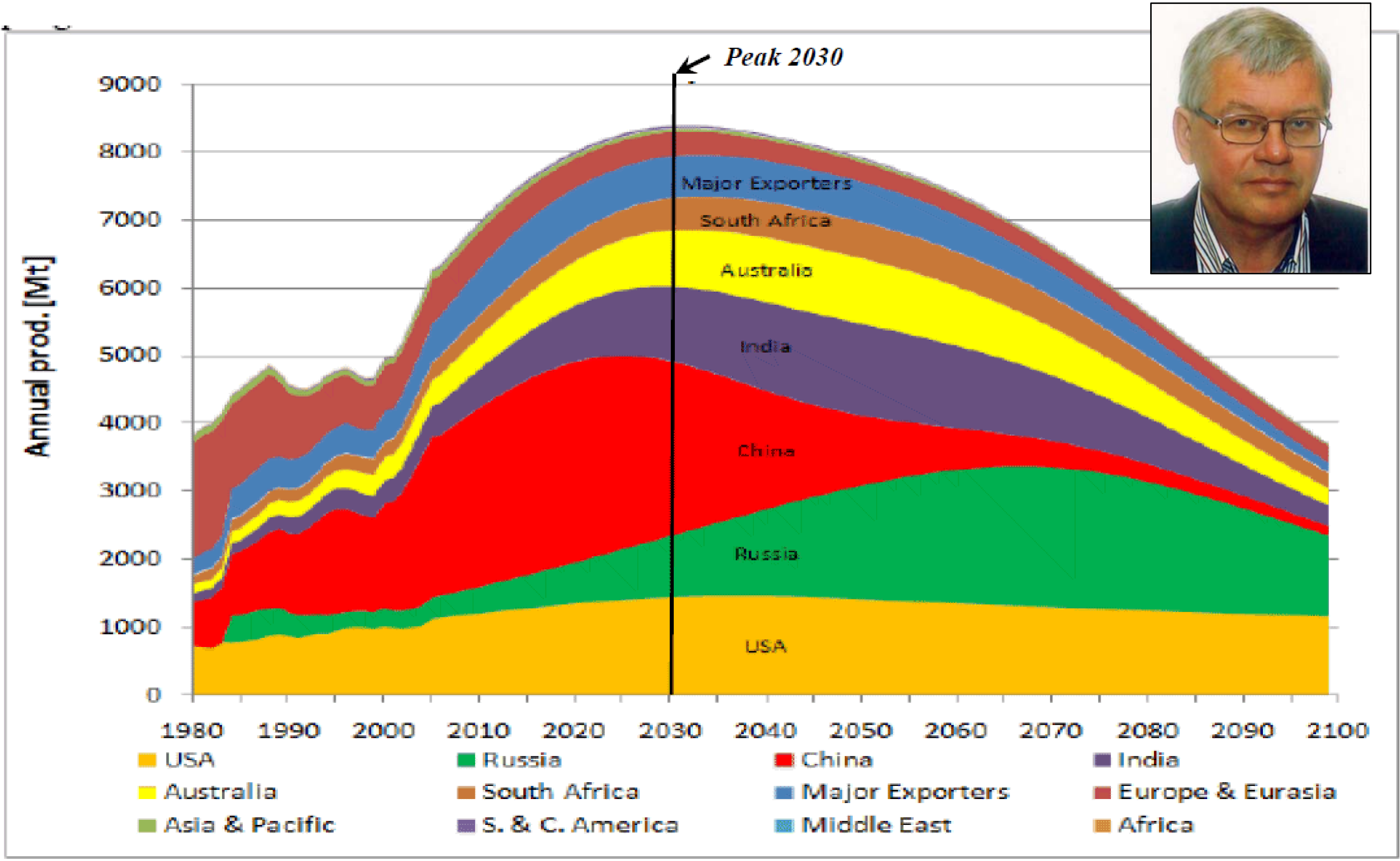


From Rutledge’s spreadsheet:
Hubbert Linearisation for Australia and New Zealand Coal

Regional Fits vs Reserves, Gt

Region	Fits for Ultimate	World Energy Council Reserves plus cumulative
Europe	155	195
US and Canada	141	316
China (with Japan and South Korea)	115	159
South Asia and Middle East	78	78
Russia	74	219
Australia and New Zealand	59	86
Africa	22	57
Latin America	19	19
World	663	1,129

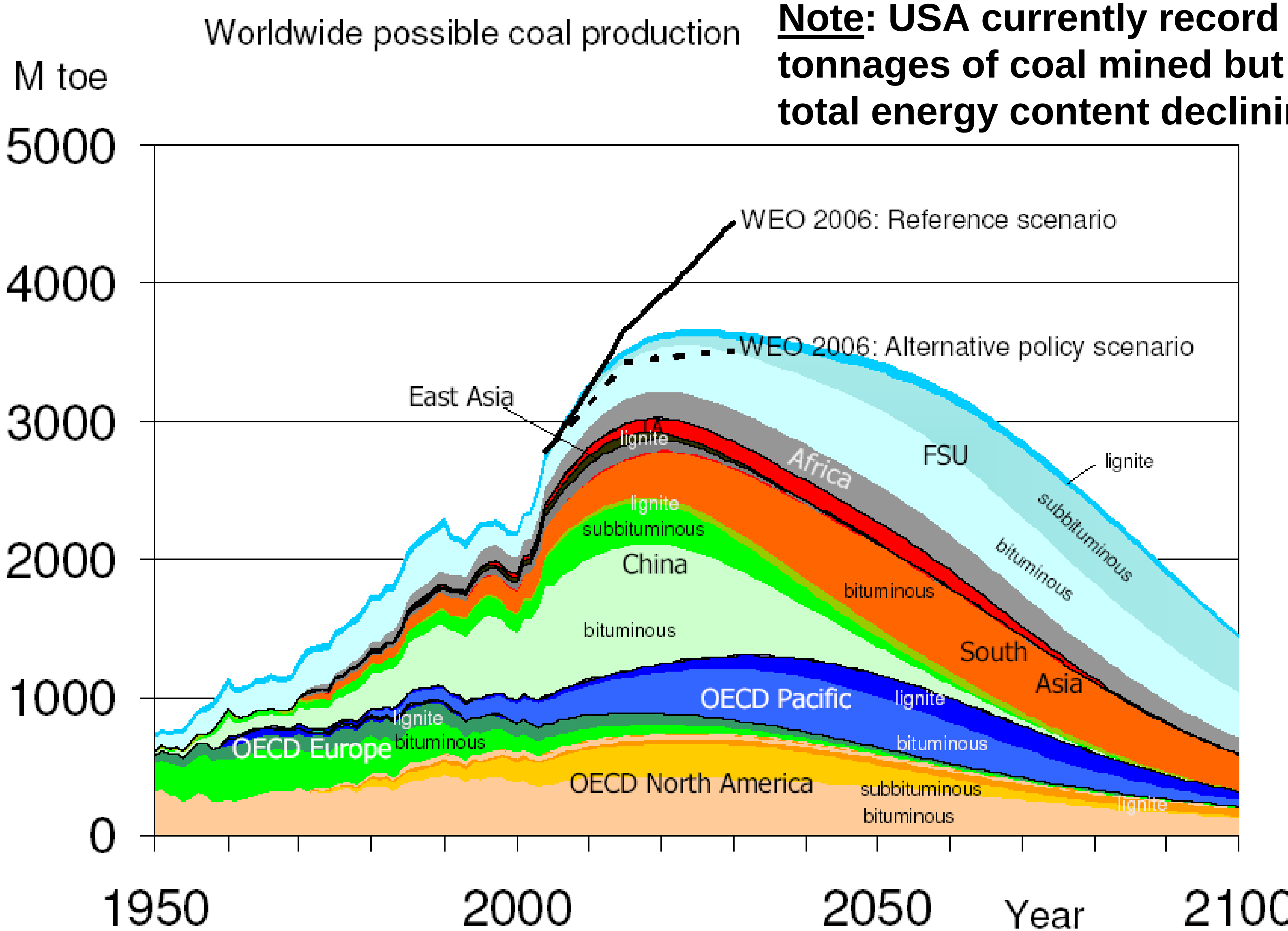
Uppsala Forecast of Global Peak Coal, 2008



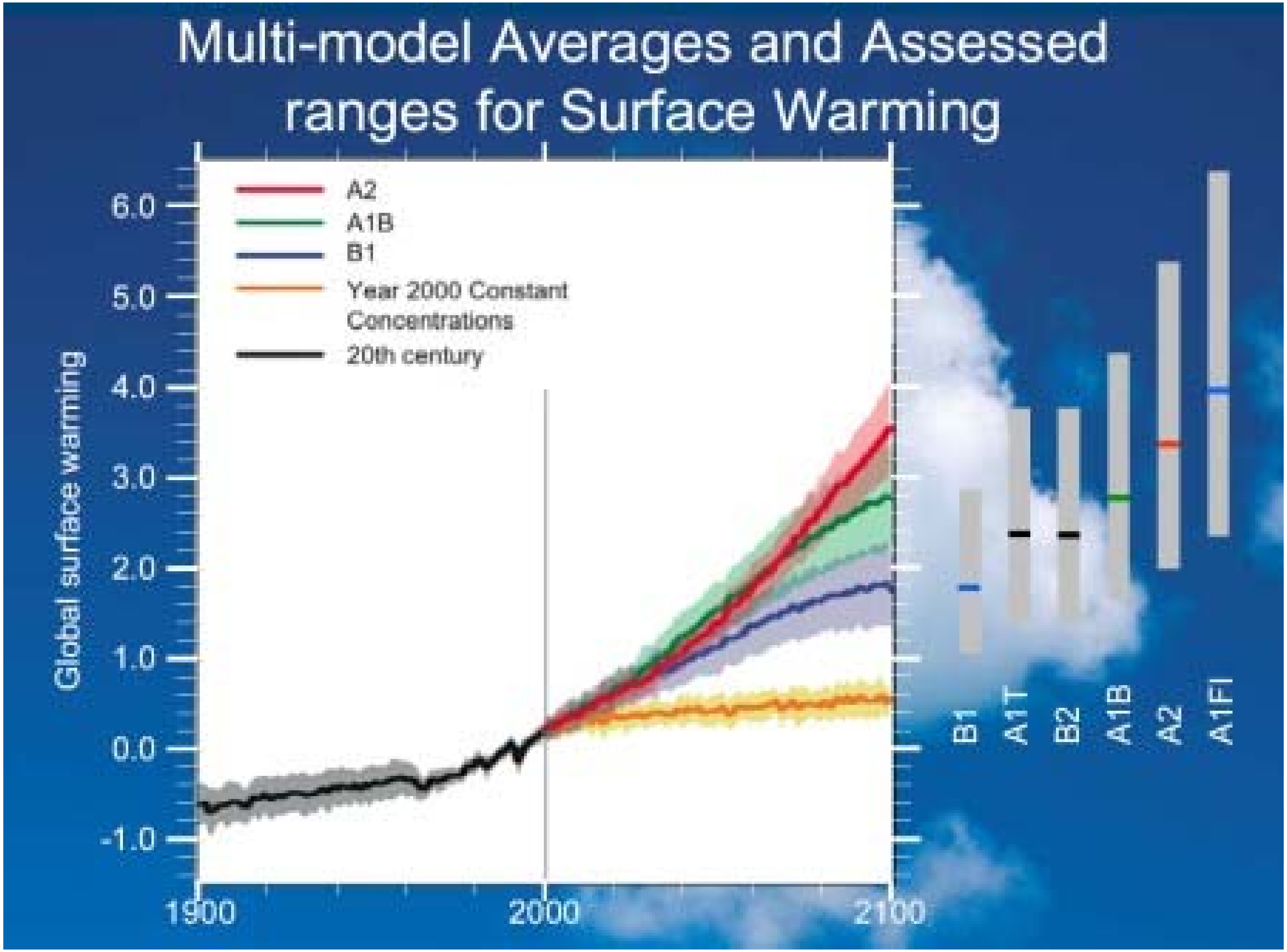
www.tsl.uu.se/uhdsg/Publications/Coalarticle.pdf *(from Hook, Zittel, Schindler, Aleklett, 2008)*

Energy Watch Group – "Best" case is a peak around 2025 at about 30% above current production rates

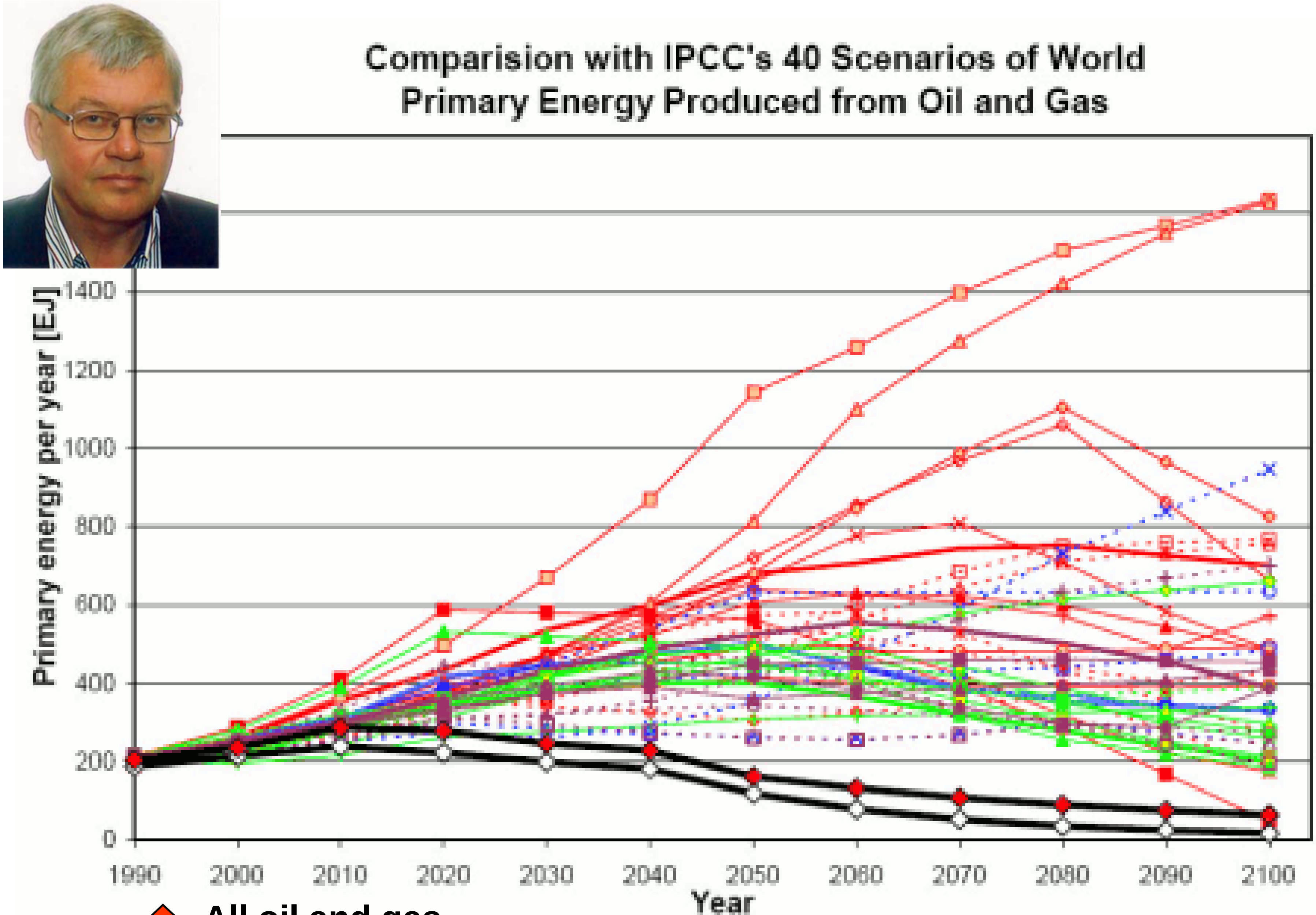
Note: USA currently record tonnages of coal mined but total energy content declining



www.energywatchgroup.org/fileadmin/global/pdf/EWG_Report_Coal_10-07-2007ms.pdf



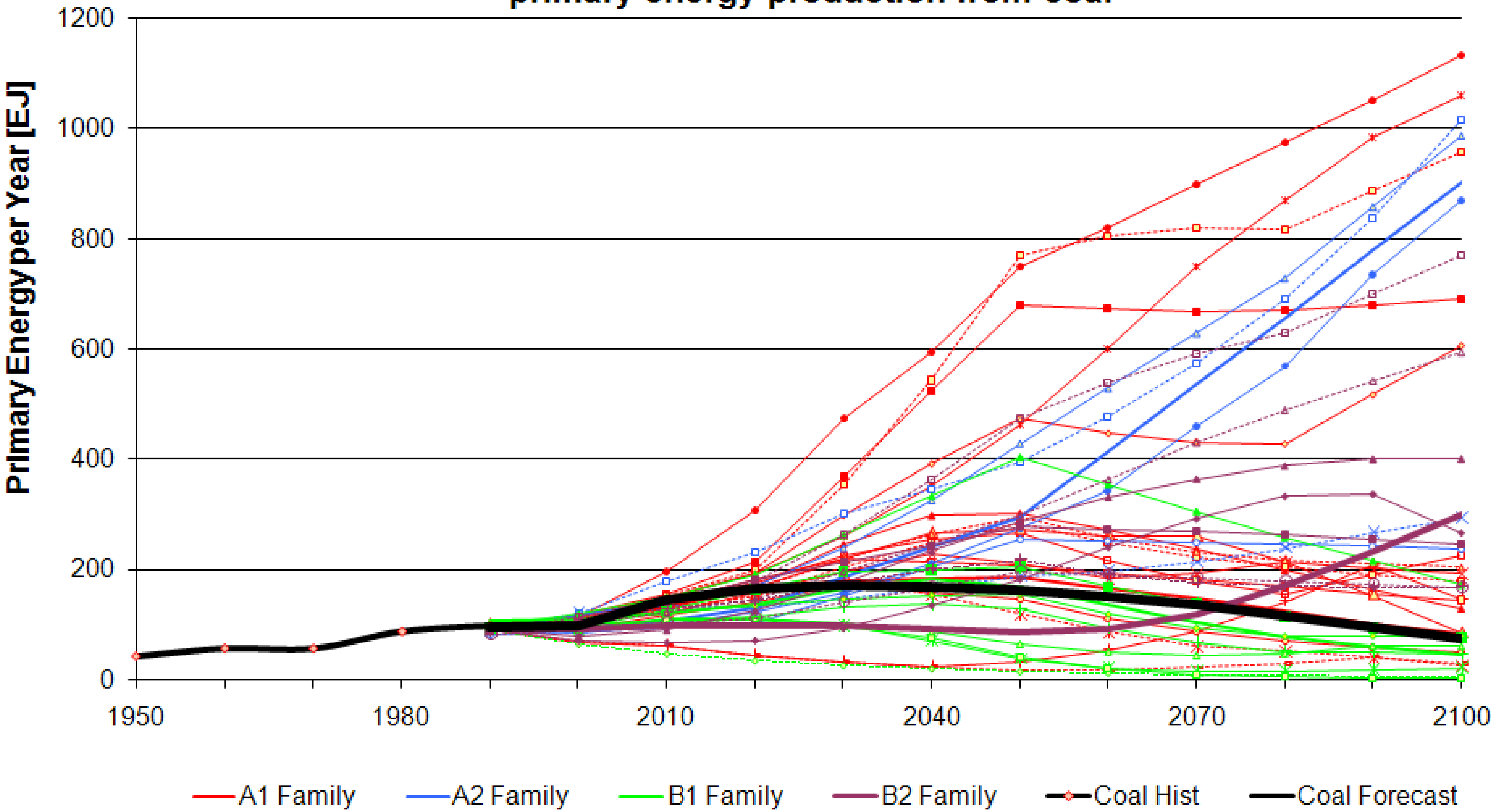
Average temperatures and temperature ranges predicted in different IPCC scenario families (<u>Note: These are politically-acceptable visions of the future of world civilization</u>).



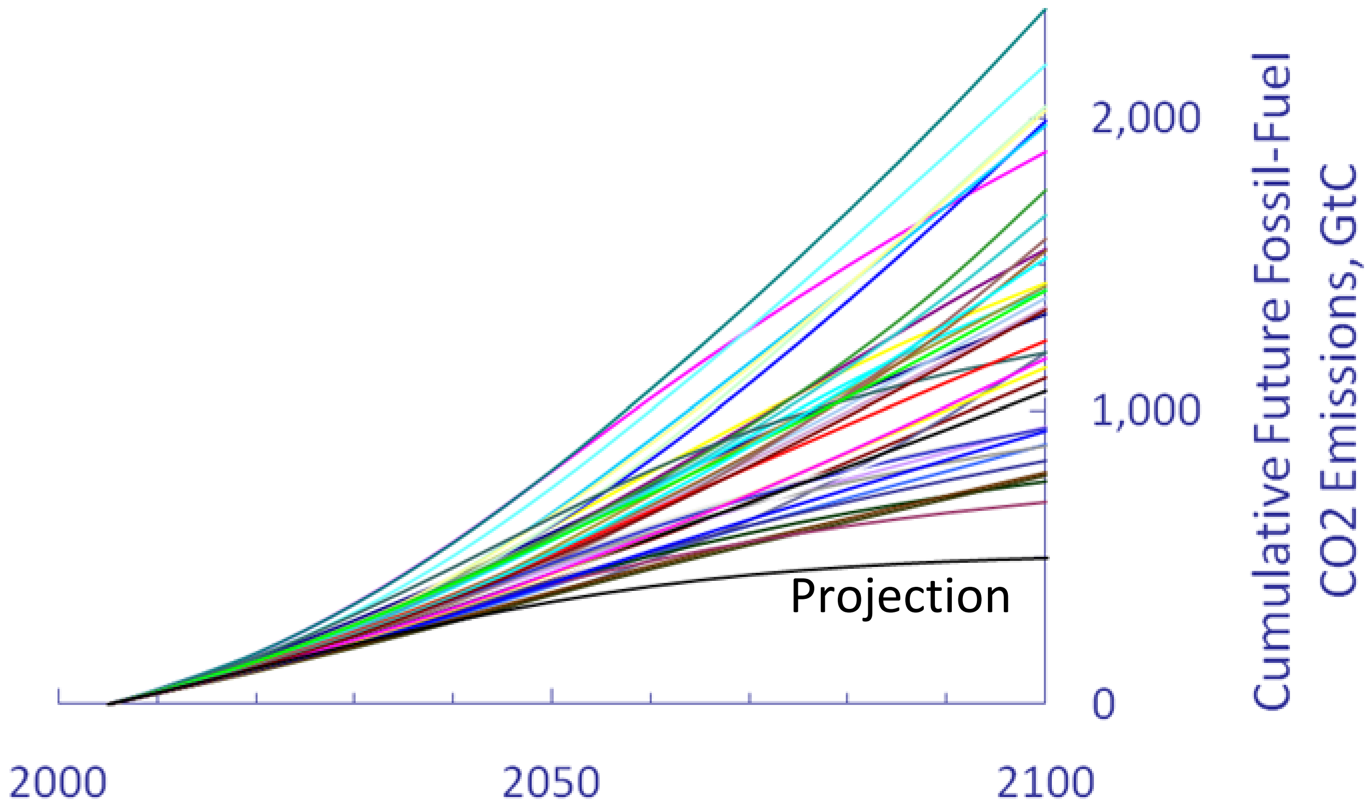
◆ **All oil and gas**

◇ **“Regular” oil and gas**

Comparison with IPCC's 40 scenarios of world primary energy production from coal



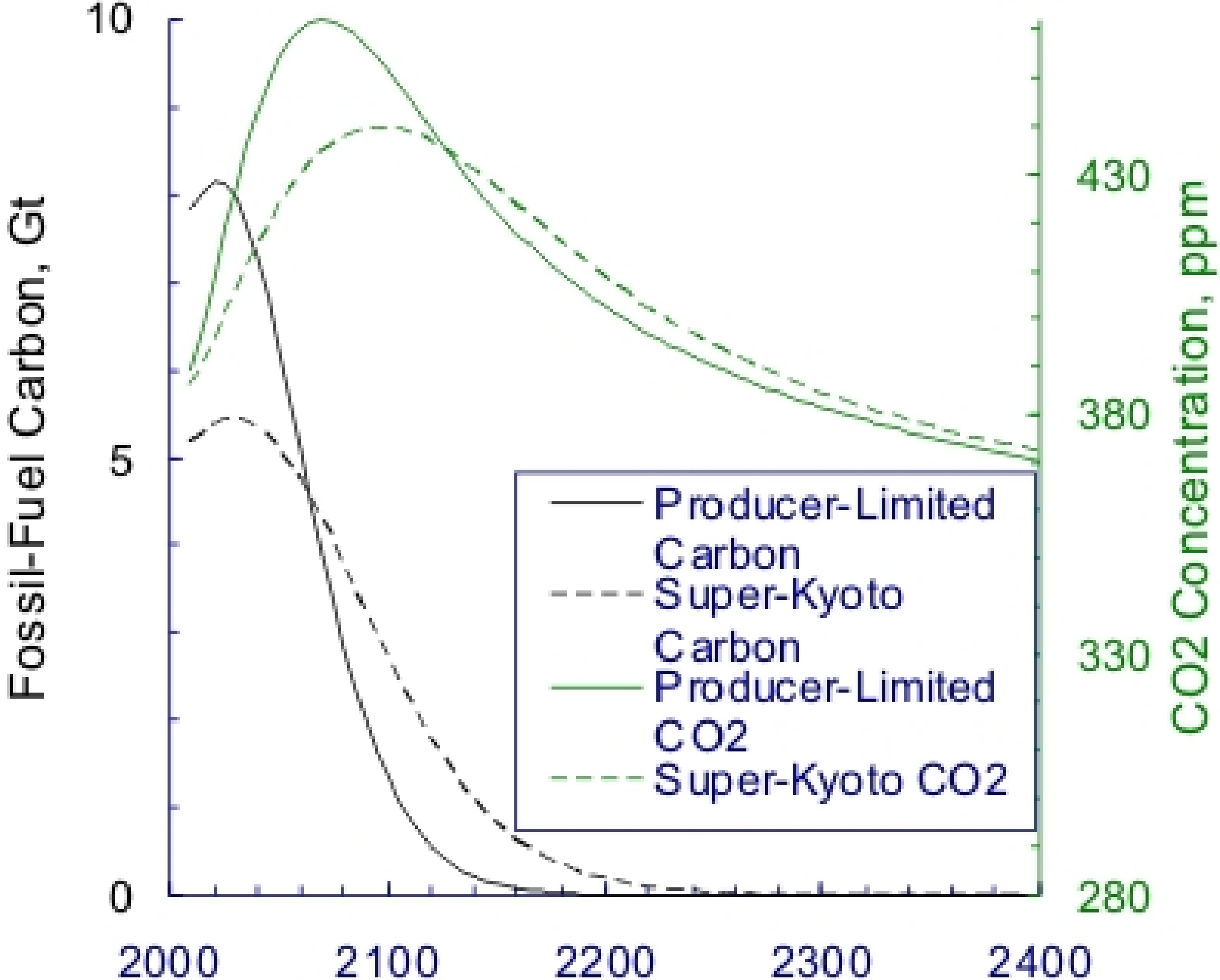
Comparison with the IPCC Scenarios



From the IPCC: "… 40 SRES scenarios together encompass the current range of uncertainties"

Our projection has lower emissions than any of the IPCC scenarios

Jean Laherrere was the first to call attention to this situation



http://www.theoildrum.com/node/2697

Other calculations from Rutledge

Predicts 90% of all fossil fuels consumed by 2076.

Peak of all fossil fuels is 2019.

Maximum possible atmospheric CO_2 = 460ppm

Future temperature rise from MAGICC simulation = 1.7°C

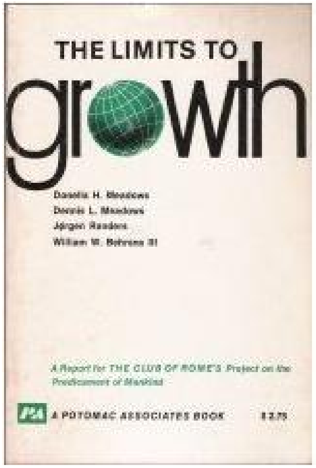
Due to the persistence of CO_2 in the atmosphere, the rate of burning makes little difference to the long term (hundreds of years) CO_2 levels in the atmosphere. Only reducing the total amount burned makes a difference.

Conclusions:

- Limited availability of fossil fuels will still allow dangerous climate change (especially for Australia) but **the IPCC scenarios are impossible**.

- "**Don't wait to mitigate**" - Delaying crash-programme of conversion to renewable energy means that the energy to do this later will not be available and so it will never be done (pain now means much less pain later).

ADDITIONAL SLIDES



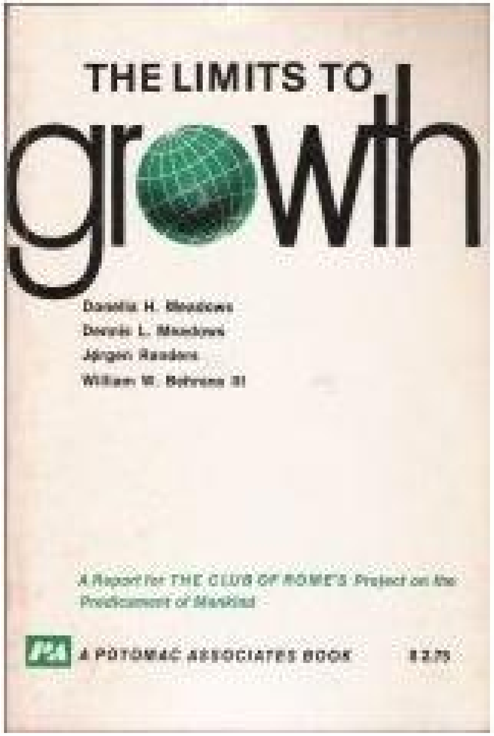
A COMPARISON OF THE LIMITS TO GROWTH WITH 30 YEARS OF REALITY by Graham Turner (CSIRO)

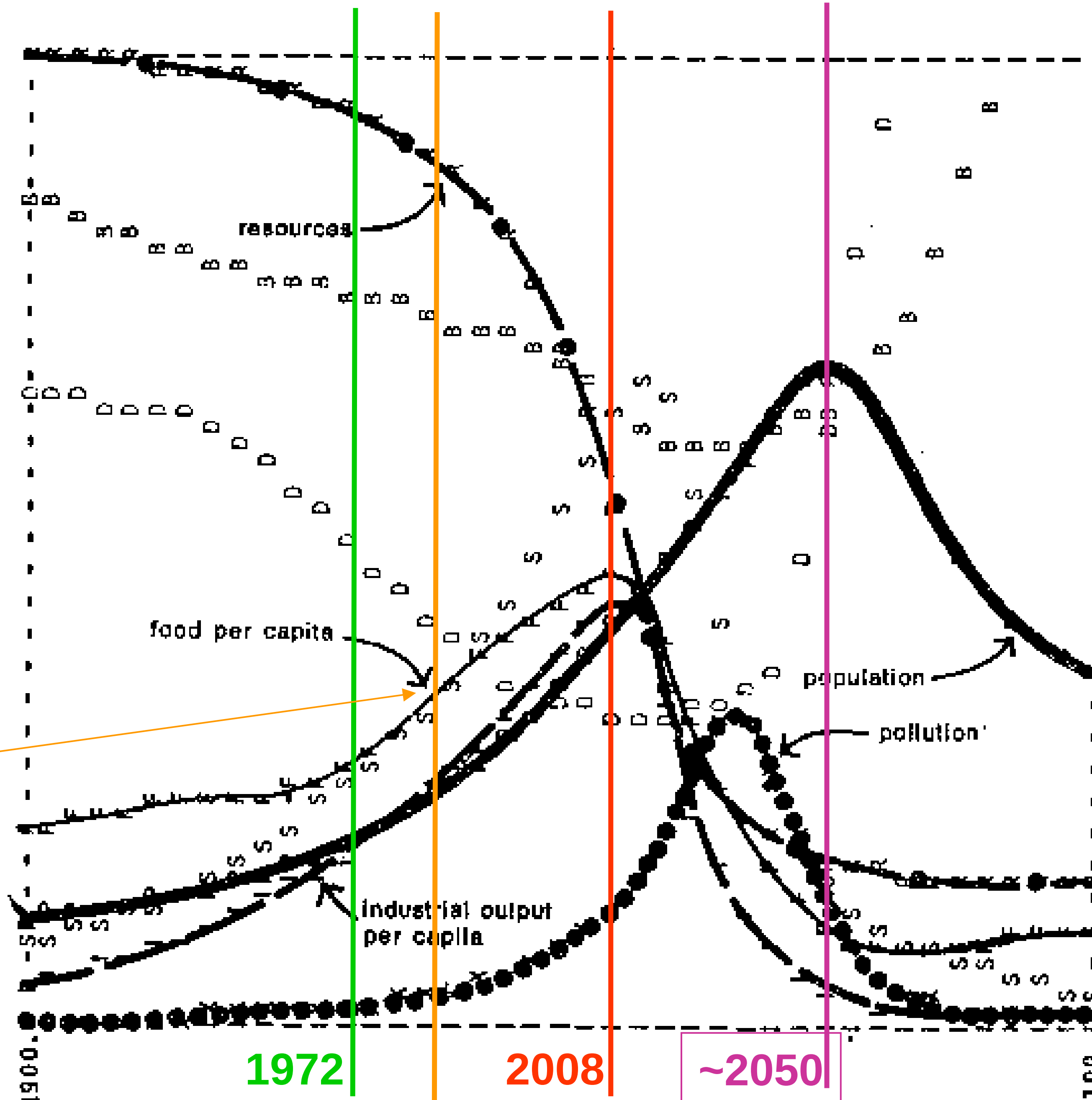
In 1972, the Club of Rome's infamous report *The Limits to Growth* (Meadows et al., 1972) presented some challenging scenarios for global sustainability, based on a system dynamics computer model to simulate the interactions of five global economic subsystems, namely: population, food production, industrial production, pollution, and consumption of non-renewable natural resources.

Contrary to popular belief, *The Limits to Growth* scenarios by the team of analysts from the Massachusetts Institute of Technology did not predict world collapse by the end of the 20th Century.

This paper focuses on a comparison of recently collated historical data for 1970–2000 with scenarios presented in *The Limits to Growth*. The analysis shows that 30 years of historical data compares favourably with key features of a business-as-usual scenario called the "standard run" scenario, which results in collapse of the global system midway through the 21st Century. The data does not compare well with other scenarios involving comprehensive use of technology or stabilizing behaviour and policies. The results indicate the particular importance of understanding and controlling global pollution.

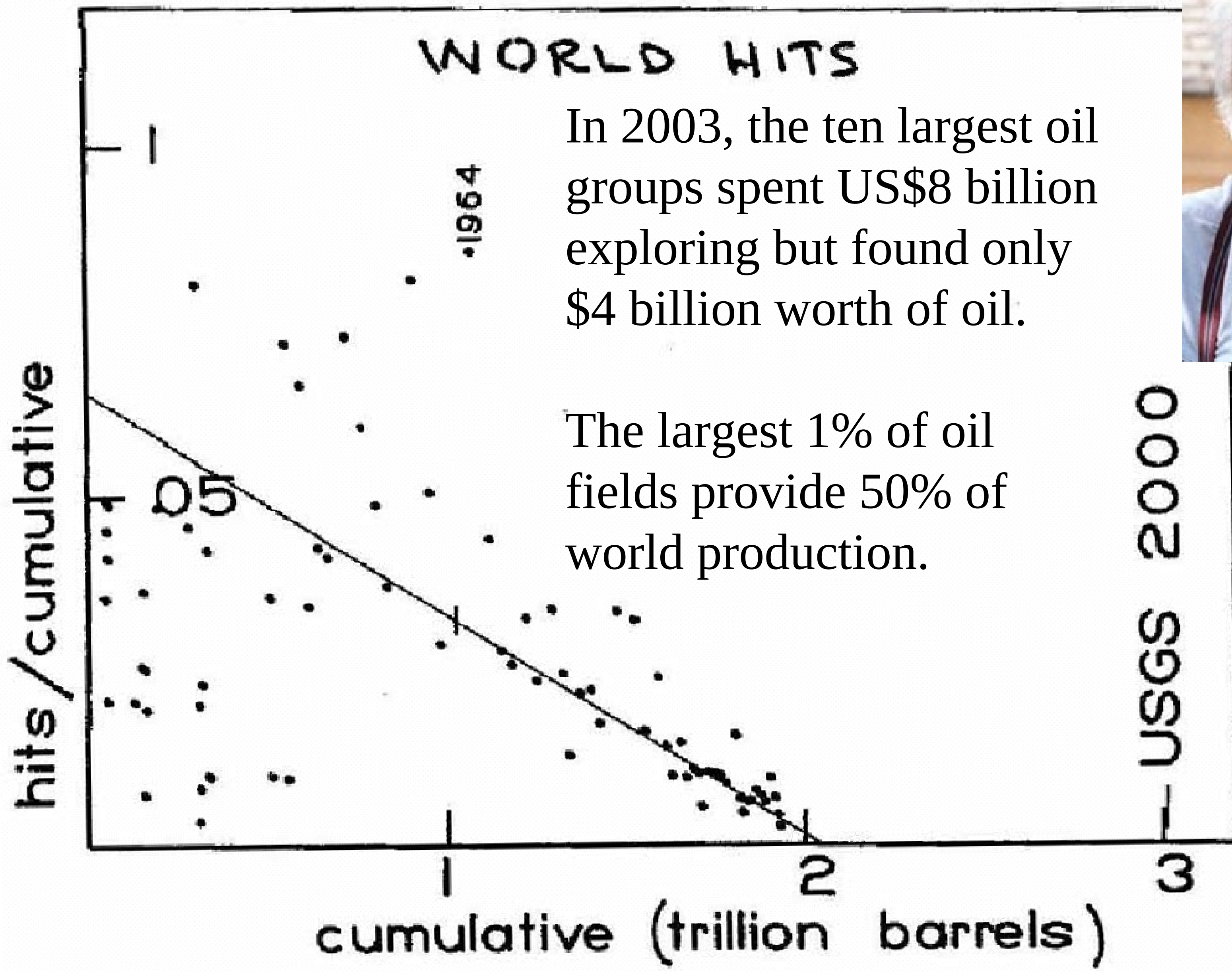
Figure 35 WORLD MODEL STANDARD RUN





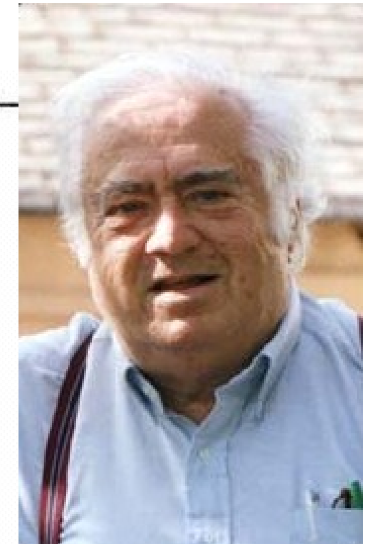
Note:
World grain (food) per capita actually peaked in 1984
(source USDA)

Oil Discovery



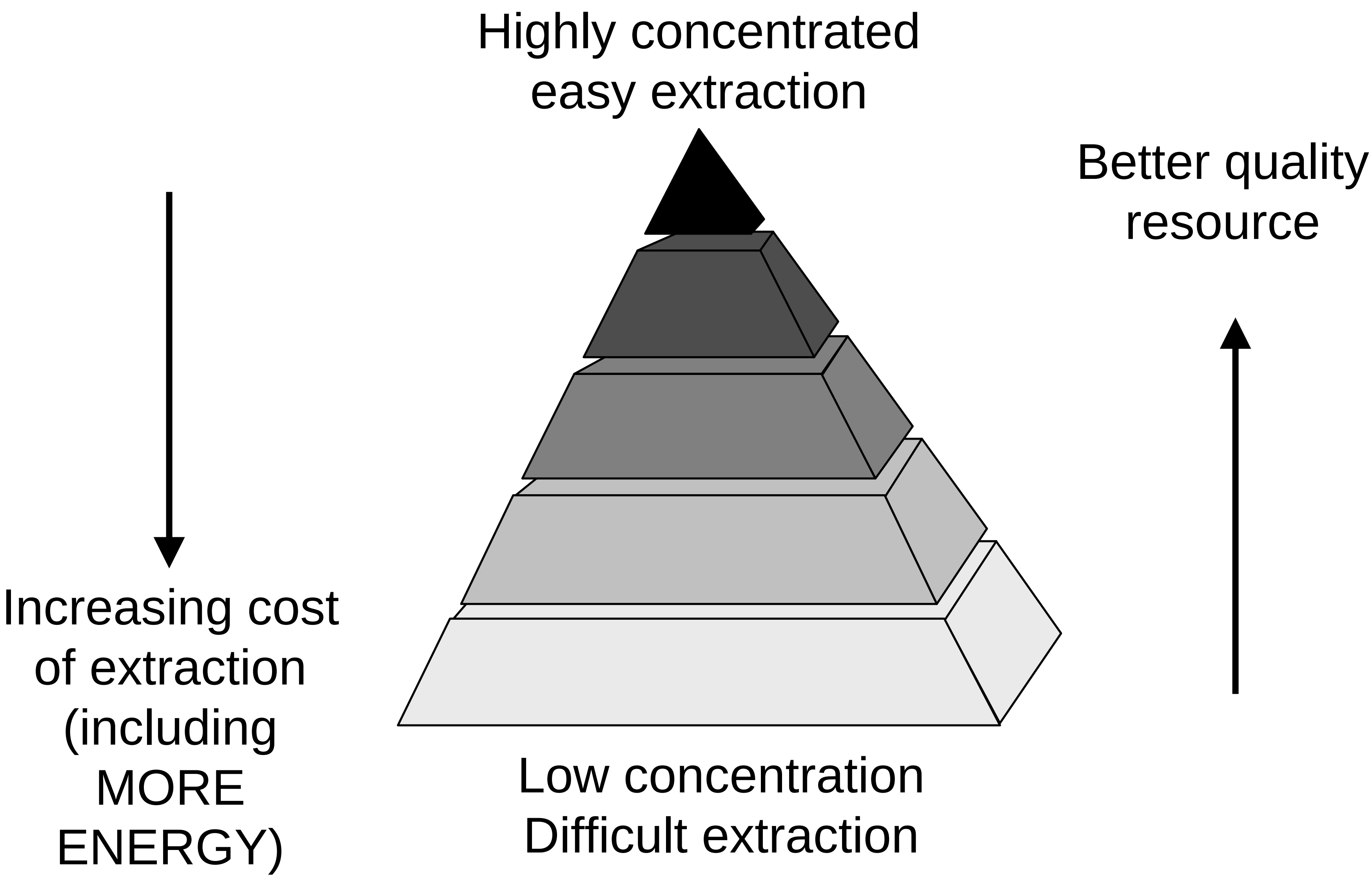
In 2003, the ten largest oil groups spent US$8 billion exploring but found only $4 billion worth of oil.

The largest 1% of oil fields provide 50% of world production.



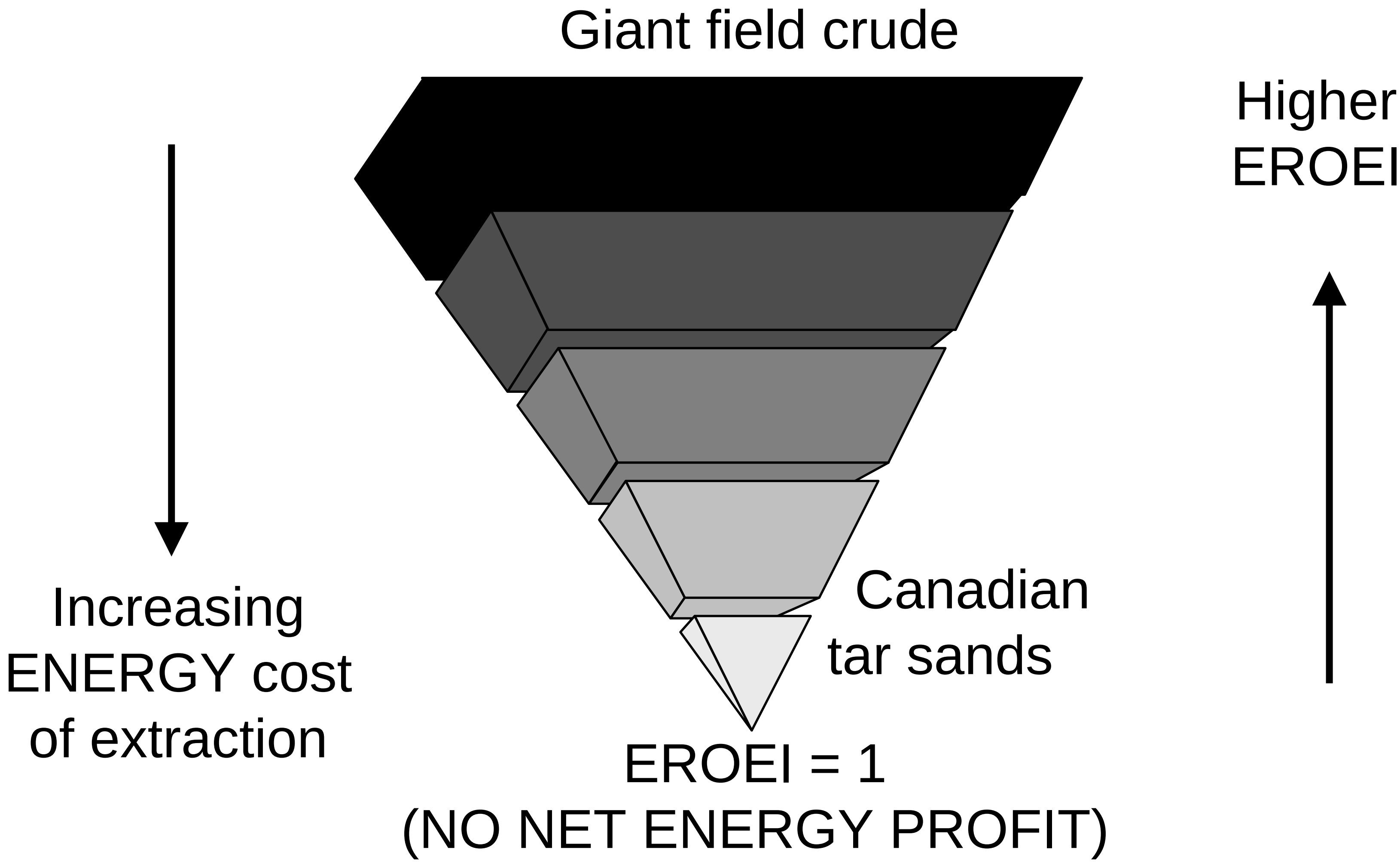
(Deffeyes SPE presentation 2004)

Resource Pyramid
(for minerals)

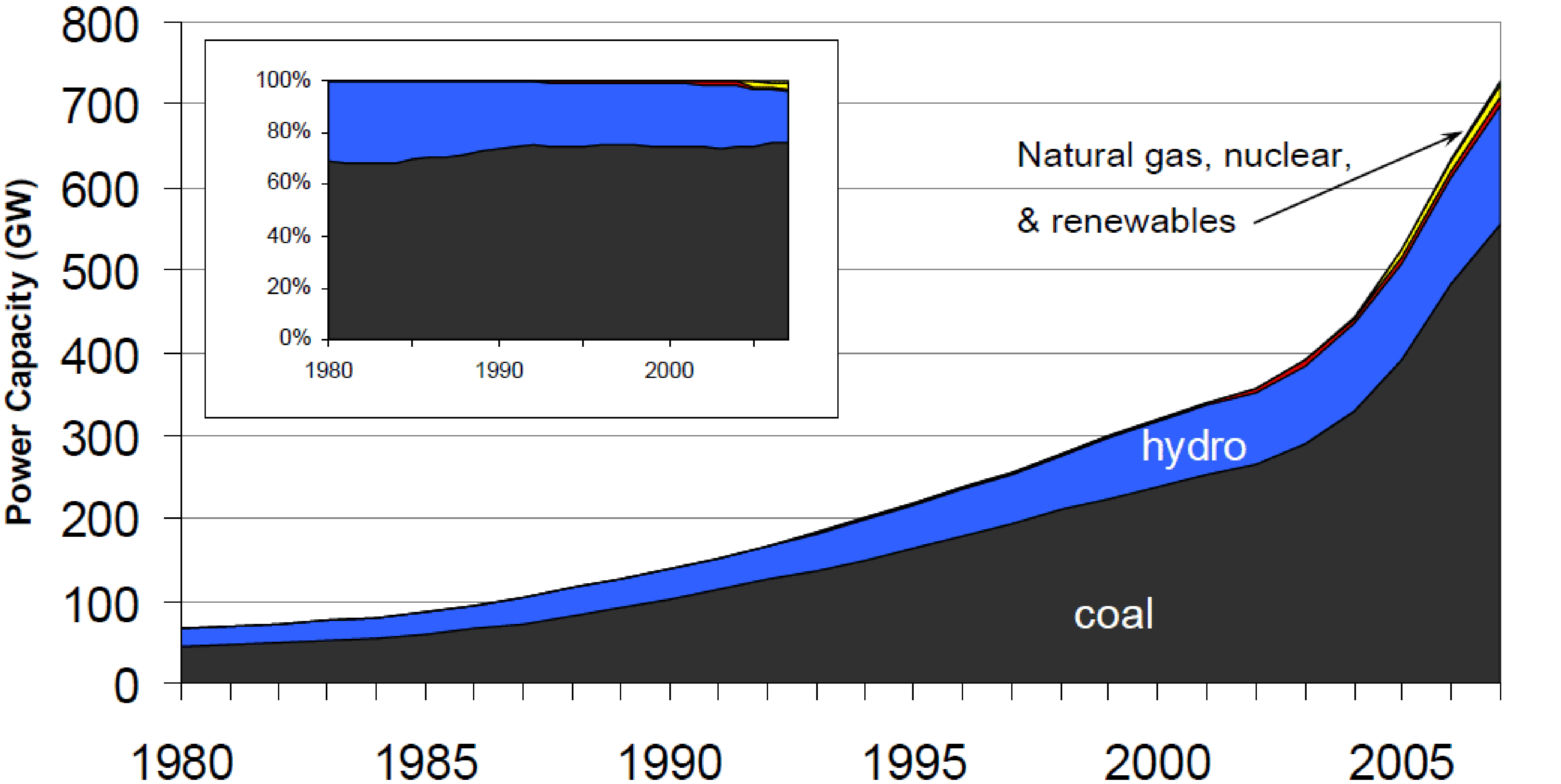


Resource Pyramid
(for energy)

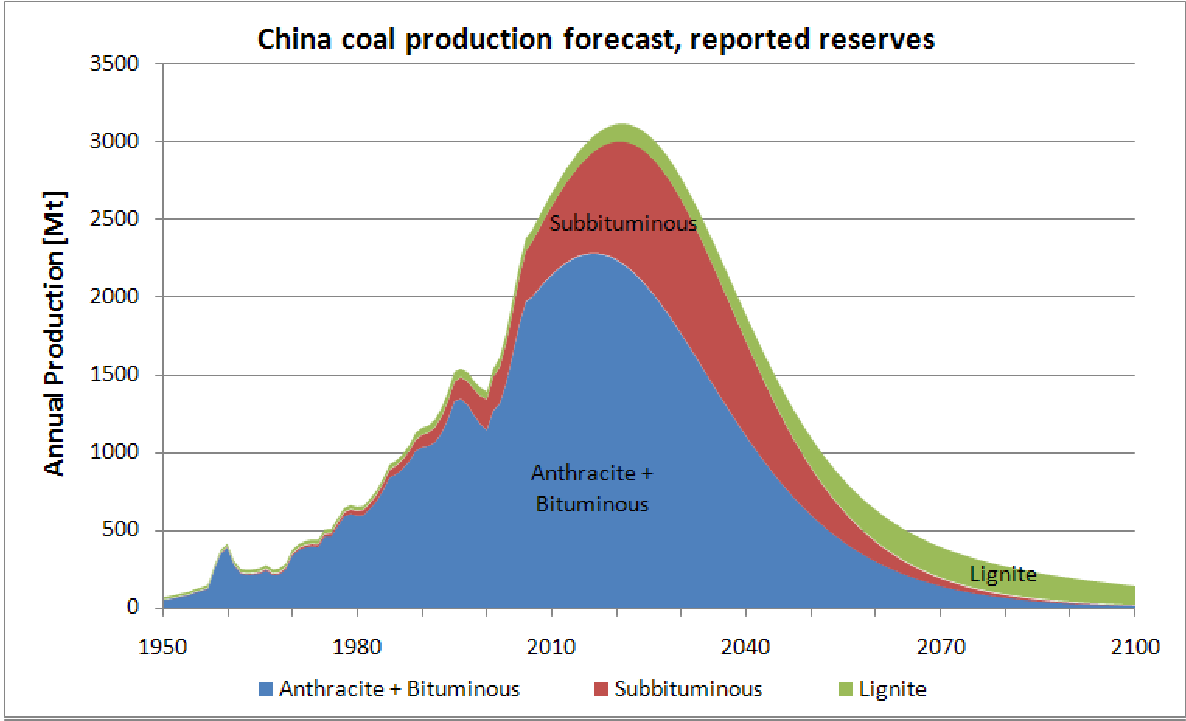
The largest 1% of oil fields provide 50% of world production.

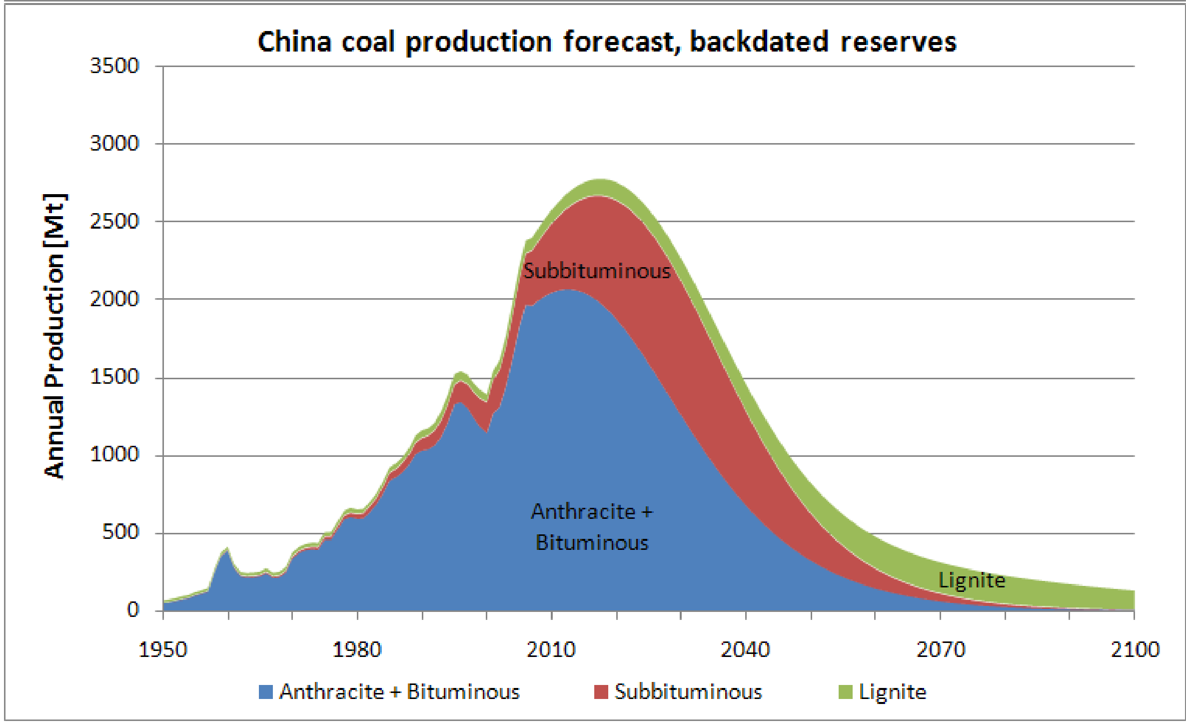


How is China generating electricity?



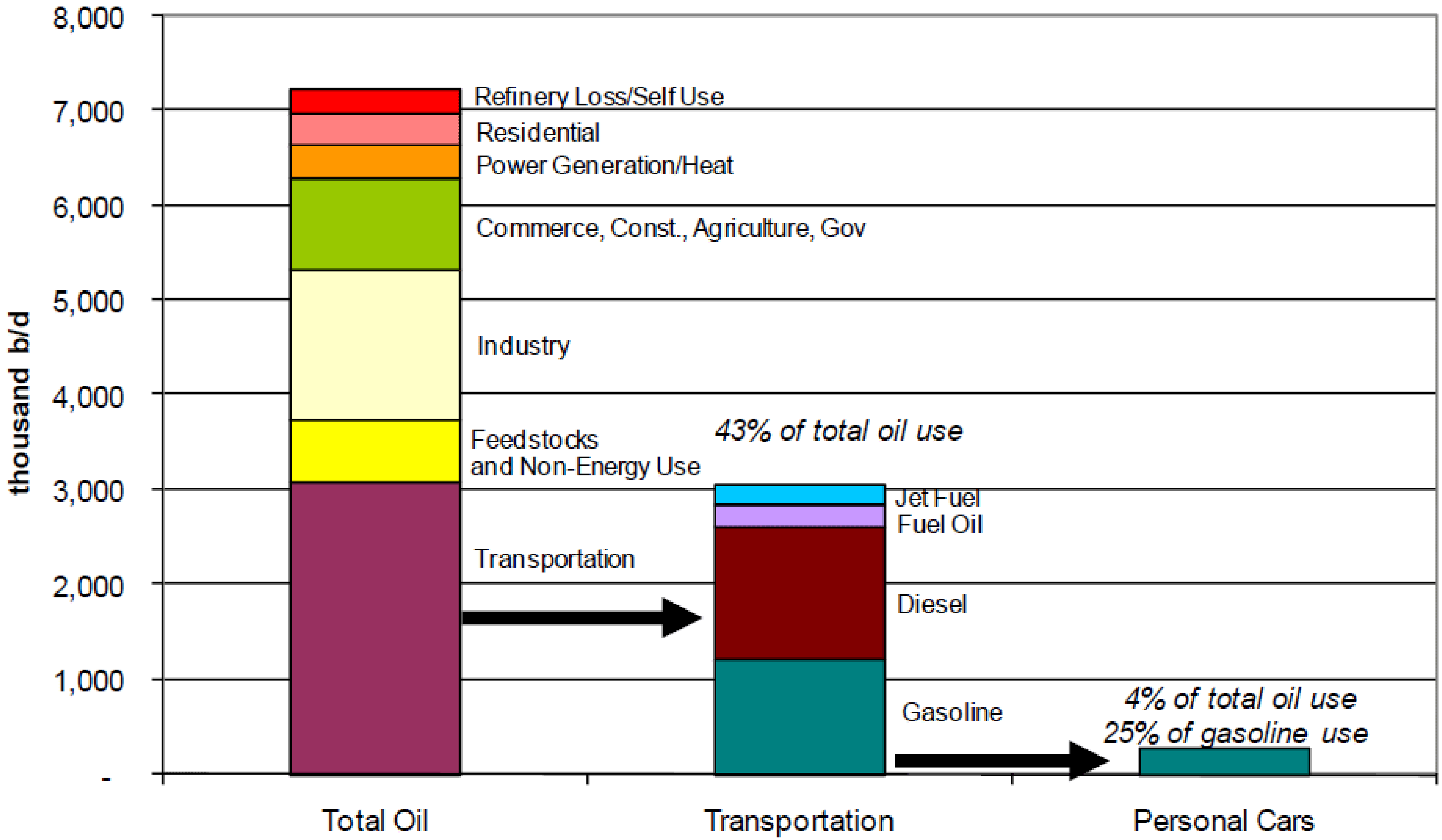
David Fridley, ASPO-USA conference 2008





www.tsl.uu.se/uhdsg/Publications/Coalarticle.pdf

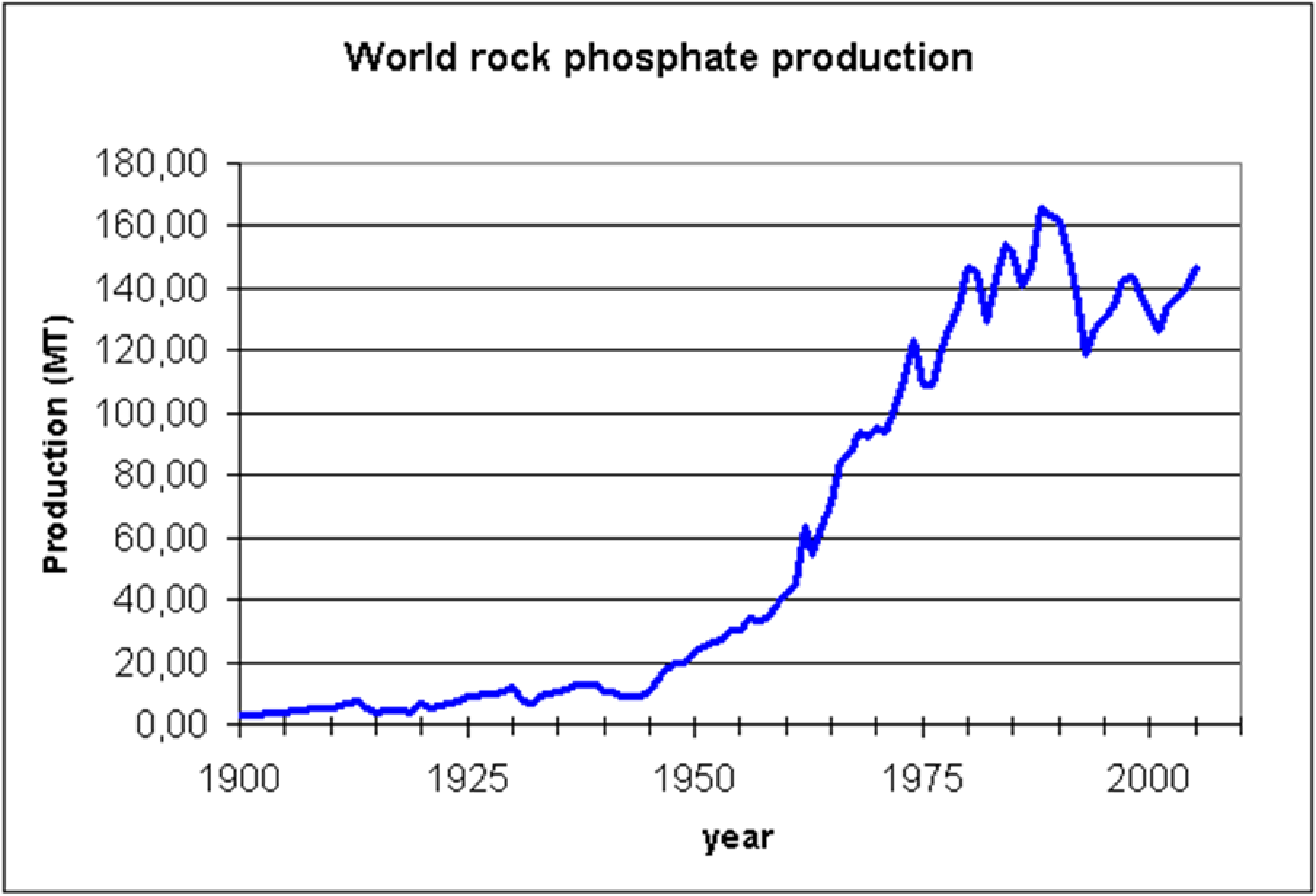
Oil consumption in China supports fewer discretionary activities than in other large consuming countries



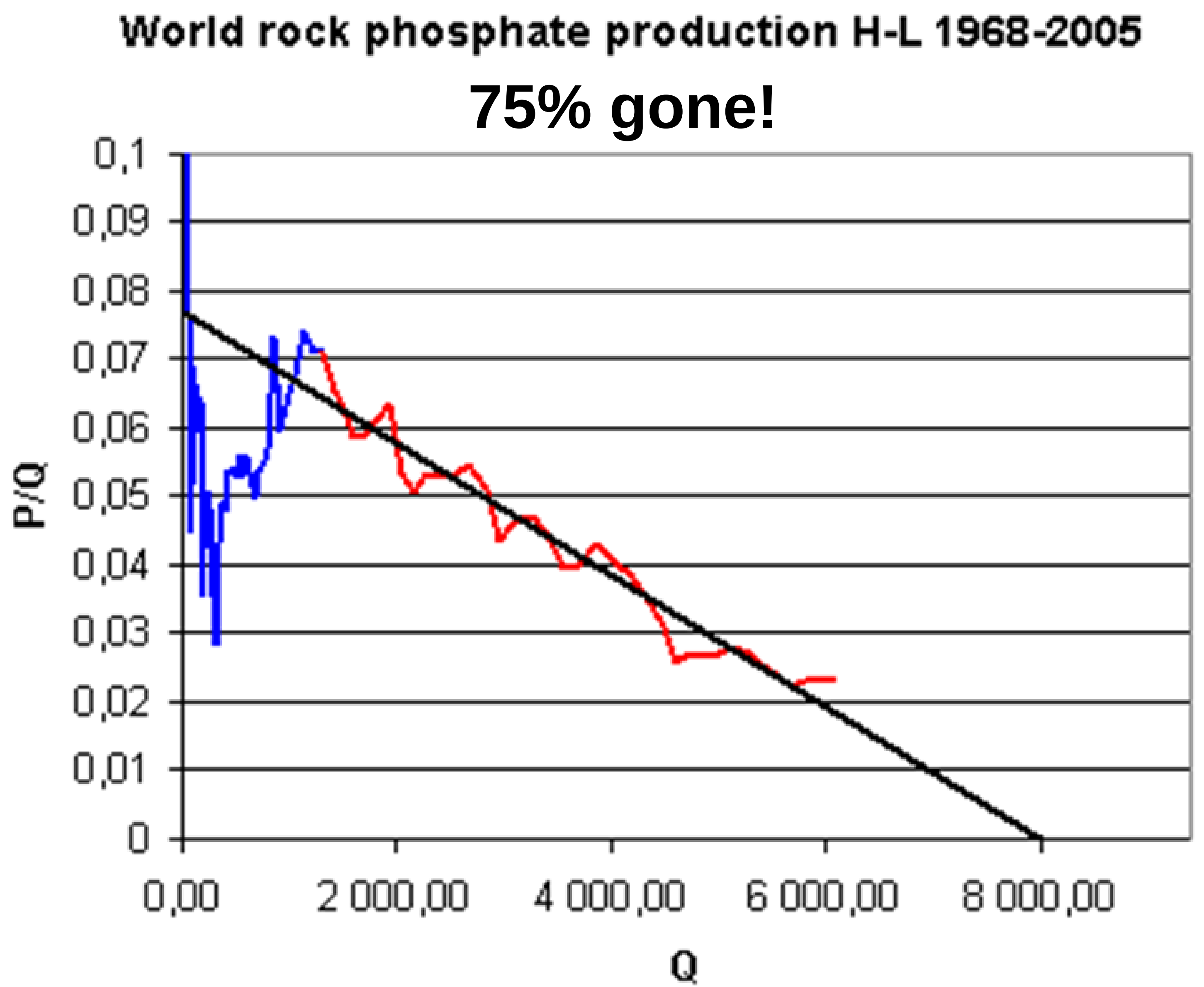
Composition of use in 2006

David Fridley, ASPO-USA conference 2008

BERKELEY LAB



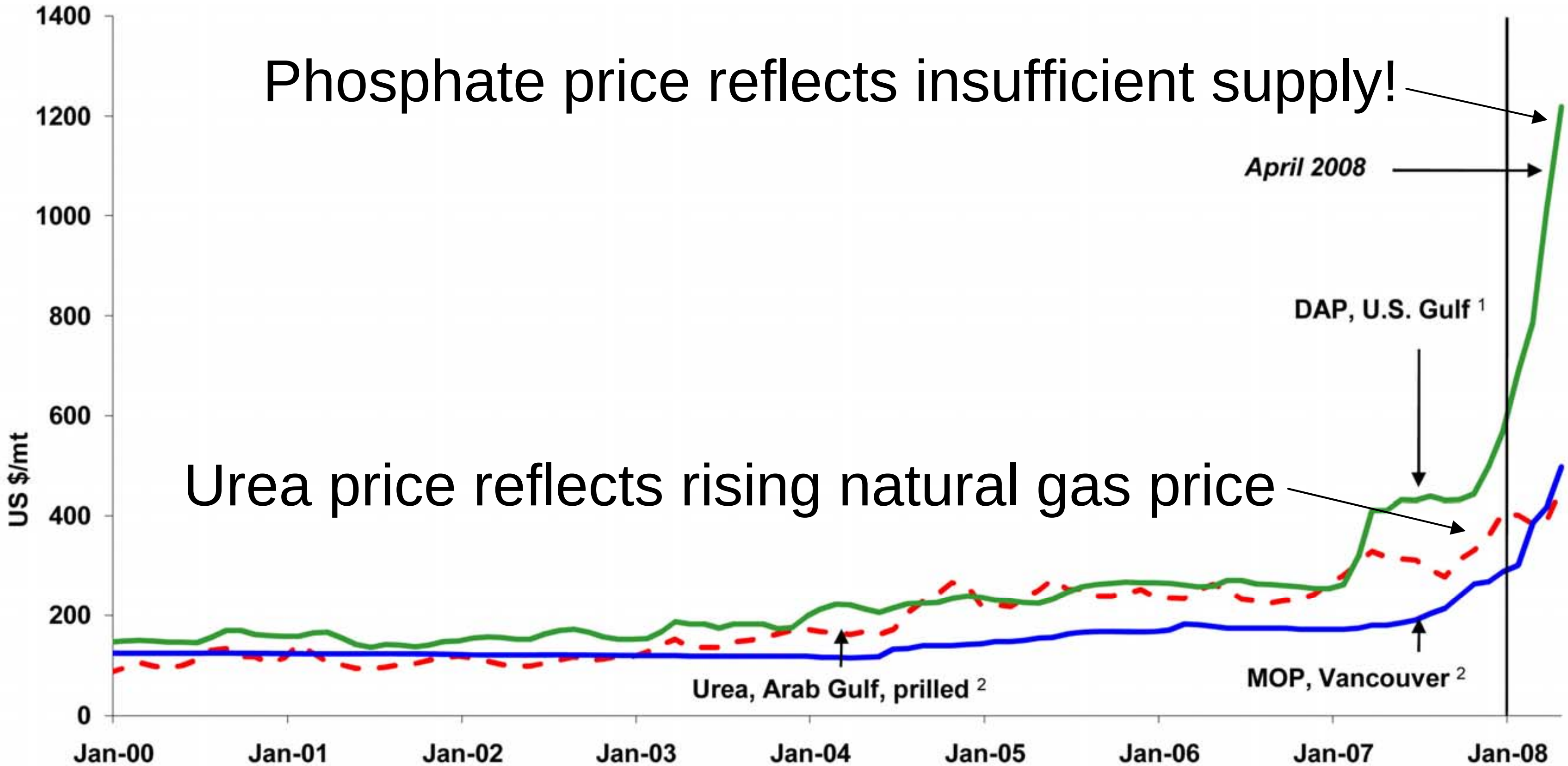
from Peak Phosphorous, by Déry and Anderson, August 2007, http://www.energybulletin.net/33164.html



What is the future of western industrial agriculture?

from Peak Phosphorous, by Déry and Anderson, August 2007, http://www.energybulletin.net/33164.html

Fertilizer Prices
(FOB, bulk)
Monthly Averages
January 2000 - April 2008



1. Derived from *Green Markets*. 2. Derived from *FMB Weekly*.

World fertilizer prices, especially diammonium phosphate, rose sharply in 2007 then skyrocketed—off the chart—from January to April 2008. FOB = free on board (average price, with buyer paying freight and insurance, to destination port). DAP = diammonium phosphate. MOP = muriate of potash.

IFDC Graph by IFDC—An International Center for Soil Fertility and Agricultural Development