

Peak Oil:
*The Challenge,
the Possible Responses*

Perth

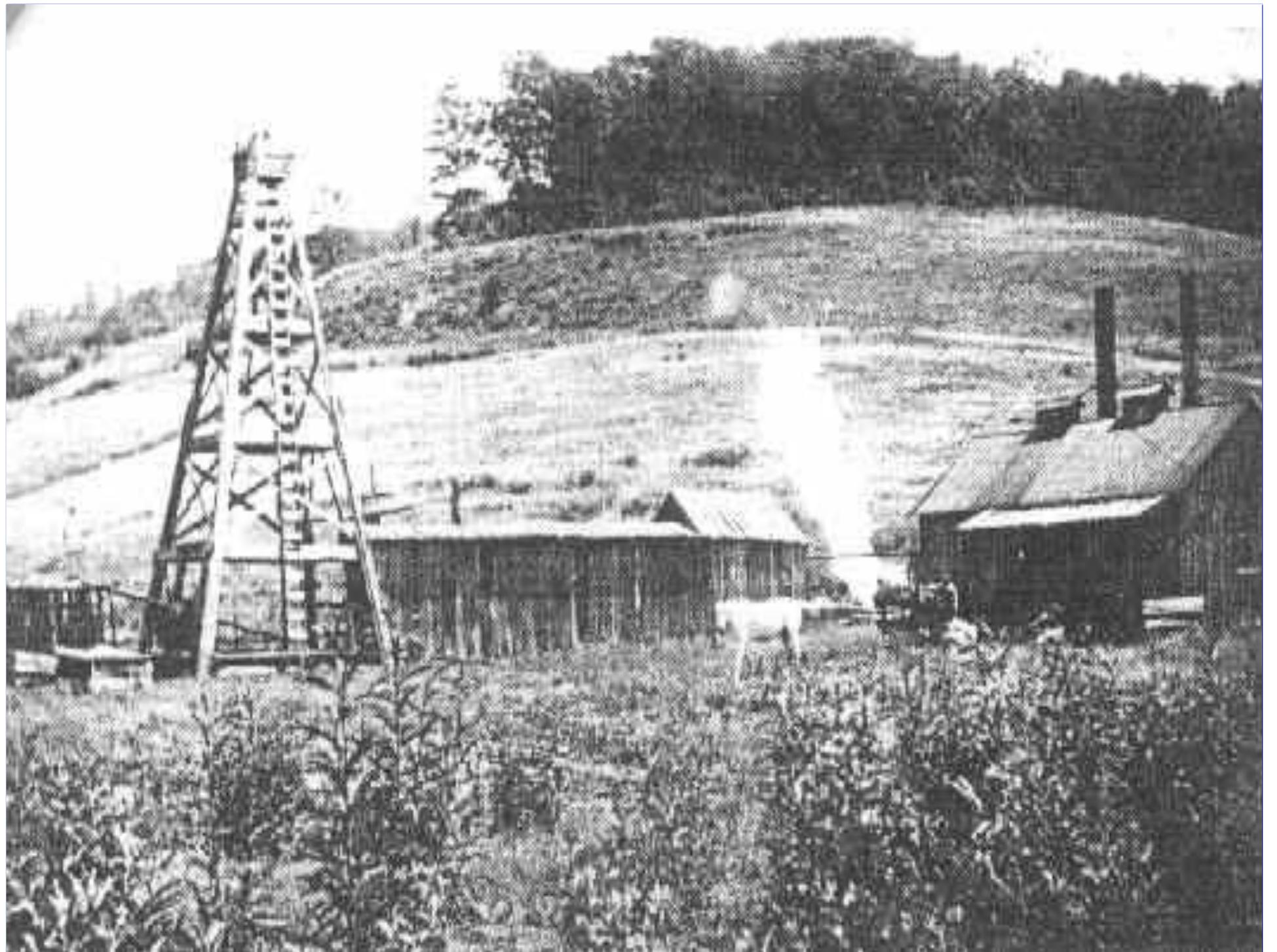
August 24, 2006

Richard Heinberg

The Fossil-Fueled
Industrial Era—

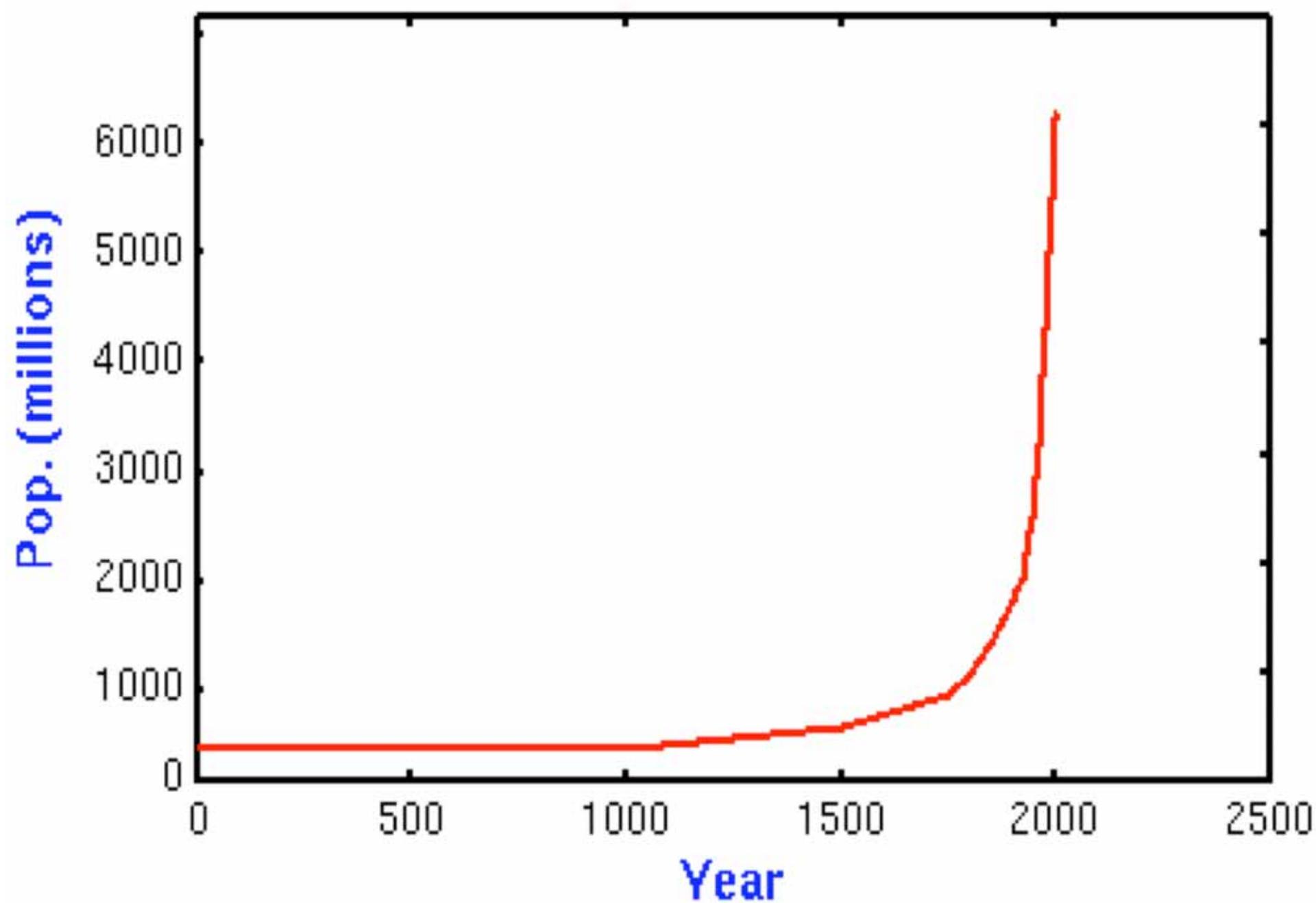
*Winning the
Energy Lottery*

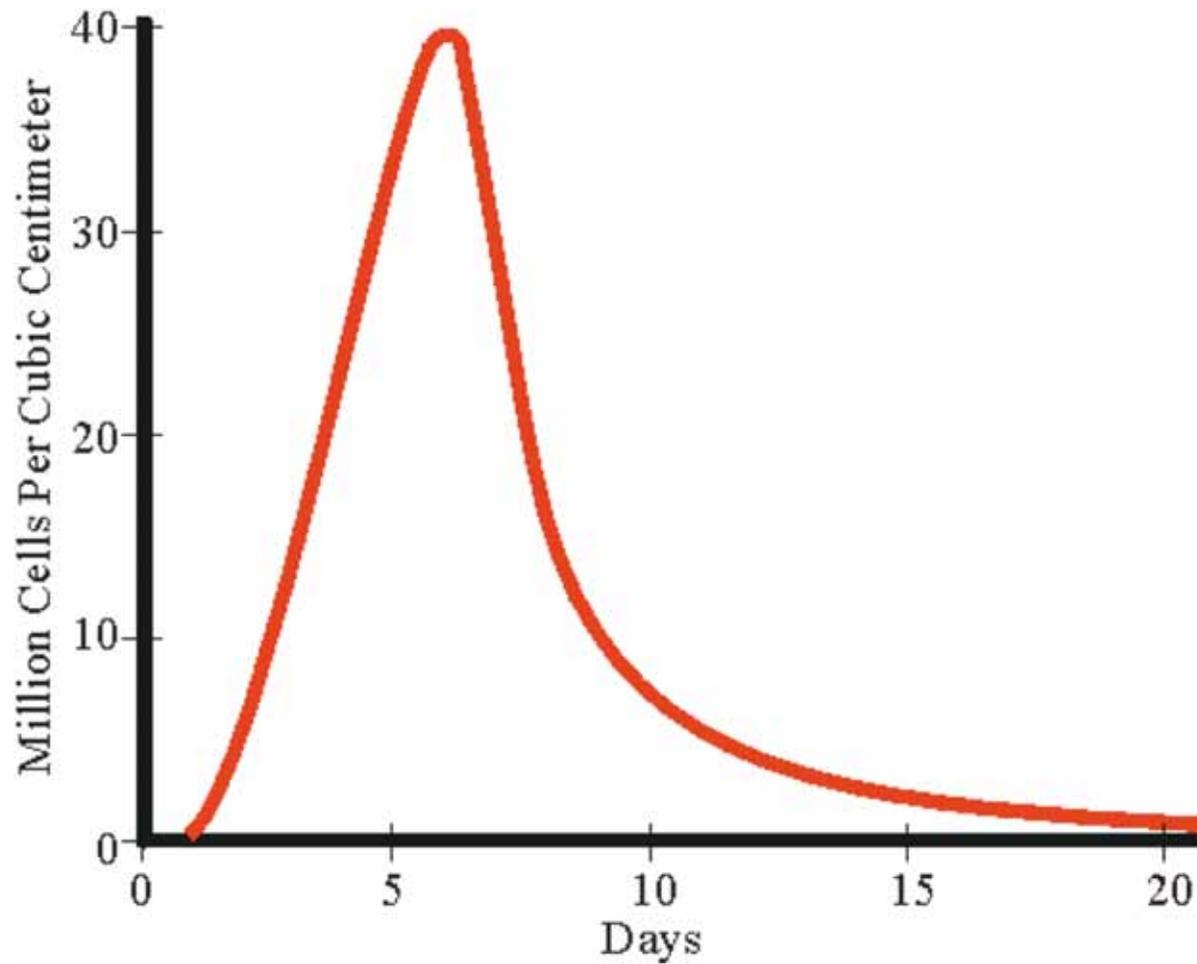






World Population, 1AD-2001



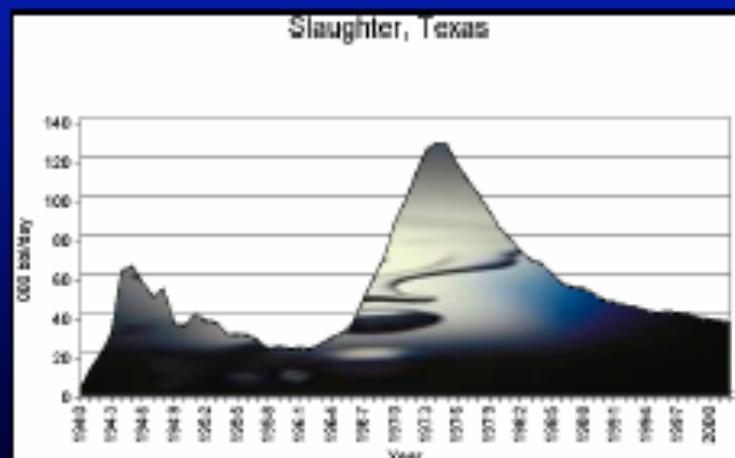
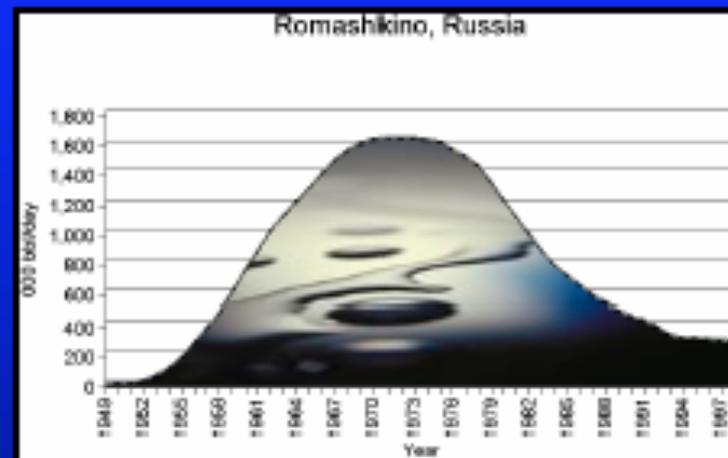
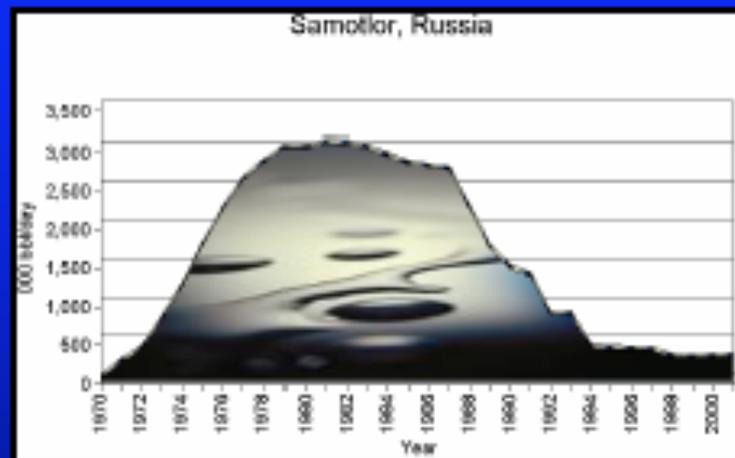


Growth of yeast in a 10% sugar solution

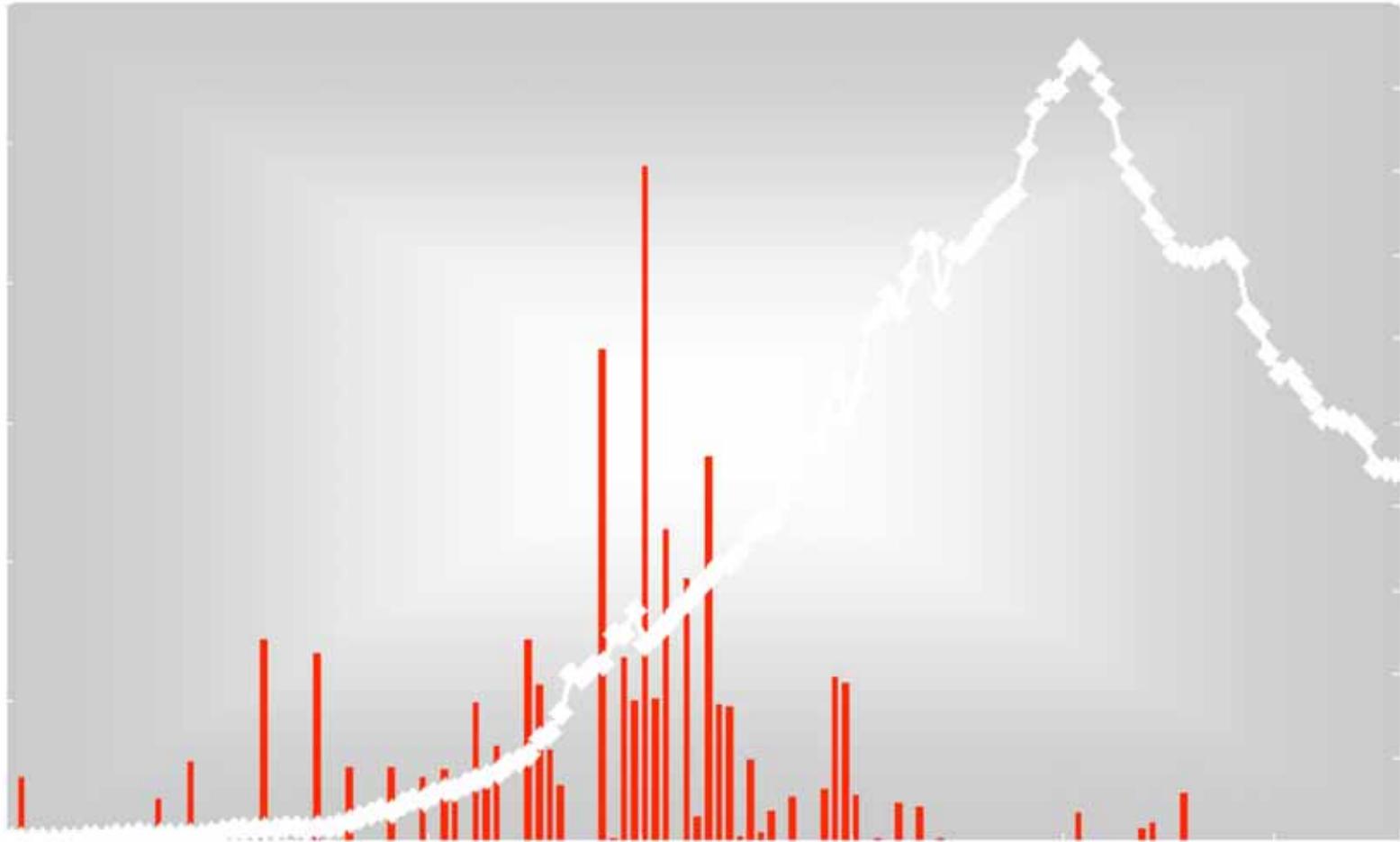
Are people
smarter than
yeast?

*What's all this talk
about "Peak Oil"?*

When Peaking Happens, Declines Come Next

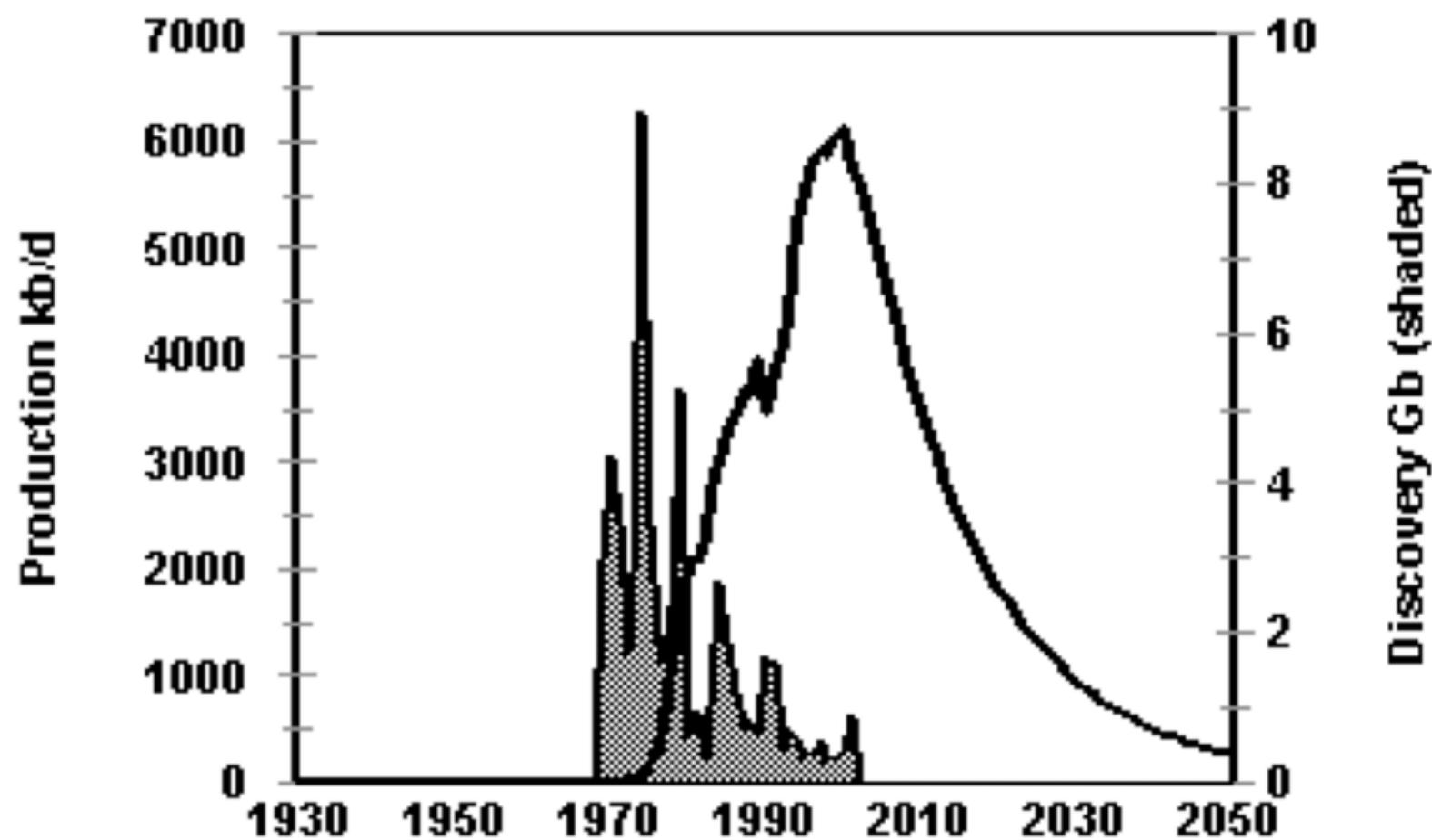


SIMMONS & COMPANY
INTERNATIONAL

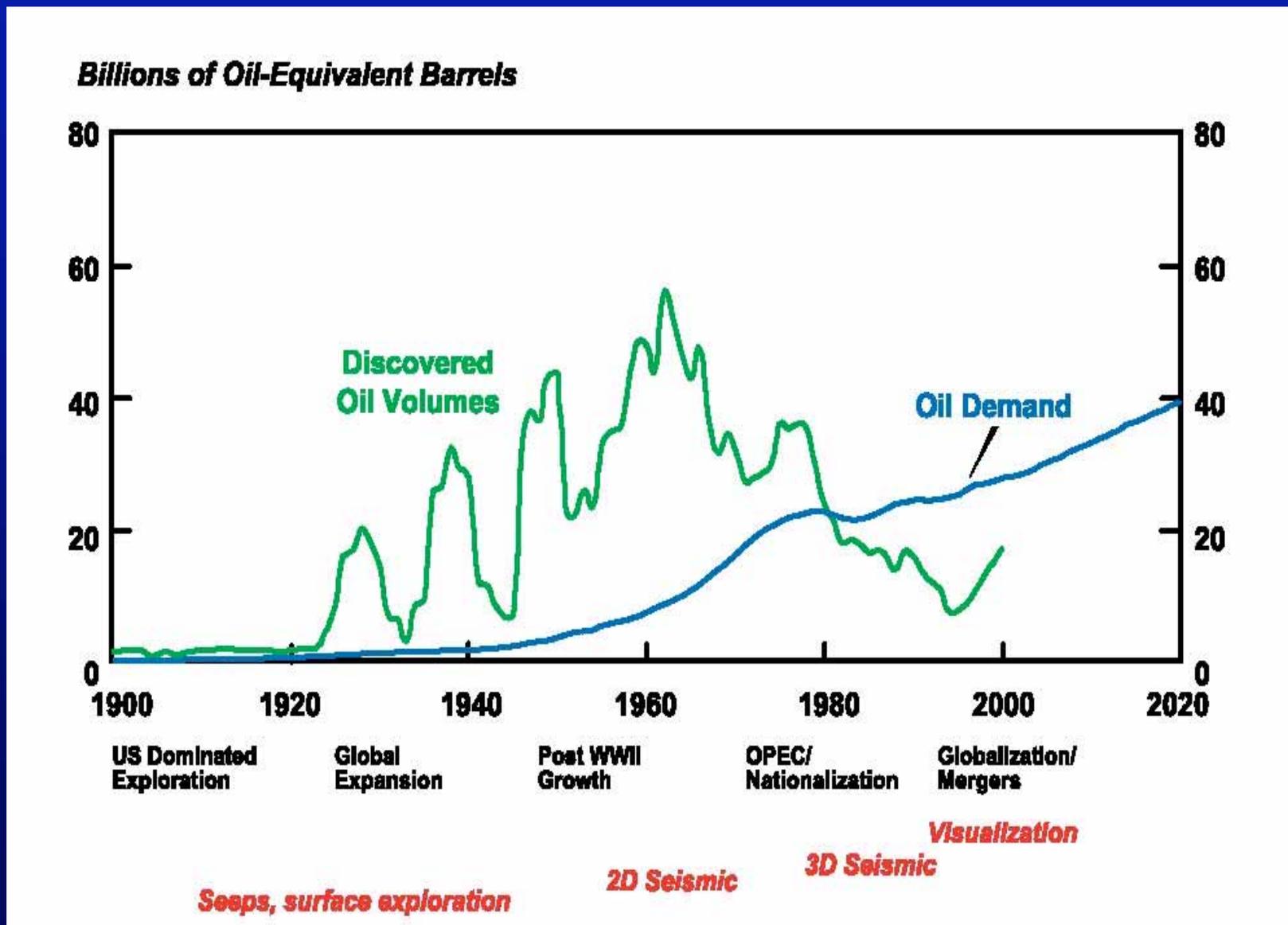


North Sea

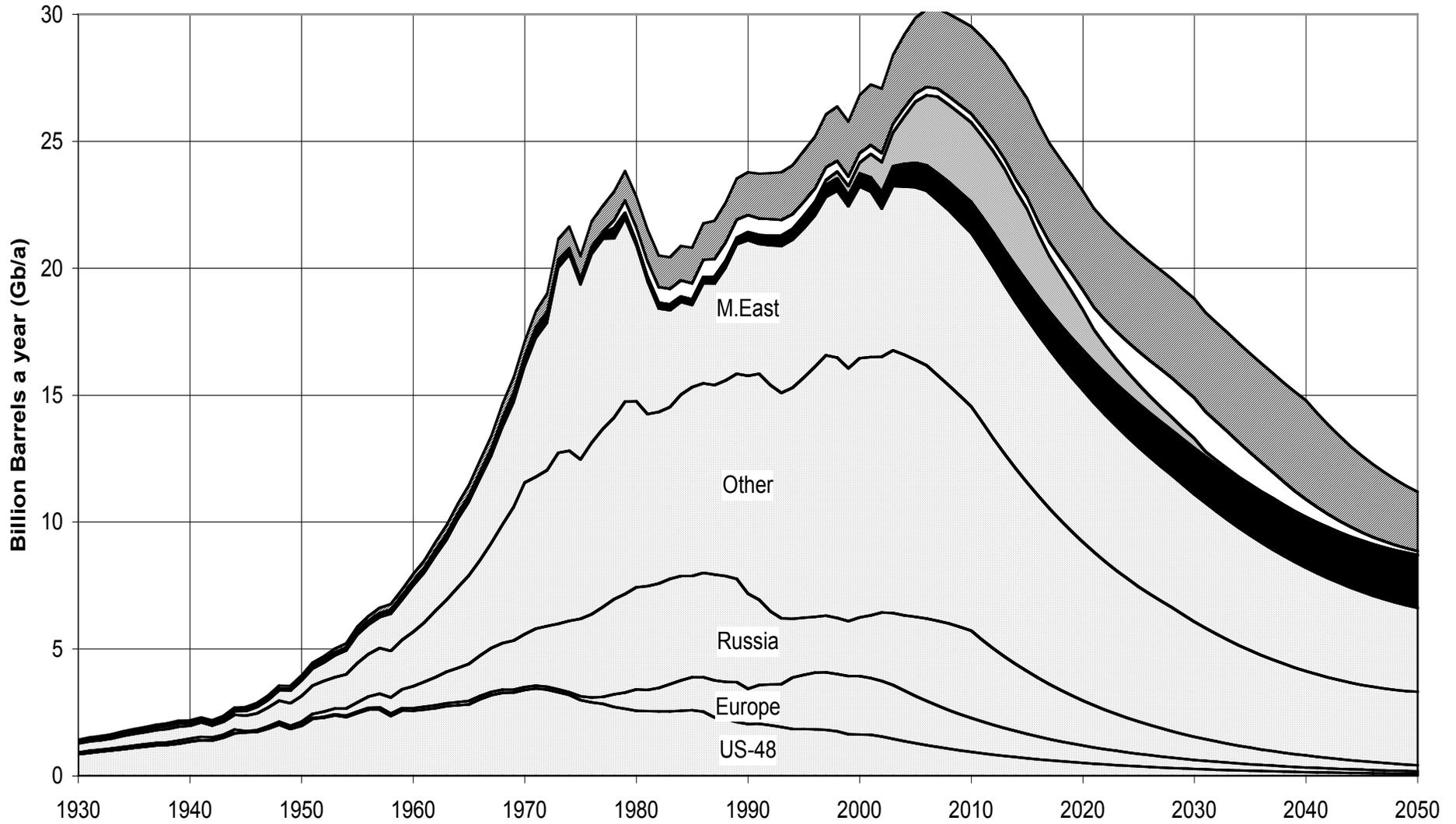
Denmark+Norway+UK



Global Oil Discoveries

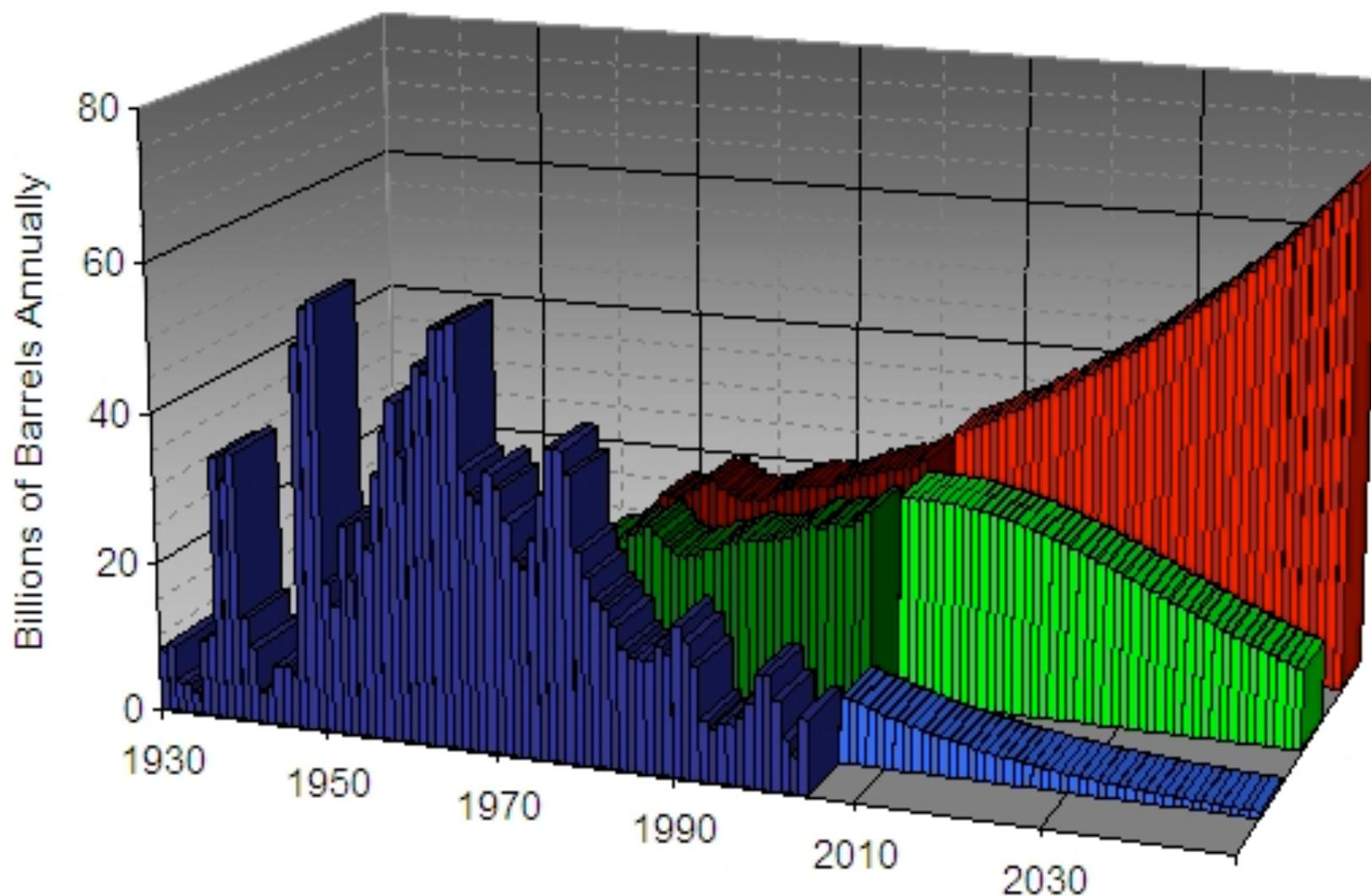


OIL AND GAS LIQUIDS 2004 Scenario



US-48
 Europe
 Russia
 Other
 M.East
 Heavy etc.
 Deepwater
 Polar
 NGL

World Overview (Discovery, Production and Demand)



■ Annual Discovery ■ Projected Discovery ■ Annual Production
■ Projected Production ■ Annual Demand ■ Projected Demand

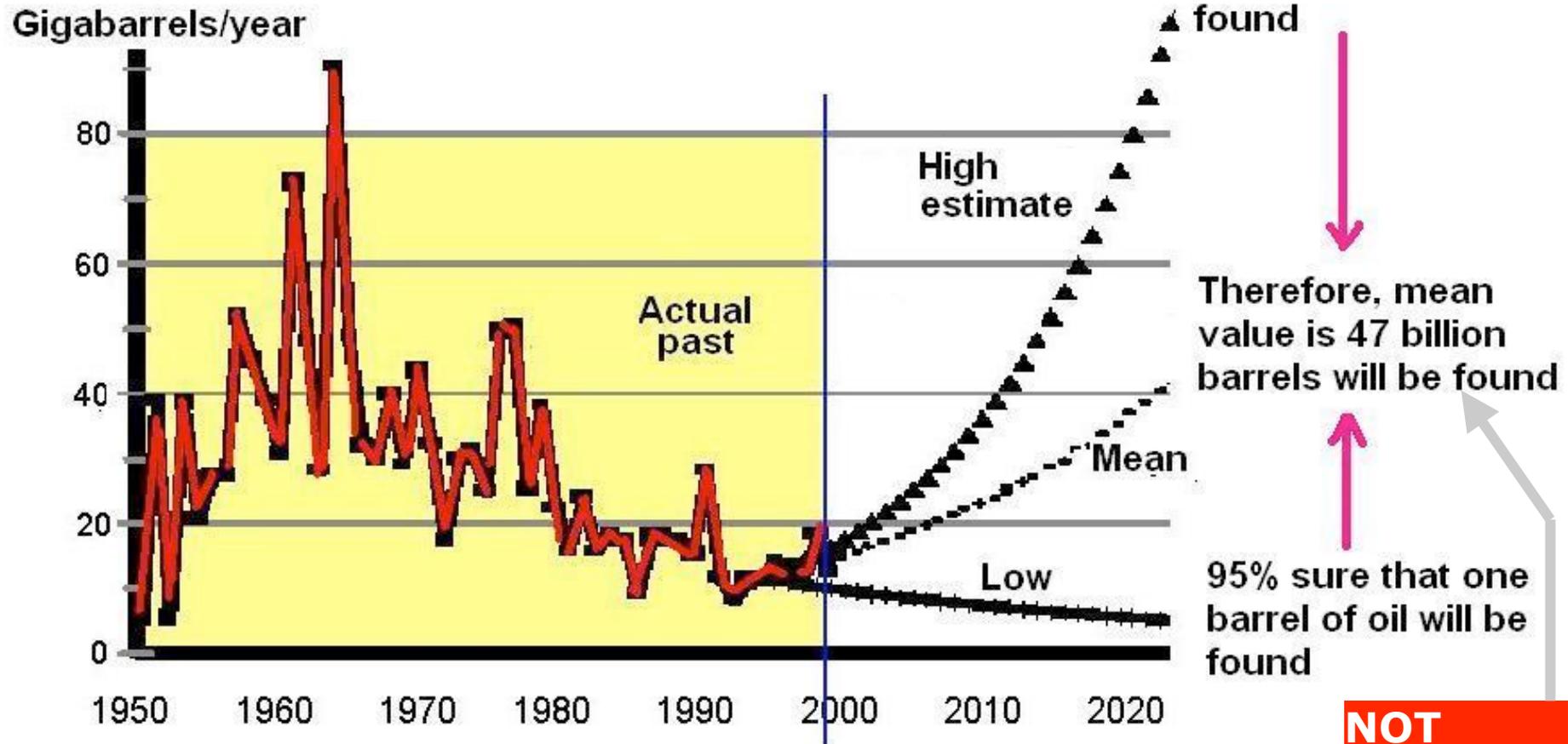
Data Sources: EIA, BP, ExxonMobil

But...

*The USGS, the US DoE,
the IEA, and CERA say
that peaking will not
occur soon*

US Geological Survey forecast

Past discovery of oil
and alternative estimates of yet-to-find



Dr Colin Campbell <http://www.econresearch.com/>

Chart 1 shows three scenarios to deliver the USGS estimates of how much oil is yet to be found in the world. Only the "low case" bears any resemblance to the actual historical trend.

The Expectation

U.S. DOE/EIA's *International Energy Outlook 2001* stated the following concerning future U.K. oil production:

“The United Kingdom is expected to produce about 3.1 million barrels/day by the middle of this decade (~2005), followed by a decline to 2.7 mb/d by 2020.”

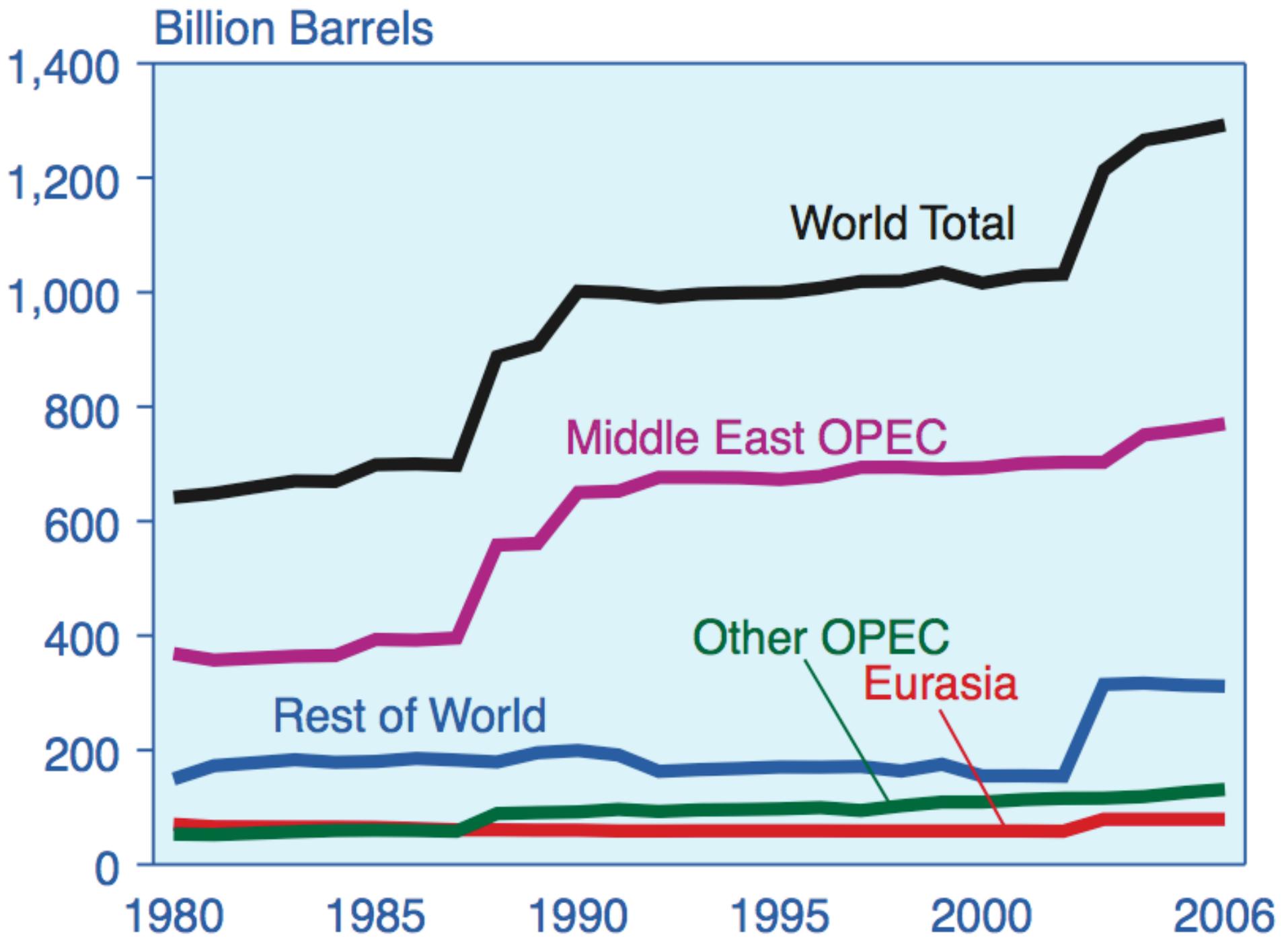
The Reality

U.K. oil production (crude oil + condensate) achieved peak production in 1999 at 2.684 mb/d. The average production rate for the first 11 months of 2005 was 1.649 mb/d or 1.035 mb/d (38.6%) less than the 1999 average.

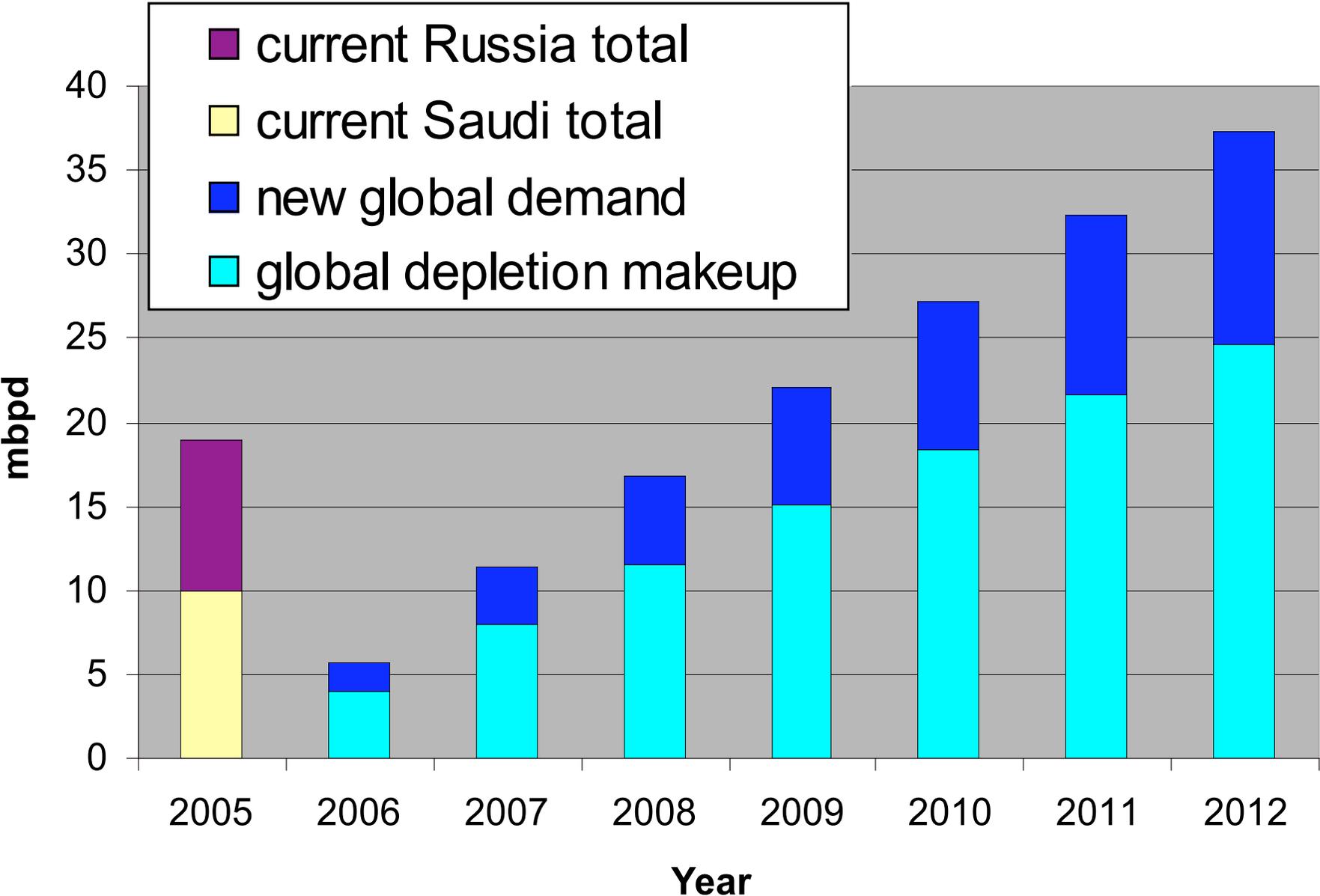
***Aren't reserves
higher than ever?***

SPURIOUS RESERVE REVISIONS

	Abu Dhabi	Dubai	Iran	Iraq	Kuwait	Neutral Zone	Saudi Arabia	Venezuela
1980	28.0	1.4	58.0	31.0	65.4	6.1	163.4	17.9
1981	29.0	1.4	57.5	30.0	65.9	6.0	165.0	18.0
1982	30.6	1.3	57.0	29.7	64.5	5.9	164.6	20.3
1983	30.5	1.4	55.3	41.0	64.2	5.7	162.4	21.5
1984	30.4	1.4	51.0	43.0	63.9	5.6	166.0	24.9
1985	30.5	1.4	48.5	44.5	90.0	5.4	169.0	25.9
1986	30.0	1.4	47.9	44.1	89.8	5.4	168.8	25.6
1987	31.0	1.4	48.8	47.1	91.9	5.3	166.6	25.0
1988	92.2	4.0	92.9	100.0	91.9	5.2	167.0	56.3
1989	92.2	4.0	92.9	100.0	91.9	5.2	170.0	58.1
1990	92.2	4.0	92.9	100.0	91.9	5.0	257.5	59.1
1991	92.2	4.0	92.9	100.0	94.5	5.0	257.5	59.1
1992	92.2	4.0	92.9	100.0	94.0	5.0	257.9	62.7
1993	92.2	4.0	92.9	100.0	94.0	5.0	258.7	63.3
1994	92.2	4.3	89.3	100.0	94.0	5.0	258.7	64.5
1995	92.2	4.3	88.2	100.0	94.0	5.0	258.7	64.9
1996	92.2	4.0	93.0	112.0	94.0	5.0	259.0	64.9
1997	92.2	4.0	93.0	112.5	94.0	5.0	259.0	71.7
1998	92.2	4.0	89.7	112.5	94.0	5.0	259.0	72.6
P50 Estimates by Petroconsultants								
1996	57.7	1.0	64.7	77.4	52.0	8.2	222.6	27.4



New Capacity Needed Over 2005



***Is Peak Oil
a fringe idea?***

Chevron: Will you join us?

Oil production is in decline in 33 of the 48 largest oil producing countries, yet energy demand is increasing around the globe as economies grow and nations develop. www.willyoujoinus.com

***Russia:
'Era of cheap fuel is over'***

Viktor Khristenko, Russia's energy minister ... declared that motorists and business would have to learn to live with expensive fuel....

“One can say with certainty that the era of cheap hydrocarbons is over.”

— *London Daily Telegraph, June 6, 2006*

China forecasts Peak Oil

CNOOC Chief Economist Predicts \$90 Oil

By Erik Dahl

06 Sep 2005 at 09:00 AM EDT

SHANGHAI (Interfax-China) -- CNOOC Dep. Chief Economist Zhang Weiping said at a conference discussing China's energy needs in Beijing on Monday **[that he expects] global oil production to peak at 94-100 mb/day during the next five years.**

"High oil prices will have adverse effects on China's economy," said Zhang.

Oil Companies at Peak

Business Week of May 15th:

“Although major oil companies are making record profits from high prices, their actual production is close to peak and their *reserve replacement* is slipping to negative.”

“We may be at a point of peak oil production. You may see \$100 a barrel oil in the next two or three years.”

— *Former US President Bill Clinton* (March 28, 2006, London Business School)

***New York Times editorial
March 1, 2006***

“The concept of peak oil has not been widely written about. But people are talking about it now. It deserves a careful look—largely because it is almost certainly correct.”

***How serious
is the problem?***

Peaking of World Oil Production: Impacts, Mitigation, & Risk Management

Robert L. Hirsch, SAIC, Project Leader

(commissioned by US Department of Energy, February 2005)

EXECUTIVE SUMMARY

The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand sides, but to have substantial impact, they must be initiated more than a decade in advance of peaking.

***Aren't there easy
substitutes for
regular oil?***

Bitumen, Heavy and Extra-Heavy Oils

- What is it? *Overly mature oil where no trap was present*
- Where is it? *Tar sands in Canada, Extra-Heavy in Venezuela, Heavy in many places*
- Resource estimates of over 1.7 trillion barrels – though only a small fraction of this number (300 Gb) is booked as ultimately recoverable
- History: Long, slow effort culminates in 1 Mb/d of current production in Canada
- Prospects: 3-5 Mb/d by 2020

Gas-to-Liquids (GTL)

- Fischer-Tropsch process: a catalyzed chemical reaction in which carbon dioxide, carbon monoxide, and methane are converted into liquid hydrocarbons of various forms. Typical catalysts used are based on iron and cobalt.
- Current production: <1 Mb/d
- Useful in cases of “stranded gas”
- Qatar investing in production

Coal-to-Liquids (CTL)

- Process: Coal gasification—coal exposed to hot steam and controlled amounts of air or oxygen under high temperatures and pressures. Carbon molecules in coal break apart, setting off chemical reactions that produce a mixture of carbon monoxide, hydrogen and other gaseous compounds.
 - Also necessary for “clean coal” technologies
- Then Fischer-Tropsch used to turn gas to liquids
- Energy penalty of about 40%
- Current production: 150,000 b/d, nearly all in South Africa (Sasol Corp.)
- China investing \$6 billion in CTL

*Where are
we now?*

Chris Skrebowski, Editor of *Petroleum Review* (London), in conversation regarding his April, 2006 study, “**Oil Field Megaprojects**,” said the following:

“At the moment roughly 28% of world production is coming from countries in outright decline and going down at roughly 5%/year. By 2010 this will rise to 40% of world production. There is the possibility that things could deteriorate much more quickly.

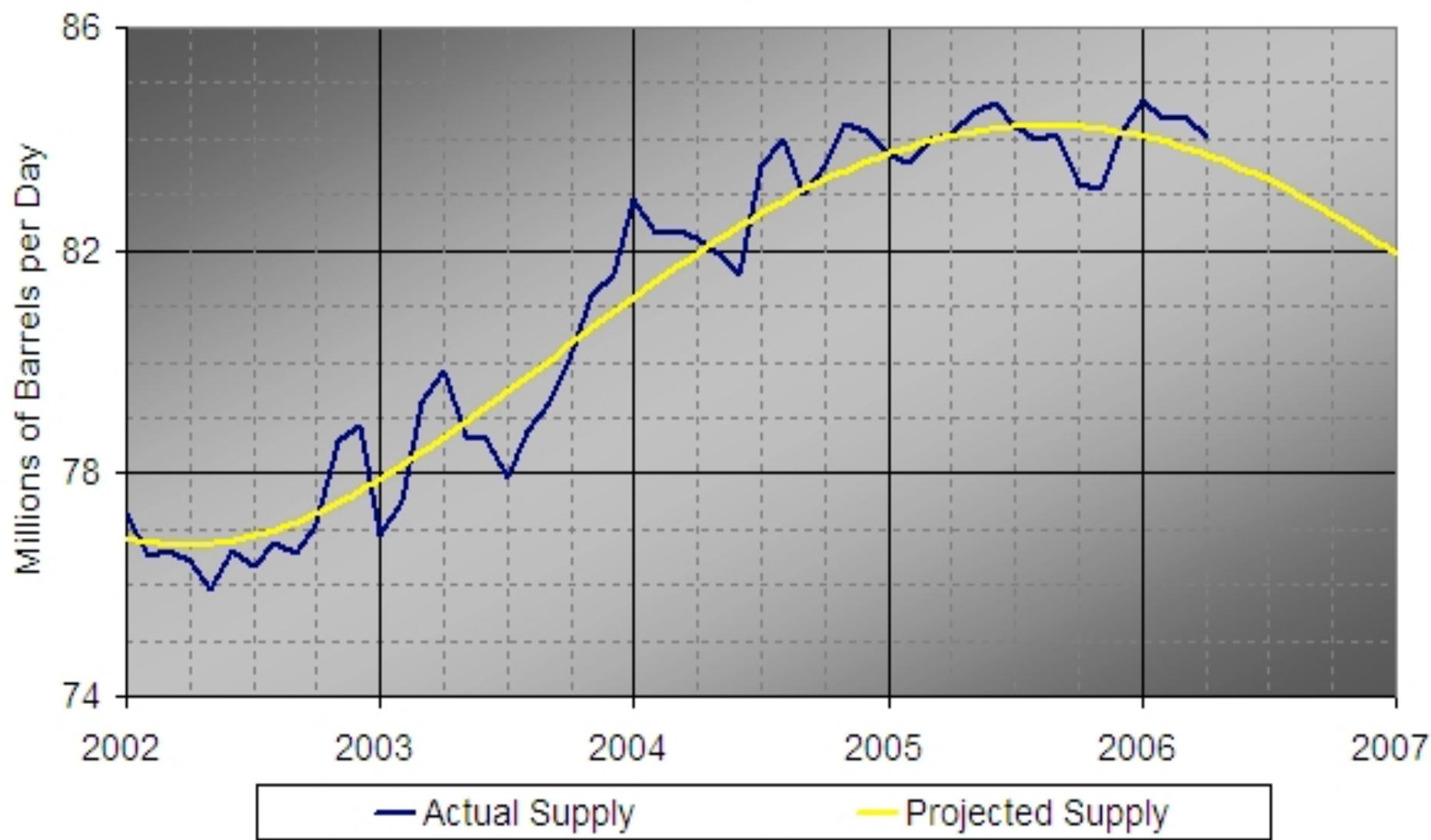
“My latest calculations show the world will develop 18.8 million b/d of new capacity in the 2006-2010 period. This is made up of 9.7 Mb/d from OPEC and 9.1 from non-OPEC. Depletion will offset 9.5 Mb/d of this over the same period. This means if all goes fully according to plan there will be 9.3 Mb/d of new capacity or just over 1.8 Mb/d each year to meet new demand. So up to 2010 we can probably muddle through with high prices and restrained demand.

“There is always the possibility of faster depletion and greater project delays which would obviously make the situation worse. After 2010, however, the situation deteriorates rapidly with negative supply growth in 2011 and 2012. We don't have any reliable data beyond 2012 but all the indications are that the situation would be getting worse quite quickly.”

Chris added, when pressed:

“I feel it is my duty, given the social and economic chaos Peak Oil will undoubtedly produce, to stick very closely to defensible assumptions. If you ask me do I personally think we’ll make it to 2010 my answer is probably not. Random factors and Murphy's law more or less rule out everything running smoothly. This however is not analysis but gut feel and hunch. On the hunch basis 2008 would probably be my answer but 2010 my analysis.”

Total World Oil Supply
(Includes condensates, natural gas liquids and refinery gains)



Data Source: U.S. Dept of Energy, Energy Information Administration

- Saudi Arabia had an average of 52 drilling rigs active in '04, 83 rigs in '05 and will have about 120 by the end of '06.
- Meanwhile, the kingdom's oil output has fallen to less than 9 mb/d. Saudi output had averaged nearly 9.5 mb/d in the first quarter, according to the IEA.
- Oil minister Ali Naimi has attributed the trend to a drop in demand and denies the country has supply problems or aims to limit supply voluntarily.

Summary

- Oil and gasoline supply problems and high prices are here to stay, and will likely increase in severity as time goes on;
- The economic, social, and political consequences will be severe;
- There are no easy or quick fixes.

2. Options and Strategies

Renewables

- Wind, solar, and biomass, etc.—the only long-term options



Biofuels: cannot fully replace oil

- Low net energy yield
- Requirements for arable land, water, fertilizer
- Tradeoff with food production
- Marginally useful for farm on-site production and use
- Some potential for biodiesel from algae

Conservation: Efficiency and Curtailment

- Like alternative energy sources, conservation (efficiency) requires investment
- Investments yield diminishing returns
- However, at least in the initial stages, efficiency is almost always cheaper than new supply options
- Curtailment is the cheapest option of all, but requires changes in habits and expectations

Agriculture

Transition from oil-based industrial model to more labor-intensive, localized, organic model:

- Promote farmers' markets, CSAs
- Promote local, organic production



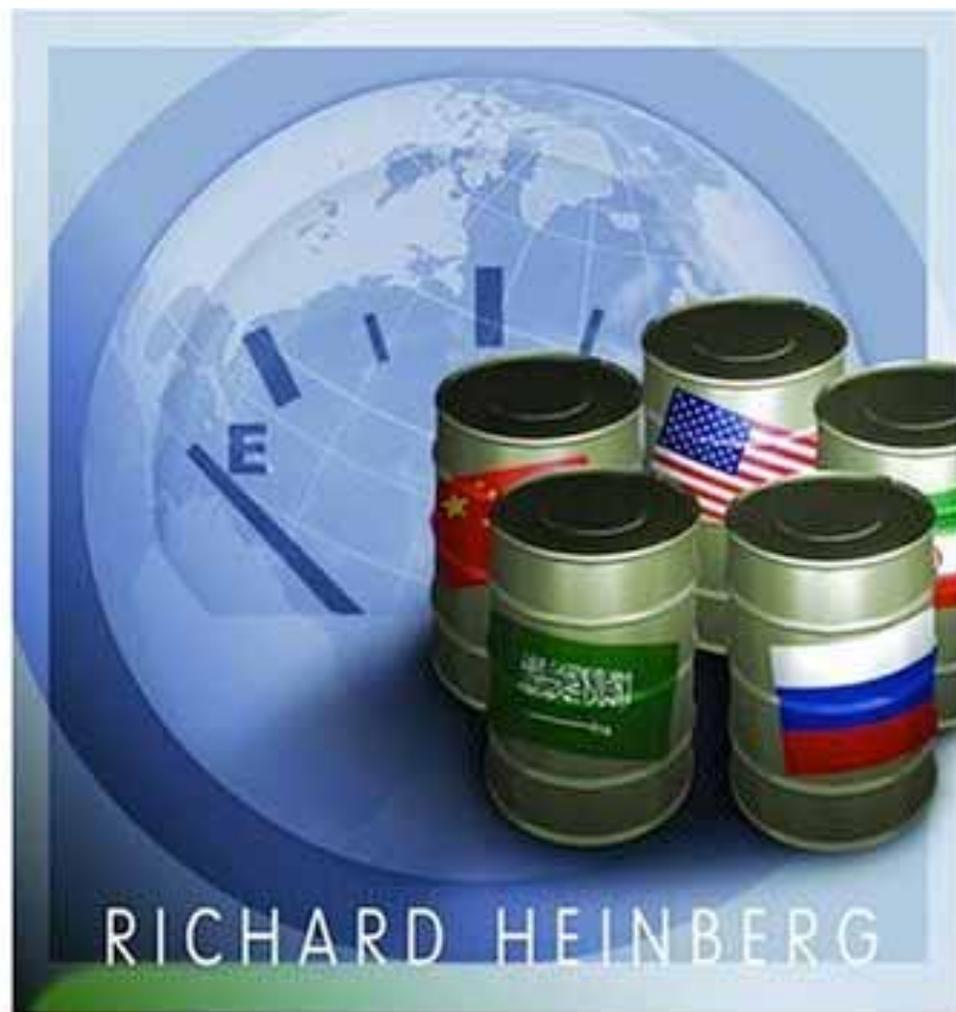
Transportation

Rail and light rail—the best long-term options for motorized transport of freight and people

Short-term strategies

- Community Car
(communitysolution.org)
- Car co-ops, ride-share, and carpooling
- Community-supported hitchhiking





RICHARD HEINBERG

THE OIL
DEPLETION
PROTOCOL

A PLAN TO AVERT
OIL WARS,
TERRORISM AND
ECONOMIC COLLAPSE

Countries in full or partial *de facto* compliance with the Protocol

- Sweden
- Kuwait
- Iceland
- Cuba
- Declining producers (Indonesia, etc.)
- Poor nations unable to afford oil at \$70+

Municipal Efforts

- San Francisco, CA
- Sebastopol, CA
- Denver, CO
- Burnaby, BC
- Plymouth, NH
- Portland, OR
- Tompkins County, NY
- Hamilton, ON
- Willits, CA
- Bloomington, IN

Personal Implementation of the Oil Depletion Protocol

- **Assess current oil consumption: gasoline, food, plastics**
- **Plan to reduce the total by 3% per year (change your transportation habits *now!*)**
- **For most Americans, food accounts for 30% of petroleum consumption: eat locally, eat organic, and garden!**
- **Publicize personal and group efforts**

www.postcarbon.org

www.oildepletionprotocol.org

heinberg@museletter.com