HALF GONE:
The coming global energy crisis, its conflation with global warming, and the implications

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Institute of Physics,
25 October 2005

Structure

A. Oil depletion

B. Global warming

C. Conflation of depletion and warming

Conclusions

Every one agrees oil is finite
There are two views of quite how: 1

Late Toppers:

- Topping Point (peak of production) in 2030s
  - "Forty years supply at least" (Lord Browne, 2004)
- Believers:
  - most oil companies and OPEC
  - almost all financial analysts & journalists
  - all governments and agencies, e.g. IEA
- Implications:
  - economies will be OK in principle
  - there will be time to develop alternatives

Every one agrees oil is finite
There are two views of quite how: 2

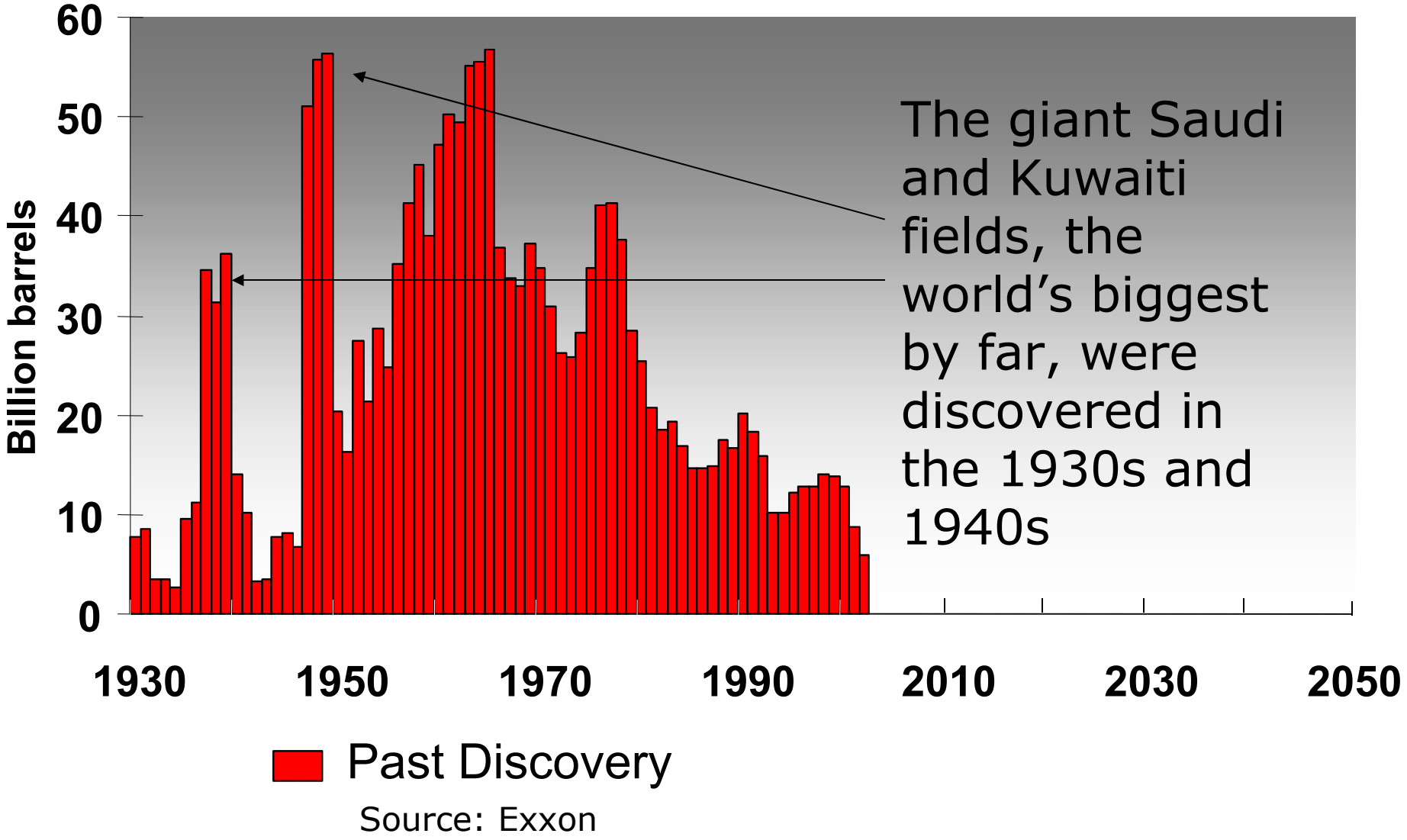
Early Toppers:

- Topping Point (peak of production) will happen this decade (maybe even 2005)
  - the market will wake up to this soon
- Believers:
  - a growing number of dissident *experts …….* mostly oil company geologists
  - some financial analysts & journalists
  - some futures traders
- Implications:
  - economies will be dislocated
  - there will be no time to develop alternatives

Leggett's qualifications on this issue

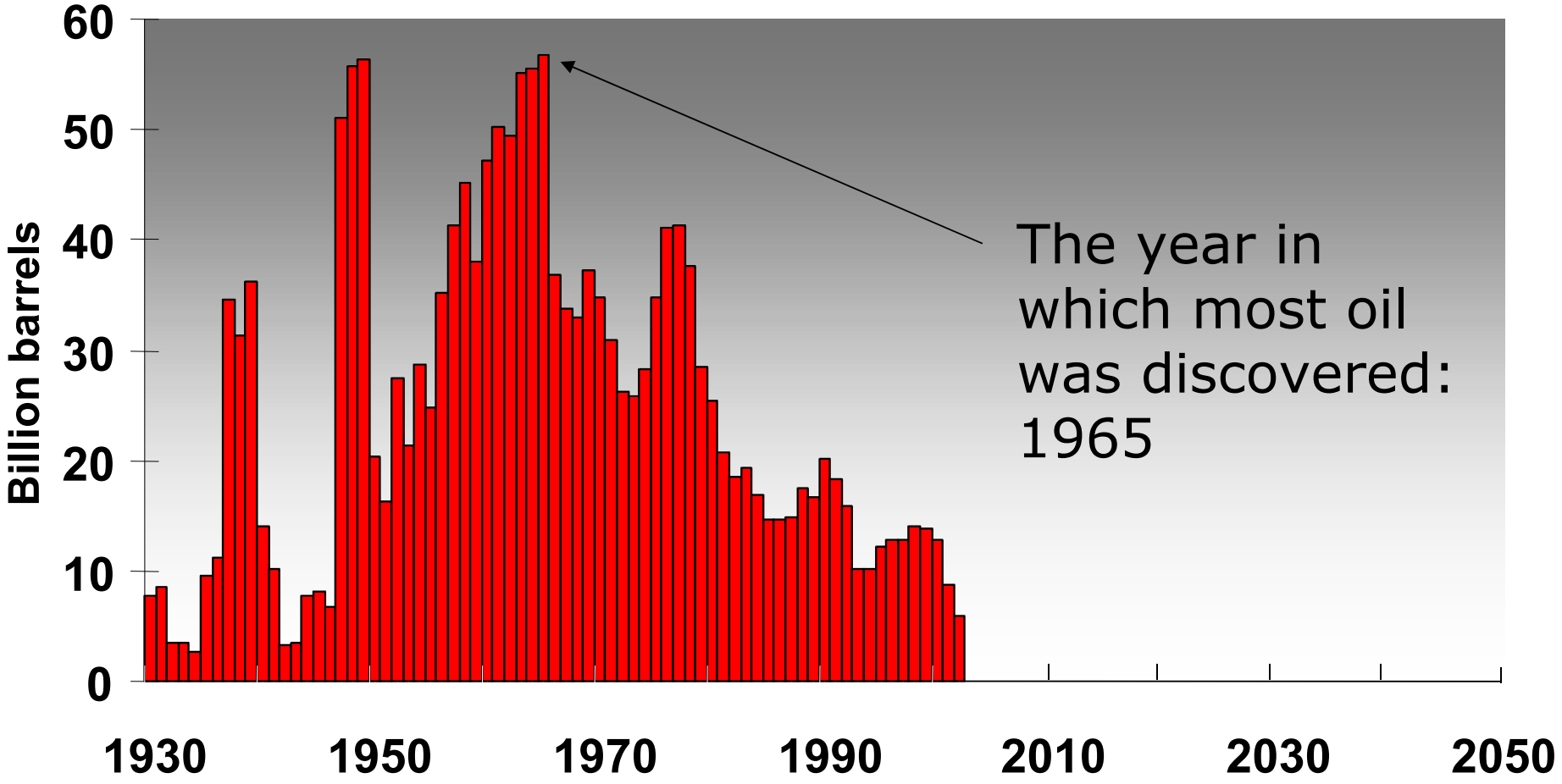
- Geologist consulting in the oil industry, 1980–1989
  - Research funding from BP, Shell, among others, at Royal School of Mines, Imperial College, including for oil source rock studies and seismic stratigraphy.
  - Taught on petroleum geology and engineering undergraduate and postgraduate courses.
  - Exploration and consultancy with Hydrocarbon Development Institute of Pakistan, Japan Petroleum Exploration Corporation among others.
  - Two major international awards for research from the premier UK professional body for geologists, the Geological Society.
- Environmental campaigner (energy), 1989-1996
  - At the international Climate Convention negotiations and the Intergovernmental Panel on Climate Change.
- Renewable energy industry executive, 1997-2005
  - Founding director of world's first renewable energy private equity fund, Bank Sarasin's New Energies Invest AG, 2000-2005.
  - CEO of UK's largest independent solar solutions company 1999-2005.
  - Member of UK Government's Renewables Advisory Board 2001-2005.

The pattern of global oil discovery



Source: Exxon

The pattern of global oil discovery



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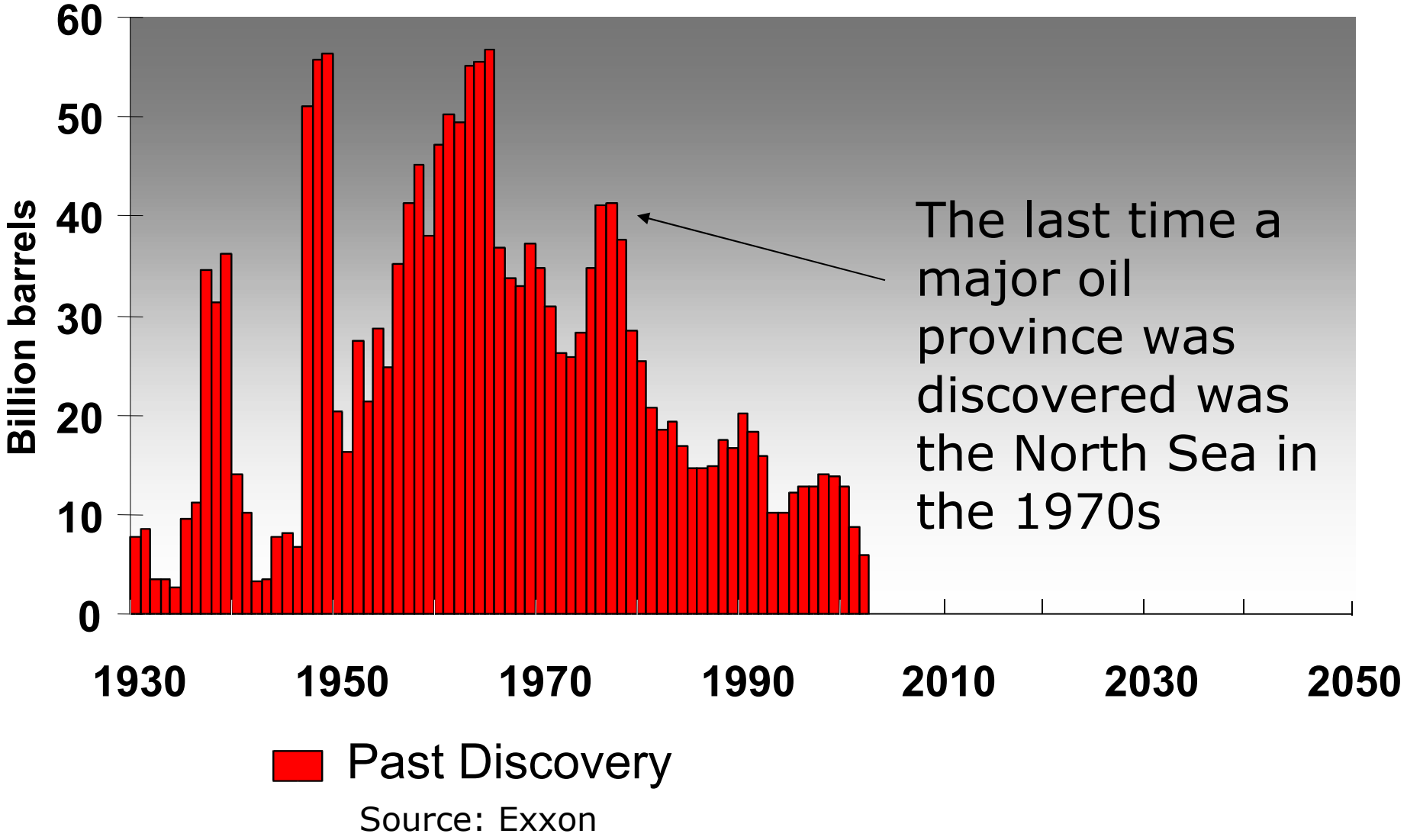
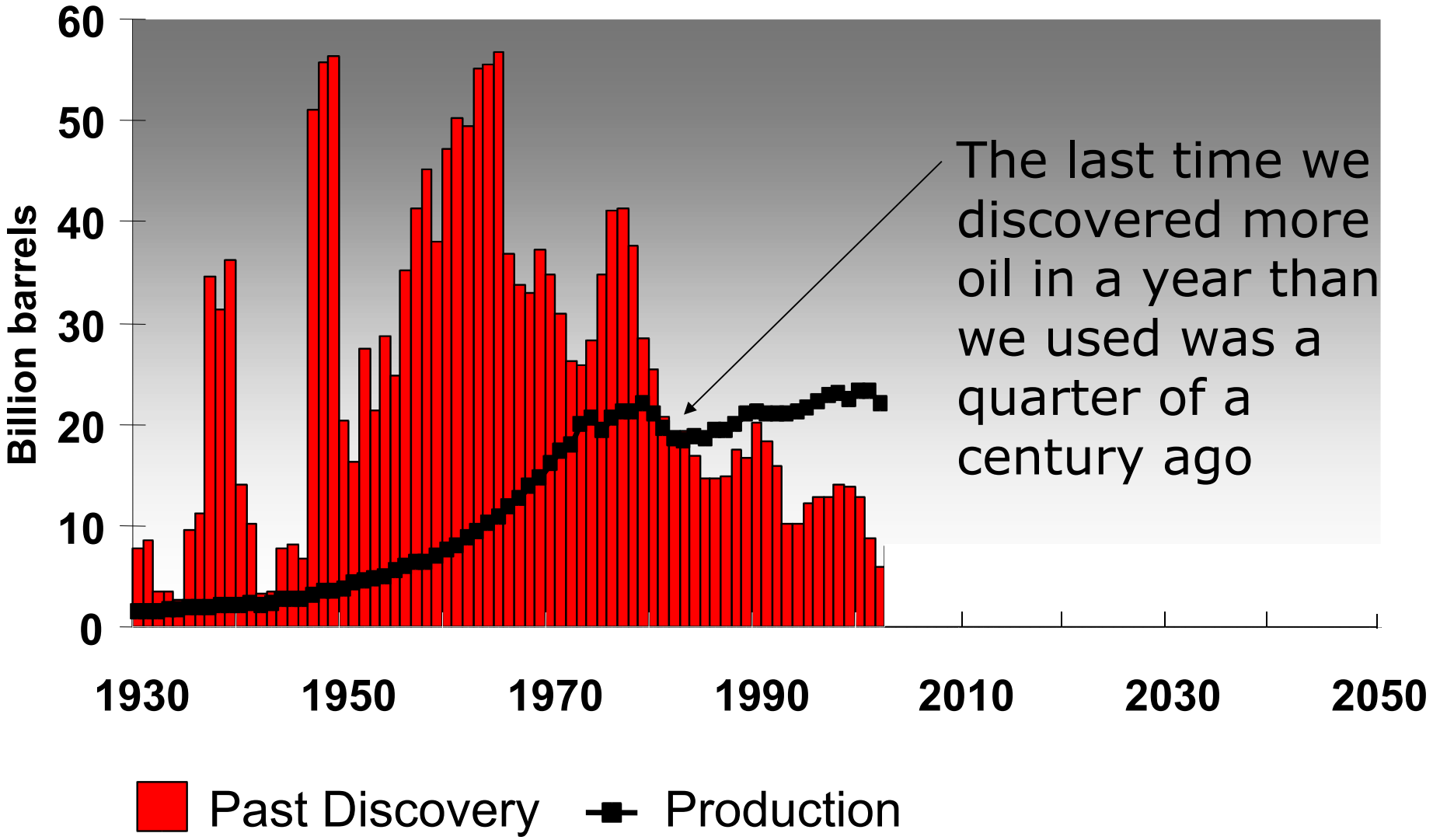
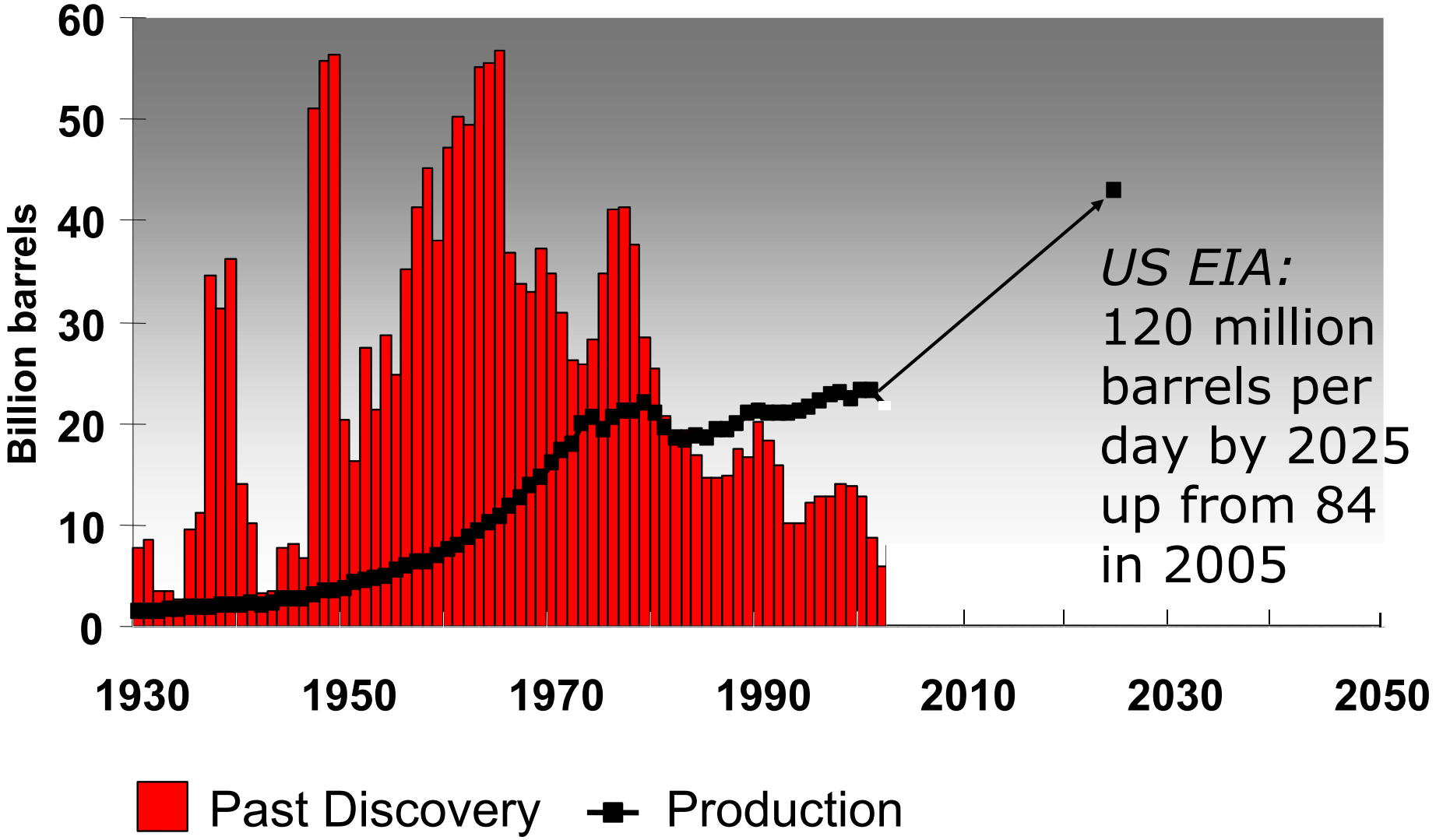


Source: Exxon

The curve of discovery versus production

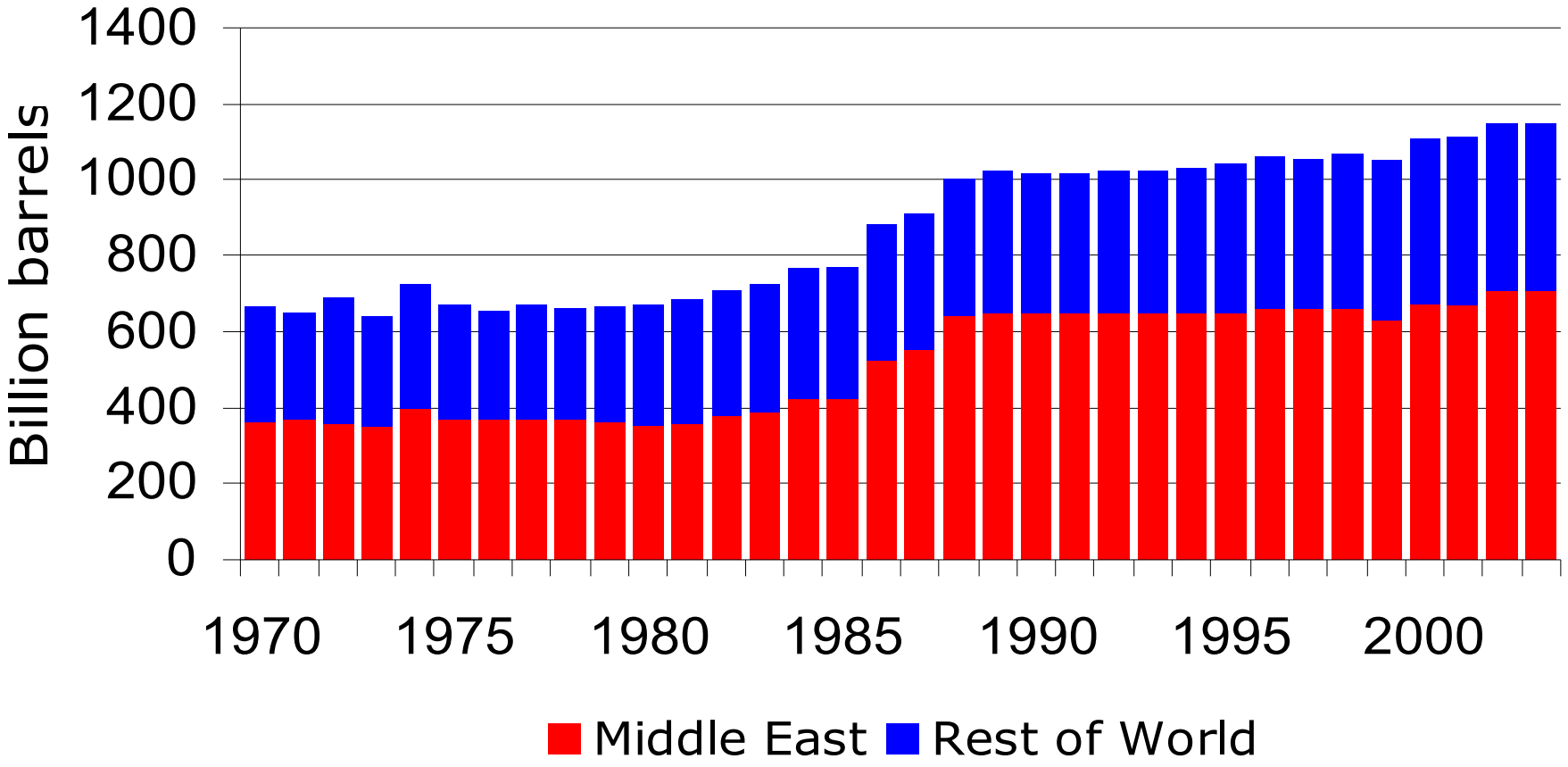


Production has to reach at least 120 mbd by 2025 ….according to almost all economic plans



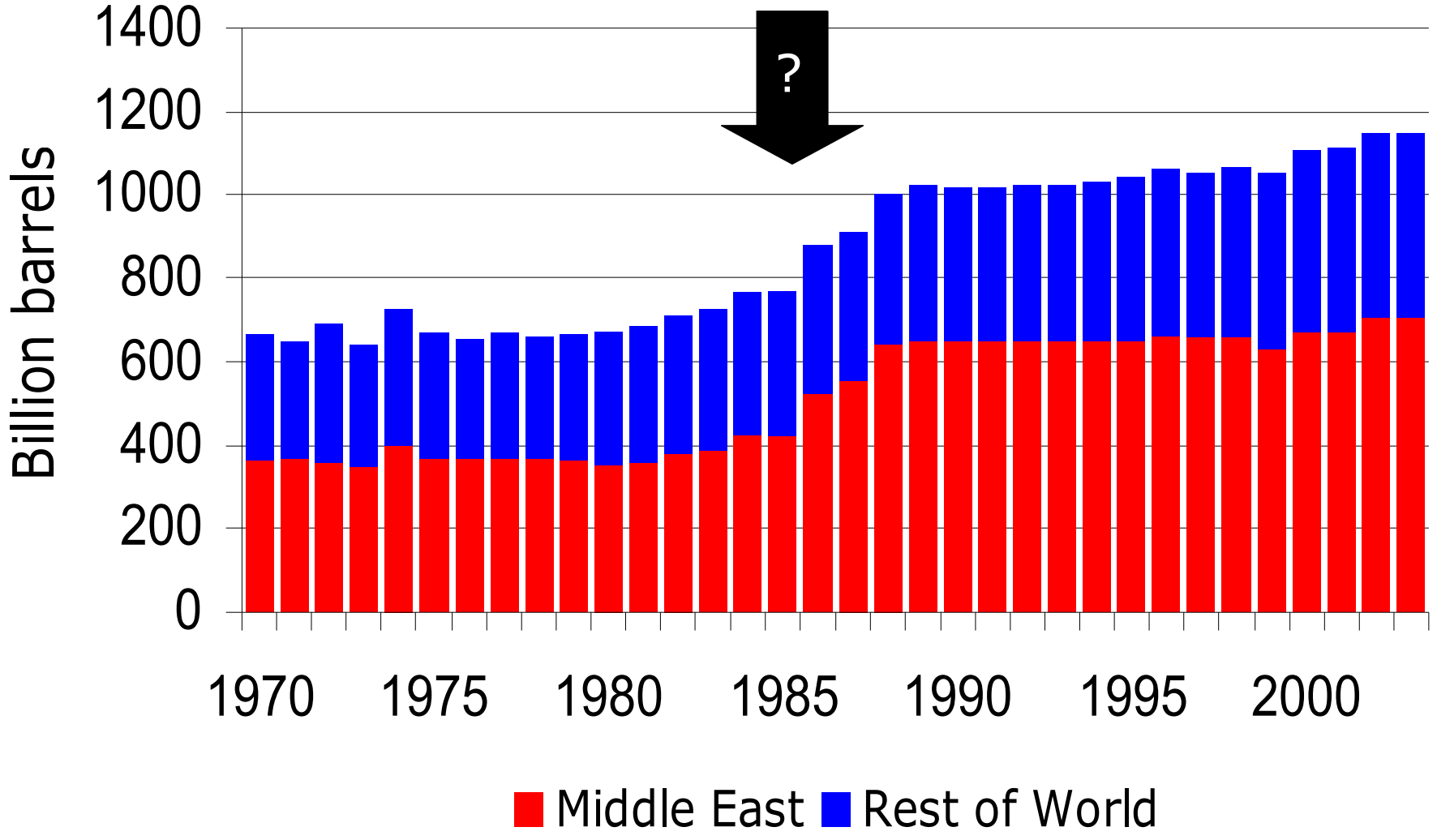
BP's view: 500 billion barrels found since 1970

Statistics to be found in the energy industry's data bible, published annually



Source: BP Annual Statistical Review of World Energy

The late 1980s: a time of major new discoveries?



Source: BP Statistical Review of World Energy

….or is that the BP view?

"The estimates have been compiled using a variety of primary official sources…. The reserves figures shown do not necessarily meet the United States Securities and Exchange Commission definitions and guidelines for determining proved reserves…

…nor necessarily represent BP's view of proved reserves by country."

Source: BP Statistical Review of World Energy

…very small print

Quotas agreed by OPEC

"Massaging" starts

Year	Abu Dhabi	Dubai	Iran	Iraq	Kuwait	Neutral Zone	Saudi Arabia	Venezuela
1980	28.0	1.4	58.0	31.0	65	6.1	163	18
1981	29.0	1.4	57.5	30.0	66	6.0	165	18
1982	30.6	1.3	57.0	29.7	65	5.9	165	20
1983	30.5	1.4	55.3	41.0	64	5.7	162	22
1984	30.4	1.4	51.0	43.0	64	5.6	166	25
1985	30.5	1.4	48.5	44.5	**90**	5.4	169	26
1986	30.0	1.4	47.9	44.1	90	5.4	169	26
1987	31.0	1.4	48.8	47.1	92	5.3	167	25
1988	**92.2**	**4.0**	**92.9**	**100**	92	5.2	167	**56**
1989	92.2	4.0	92.9	100	92	5.2	170	58
1990	92.2	4.0	92.9	100	92	5.0	**258**	59
1991	92.2	4.0	92.9	100	95	5.0	258	59
1992	92.2	4.0	92.9	100	94	5.0	258	63
1993	92.2	4.0	92.9	100	94	5.0	259	63
1994	92.2	4.3	89.3	100	94	5.0	259	65
1995	92.2	4.3	88.2	100	94	5.0	259	65
1996	92.2	4.0	93.0	112.0	94	5.0	259	65
1997	92.2	4.0	93.0	112.5	94	5.0	259	72
1998	92.2	4.0	89.7	112.5	94	5.0	259	73
1999	92.2	4.0	89.7	112.5	94	5.0	261	73
2000	92.2	4.0	89.7	112.5	94	5.0	261	77
2001	92.2	4.0	89.7	112.5	94	5.0	261	78
2002	92.2	4.0	89.7	112.5	94	5.0	261	78

These reserves, which are closed to scrutiny, are not "proved" in any sense a court would recognise

Worse to come: dwindling discovery

Statistics for "giant" oilfields of 500 million barrels of more

Context: at >80 million barrels per day current global demand, 500 mb is *less than a week's* global supply

- In 2000 there were 16 discoveries
- In 2001 there were 9
- In 2002 there were just 2
- In 2003 there were none

Source: Petroleum Review

Mega-projects coming on stream 2003-2006

Bearing in mind that:

- Oil demand has been growing at 3.5% per year for the last two years …. > 3 million barrels a day
- it takes an average of around 6 years from the discovery of an oilfield for the first oil to come to market…

- 2003: 9 projects – will supply at peak 1.4 m b/d
- 2004: 18 projects – will supply at peak 3.1 m b/d
- 2005: 18 projects – will supply at peak 2.7 m b/d
- 2006: 18 projects – will supply at peak 2.9 m b/d

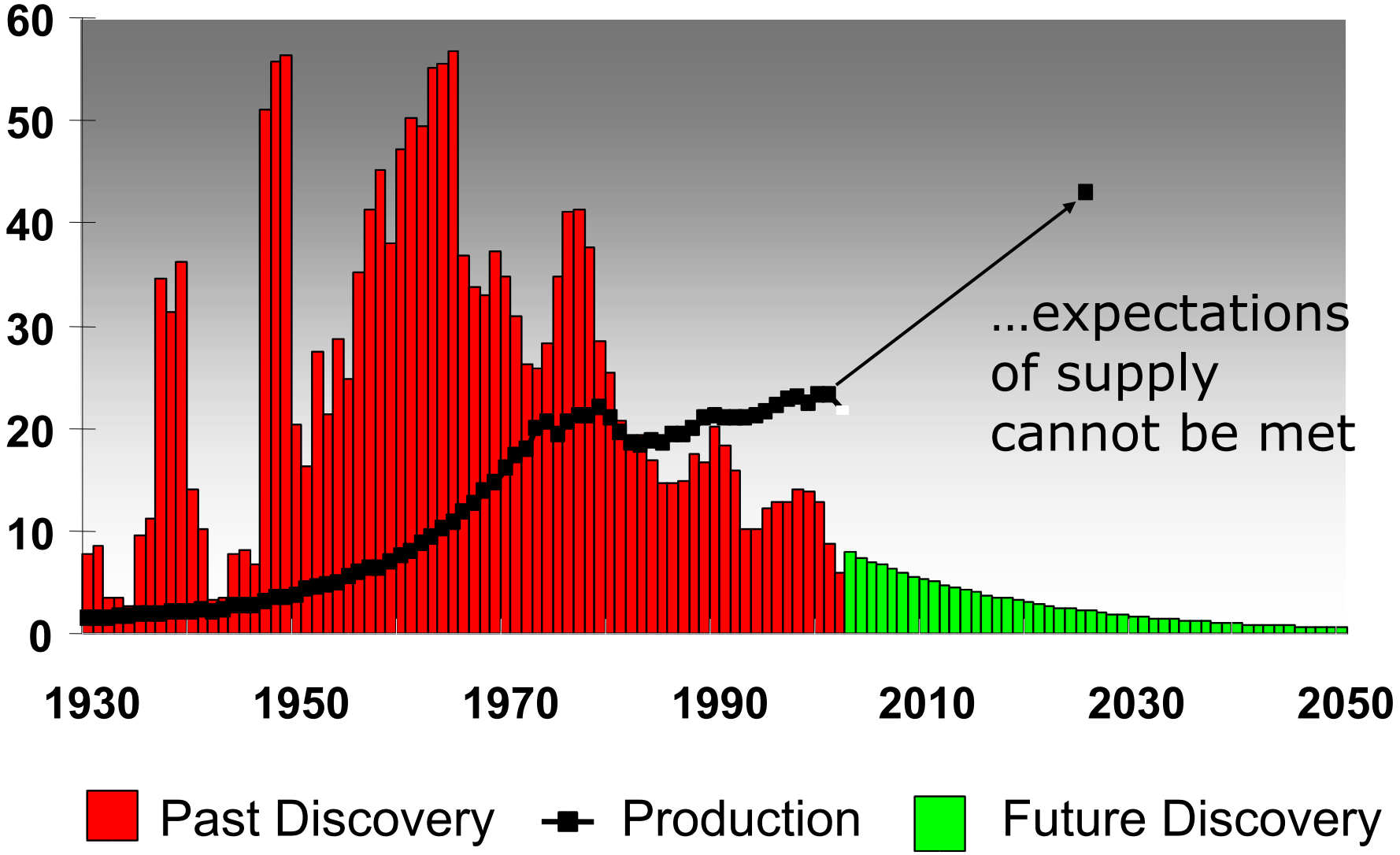
Source: Petroleum Review

Mega-projects coming on stream 2007-2012

- 2007: 8 projects - peak 1.5 million b/d
- 2008: 6 projects - peak 1.5 million b/d
- 2009: 3 projects - peak 0.8 million b/d
- 2010: 1 project - peak 0.45 million b/d
- 2011: 1 project - peak 0.07 million b/d
- 2012: 1 project - peak 0.30 million b/d

Source: Petroleum Review

ASPO projects a major shortfall of future discovery against projected demand

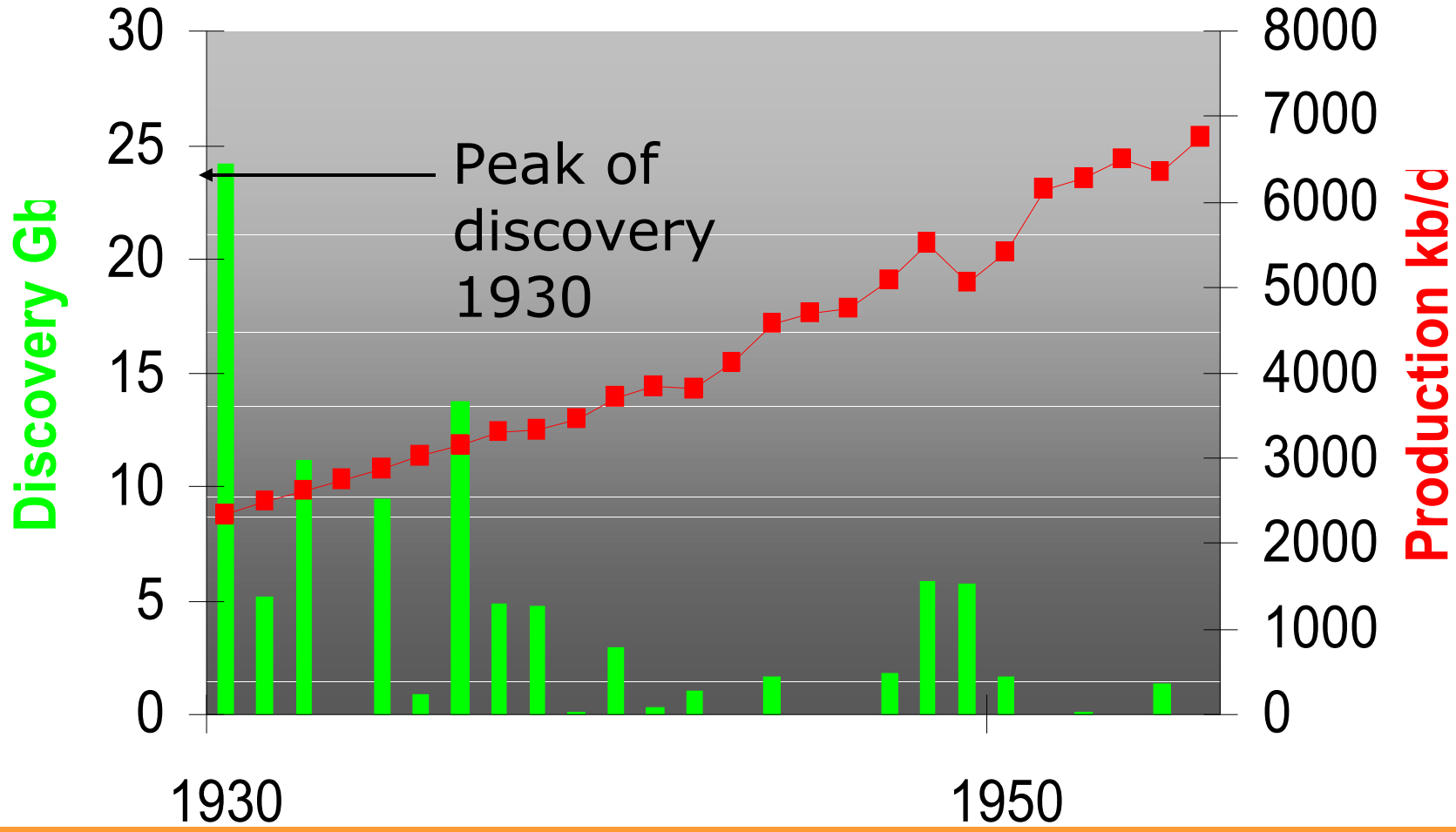


Split the difference …it matters a lot

	Early Toppers (ASPO)	Late Toppers
Past production	920	875
Future production: known fields	780	1,100 (BP) - 1,700 (USGS)
New fields	150	900 (USGS)
Total to use	< 1 trillion	2 – 2.7 trillion
Planet total	1.8 trillion	2.9 – 3.4 trillion

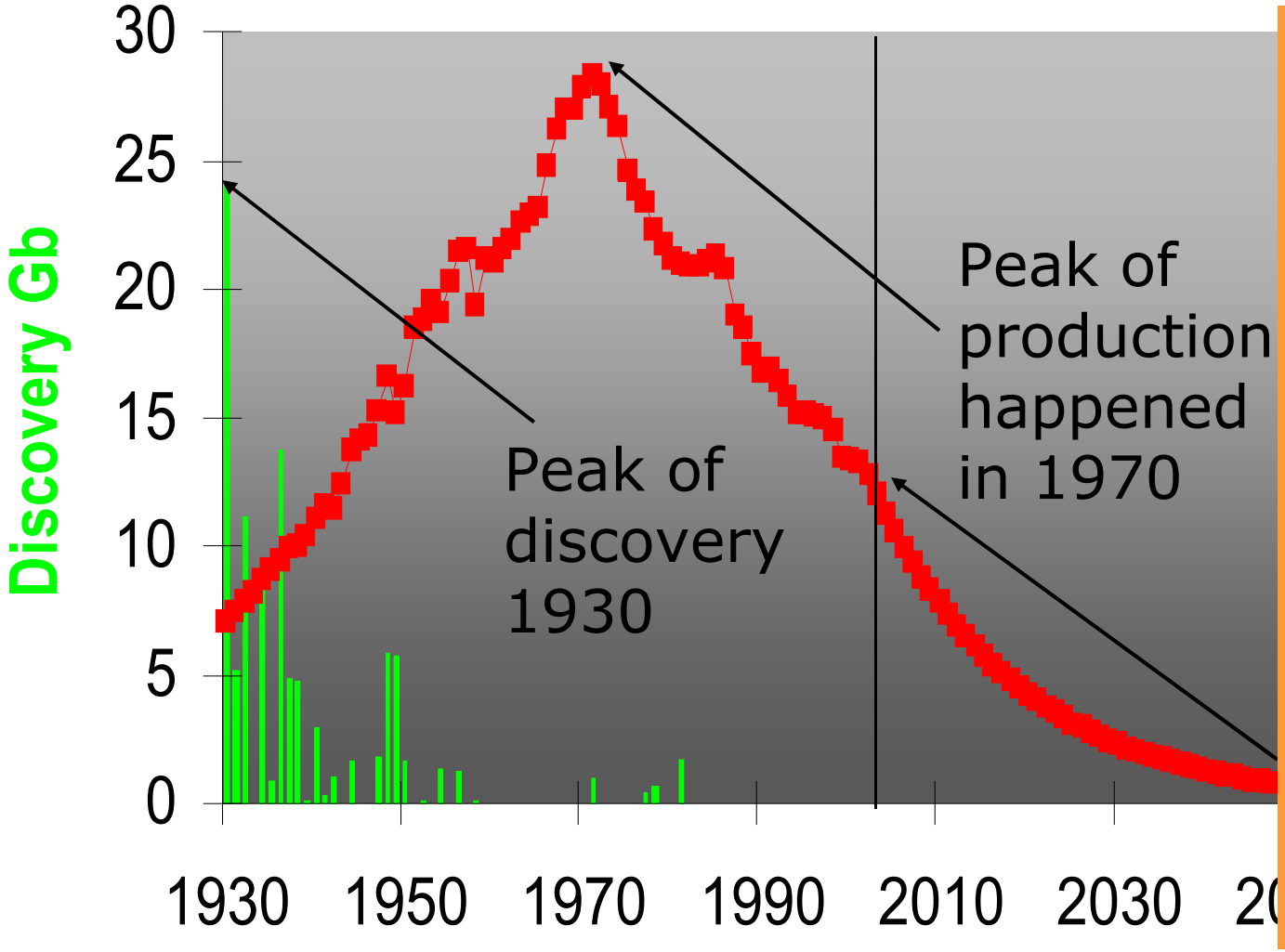
Regular oil, in billions of barrels

In 1956, M.K. Hubbert predicted the US national oil production peak would be 1971



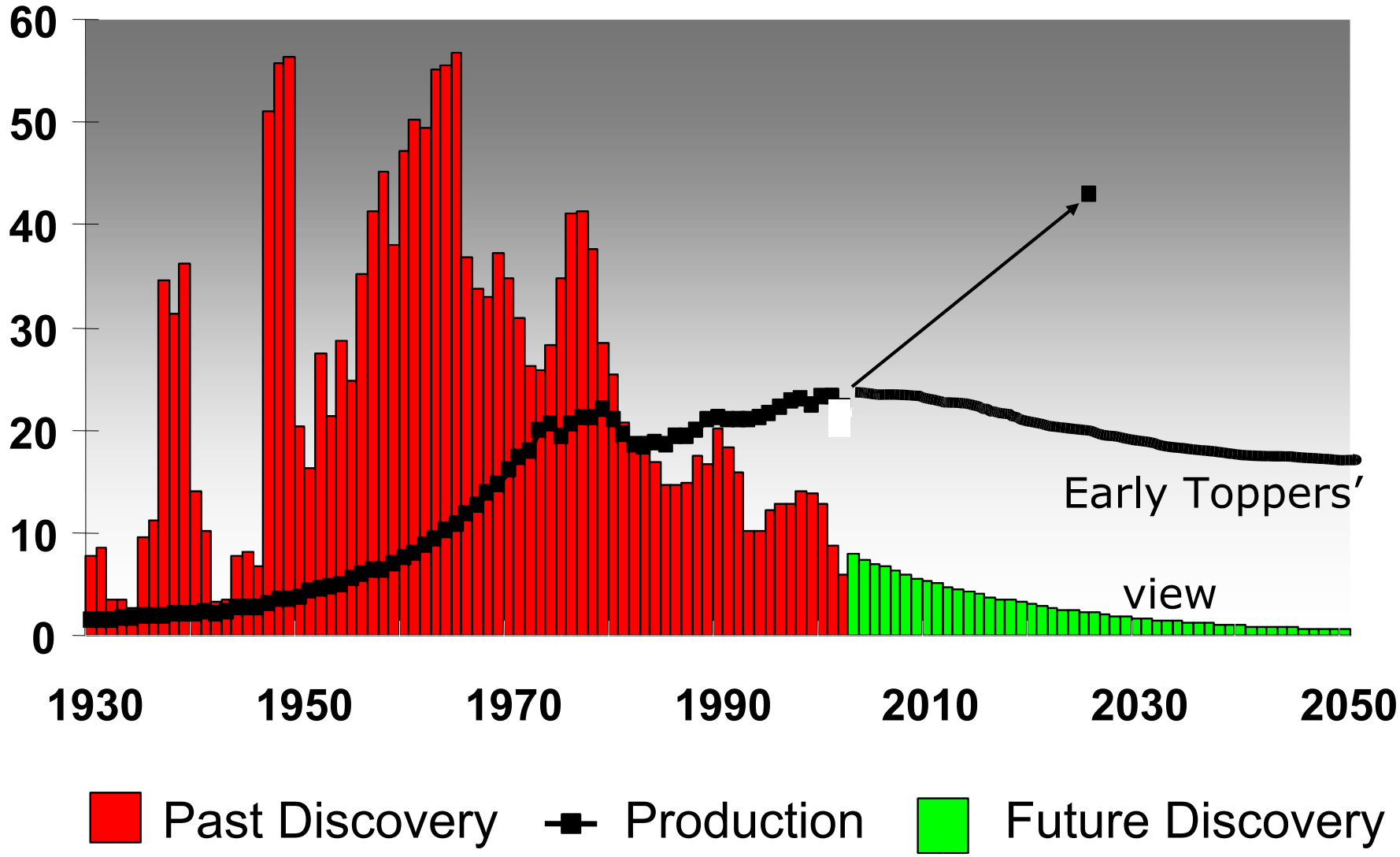
Despite being a geologist of demonstrable world class, Hubbert was disbelieved by almost everyone …especially Shell, his employer, and the US Geological Survey

What then happened ought to be a lesson

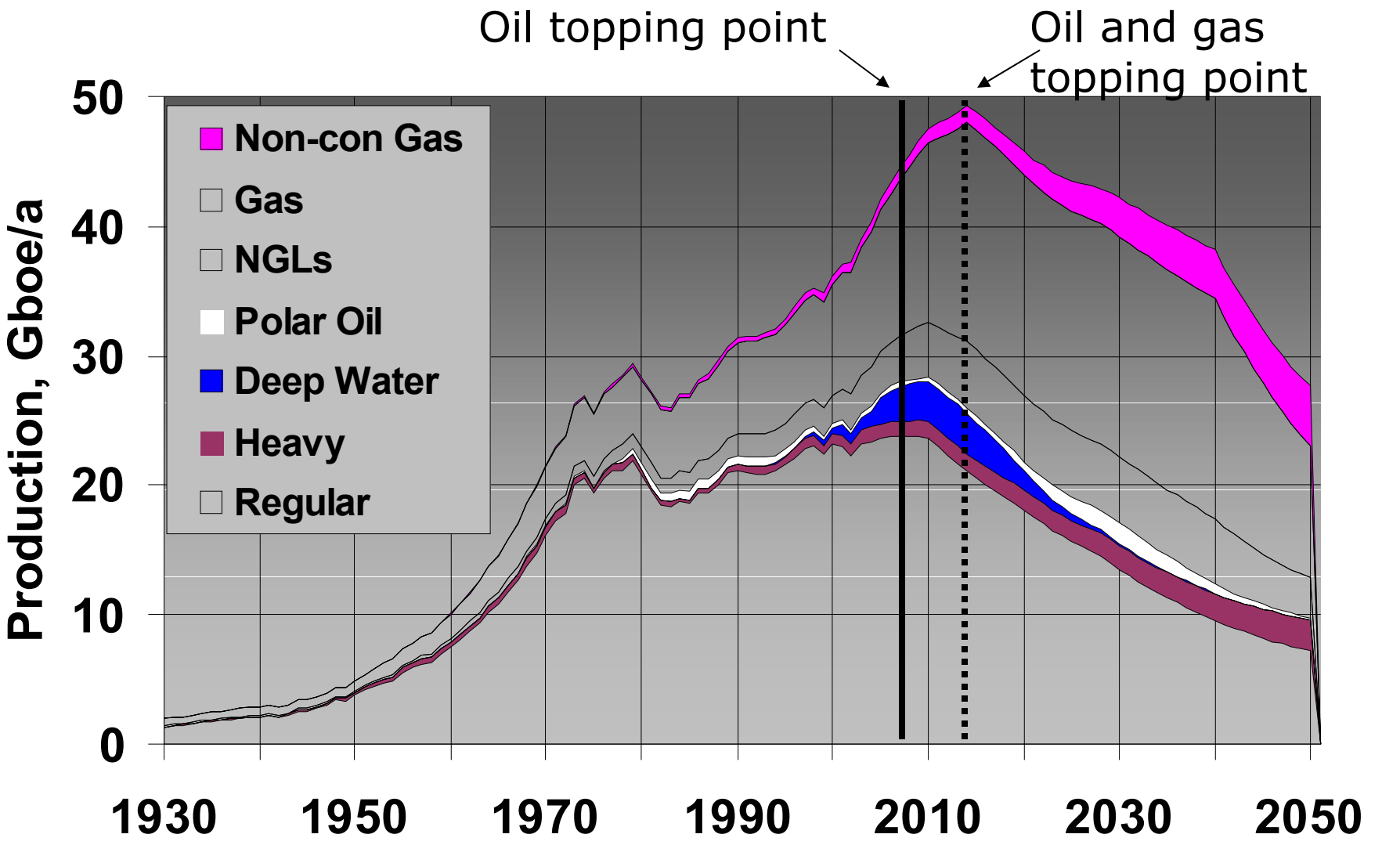


…and despite massive investment in enhanced recovery and deep water exploration, "Hubbert's Curve" falls smoothly to this day…

The ASPO view of future production

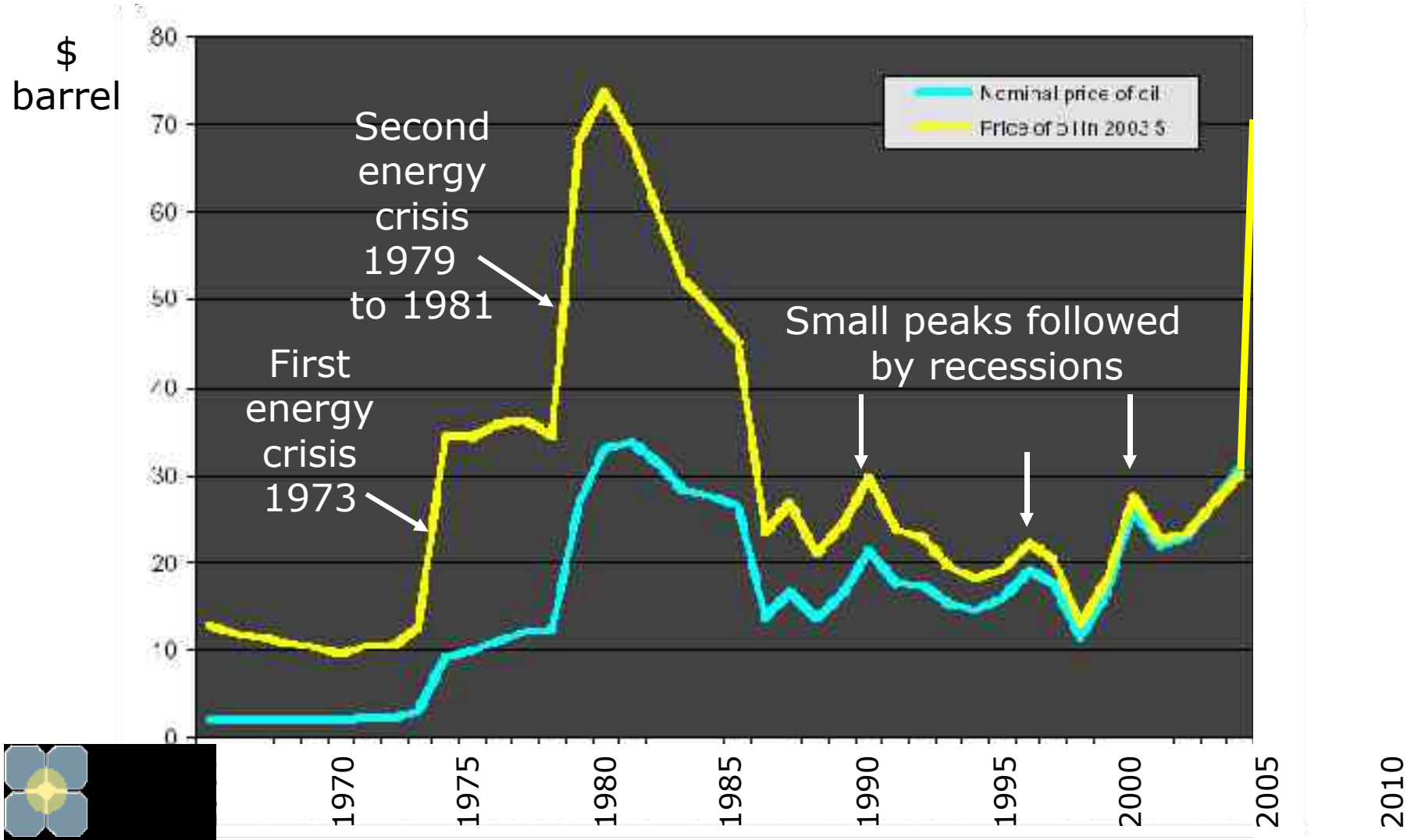


Nothing can close the gap: future oil and gas production from all sources



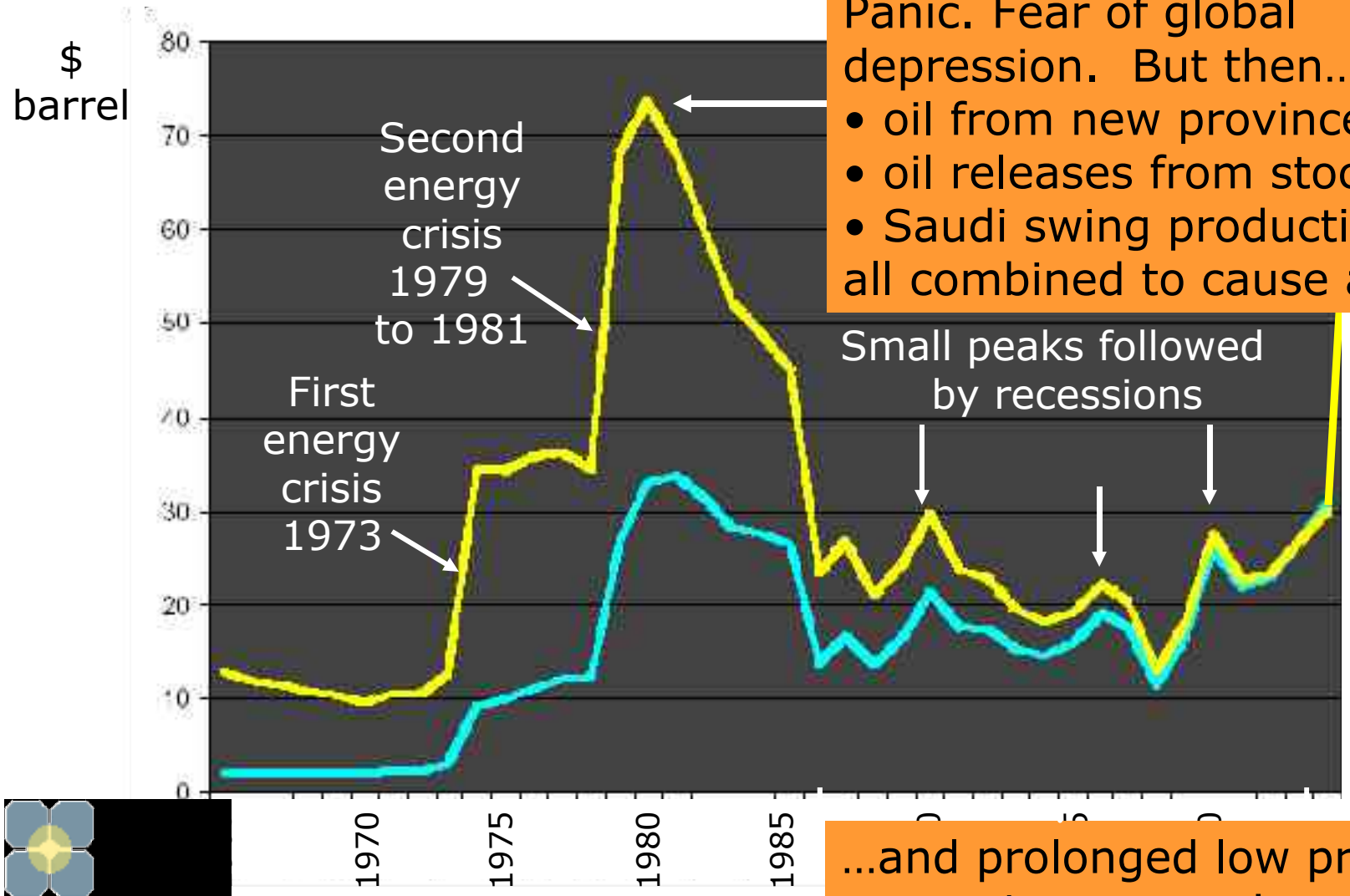
Source: ASPO

Past oil price peaks have all involved economic trauma



Source: CGES

What happened during and after the last global energy crisis?



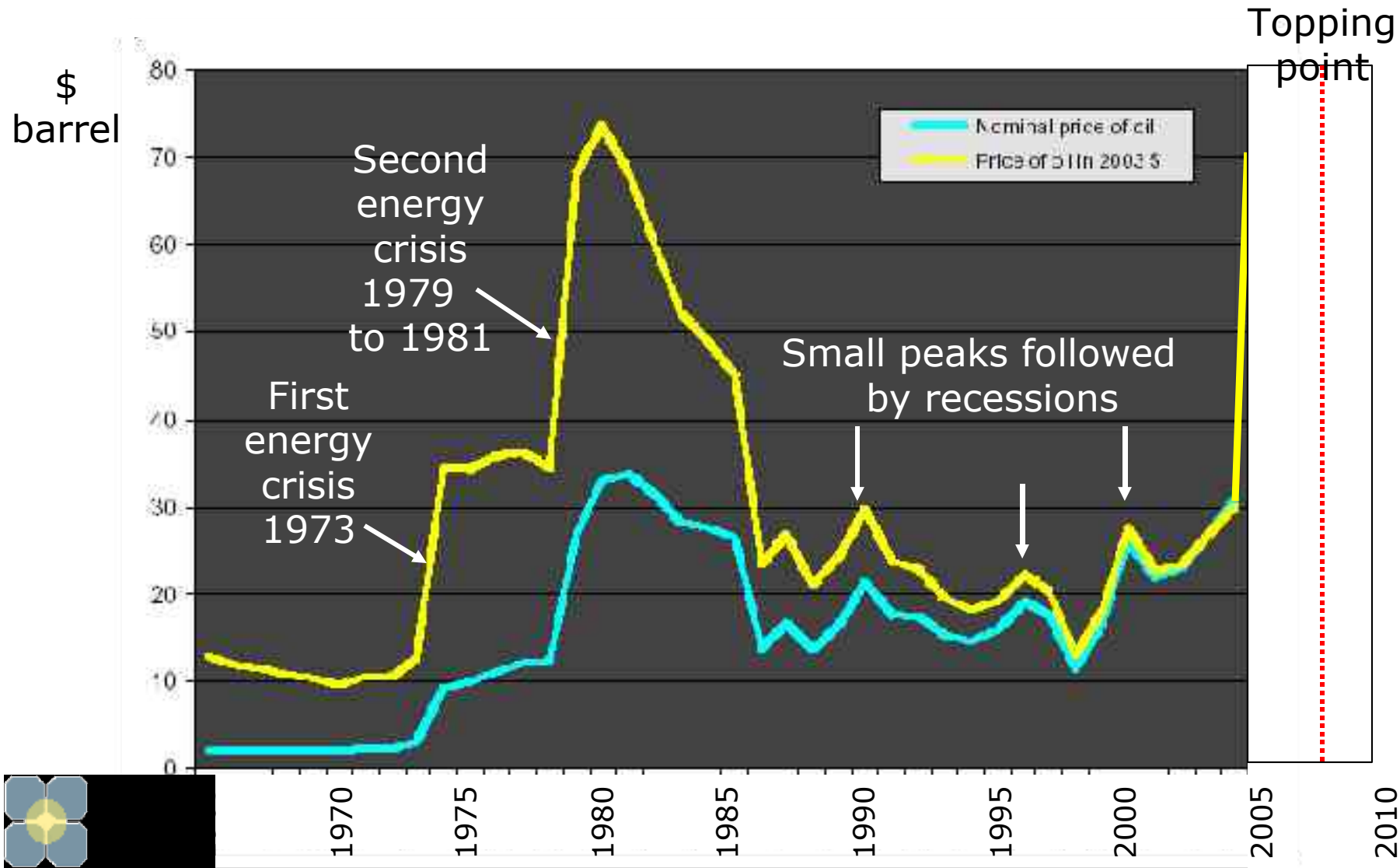
Panic. Fear of global depression. But then…
- oil from new provinces
- oil releases from stockpiles
- Saudi swing production

all combined to cause a glut

…and prolonged low prices & poor returns, causing years of chronic underinvestment

solarcentury

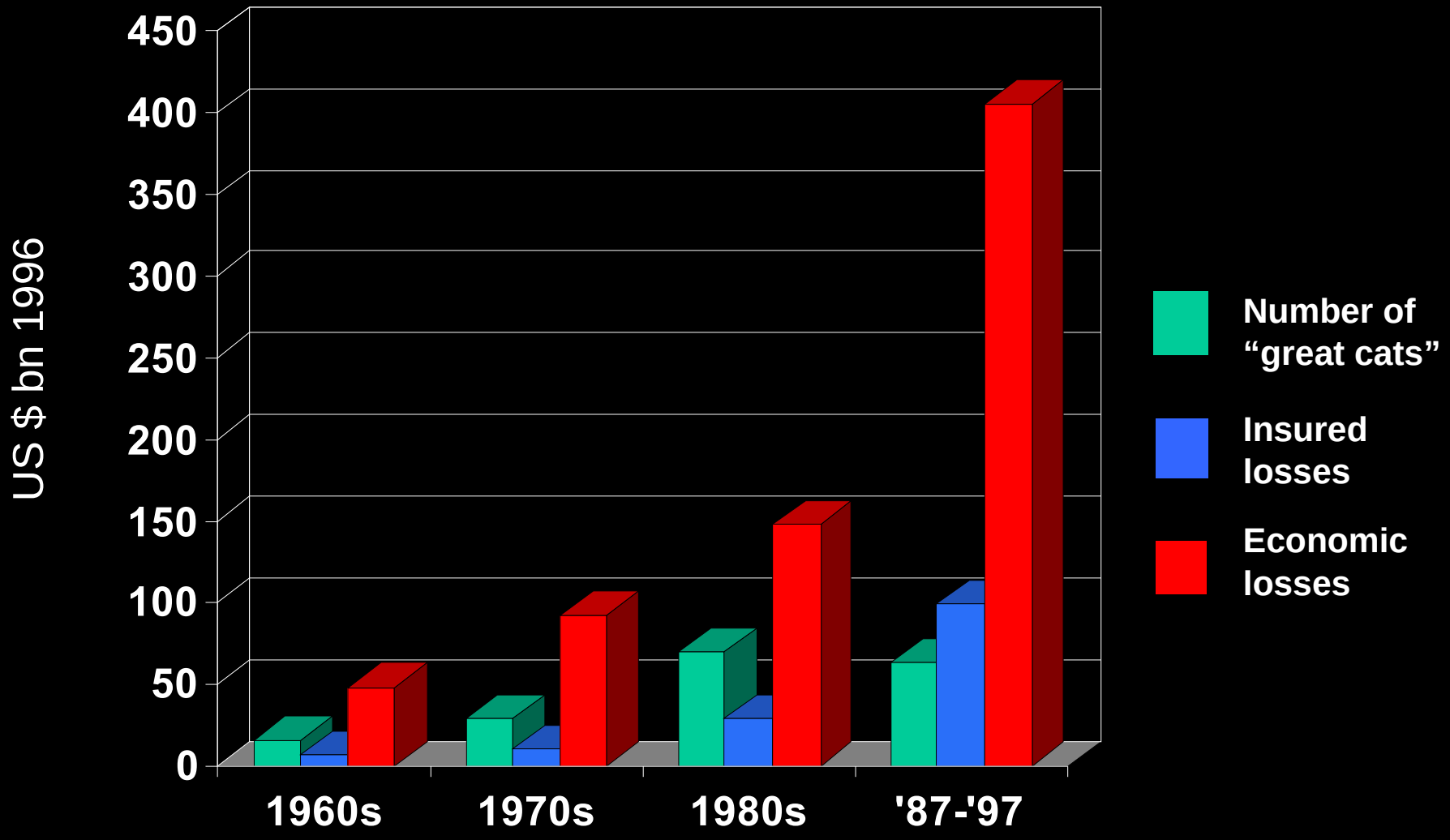
The approach of the third global energy crisis: peak panic point



Source: CGES


The second
great oversight

Property catastrophe losses



Source: Munich Re 1997

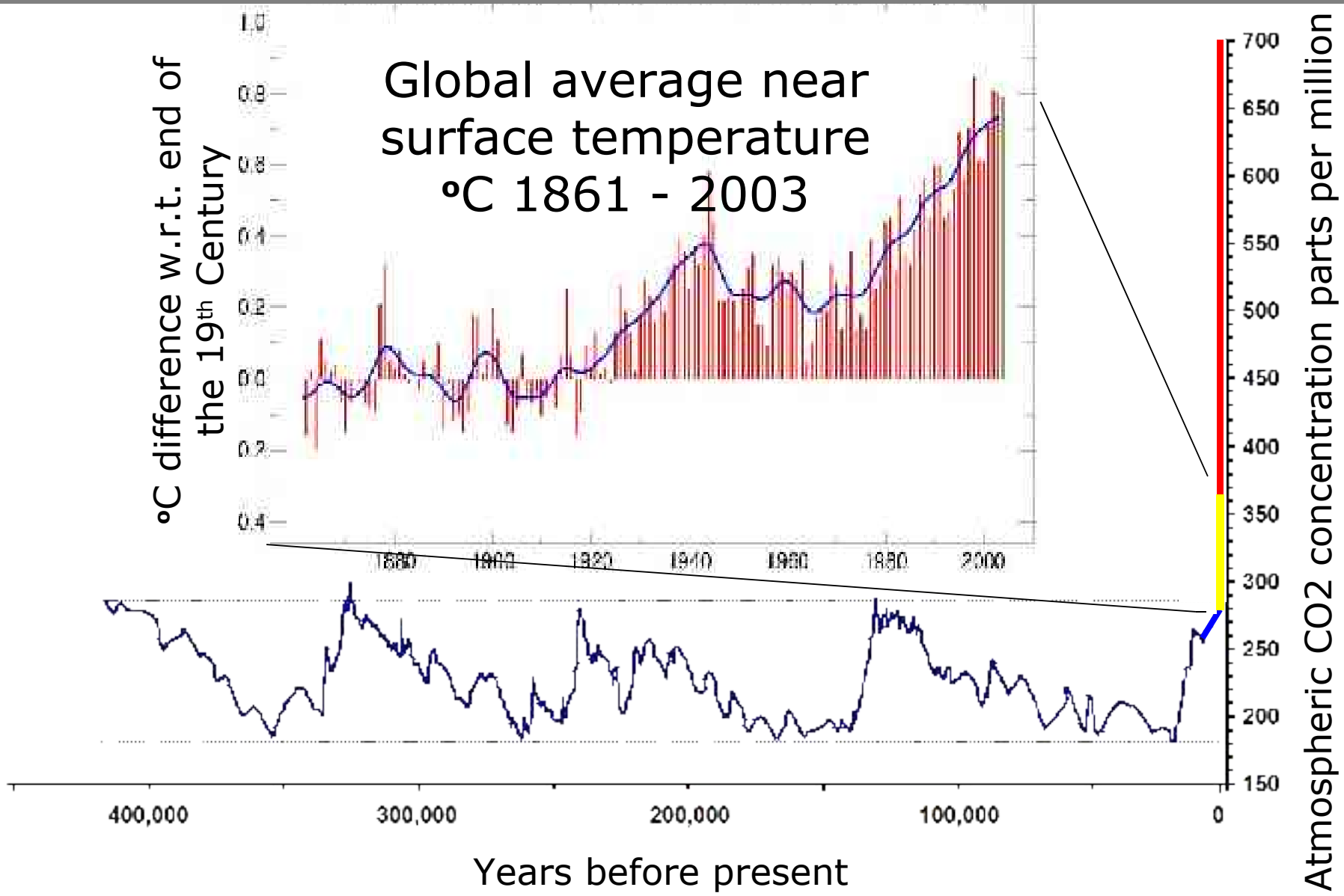
"The possible extent of losses caused by extreme natural catastrophes in one of the world's major metropolises or industrial centres would be so great as to cause the collapse of entire countries' economic systems and could even bring about the collapse of the world's financial markets."

Source: Munich Re 1997

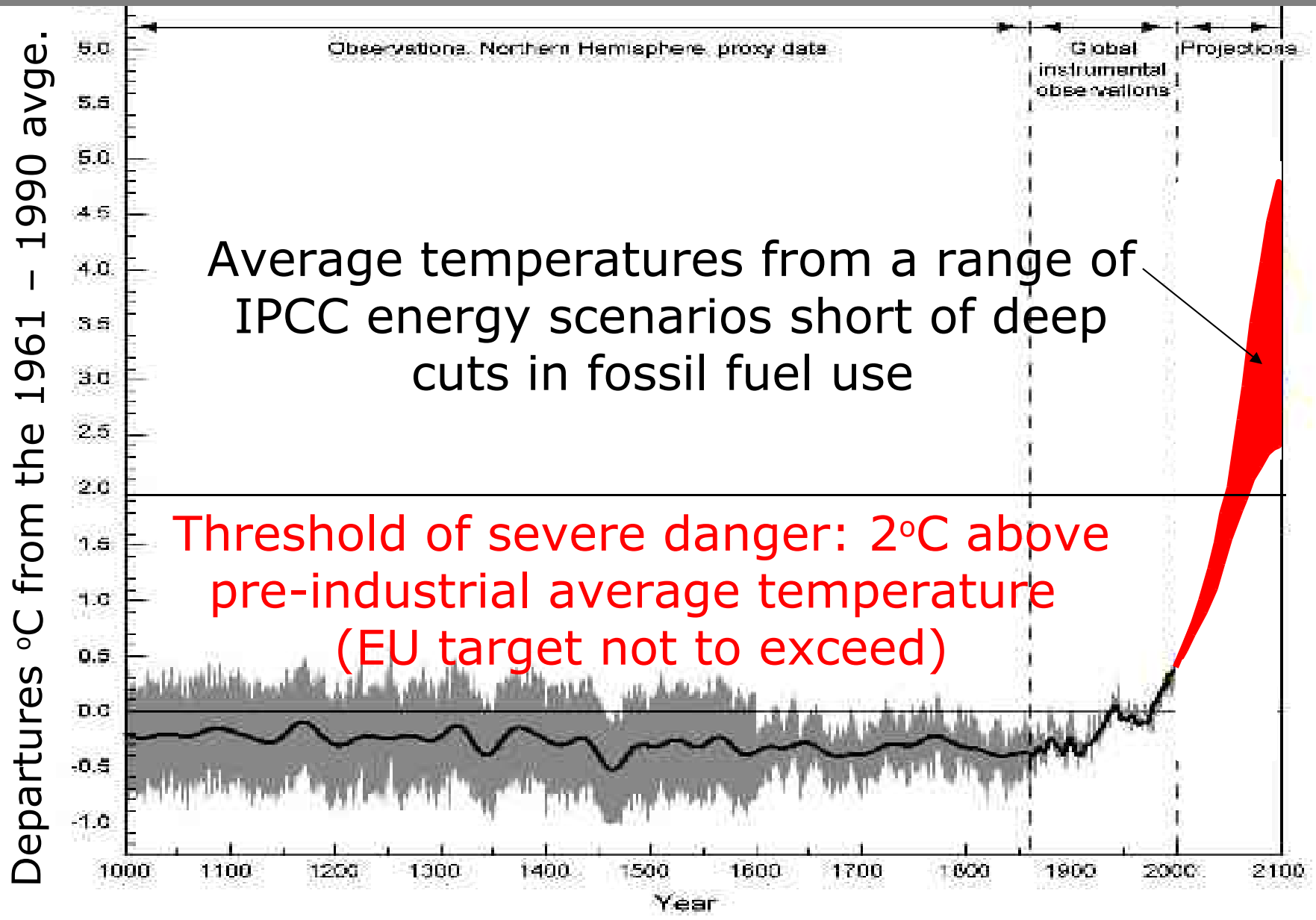
Reasons to fear global warming

1. The degree
2. The rate
3. Biodiversity loss
4. Sea level rise
5. Threat to insurance industry
6. Threat to capital markets
7. Threat to food supplies
8. Threat to water supplies
9. Threat to human health
10. Increased risk of conflict
11. Threat to societal stability
12. Danger of amplifying feedbacks
13. Danger of runaway effect

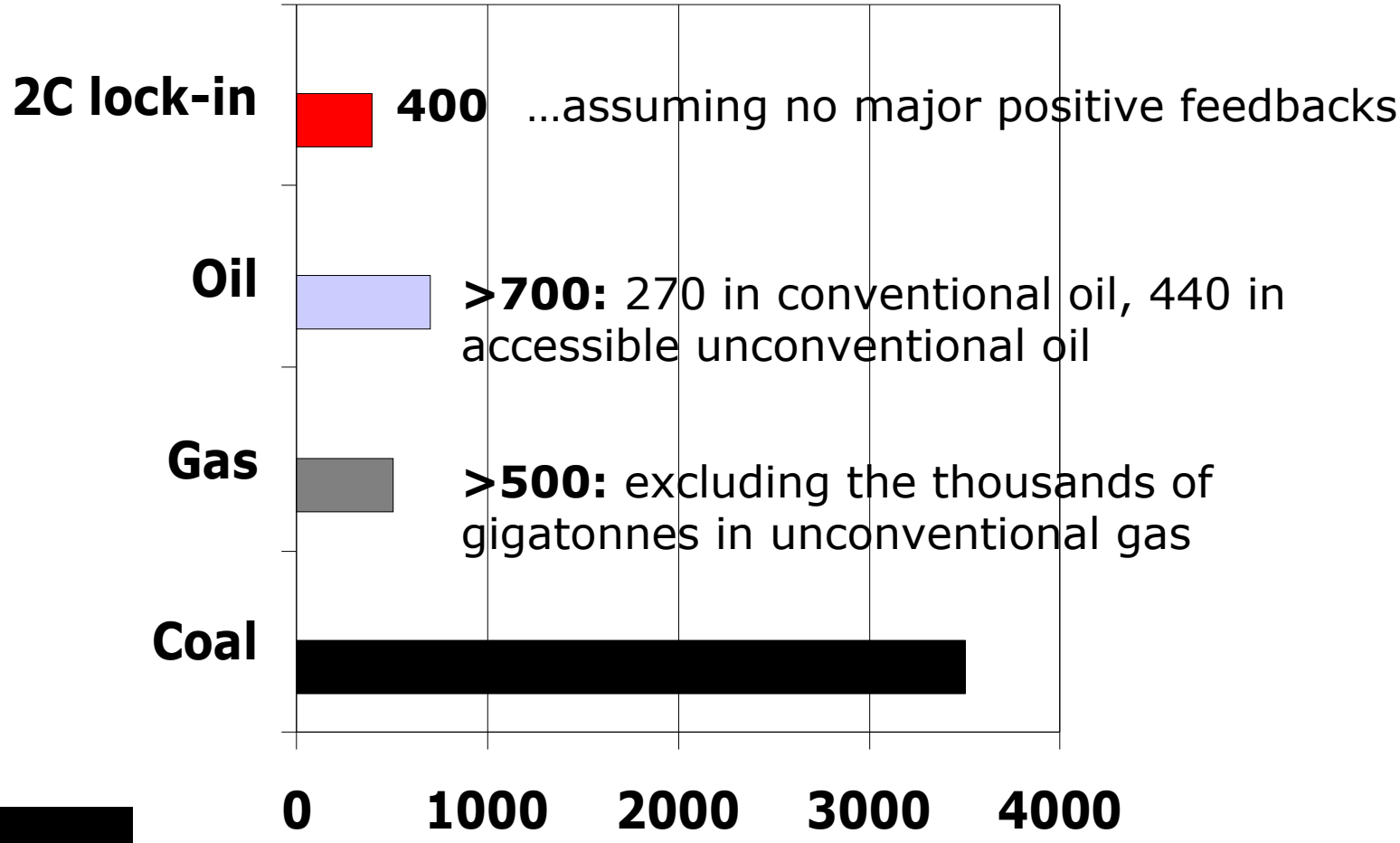
CO_2 and fossil fuel use 1861 -2100



Surface temperatures 1000 – 2100 AD



The ghastly arithmetic of carbon



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Summary: Oil depletion

1. The topping point of oil production will happen this decade.

3. Its economic impact will be horrible.

3. The shortfall between current expectation of oil supply and actual availability will be such that neither gas, nor renewables, nor liquids from gas and coal, nor nuclear, nor any combination thereof, will be able to plug the gap in time to head off economic trauma.

Summary: Global warming

4. The enhanced greenhouse will destroy economies and ecosystems if more than a small fraction of remaining coal is burned. Burning most of the remaining oil and gas will have the same effect, wherever the oil and gas topping points lie.

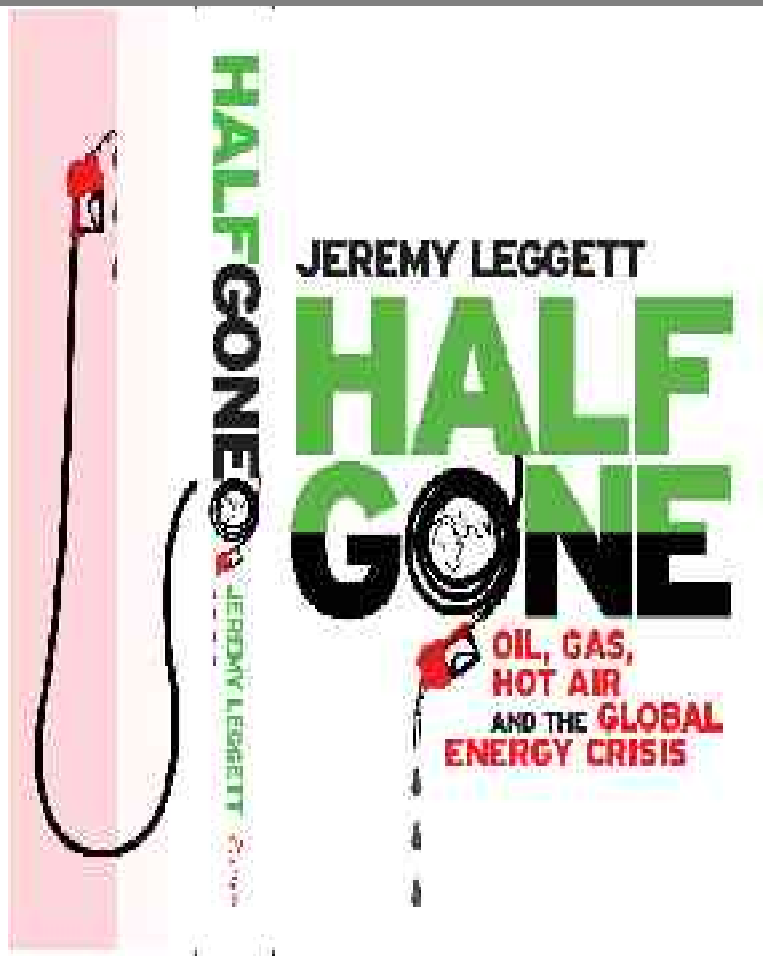
Summary: Conflation of oil depletion & global warming (1)

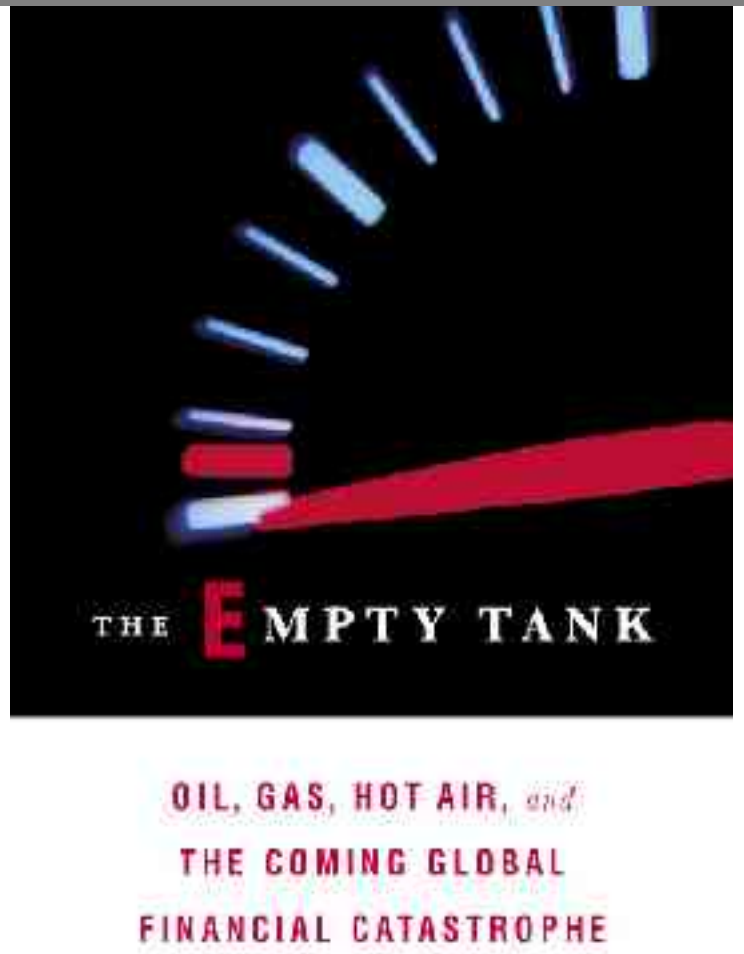
5. Amid the ruins of the old energy modus operandi, the oil depletion and global warming issues will conflate as many try to turn to coal in extremis.
6. Renewable energy use, alongside energy efficiency, will increasingly substitute for oil and gas, growing explosively whatever happens.
7. The extent that it grows explosively *instead* of coal expansion, rather than alongside it, will determine whether economies and ecosystems can survive the global warming threat.

Summary: Conflation of oil depletion & global warming (2)

8. There is much that individuals, communities, companies, institutions and governments can do to influence the outcome of this struggle to grow renewables faster than coal, and in parallel to ameliorate the worst excesses of the global energy crisis, and to create a better society in the process.

For further information





Please see "The Empty Tank", Random House (USA) and "Half Gone", Portobello Books (UK & Rest of World)
1st November 2005