# WORKSHOP OR OIL AND GAS RESSOURCES

## The depletion of oil and gas world reserves and their consequences on major energy issues

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# PLAN OF PRESENTATION

1. **Oil and gas world production peaks: *13 slides***
   - **When ?**
   - **At which production levels ?**

2. **Consequences for the world energy mix: *2 slides***

3. **Consequences for transportation systems: *2 slides***

# Part 1:

**Oil and gas world production peaks.**

**- When ?**

**- At which production levels ?**

# PESSIMISTS HAVE HISTORICALLY BEEN WRONG

| | |
|---|---|
| ***1919*** | ***"... The peak of U.S. production will soon be past - possibly within three years"*** |
| ***1936*** | ***"…it is unsafe to rest in the assurance that plenty of petroleum will be found in the future merely because it has been in the past."*** |
| ***1981*** | ***"If petroleum is not there to begin with, all of the human ingenuity that can be mustered into the service of exploration cannot put it there…"*** |
| ***1990*** | ***"… non-OPEC production in the longer term will at best remain stagnant and is more likely to fall gradually due to resource constraints."*** |
| ***1998*** | ***"Global production of conventional oil will begin to decline sooner than most people think probably within 10 years"*** |

***Source : Daniel BUTLER, U.S. EIA/DOE AEO 2001 conference***

# RESERVES and RESSOURCES

- **What people "can see": published information, i.e. proven reserves, which is an economical concept, which therefore changes with changes in technology and oil prices - These are the visible part of the iceberg**
- **What 99% of people "cannot see", i.e. the non visible part of the iceberg, i.e. the already discovered resources in place on one hand the ultimate reserves on the other hand**

**Discovered resources** **are not published, but could be estimated at 3,000 Gbbl i.e. three times the proven reserves of 1,000 Gbbl**

**Ultimate reserves** **today (estimated 2000/3000 Gbbl) are two to three times the proven reserves of around 1,000 Gbbl**

# PROVEN RESERVES : AN OPTIMISTIC PICTURE

| | 1973 | | 2000 | |
|---|---|---|---|---|
| | GTOE | Years of consumption | GTOE | Years of consumption |
| Oil world reserves | 86 | 30 | 140 | 40 |
| Gas world reserves | 52 | 48 | 140 | 65 |

**Observing the "visible part of the iceberg" leads to conclude that we have plentiful and fast growing oil and gas reserves and that there is no problem**

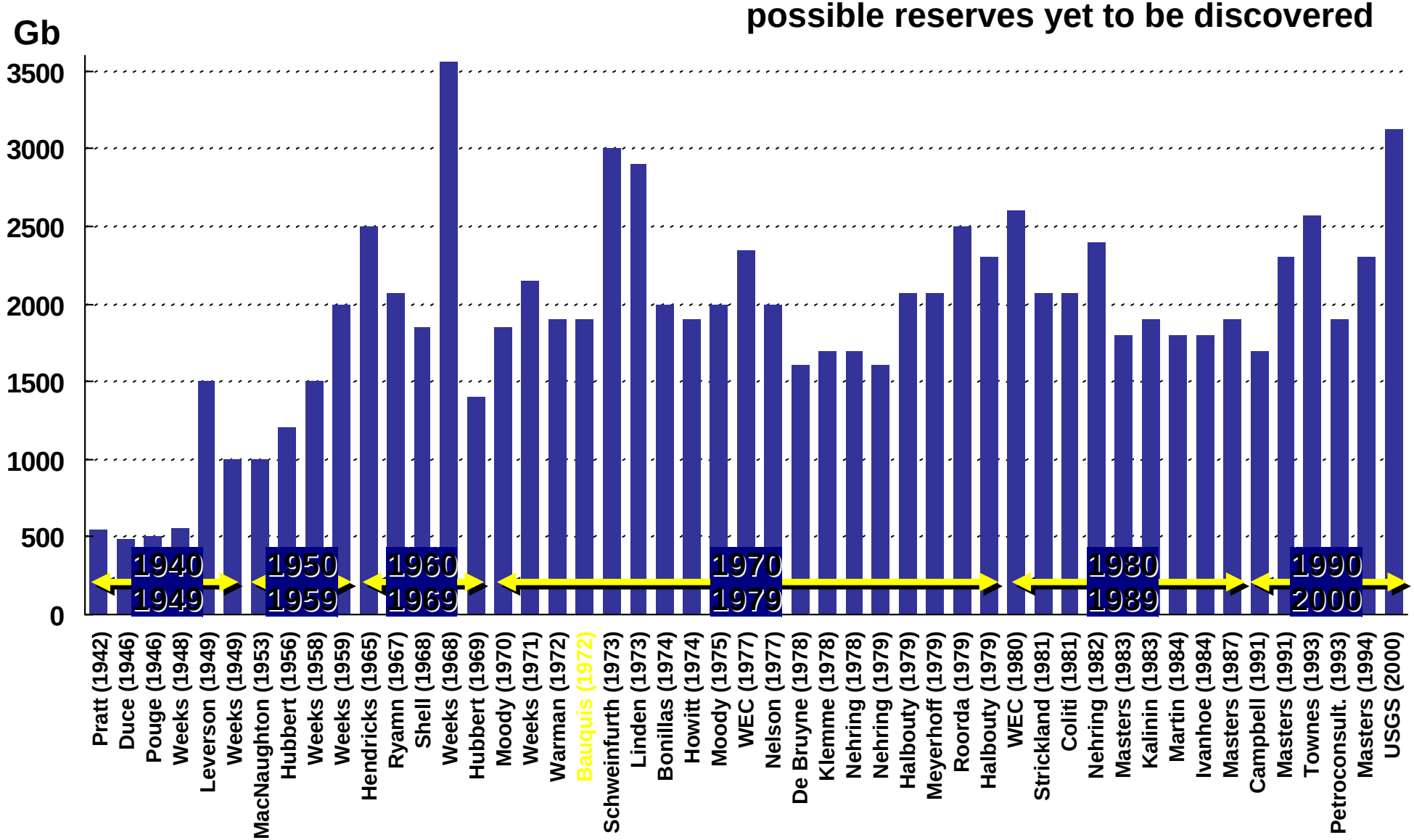
# ULTIMATE RESERVES : A PESSIMISTIC VIEW

| Ultimate world oil conventional reserves | 1973 | 2000 |
|---|---|---|
| Gbarrels | 2000 - 3000 | 2000 - 3000 |

**Beetween 1973 and 2000 there is practically no increase in ultimate conventional oil reserves estimates**

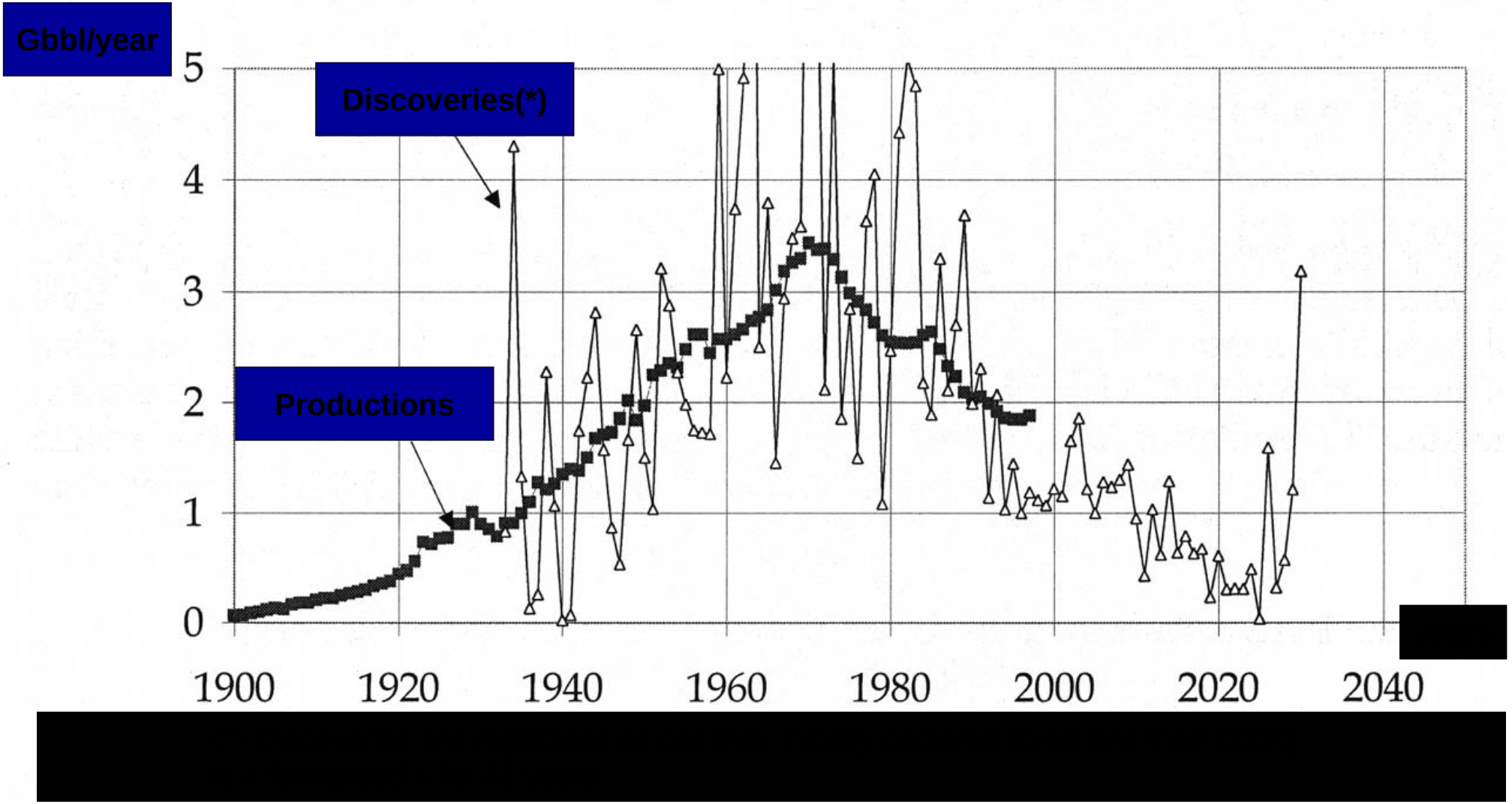
# HISTORICAL VIEWS ON ULTIMATE RESERVES

*** Cumulative production + proven reserves + possible reserves yet to be discovered**

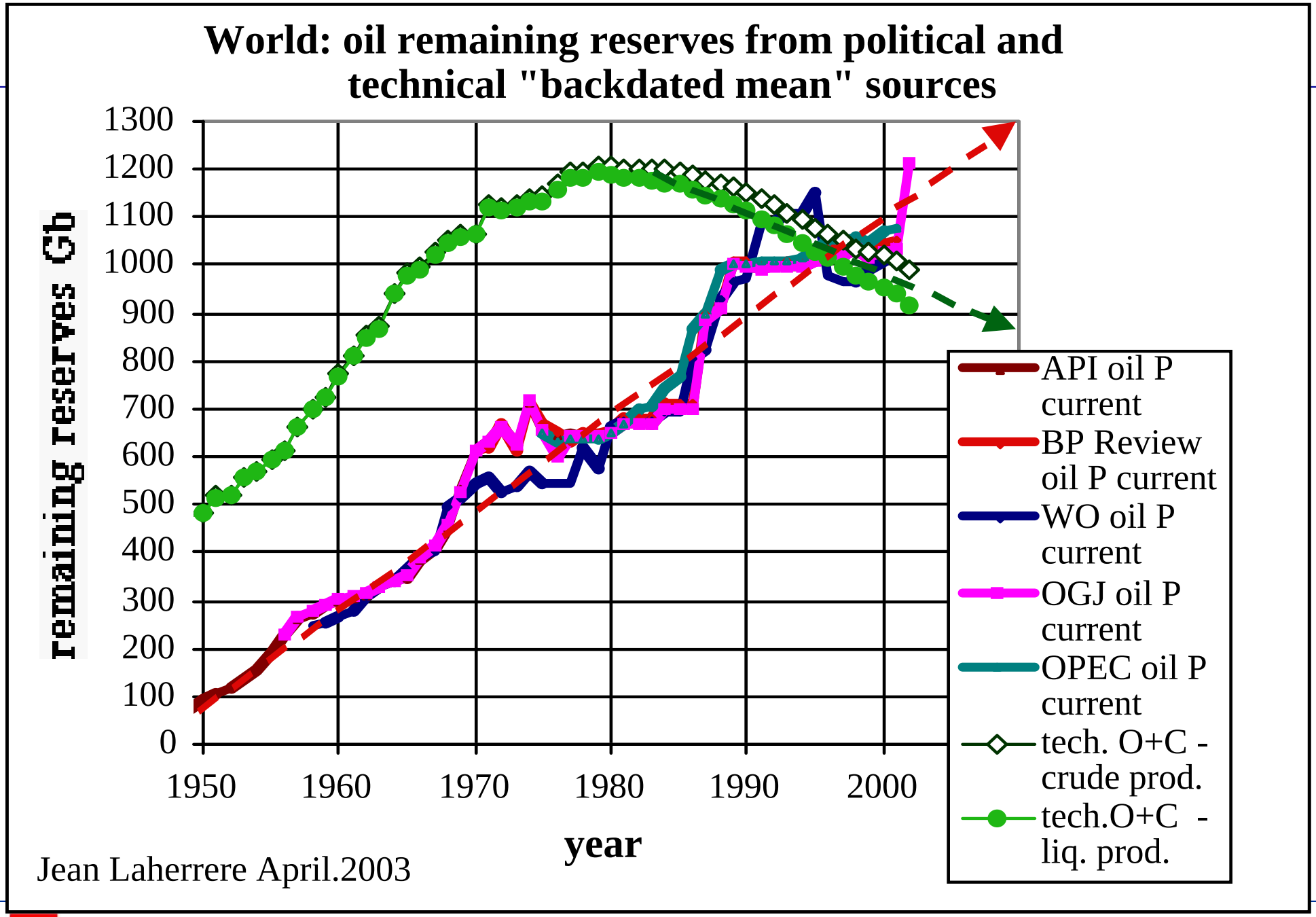


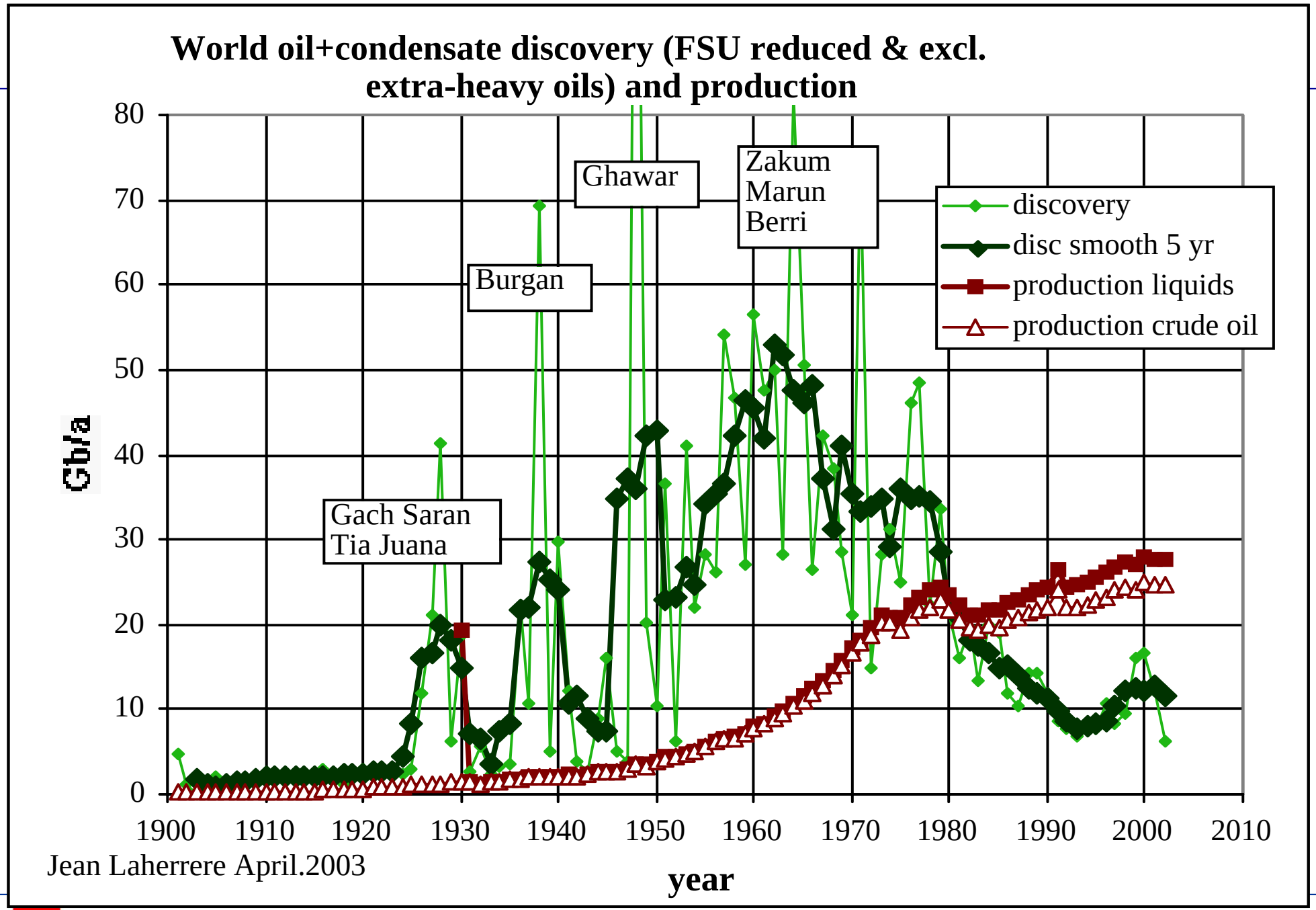

Source: IFP/DSEP adapted from Martin (1985) and Campbell (1992) - Updated 2000

# THE IRREVERSIBLE DECLINE OF OIL PRODUCTIONS IN THE USA

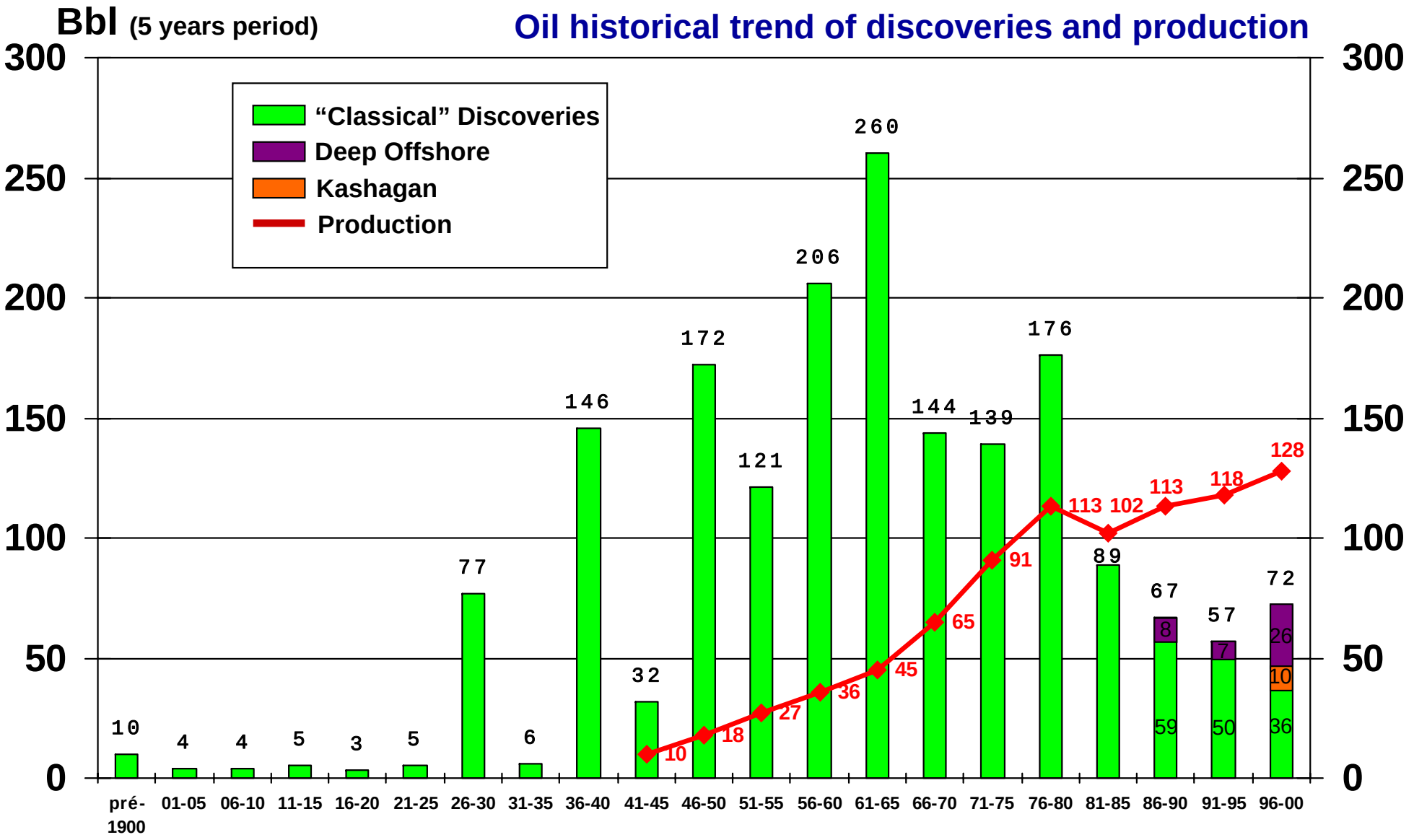



Source : King Hubbert 1956 - Updated by Jean Laherrere


World: oil remaining reserves from political and technical "backdated mean" sources
remaining reserves Gb
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1950
1960
1970
1980
1990
2000
year
Jean Laherrere April.2003
API oil P current
BP Review oil P current
WO oil P current
OGJ oil P current
OPEC oil P current
tech. O+C - crude prod.
tech.O+C - liq. prod.

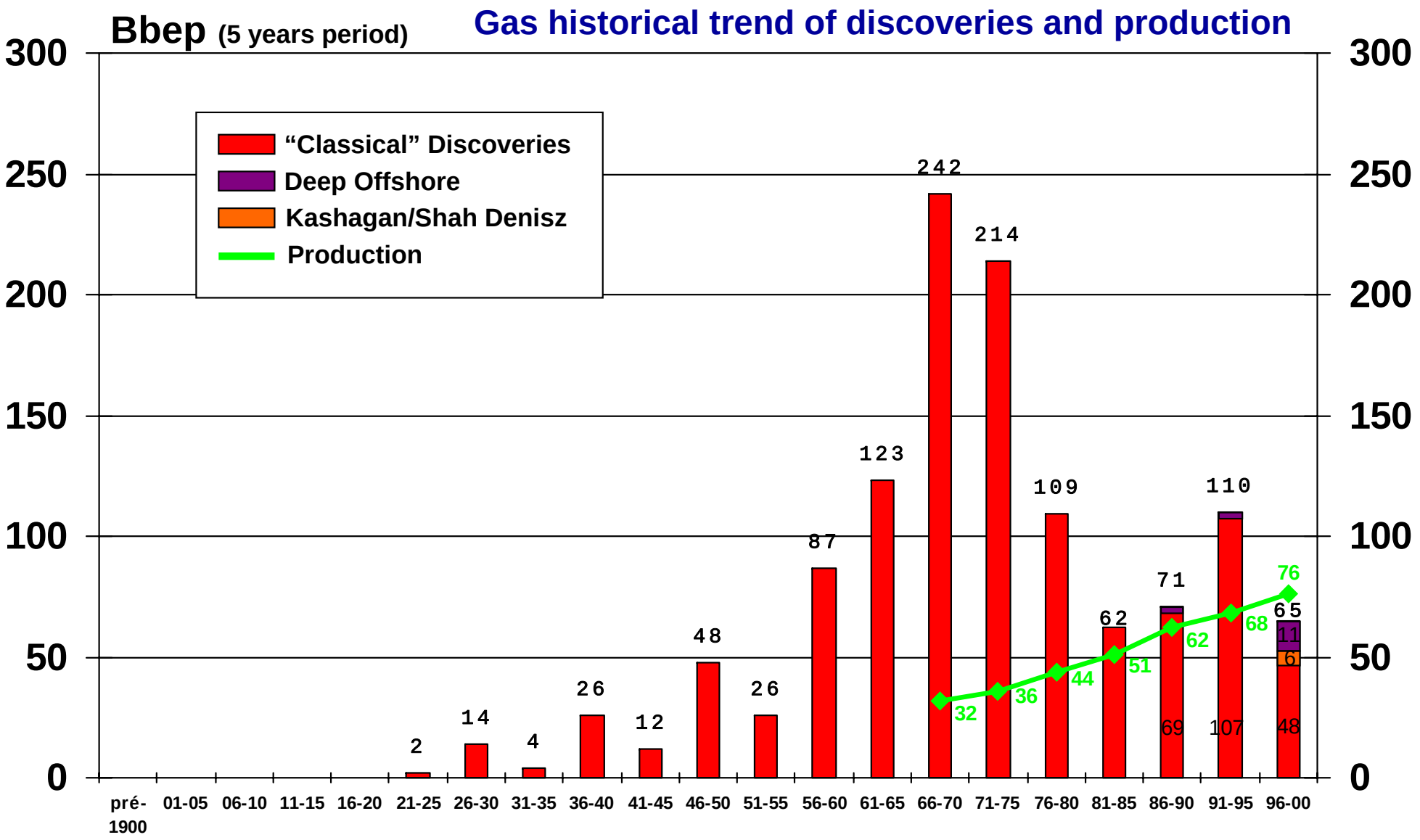

World oil+condensate discovery (FSU reduced & excl. extra-heavy oils) and production
Gb/a
year
Jean Laherrere April.2003
Ghawar
Zakum
Marun
Berri
Burgan
Gach Saran
Tia Juana
discovery
disc smooth 5 yr
production liquids
production crude oil
0
10
20
30
40
50
60
70
80
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

# Oil: towards a world of mature reservoirs




*Source: IHS, Total (est)*

# Gas: same trend with 20 y delay and less impact




*Source: IHS, Total (est)*

# CAN WE RECONCILE LONG-TERM VIEWS

- **Increase in proven reserves from 1973 to 2000 largely due to old discoveries reevaluations and not essentially to new discoveries**
- **Reevaluations due both to increases in expected recovery rates, and to underestimation of accumulation volumes at early evaluation stages**
- **A secondary factor has been the acceleration of the delineation - development process**
- **Last but not least the emergence of non conventional reserves as part of new proven reserves (permanent blurring of frontiers beetween the two categories)**

**Source : P.R. BAUQUIS. Fort Lauderdale 28 NOV 2000**

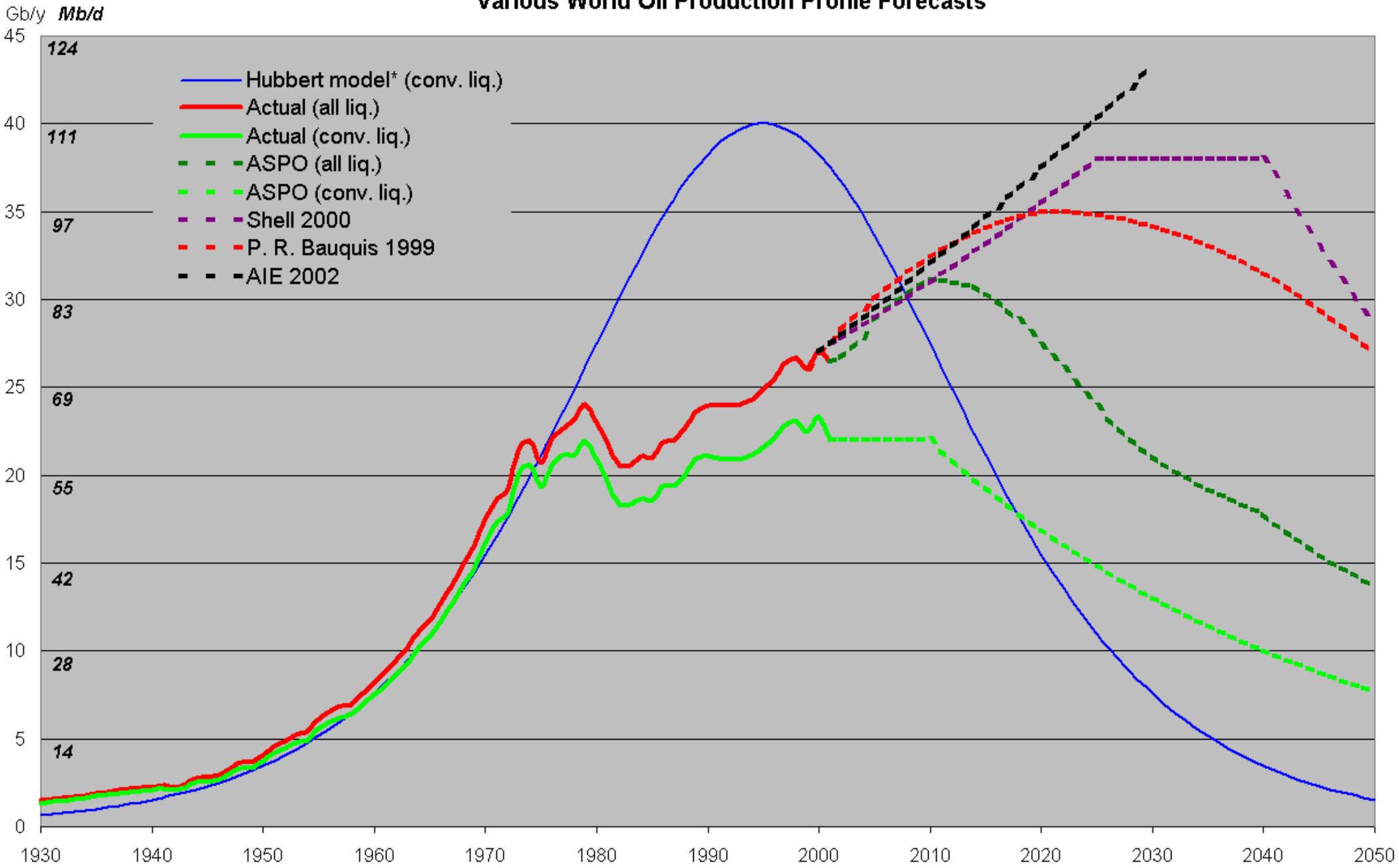
# THE ROLE OF ULTRA-HEAVY OIL IN FUTURE RESERVES GROWTH

| In billion of barrels | Estimated volume in place | 1995 estimated reserves | 2030 estimated reserves |
|---|---|---|---|
| Orinoco | 1,200 | 100 | 300 |
| Athabasca | 1,700 | 100 | 300 |

**Extra heavy crude - bitumens will represent the major portion of new "reserves"**

**(See World Energy Congress Houston September 1998 - Paper by P.R. Bauquis)**

## Various World Oil Production Profile Forecasts




Source : ASPO Uppsala 2002 press release - USGS mean estimates 2000 (Shell) - Author

* Best fit for a Hubbert model based on current ultimate reserves estimates.

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# Part 2:

## Consequences of the oil and gas peaks for the world energy mix

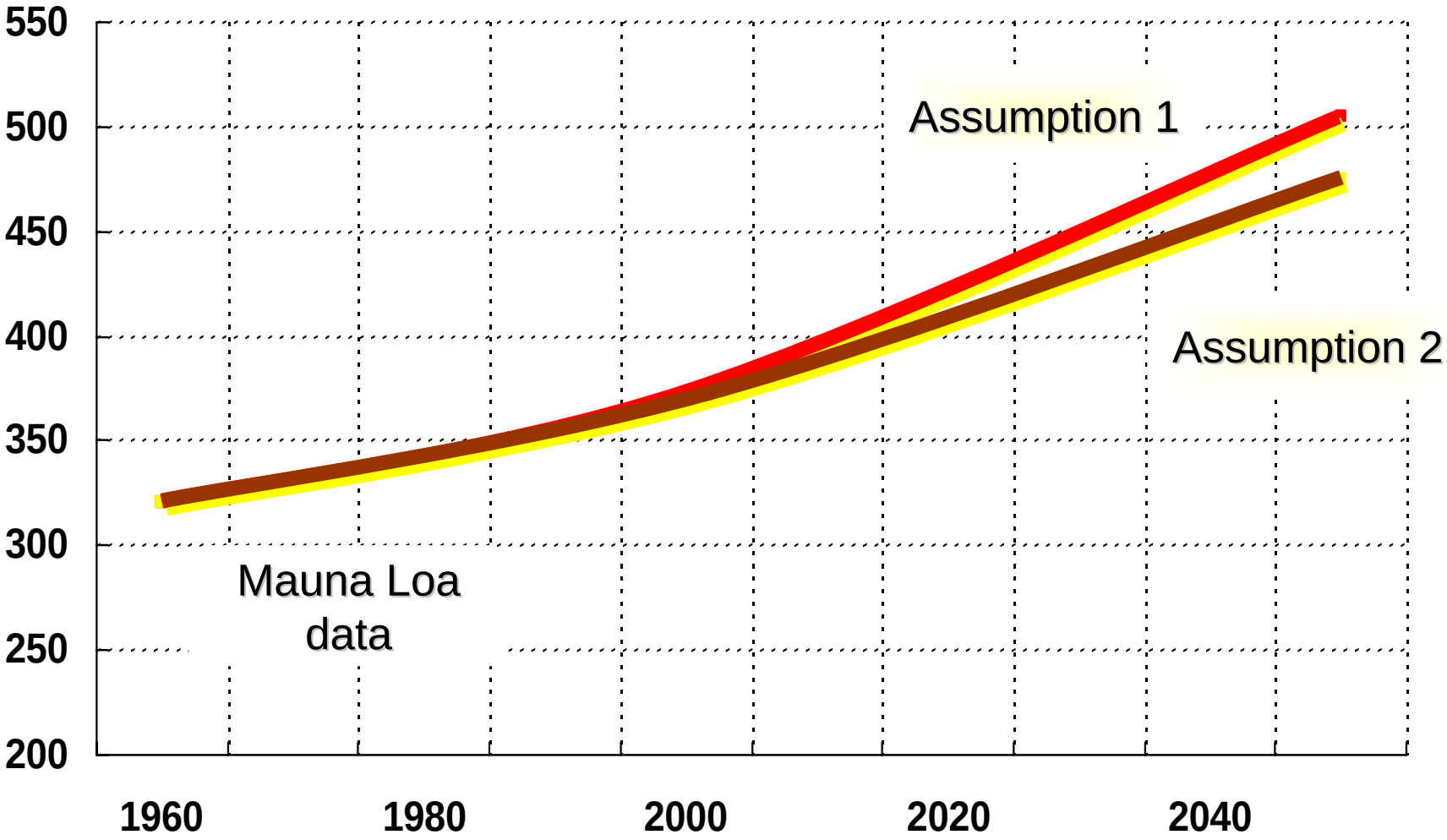
# AUTHOR SYNTHETIC ENERGY FUTURE VIEW

**Source: Revue de l'Energie**, 50 ans, n° 509 Sept. 99

| | 2000 | | 2020 | | 2050 | |
|---|---|---|---|---|---|---|
| | Gtep | % | Gtep | % | Gtep | % |
| **Oil** | 3.7 | 40 | 5.0 | 40 | 3.5 | 20 |
| **Natural gas** | 2.1 | 22 | 4.0 | 27 | 4.5 | 25 |
| **Coal** (including lignite) | 2.2 | 24 | 3.0 | 20 | 4.5 | 25 |
| **Total fossil fuels** | 8.0 | 86 | 12.0 | 87 | 12.5 | 70 |
| **Renewables** | 0.7 | 7.5 | 1 | 6.5 | 1.5 | 8 |
| **From which used for electricity generation** | (0.5) | | (0.7) | | (0.9) | |
| **Nuclear** | 0.6 | 6.5 | 1 | 6.5 | 4 | 22 |
| **Total commercial energies** | 9.3 | 100.0 | 14.0 | 100.0 | 18.0 | 100.0 |

# THE RELATED GREEN-HOUSE GASES ISSUE

$CO_2$ ppm

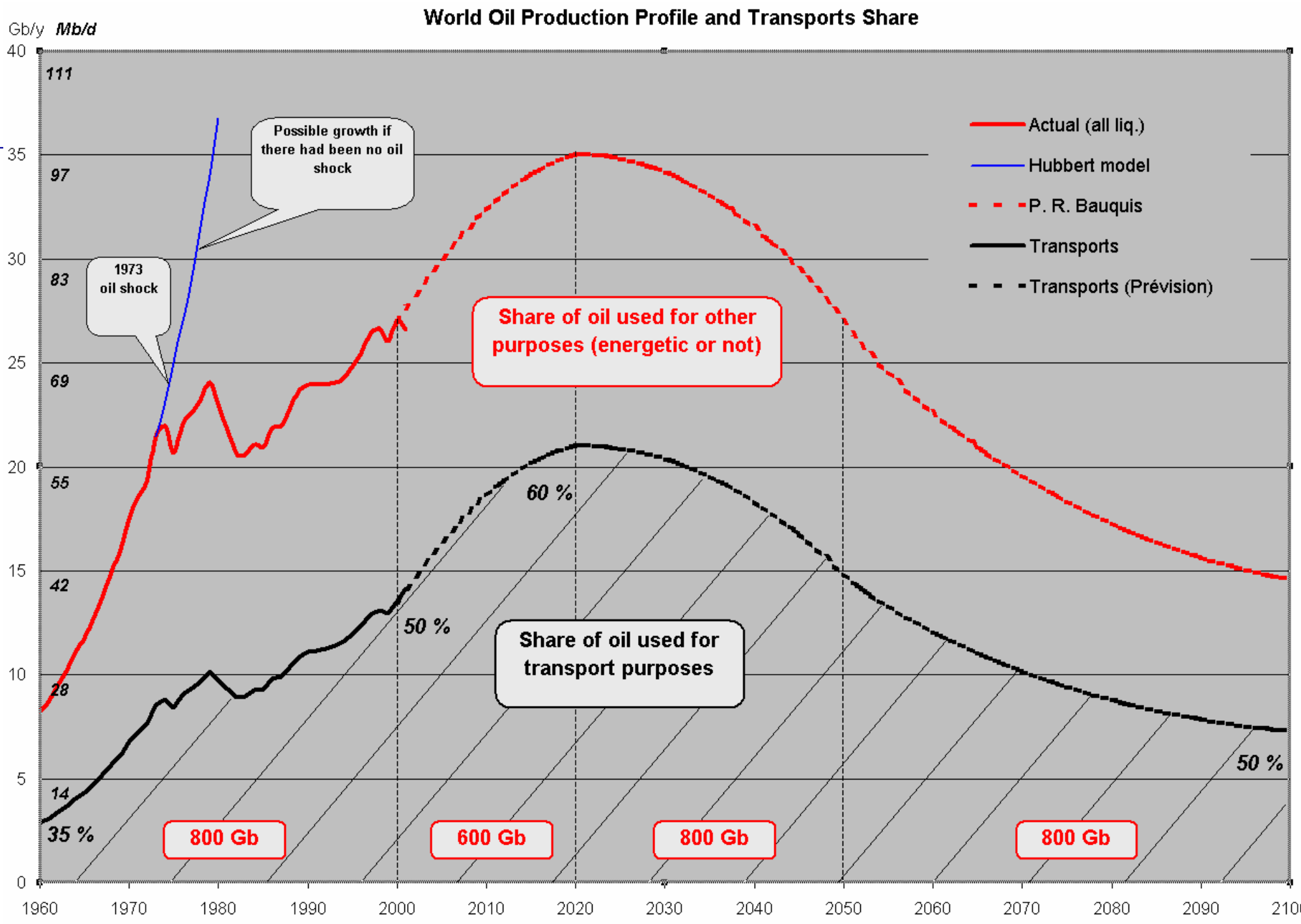



**Assumption 1: use of 1 GtC generates an increase of 0.277 ppm $CO_2$ in the atmosphere**

**Assumption 2: use of 1 GtC generates an increase of 0.228 ppm $CO_2$ in the atmosphere**

# Part 3:

## Consequences: what energy supplies for transportation systems in the long term ?




Source : P.R. Bauquis

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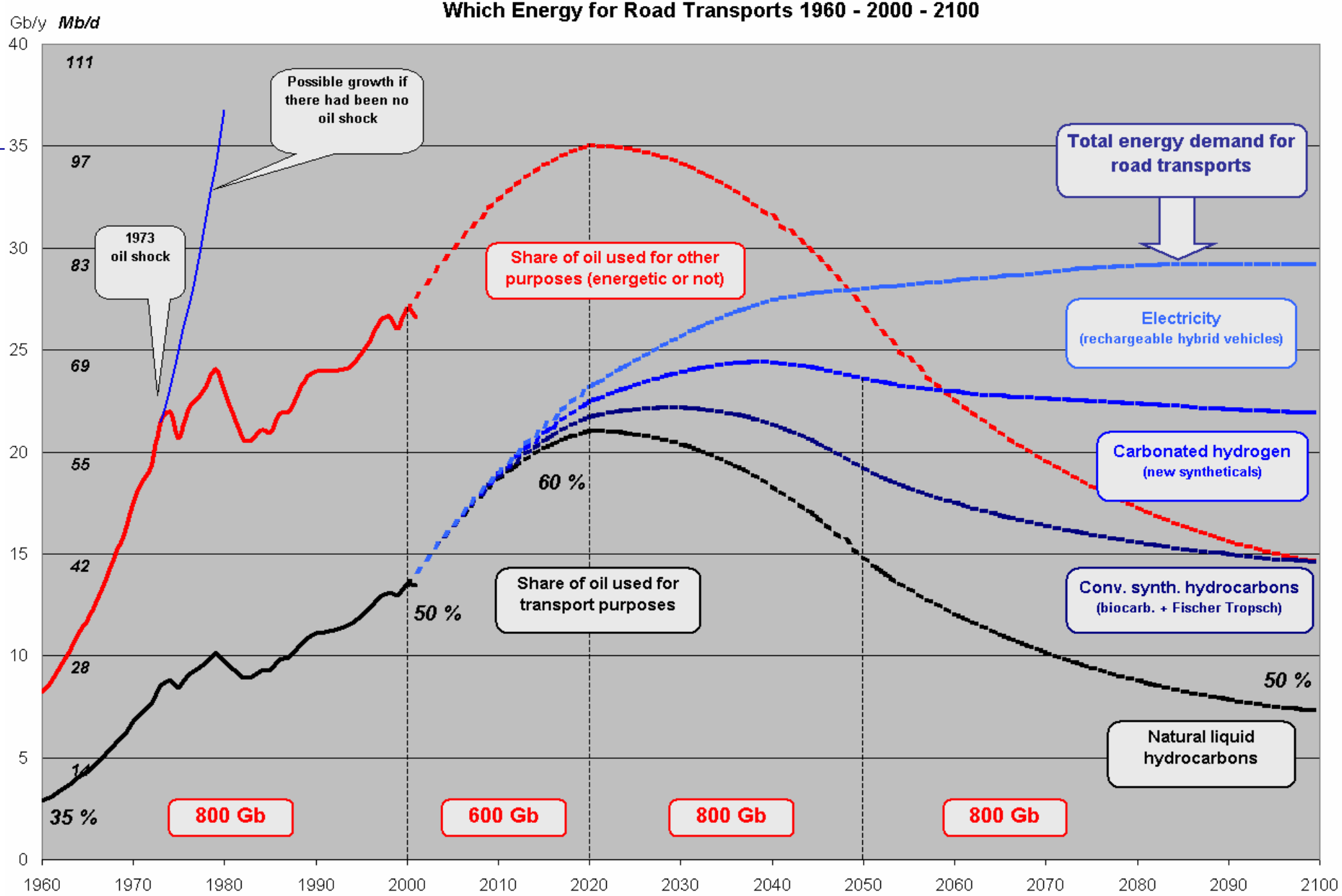
# Which Energy for Road Transports 1960 - 2000 - 2100




Source : P.R. Bauquis

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