

WORKSHOP ON OIL AND GAS RESOURCES

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

By Pierre-René Bauquis

Former head of strategy and planning of TOTAL Group.

Associated Professor IFP School

Swiss Federal Office of Energy



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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

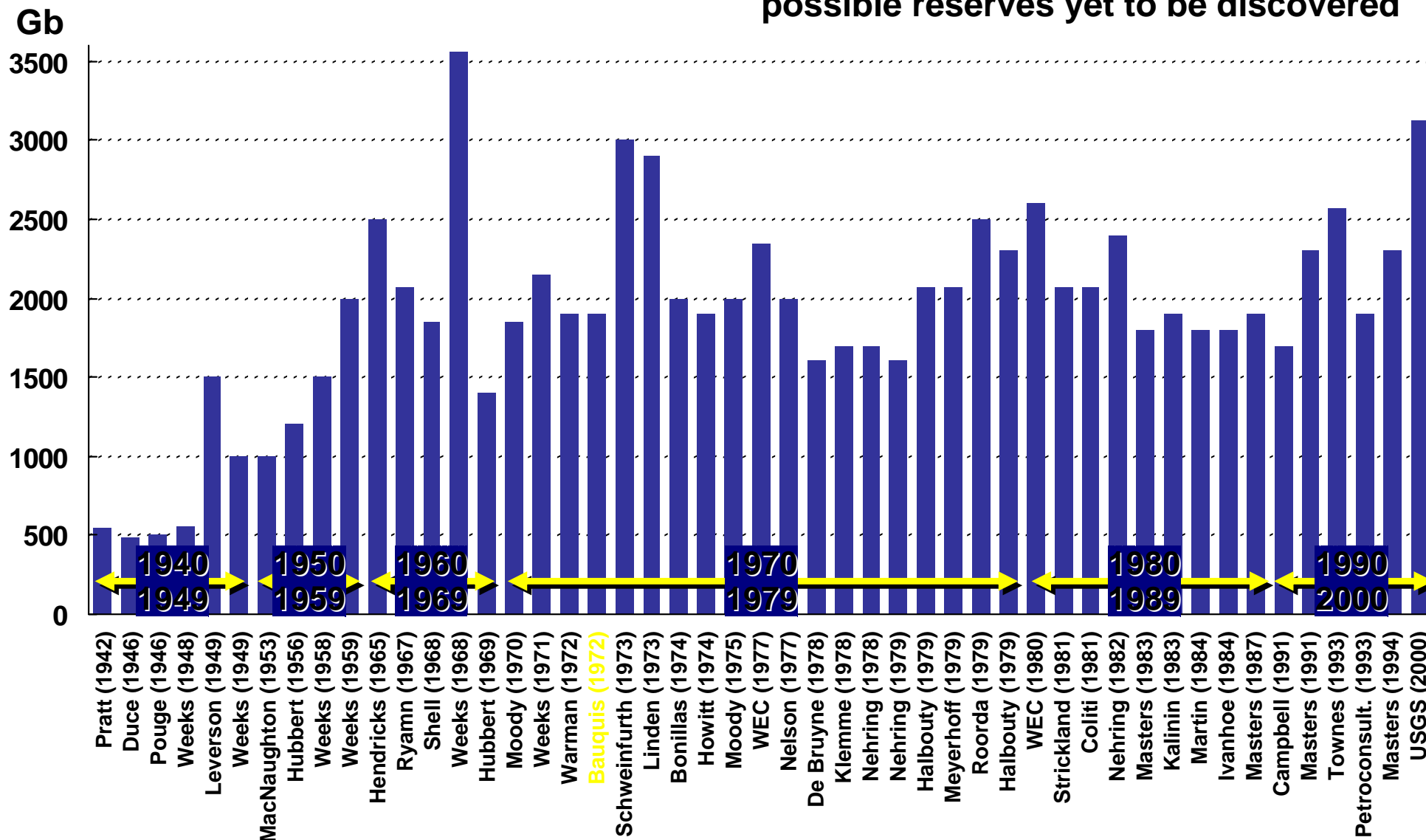
2000 - 3000

2000 - 3000

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

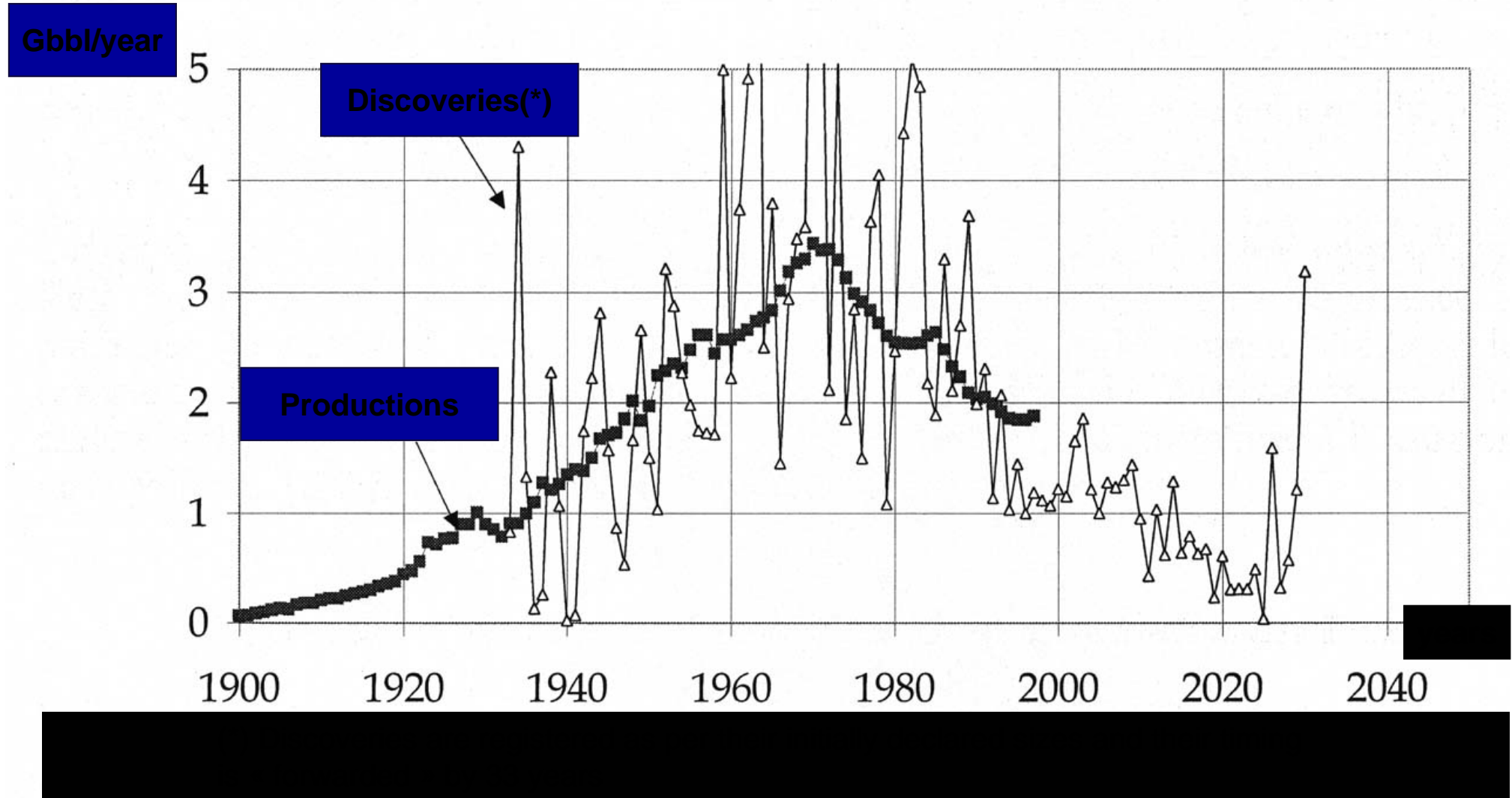
HISTORICAL VIEWS ON ULTIMATE RESERVES

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

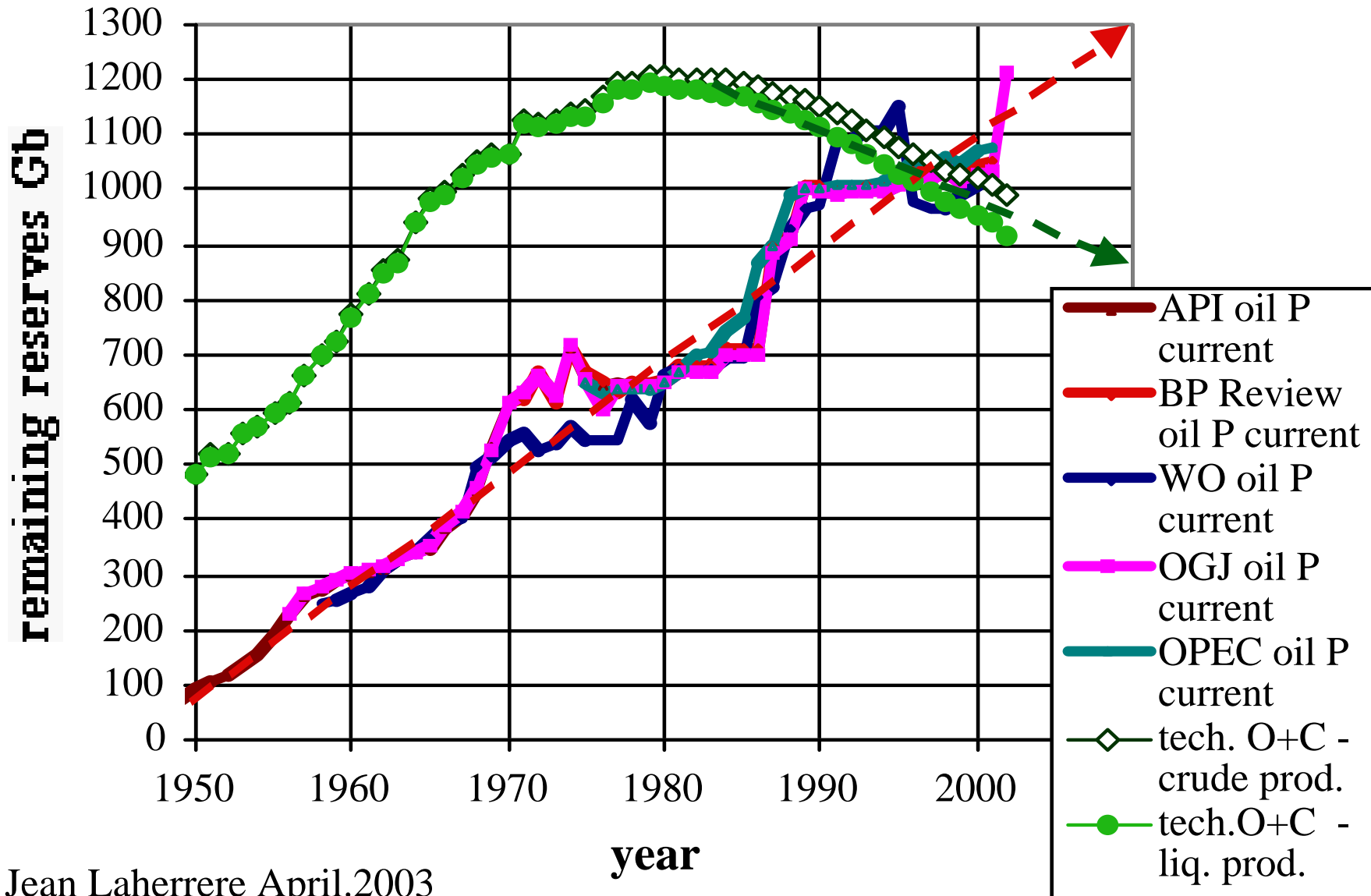


Source: IFP/DSEP adapted from Martin (1985) and Campbell (1992) - Updated 2000

THE IRREVERSIBLE DECLINE OF OIL PRODUCTIONS IN THE USA

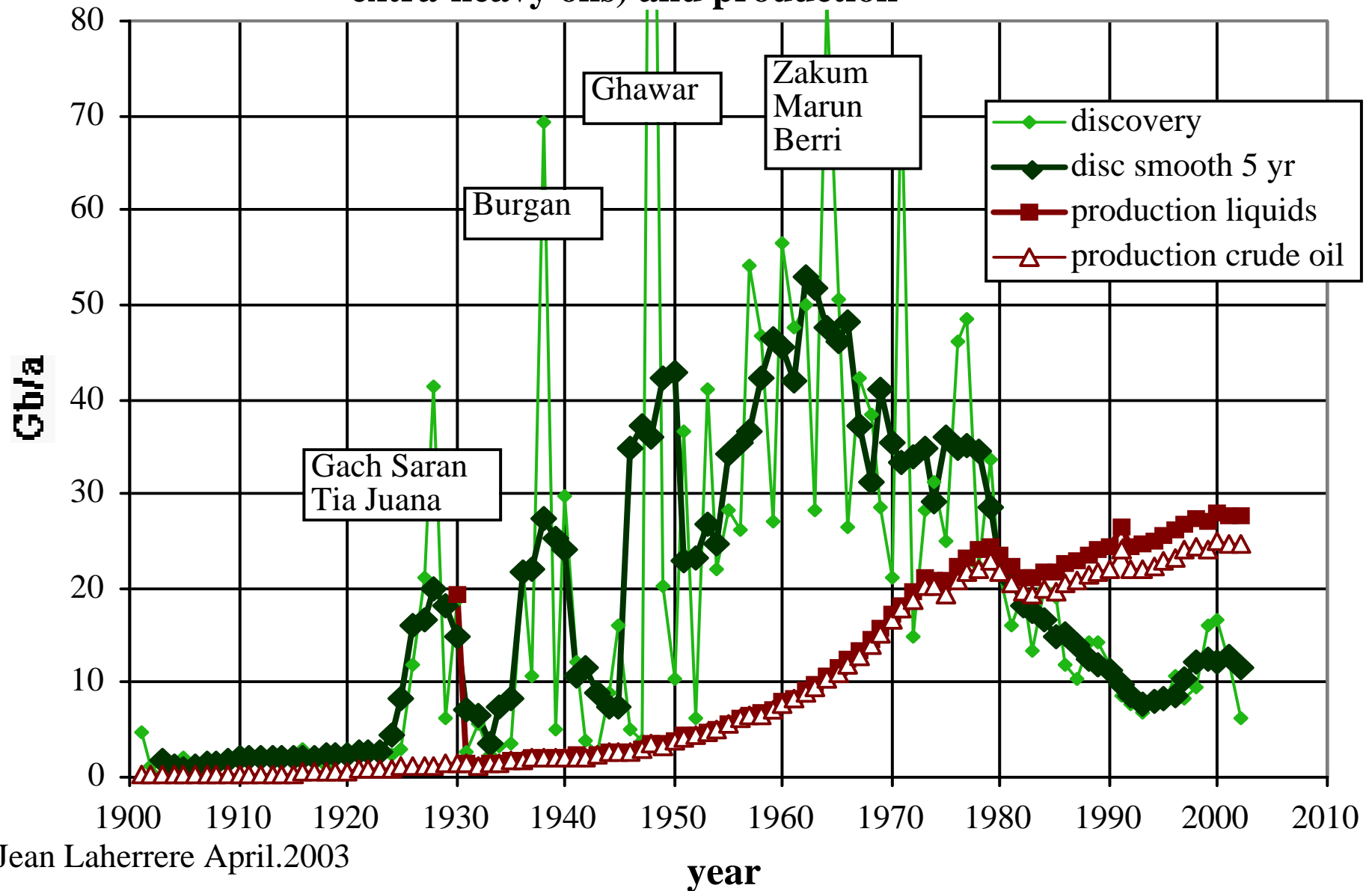


World: oil remaining reserves from political and technical "backdated mean" sources



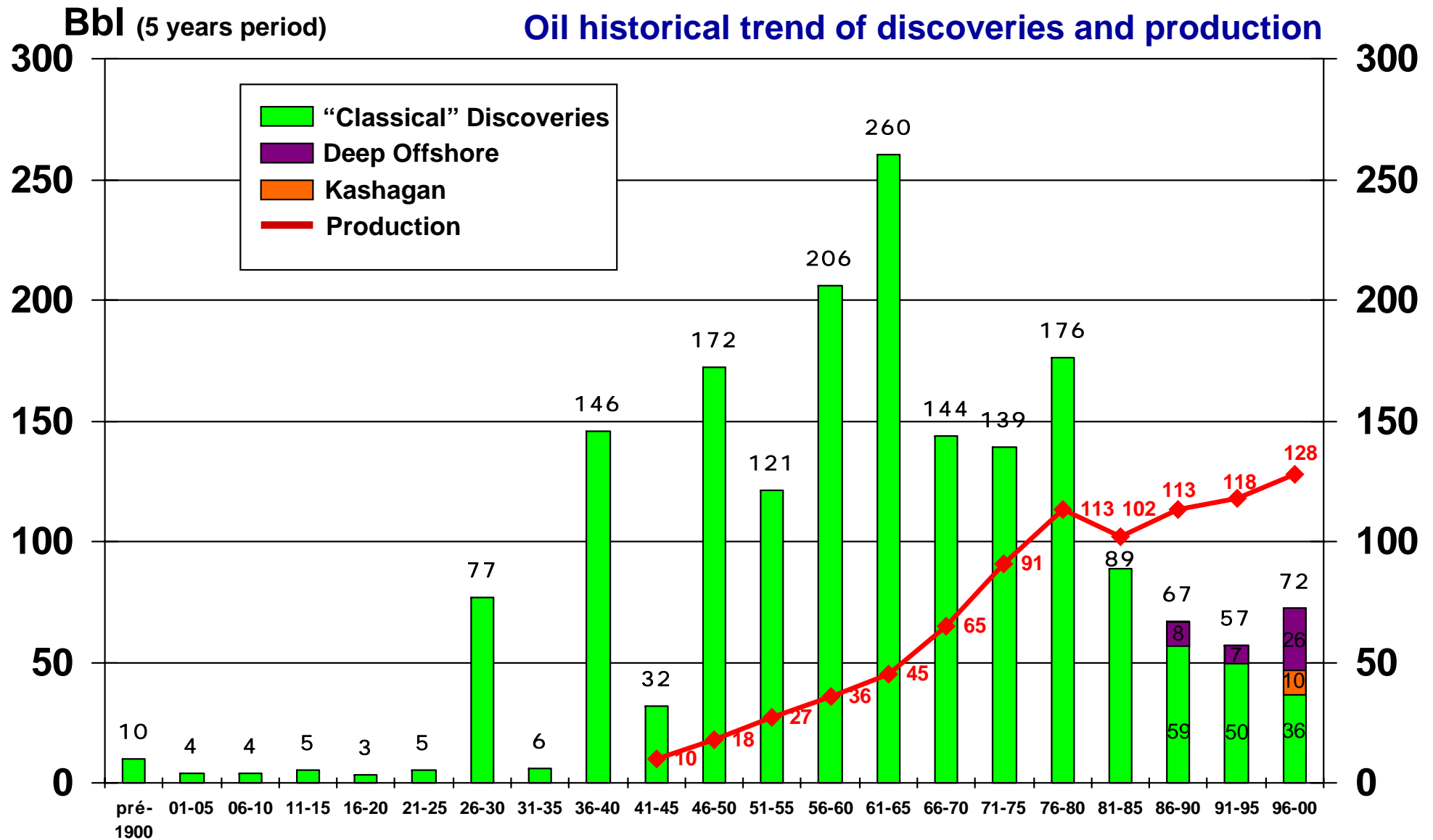
Jean Laherrere April.2003

World oil+condensate discovery (FSU reduced & excl. extra-heavy oils) and production

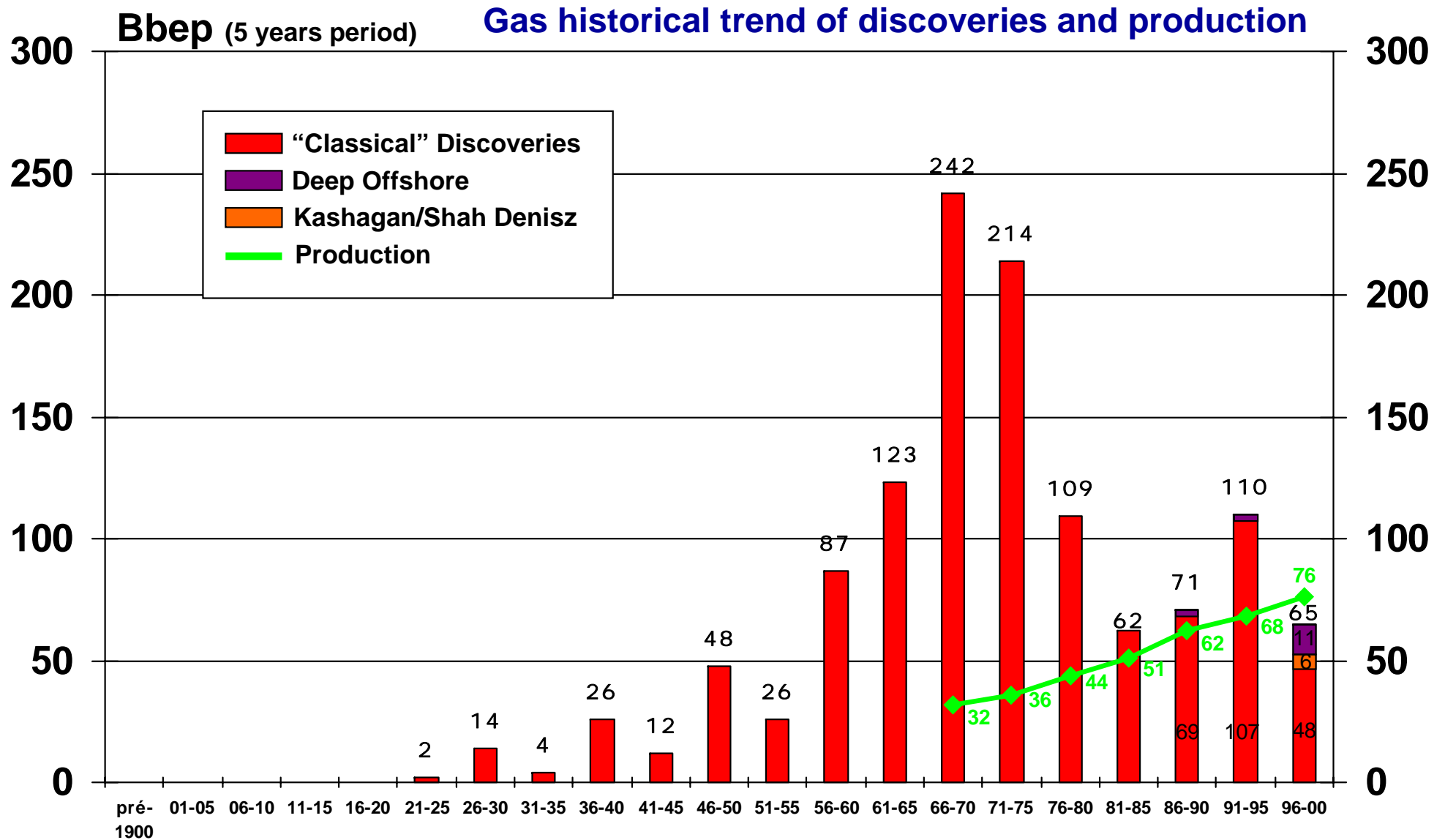


Jean Laherrere April.2003

Oil: towards a world of mature reservoirs



Gas: same trend with 20 y delay and less impact



Source: IHS, Total (est)

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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 between the two categories)

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

THE ROLE OF ULTRA-HEAVY OIL IN FUTURE RESERVES GROWTH

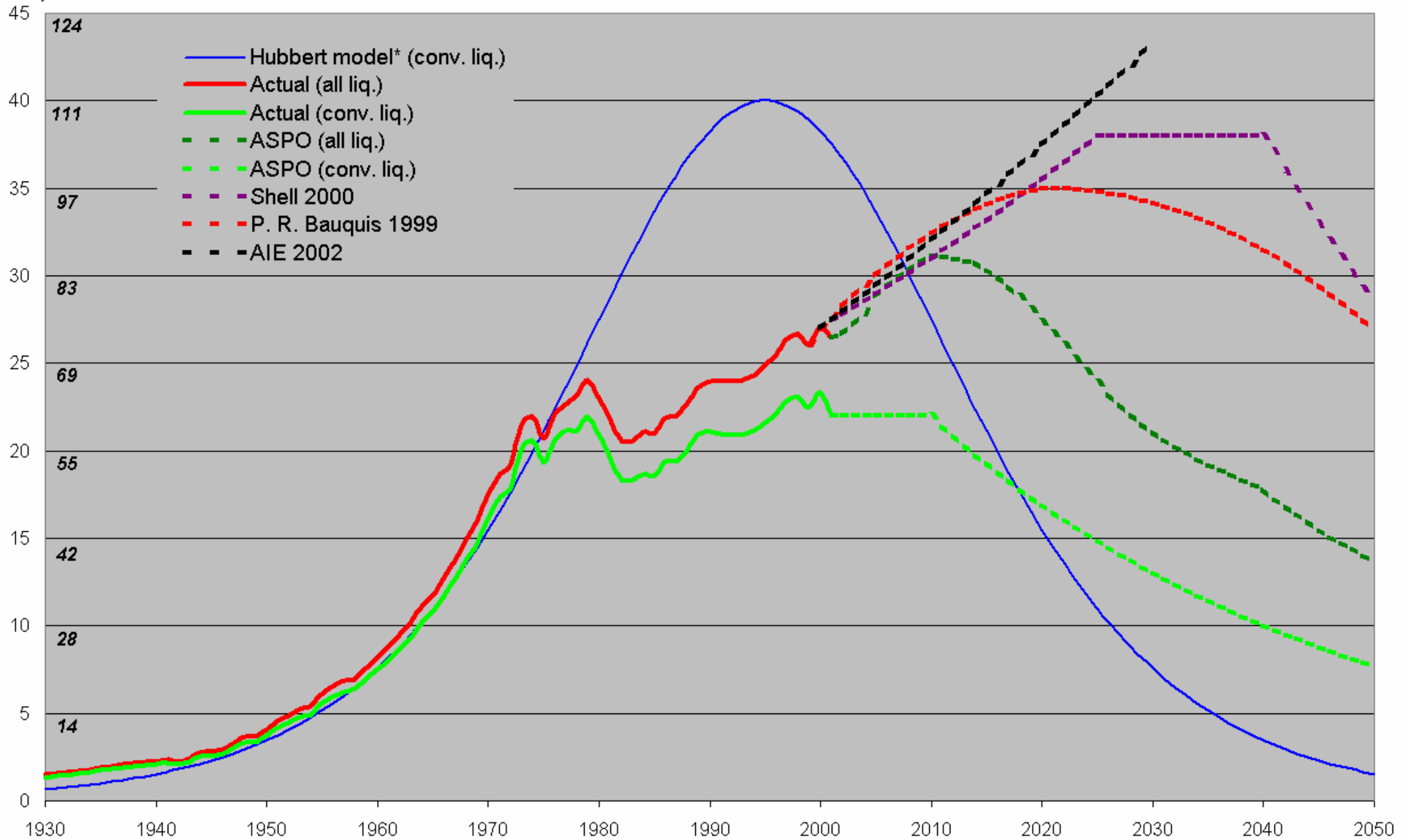
In billion of barrels	Estimated volume in place	1995 estimated reserves	2030 estimated reserves
Orinoco	1,200	100	300
Athabasca	1,700	100	300

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

Gb/y Mb/d



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

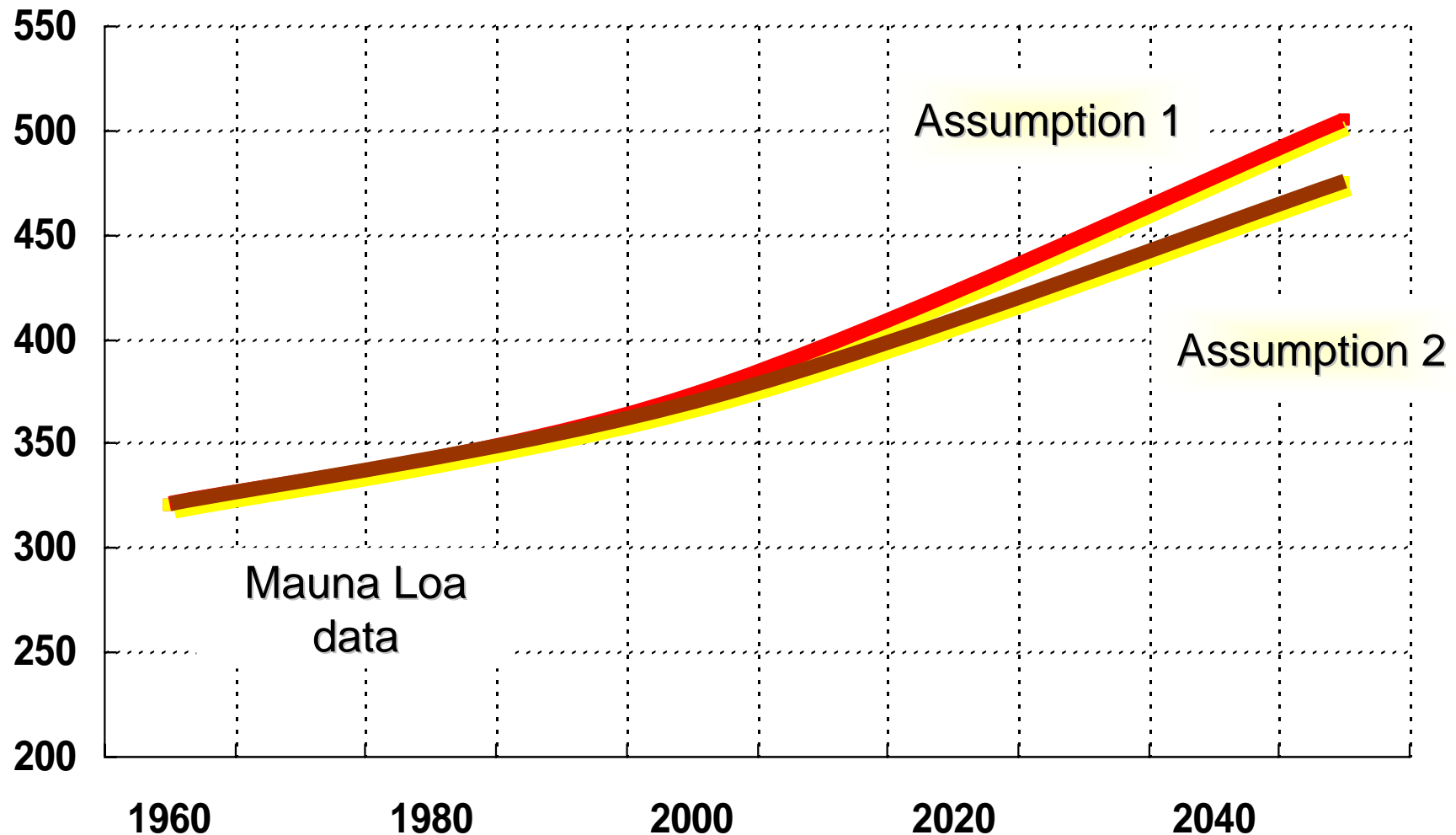
AUTHOR SYNTHETIC ENERGY FUTURE VIEW

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

CO₂ ppm



Assumption 1: use of 1 GtC generates an increase of 0.277 ppm CO₂ in the atmosphere

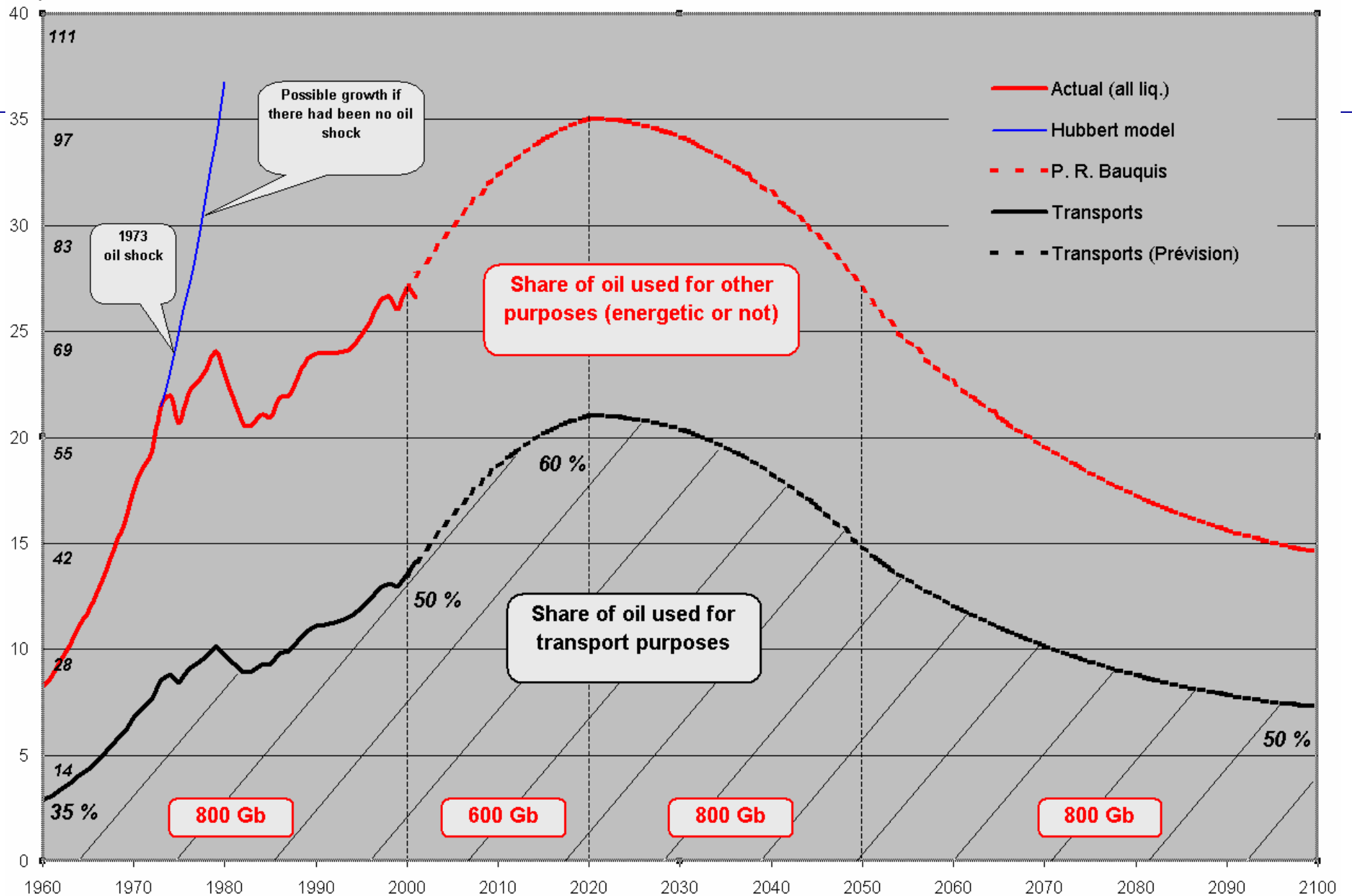
Assumption 2: use of 1 GtC generates an increase of 0.228 ppm CO₂ in the atmosphere

Part 3:

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

World Oil Production Profile and Transports Share

Gb/y Mb/d



Source: P.R. Bauquis

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DEMI

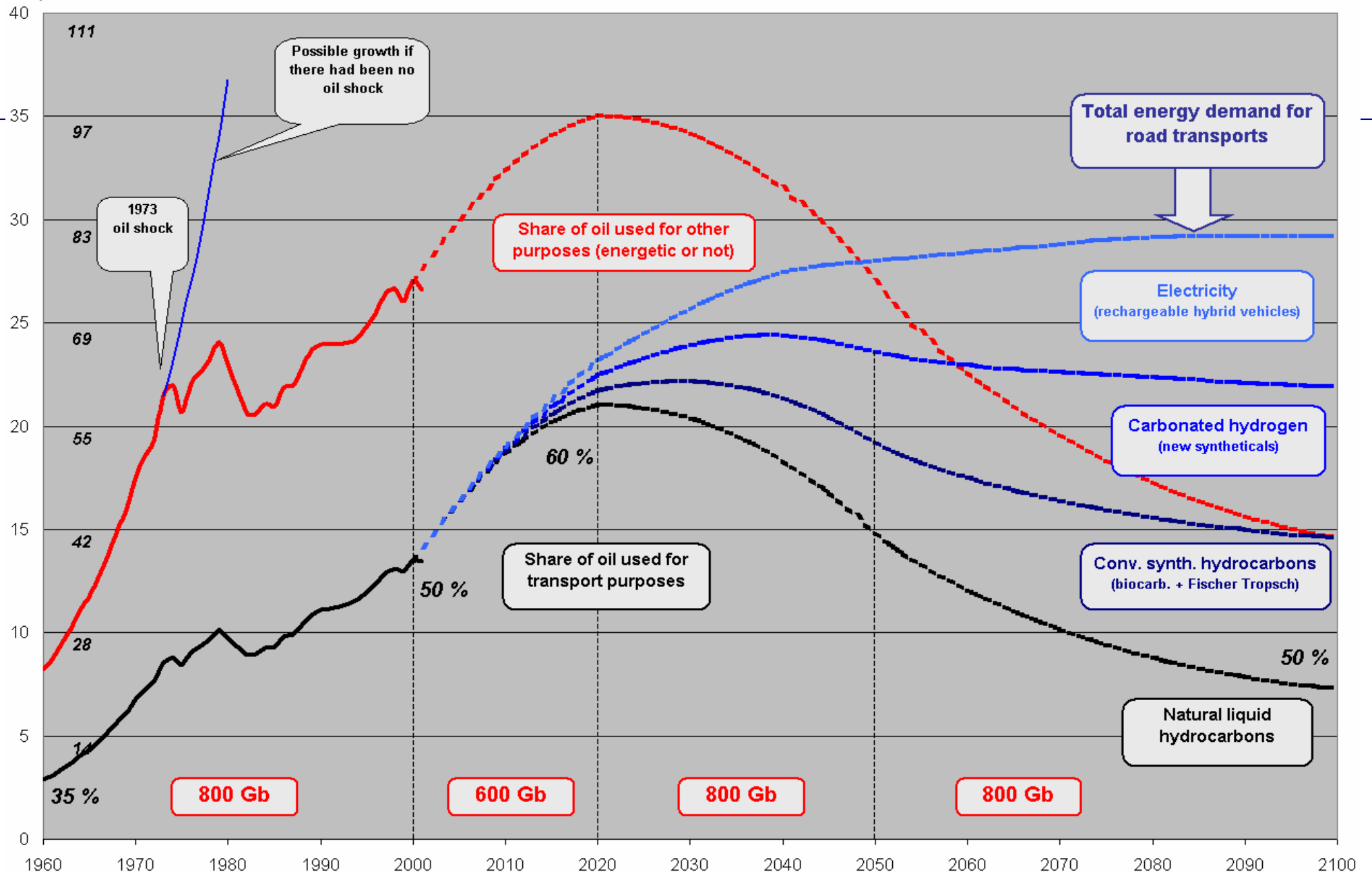


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Which Energy for Road Transports 1960 - 2000 - 2100

Gb/y Mb/d



Source: P.R. Bauquis

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