The background of the slide is a photograph of an offshore oil rig at sunset. The rig's complex metal structure is silhouetted against a sky that transitions from deep blue at the top to bright orange and yellow near the horizon. The sun is a large, glowing orb on the right side, casting a shimmering reflection on the dark water in the foreground. The overall mood is dramatic and industrial.

Reserves uncertainties:
Fallow fields (and other questions)

ASPO, Vienna, May 2012

Richard G. Miller PhD

Uncertain Reserves

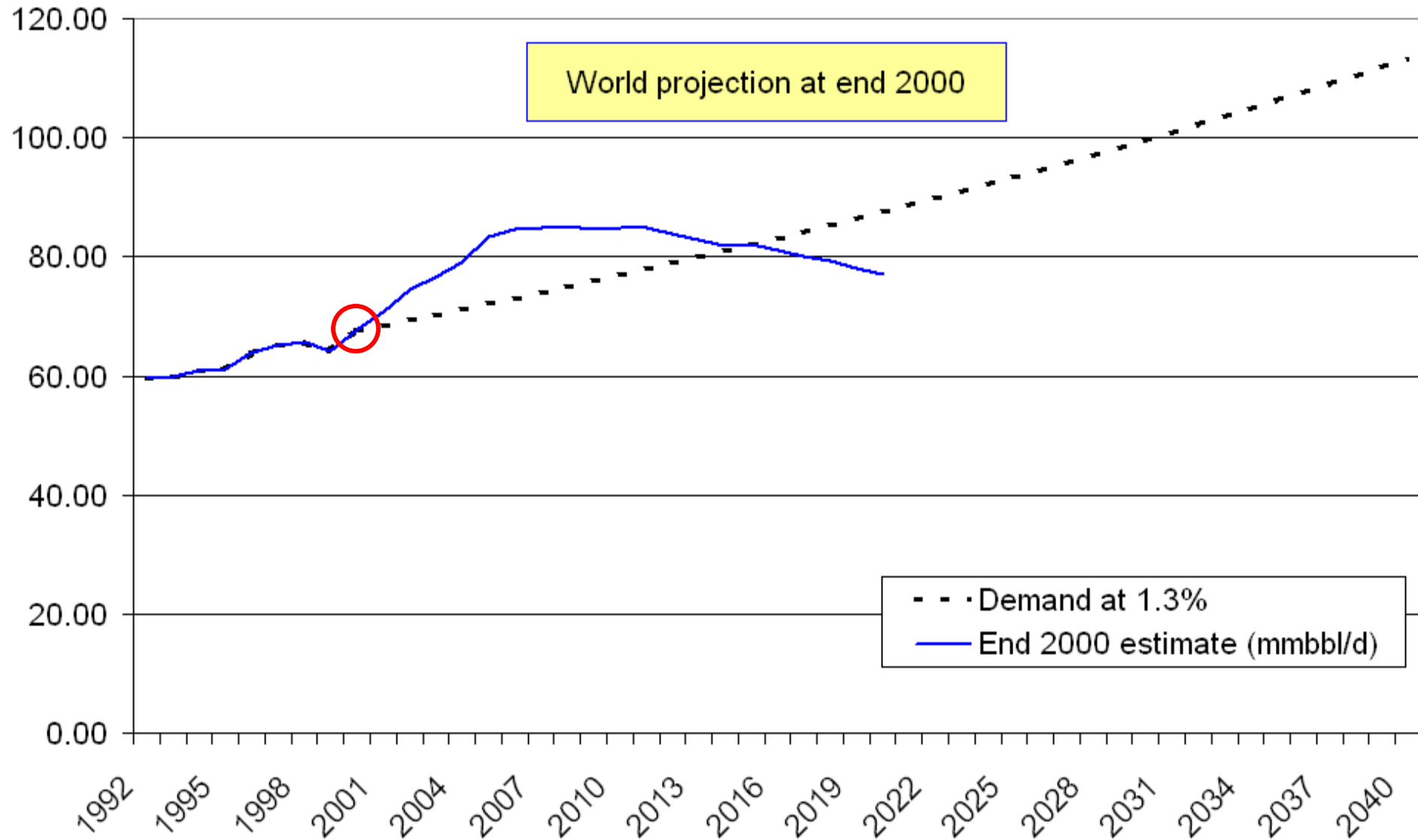
- Primary reserves uncertainties:
 - Definitions: “oil”, NGLs, 1P/2P/(3P)
 - Price/demand, cost of production
 - Reserves growth, EOR, technological improvements
 - **Accuracy of reported reserve volumes**

Uncertain reserves data are not always claimed to be too high (or too low), simply uncertain

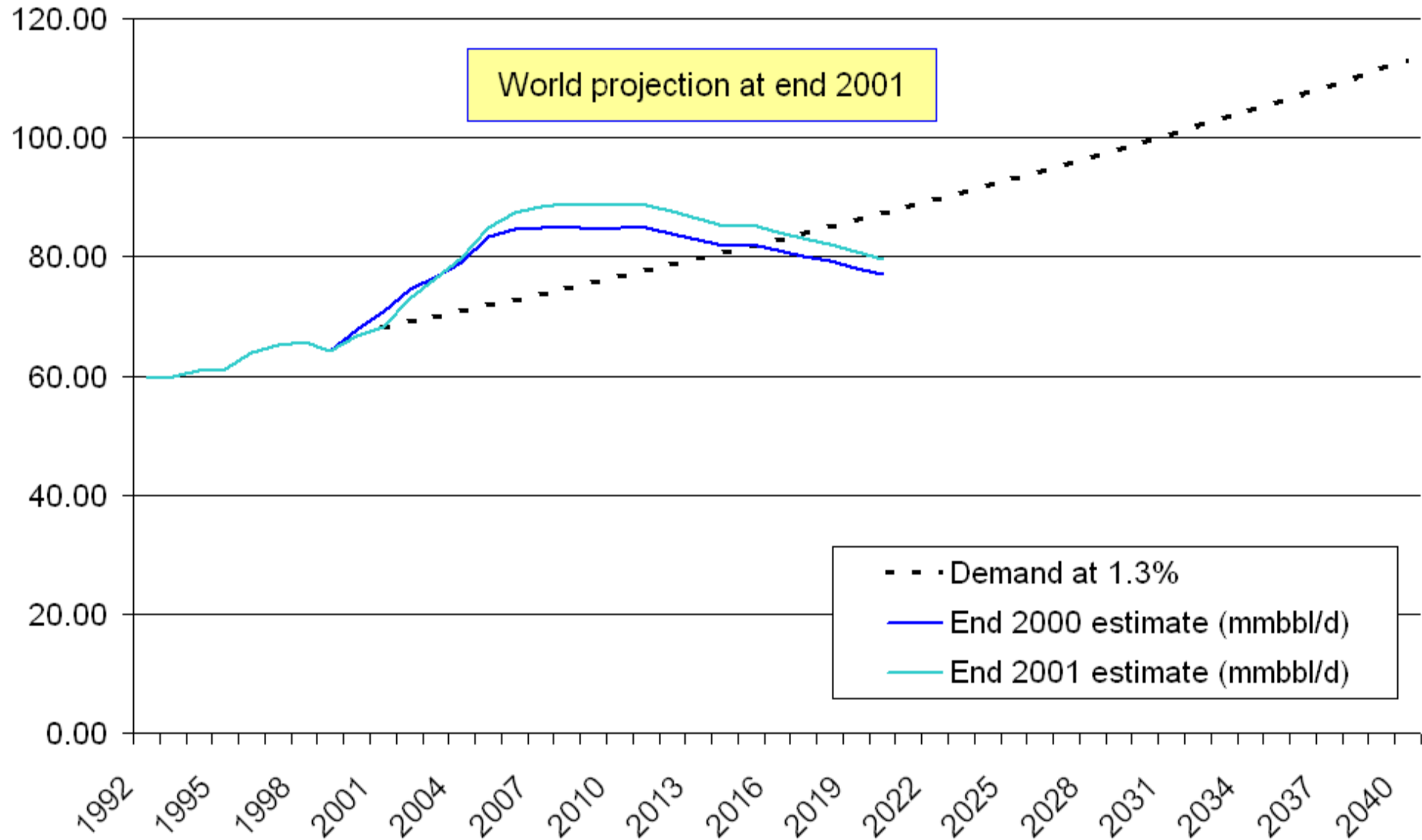
Four sources of inaccurate reserves data

1. Some OPEC national data
2. Producing fields whose claimed reserves seem too high for their production rates
- 3. Fallow fields (fields not yet scheduled for production). Some possibly counted as reserves but not commercially producible**
- 4. Developed fields: non-producing or non-recorded production**

World field model: projection end 2000



World field model: projection end 2001



Hypothesis and approach

Some potential fields are not being developed/produced

- What evidence exists for unproductive fallow fields?
- Data sources:
 - BP Statistical Review – public data by country
 - Oil & Gas Journal – public data by country and sometimes by field
 - Confidential fields data-base. *The data cannot be shown but the analysis is always numerical*

Comparison of data sources

BP Statistical Review: 1383 Gb as at end 2010

Reserves are “economically recoverable with reasonable certainty”

Excludes: 143 Gb of undeveloping Canadian oil sands

Includes: 26.5 Gb of Canadian oil sands
NGLs

Fields database: 1324 Gb as at early 2008

Reserves are 2P data

Excludes: onshore China, Canada and US lower 48
Canadian oil sands
NGLs

Fallow fields analysis (early 2008)

Reserves volume by “field status”

Producing fields:	79%
Developing, re-developing, temporary shut-ins:	8%
Abandoned ex-producing fields (1 Gb):	0.1%
Awaiting sanction or in appraisal (85 Gb):	6%
Discoveries (88 Gb):	7%

(58 Gb discovered before 2000)

Up to 173 Gb of reserves had not been developed by 2008, but clearly many will. What else is going on?

The non-producing producers

Many fields classed as producing have no recorded production, and record a date when production stopped.

Possibly:

- Producing but no production data. Reserves probably over-stated.
- Co-producing, production recorded against a single field. Net neutral on reserves
- Temporarily shut in (but, why?). Reserves may exist
- Abandoned. Reserves do not exist

Reserves for all fields without recorded production

Total 304 Gb. >70 Gb lies in large fields known to be actively producing today.

Discoveries:	29%
Awaiting sanction or under appraisal:	28%
Abandoned ex-producing fields:	0.3%
(Developing, re-developing, temporary shut-ins:	20%)
“Producing” fields:	23%

Where are these apparently dormant “producing” fields?

Non-producing producers by country

Examples of “producing fields” without recorded production

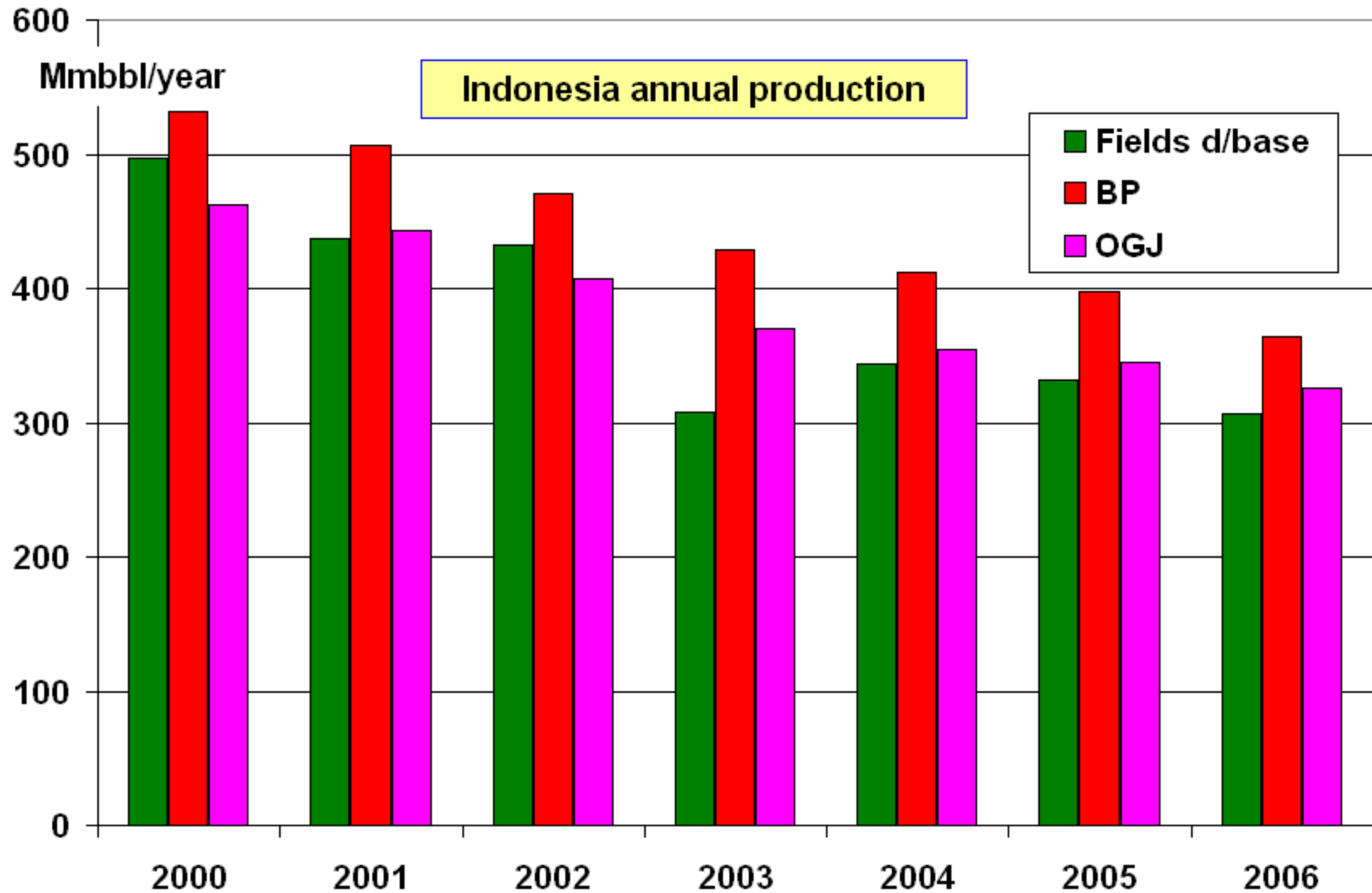
COUNTRY	RESERVES (Gb)	No. FIELDS
Algeria	1.6	35
Angola	3.7	16
China	3.7	130
Indonesia	0.55	59
Iraq	20.2	8
Russia	2.9	62
Saudi Arabia	5.0	8
UK	1.0	55

Null data, shut in or co-producing?

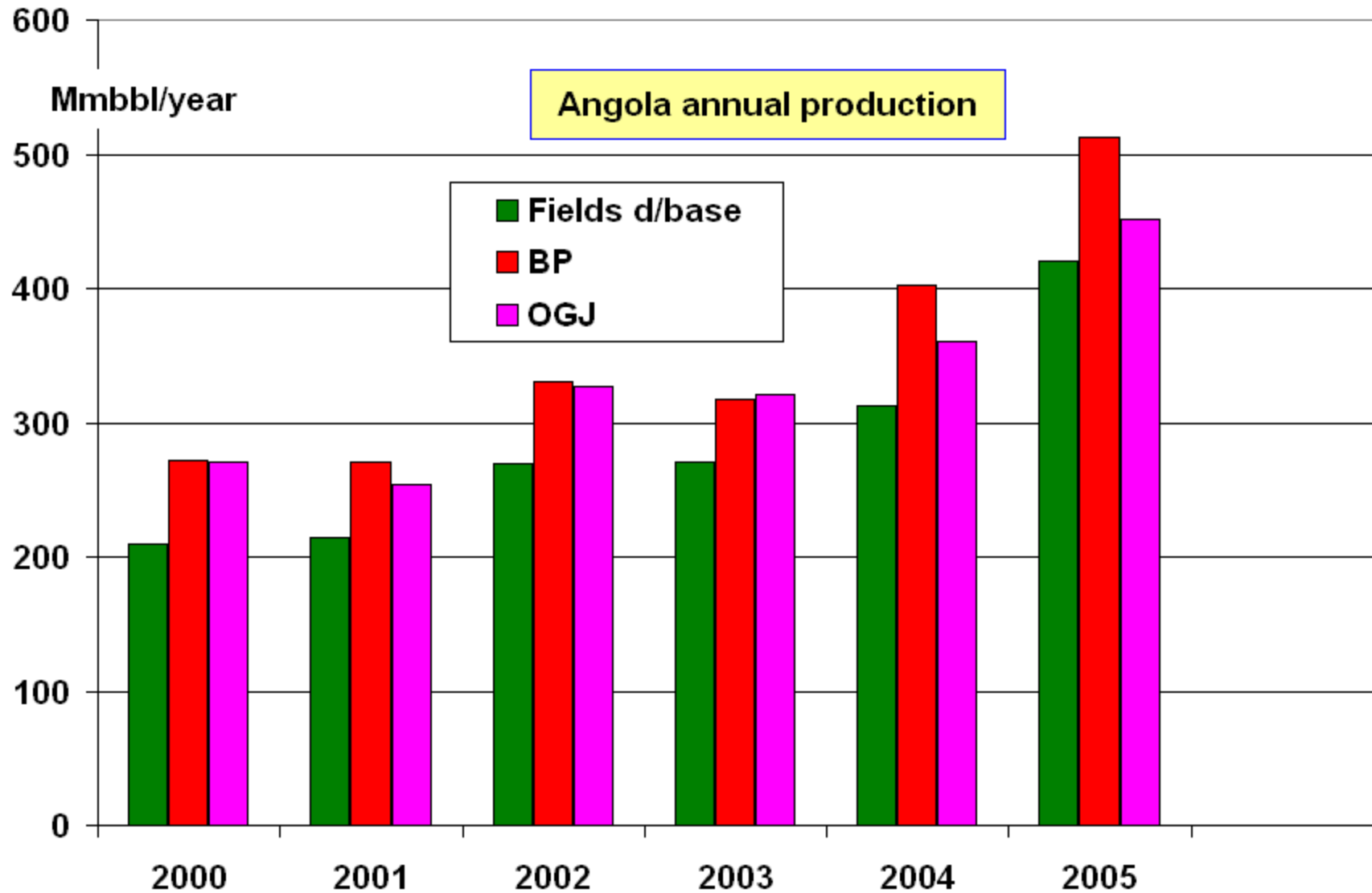
“Producing” fields with no recorded production

- Compare annual national production from fields database with other sources.
 - If comparable, then total fields reserves may be correct but divided wrongly between the various fields; or producers really are shut.
 - If not, then reserves possibly overstated
- Test cases: Angola and Indonesia
 - Indonesia may have significant NGL production.

Indonesia (2008): co-production?



Angola (2008): null data?



Improbable reserves (2008) (i)

(Gb)	Producing until...	Dev + temp. shut in	Waiting approval	Appraisal	Discov.	Aband.	Total
Raw data	69	61	19	66	88	0.8	304
Decade	(Shut in)		(Disc.)	(Disc.)	(Disc.)		
<1960	0.4		1.0	1.9	4.6		
1960-1969	0.8		5.0	1.6	6.6		
1970-1979	2.3		1.8	8.4	21.5		
1980-1989	5.6		7.7	7.9	14.0		
1990-1999	7.5		1.9	12.8	11.6		
2000-2007	44.0		1.4	33.7	30.1		
2000-2002					6.9		
2002-7 <10 mmbbl					2.0		

Improbable reserves (2008) (ii)

(Gb)	Producers shut in from 2000 onwards by country	Reserves
	Angola, selected Brazil, Iran, Iraq, Saudi Arabia, Sudan, some Venezuela (Corocoro)	28.2
	Remainder	15.8

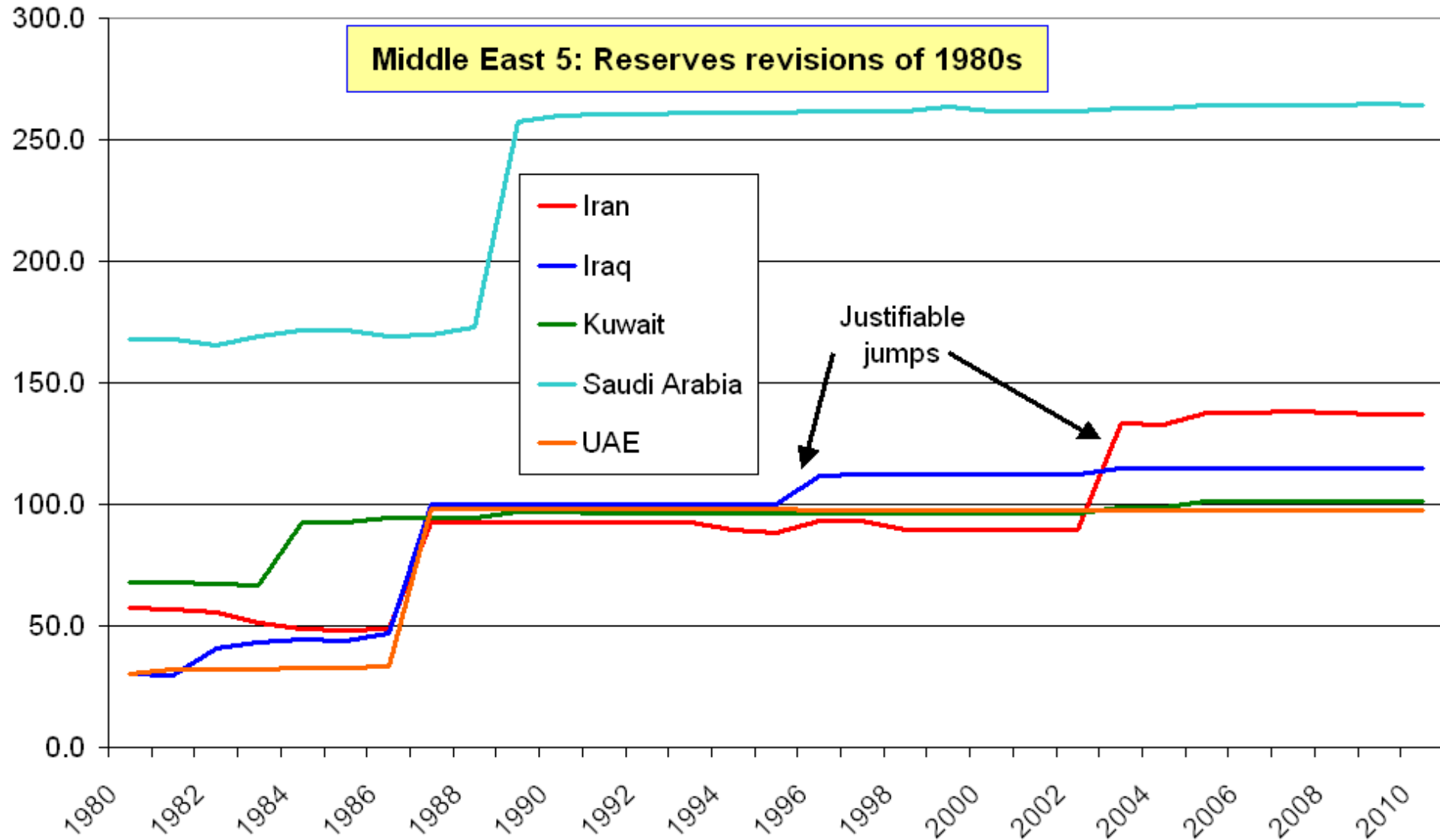
Total doubtful reserves (all the red, 50% of the orange):
138 Gb

SUMMARY

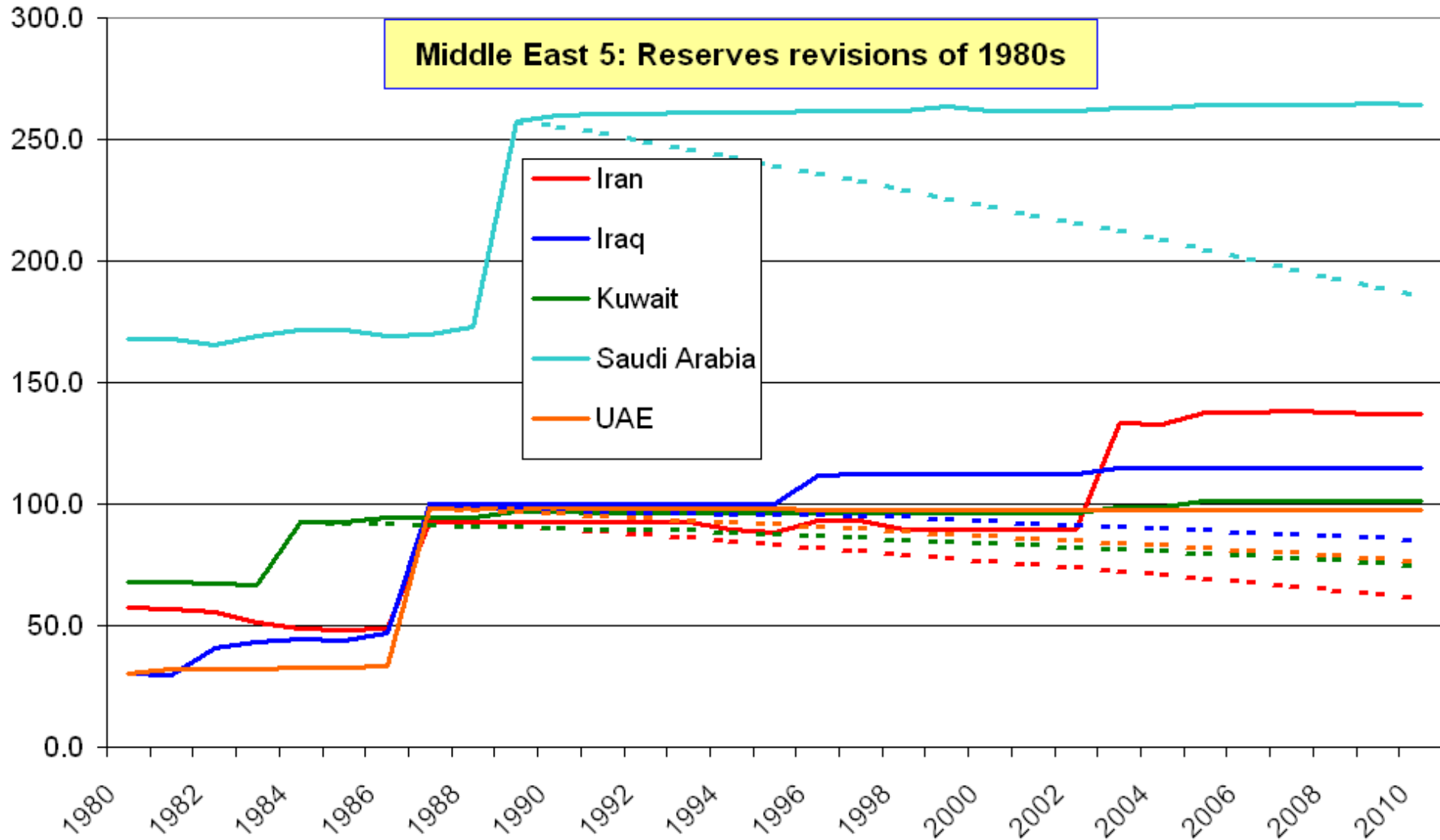
Up to 138 Gb of reserves – 10% of global reserves – may derive from errors.

- Some has not been developed for too long
- Some has been produced but not recorded
- Some has been abandoned and may reflect original over-estimates of reserves

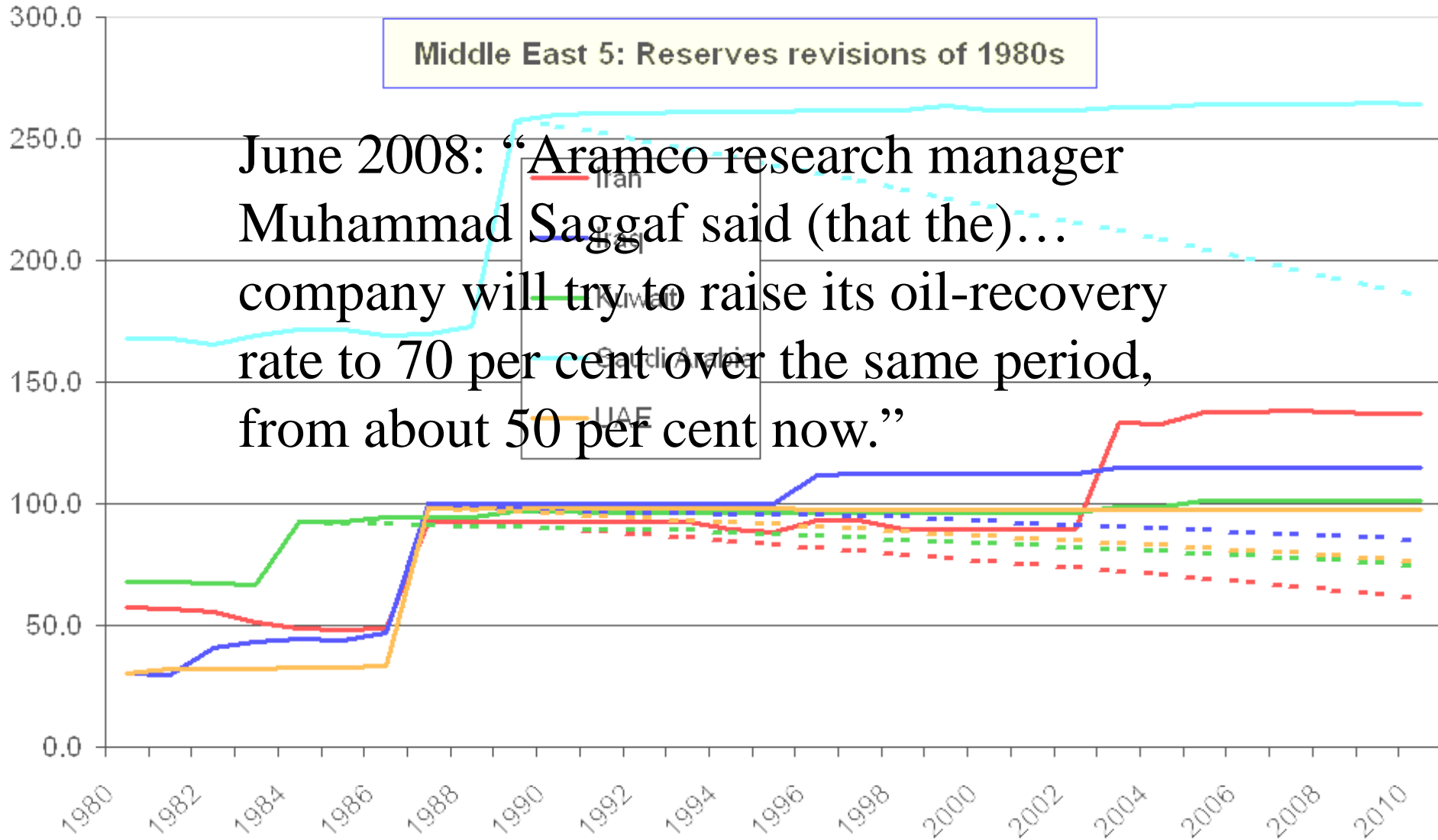
1. OPEC Big M/E 5 reserves



OPEC Big M/E 5 – 165 Gb production



OPEC Big M/E 5 - production



Initial questions

- How good are the input data?
- How old are the undeveloped fields?
- Are all fields recorded as “Producing” really doing so?
- How many “temporary shut-ins” are permanent?