

Global Liquids Supply Outlook

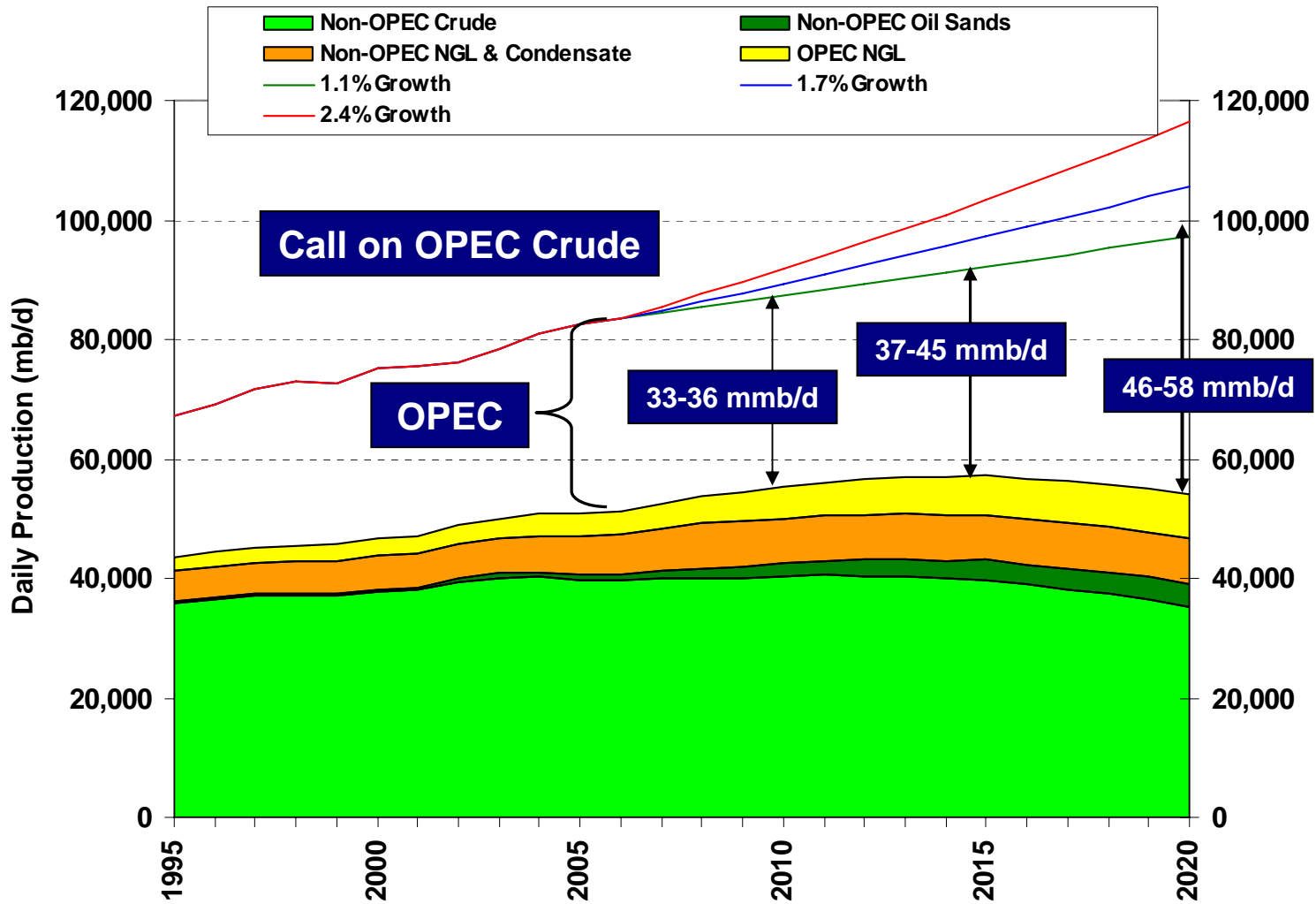
Bob MacKnight

Includes: OPEC and Non-OPEC Conventional, Tar Sands, Biofuels, and Others

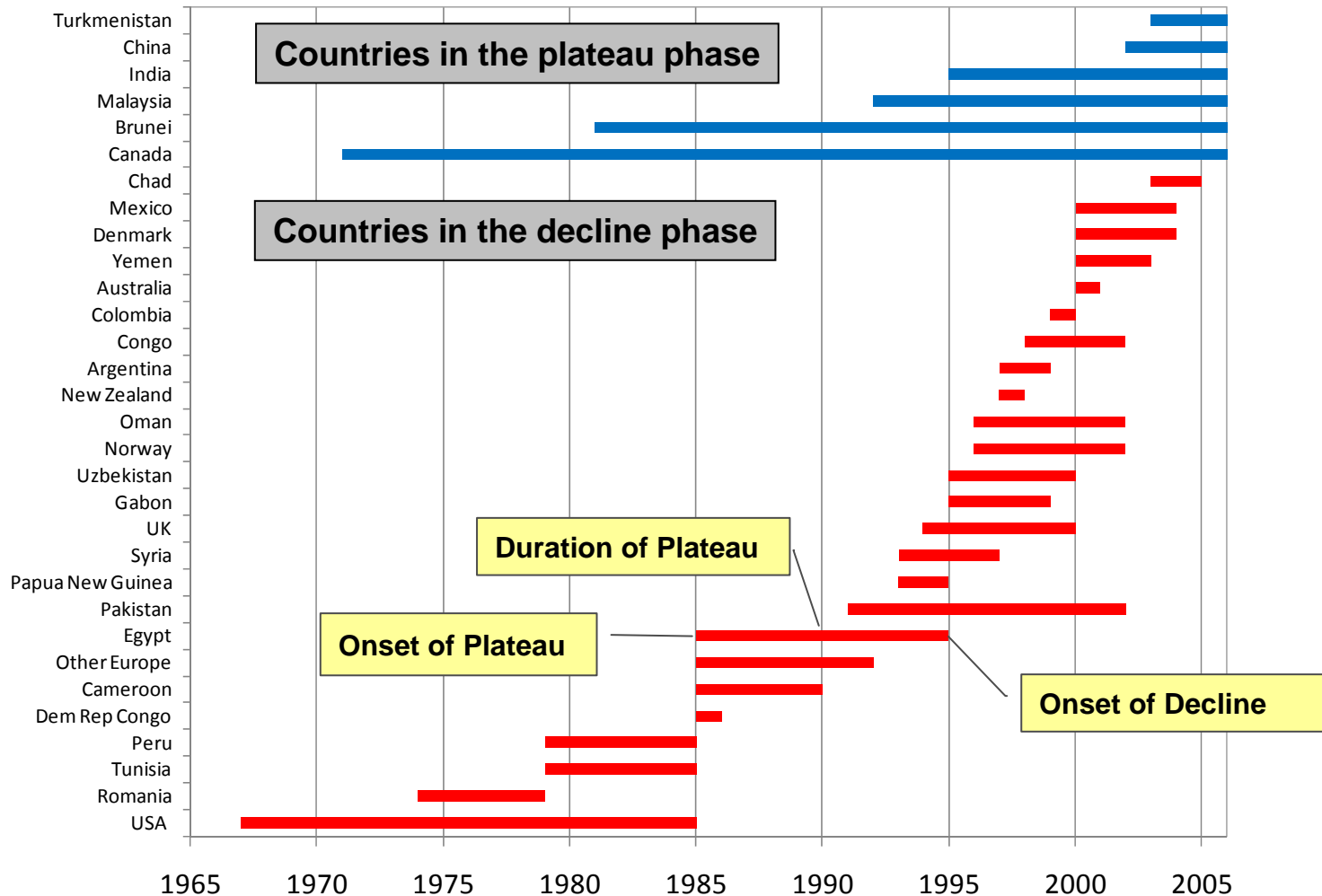
26 March 2008



The Dilemma - The Expected Growing Gap Between Global Demand and Global Non-OPEC Supply in the Next Decade

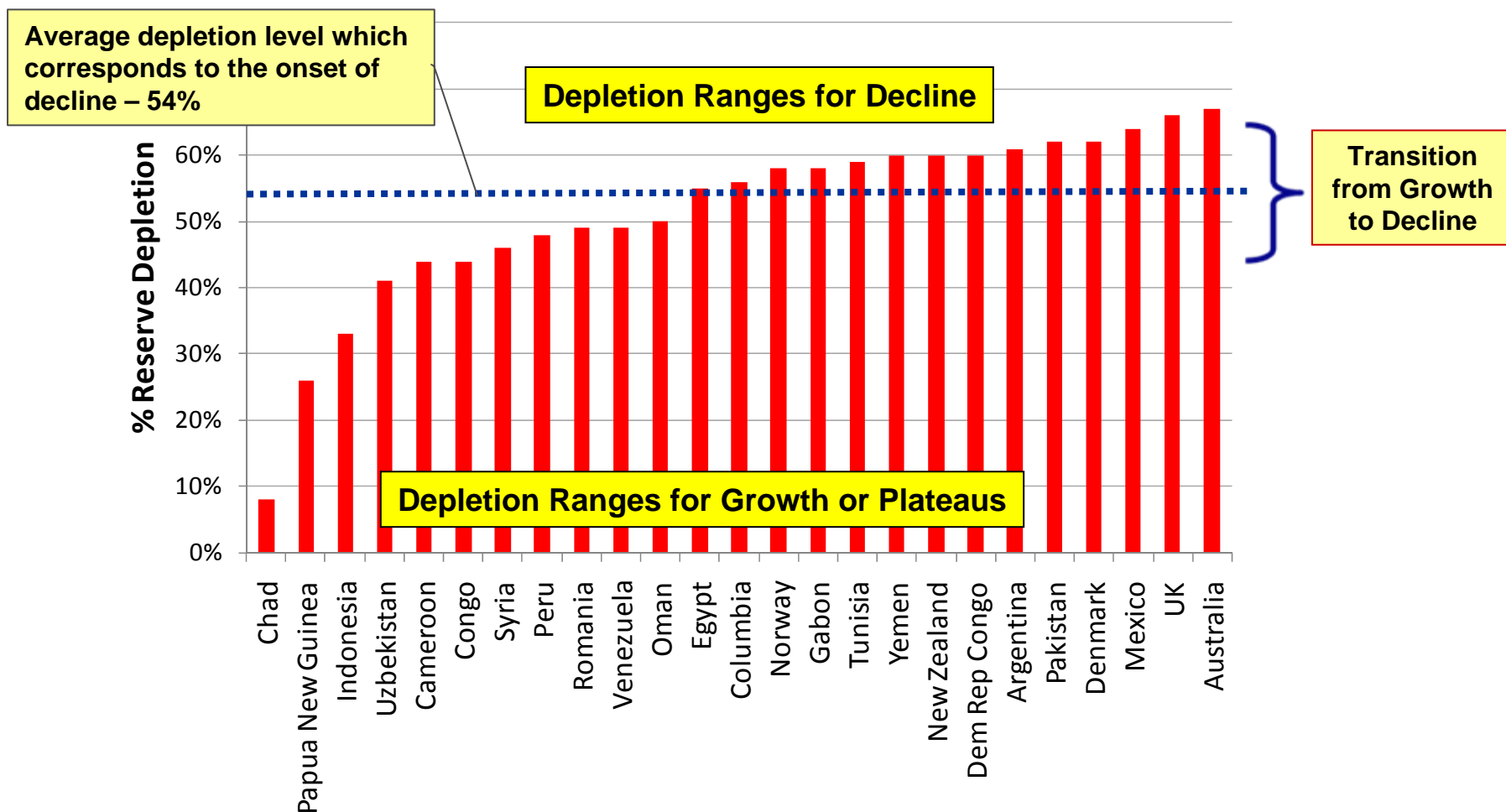


Non-OPEC Countries in Decline or in Plateau



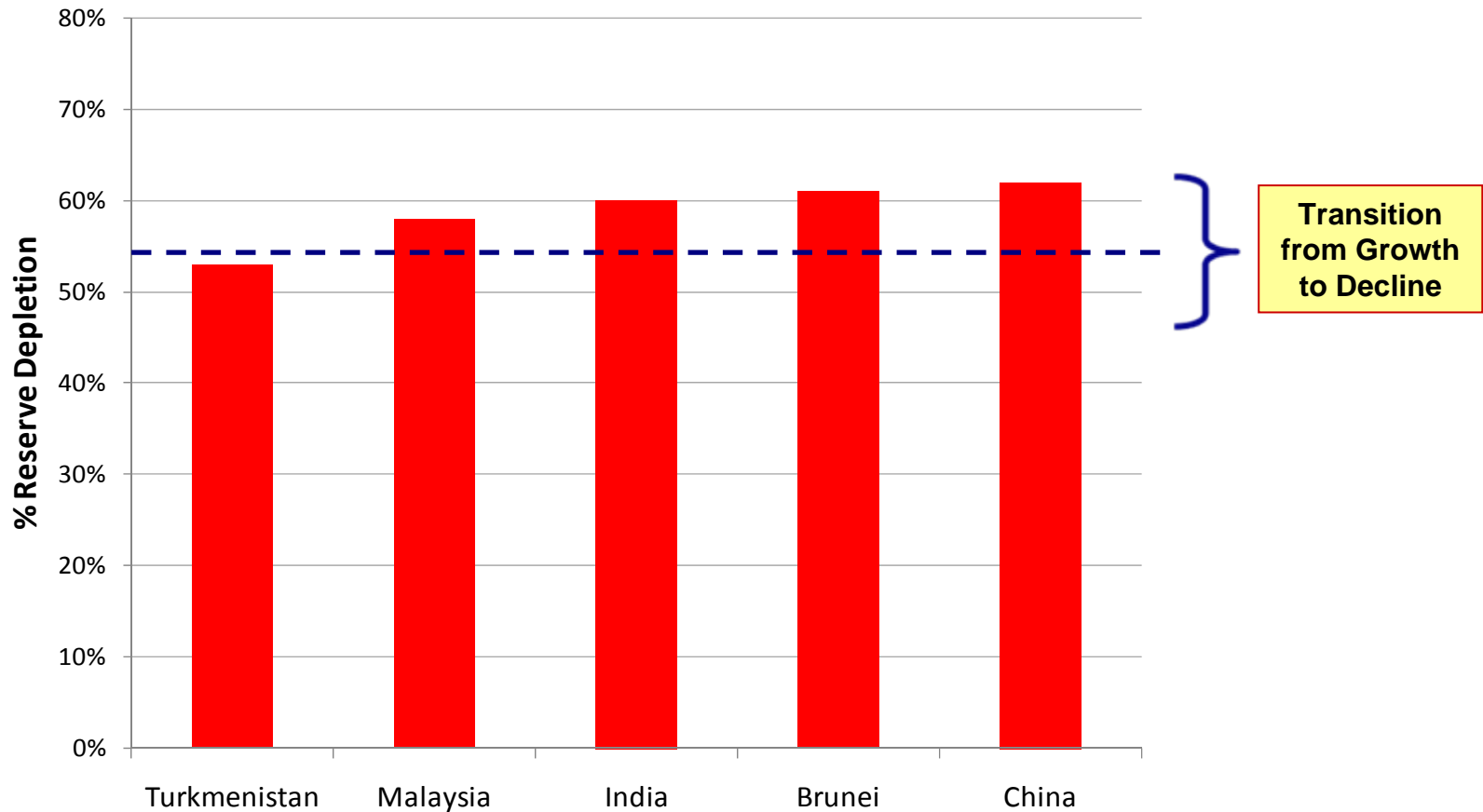
The above bars show the onset and duration of documented production peaks or plateaus – *tracking country life cycle shows an acceleration of the number of countries passing from peak to decline*

Non-OPEC Countries that are in Decline



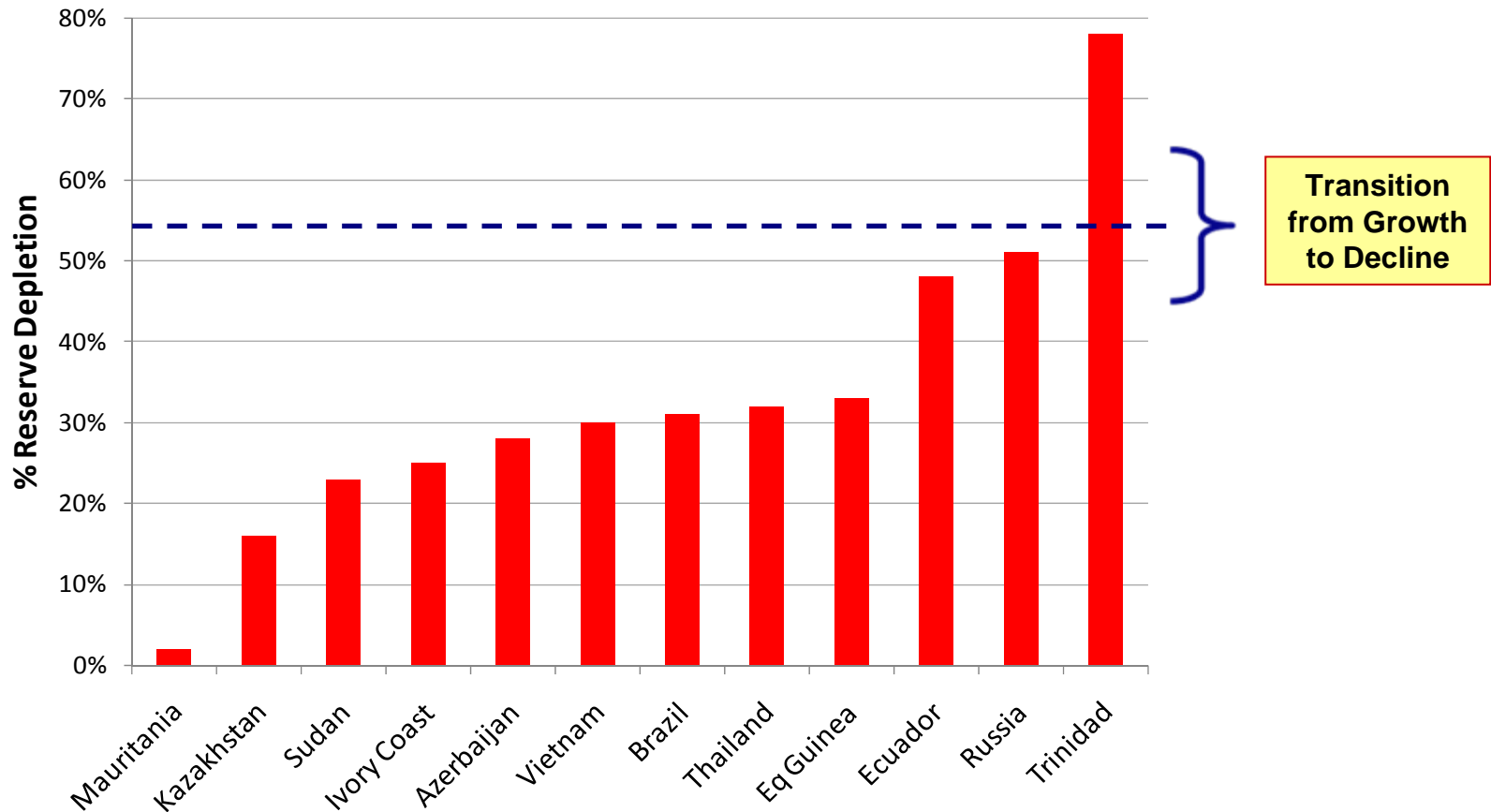
The above bars shows the depletion level at the transition from peak/plateau to decline – *tracking depletion level is a good way to anticipate the cessation of growth and the onset of decline*

Non-OPEC Countries that are in Plateau



The above bars shows the depletion level of several producers which have reached a production plateau – *several significant producers are rapidly approaching 60 - 65% depletion levels which typically signal the onset of production declines*

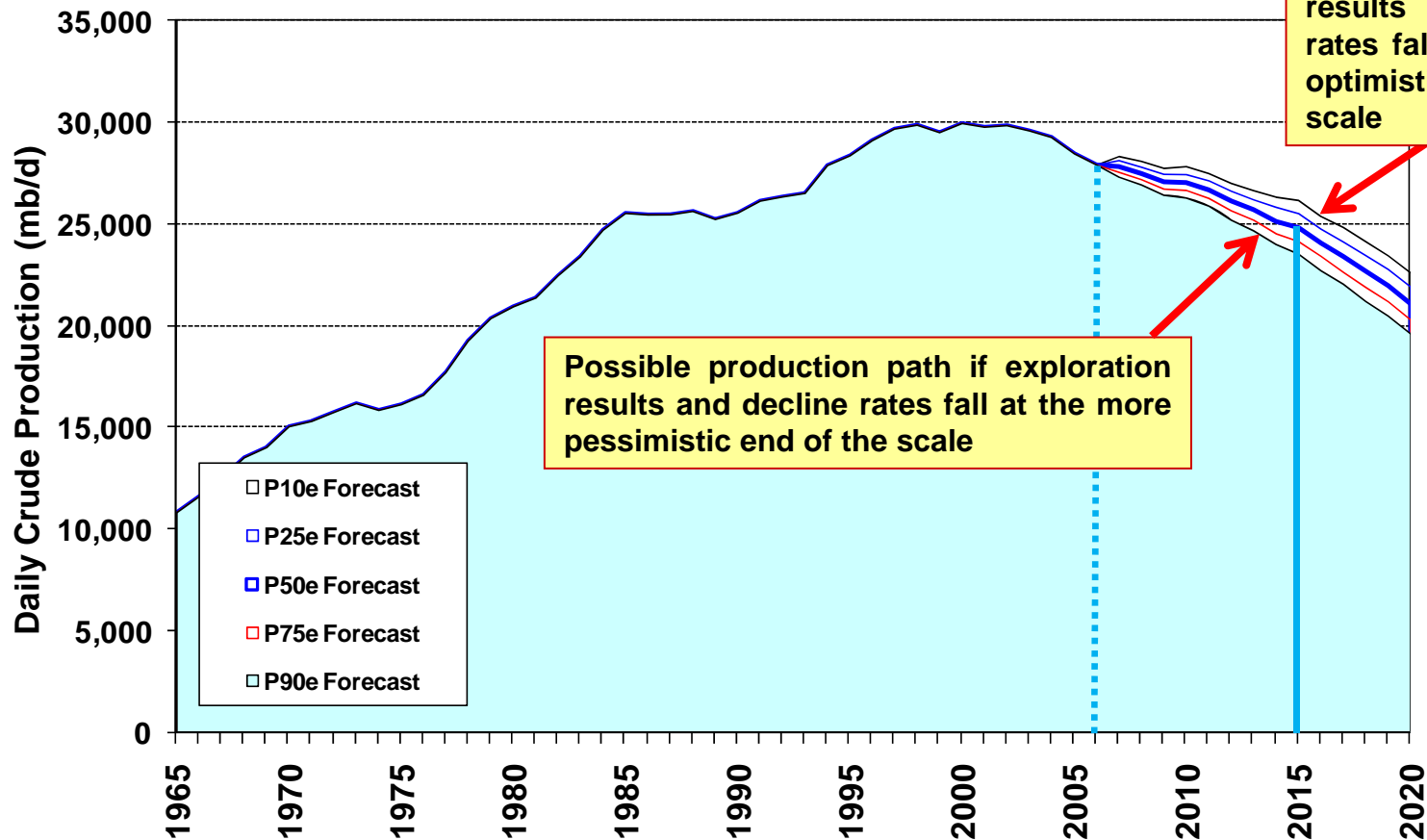
Non-OPEC Countries with Production Growth



The above bars shows the depletion level of several producers, which have new discoveries and are considered very likely to increase production.

Non-OPEC Crude Oil Forecast with Exploration (excluding NGLs, FSU, and Uncon. Heavy Oil)

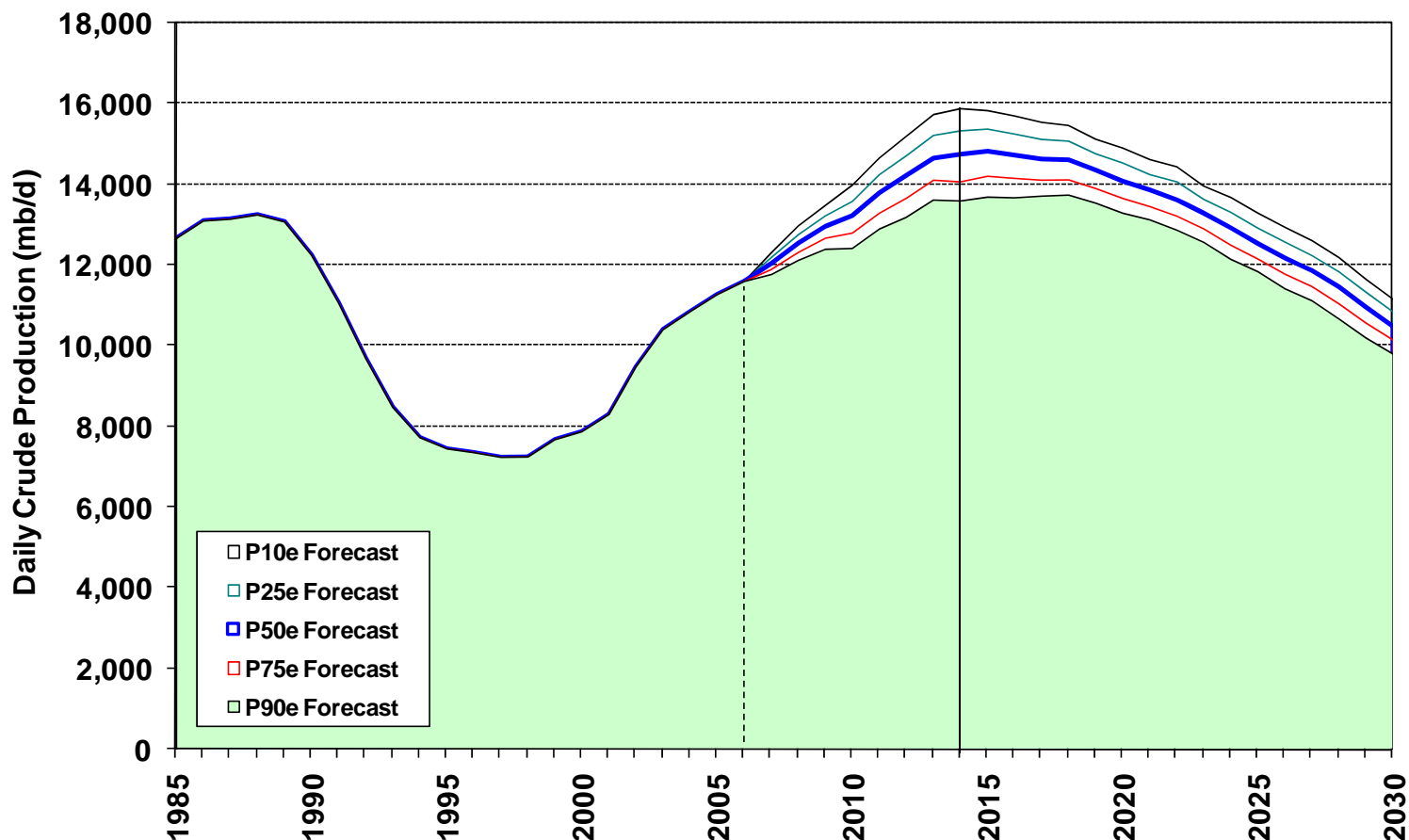
Global: Non-OPEC, Non-FSU, Non-Unconventional Crude
Supply Forecast (with Exploration)



PFC Energy's models suggest that production has declined but reserve addition from exploration will keep production level above 25,000 million barrels per day until the middle of the next decade.

FSU / Eastern Europe Crude Oil Production Forecast

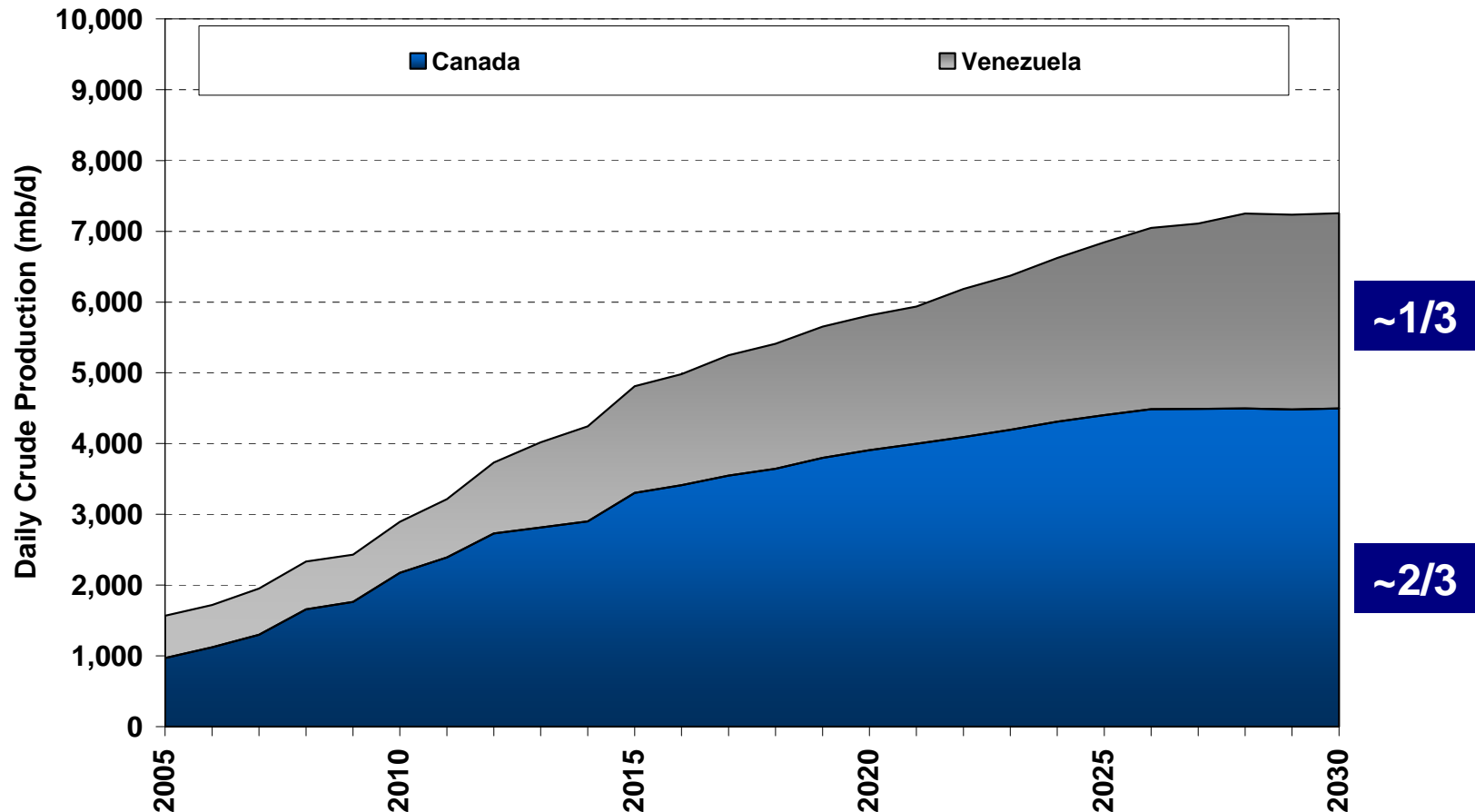
FSU/Eastern Europe Crude Supply Forecast (With Exploration)



- When potential production from future exploration reserves is incorporated with current P1 and P2 reserves, total crude oil production is expected to peak within a range of 14,000 to 15,000 mb/d by the middle of the next decade.

Regional Distribution of Heavy Oil Forecast

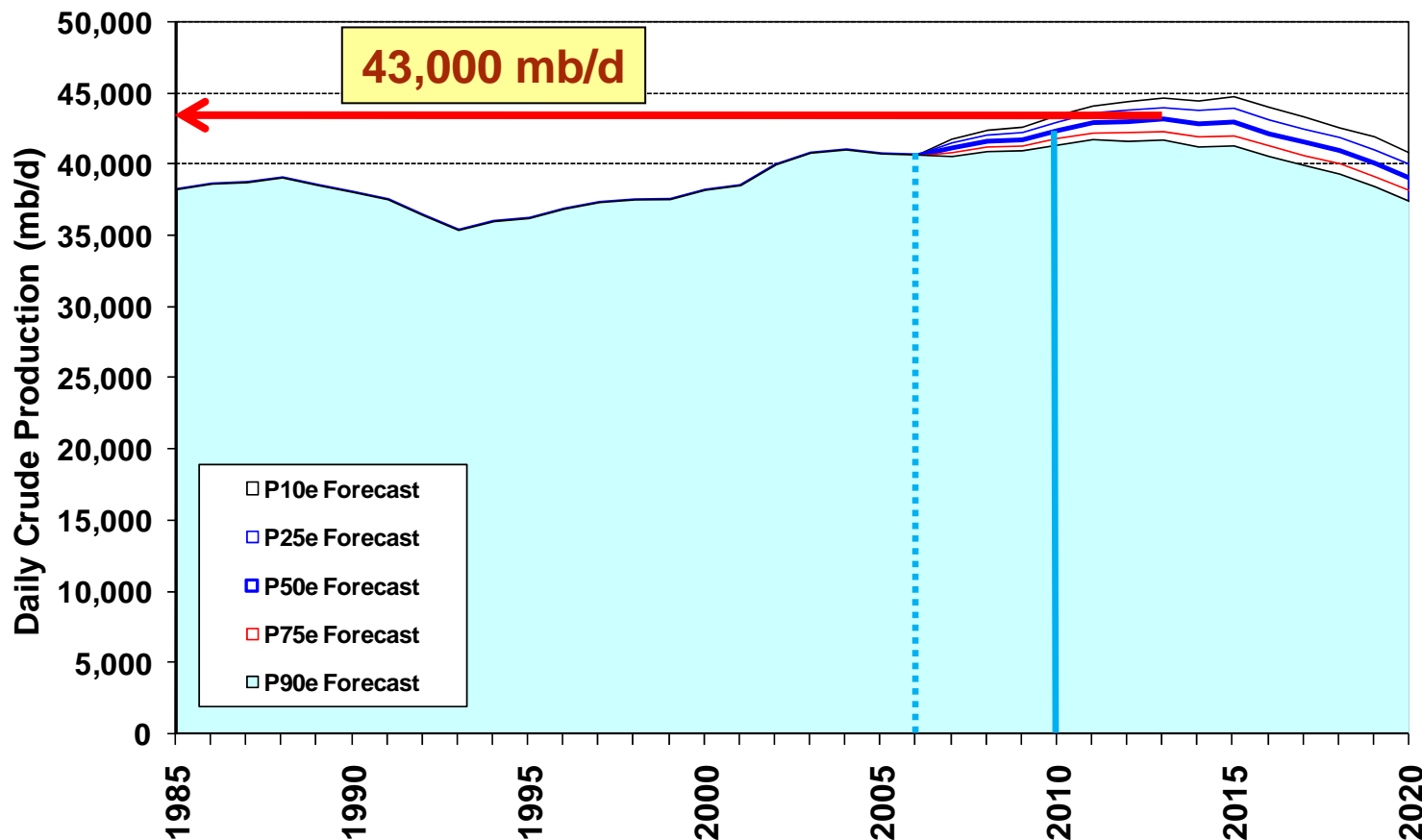
Global Unconventional Crude Supply Forecast



- The current heavy oil production is comprised of 65% production from Canada and 35% production from Venezuela, and it is assumed that this distribution will be maintained in the future.

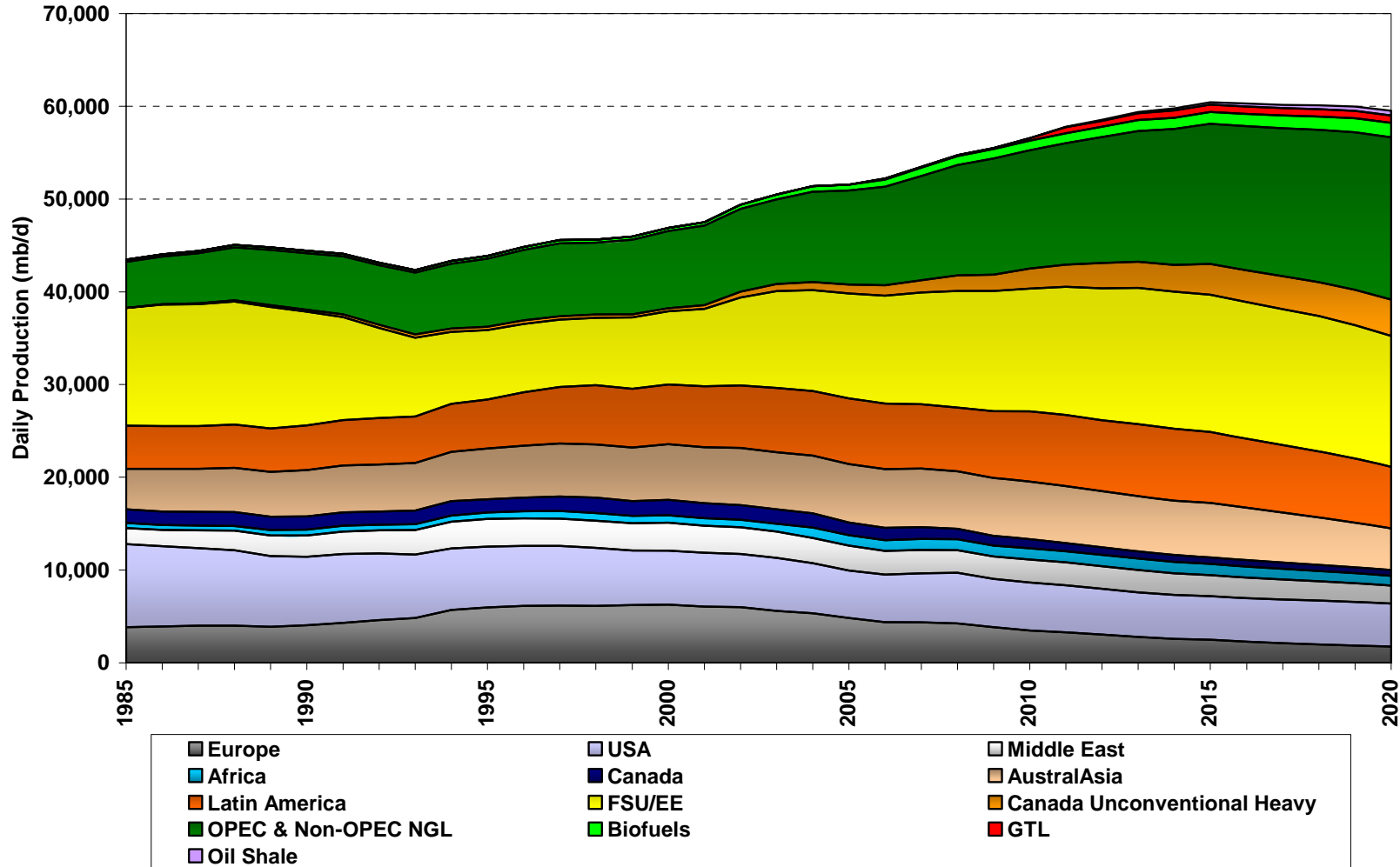
Global Non-OPEC Liquid Supply Forecast with Exploration (including Canadian Tar Sands)

Global Non-OPEC Liquid Supply Forecast (With Exploration)



Global Non-OPEC & OPEC Non-Quota Total Liquids Forecast with Exploration

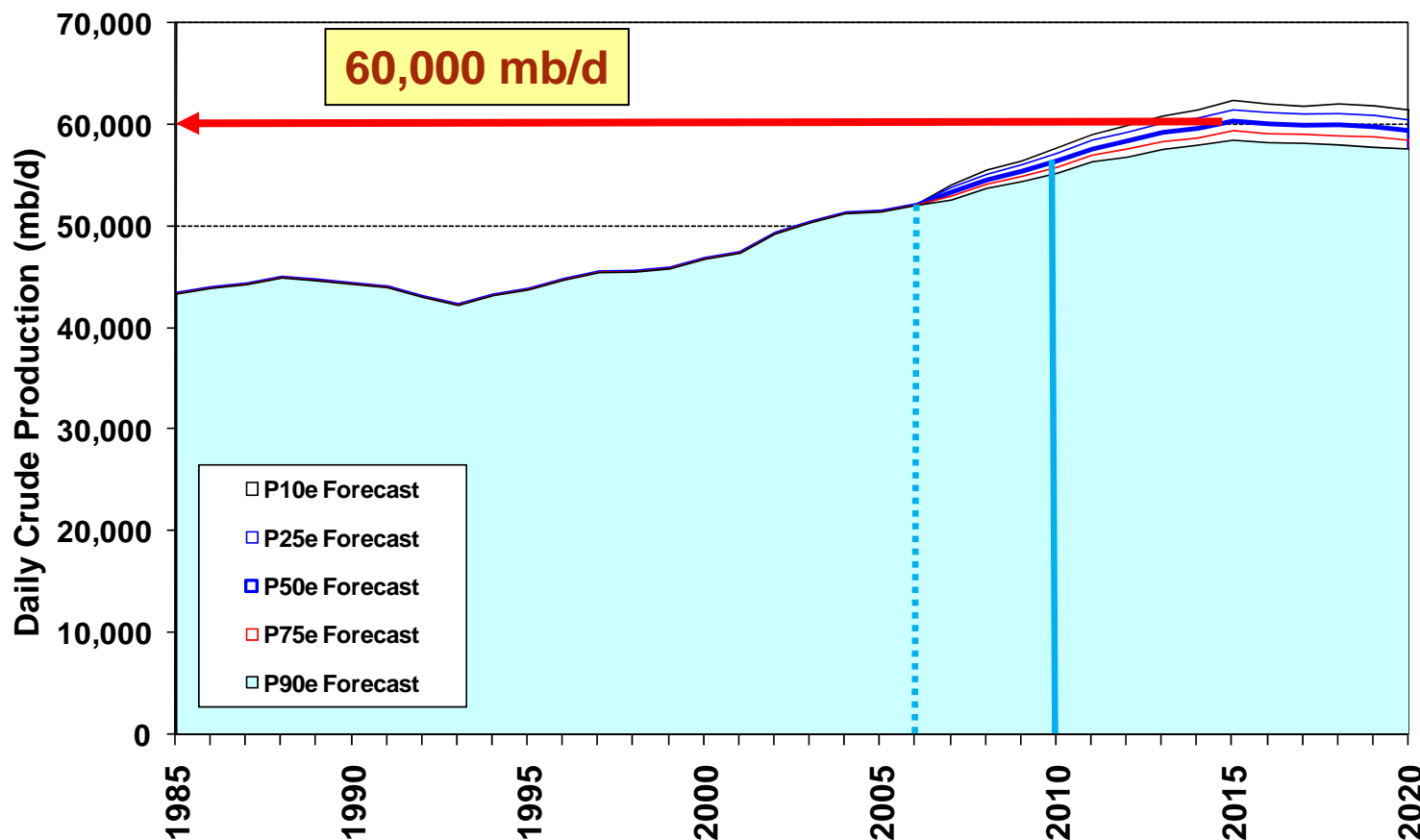
Global Non-OPEC Liquids & OPEC Non-Quota Liquids Supply Forecast (With Exploration)



A combined forecast of Non-OPEC liquids and OPEC non-quota liquids suggests that production will grow to just around 60 million barrels per day by 2015.

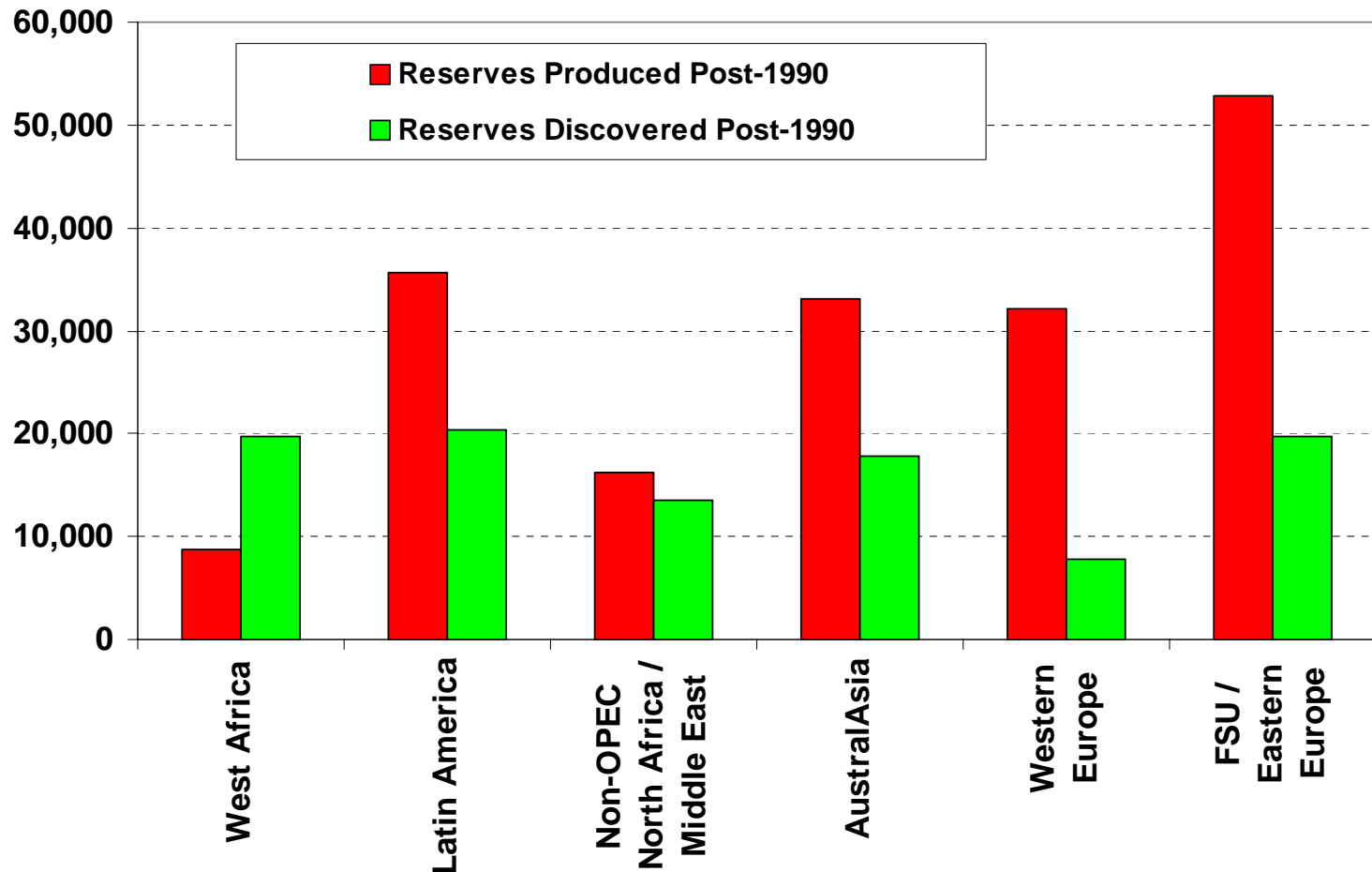
Global Non-OPEC Liquid & OPEC Non-Quota Liquid Supply Forecast with Exploration

Global Non-OPEC Liquid and OPEC Non-Quota Liquid Supply Forecast
(With Exploration)



A combined forecast of Non-OPEC crude, Non-OPEC NGLs, and OPEC Non-Quota NGLs suggests that, with exploration success, production will reach 60 million barrels per day with declines beginning towards the end of the next decade.

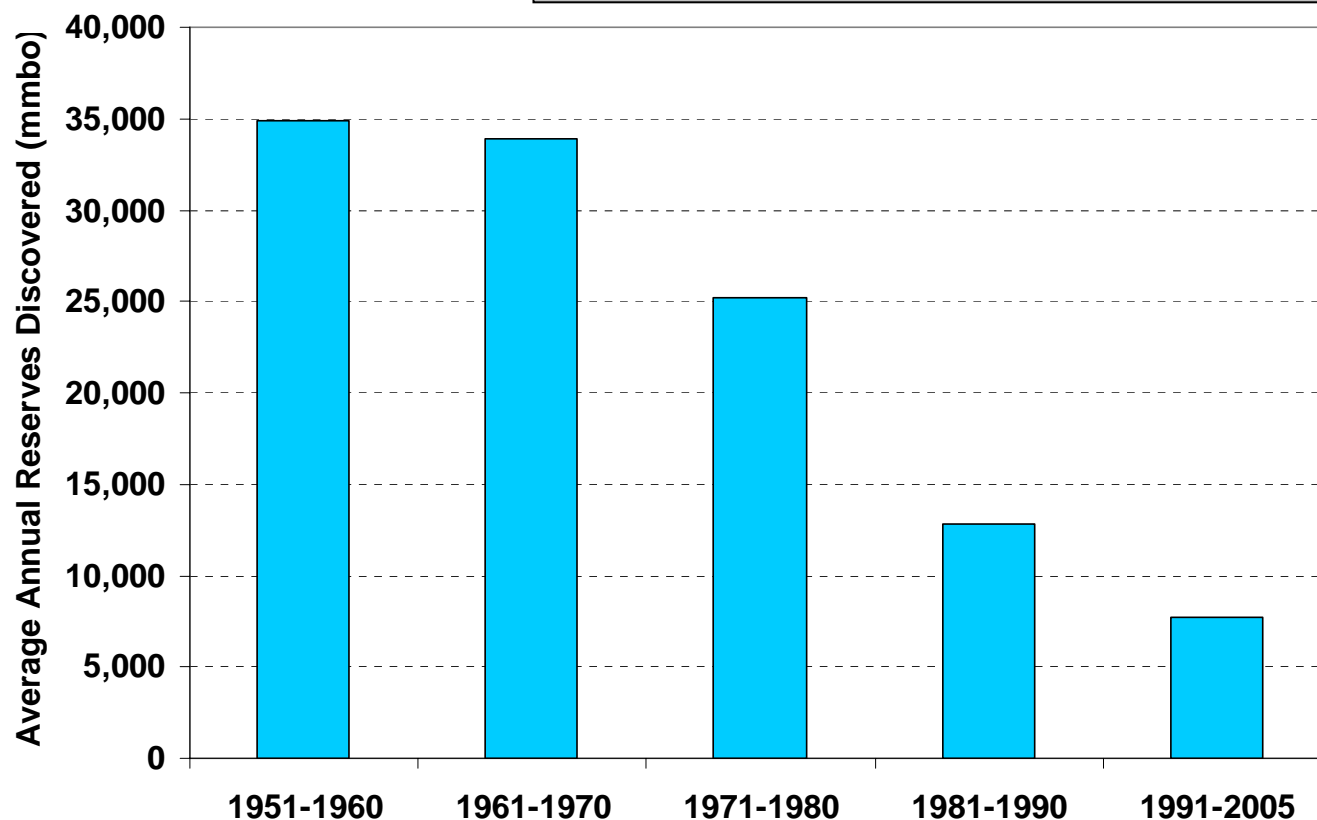
Reserves Discovered vs. Reserves Produced: post-1990



PFC Energy's analysis indicates that all oil producing regions of the world, except for West Africa, have produced more oil than they have found from 1990 to the present – *this continuing depletion of the reserve base will ultimately lead to the inability to continue growing production*

Average Annual Reserve Additions Decline Every Decade, yet Demand Increases Every Decade

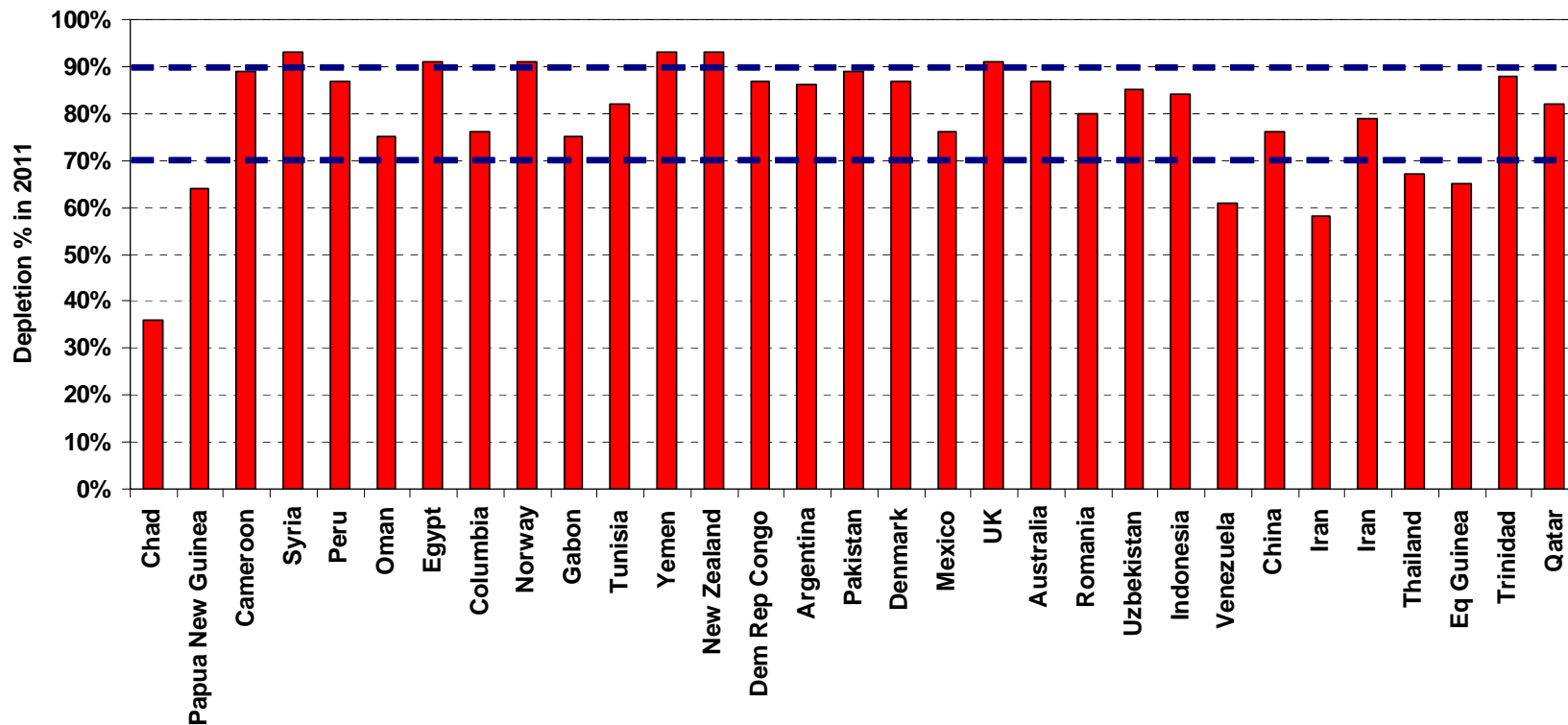
Reserves Discovered Outside of North America



In order to stabilize the depletion of Non – OPEC reserves we would need to start offsetting every barrel produced with a new barrel found (either through discovery or enhanced recovery) – given current and projected levels of consumption that means we would have to return to success levels typical of the period prior to 1980

Identifying Countries Undergoing Oil Production Declines and Critical Reserve Depletion Levels: 2011

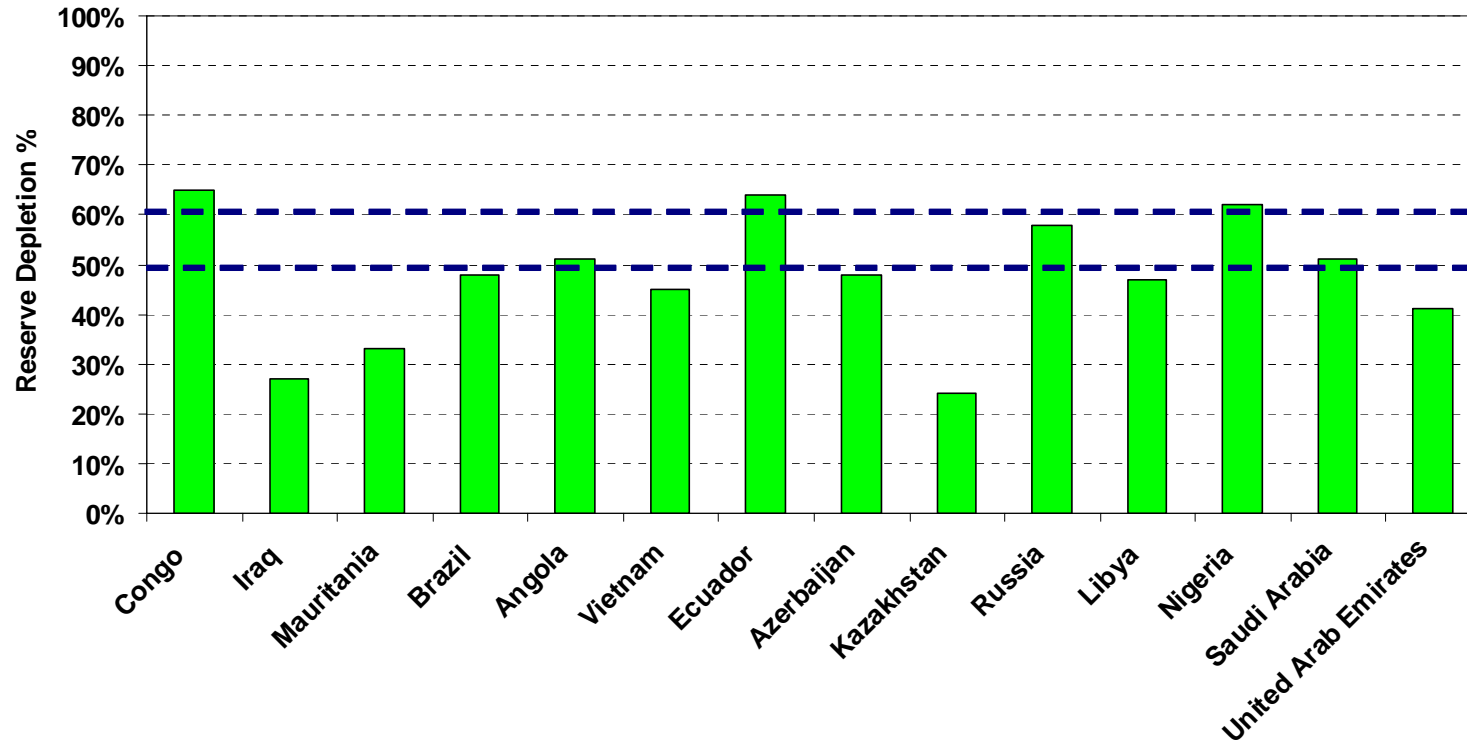
Countries with Oil Production Declines in 2011 and their Oil Reserve Depletion



- By 2011, there are 30 countries that are experiencing oil production declines.

Countries Experiencing Oil Production Growth in 2011

Countries in Oil Production Growth: 2011



- In 2011, there are only 14 countries that have a sufficient oil reserve base to support production growth.

OPEC Outlook

- Reserves and Production Forecast
- Saudi Arabia and Kuwait Crude Reserve Views

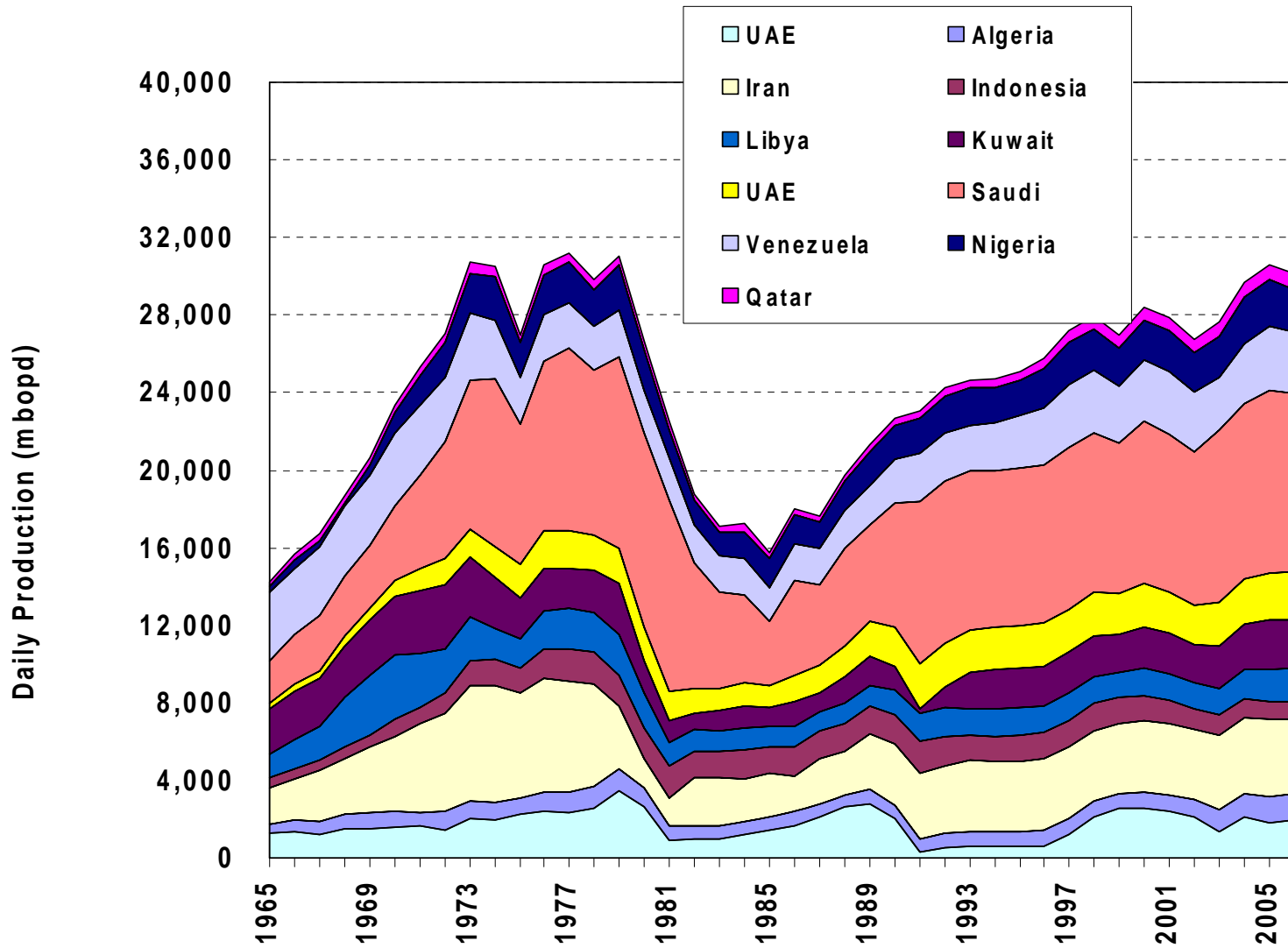
Concerns With OPEC Reserves

- 1. The Gulf members on the OPEC Group substantially increased their officially reported remaining reserve number during the early 1980s during the competition for OPEC quotas.**
- 2. Since the mid 1980s OPEC countries in the Gulf has essentially kept their officially reported remaining reserve flat, despite the fact that all data bases and their own reporting indicate minor reserve additions through exploration.**
- 3. OPEC keeps their remaining reserve numbers flat by arguing that for every barrel they produce they are able to offset this by adding a barrel through adjustments to reservoir parameters (porosity, water saturation, recovery factor, net to gross ratio, etc.).**
- 4. When we track reserve additions through exploration and the depletion of those reserve through production, we see a much lower remaining reserve number than what is reported by OPEC.**

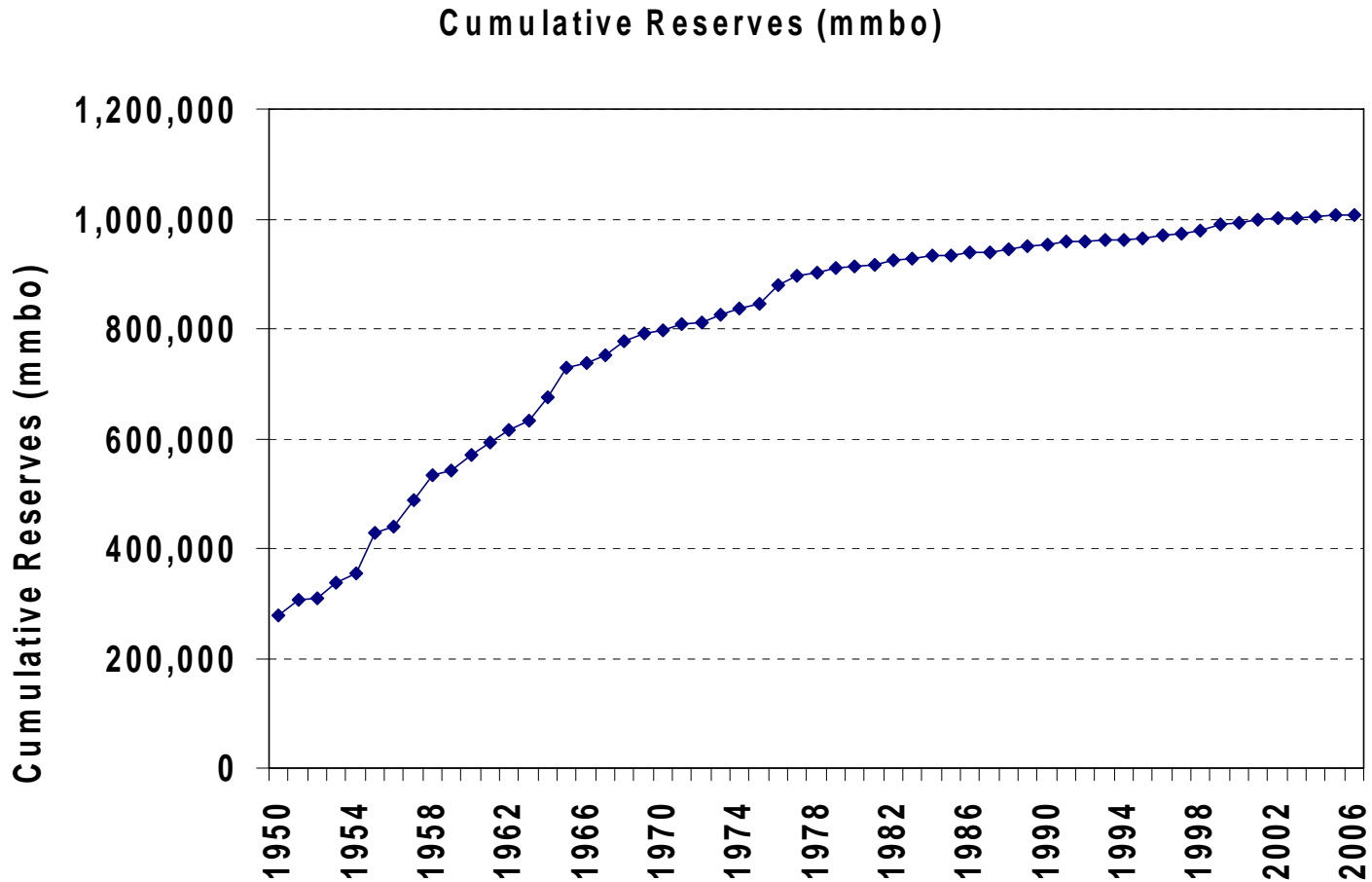
Concerns With OPEC Reserves

5. The real issue here is that we really do not know what several key OPEC countries reserves really are because there is no way to independently verify them as we can in most non-OPEC countries where you have foreign companies doing the exploration and development.
6. The shape and style of these country's remaining reserve profiles in the face of disappointing exploration results over the last 20 years and the fact that they almost exactly offset production with reserves through book keeping has to raise suspicions.
7. Our analysis suggests that OPEC overall has depleted approximately 40 percent of its reserve base with annual depletion levels running at 1 %/year (OPEC would argue that it is their policy to have 0% depletion) *If PFC's estimated rate of depletion is correct then OPEC will reach the critical level of 60% in the later part of the next decade.*

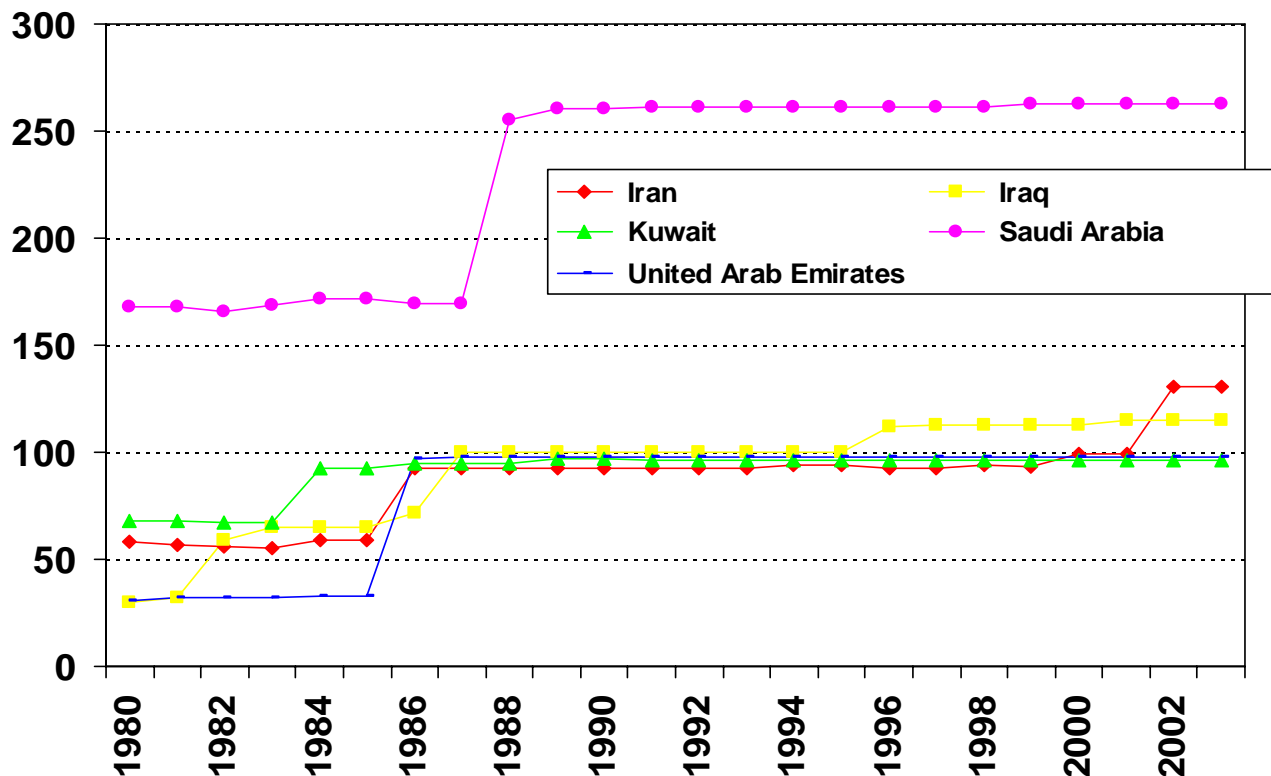
Historical Production (OPEC)



OPEC Creaming Curve

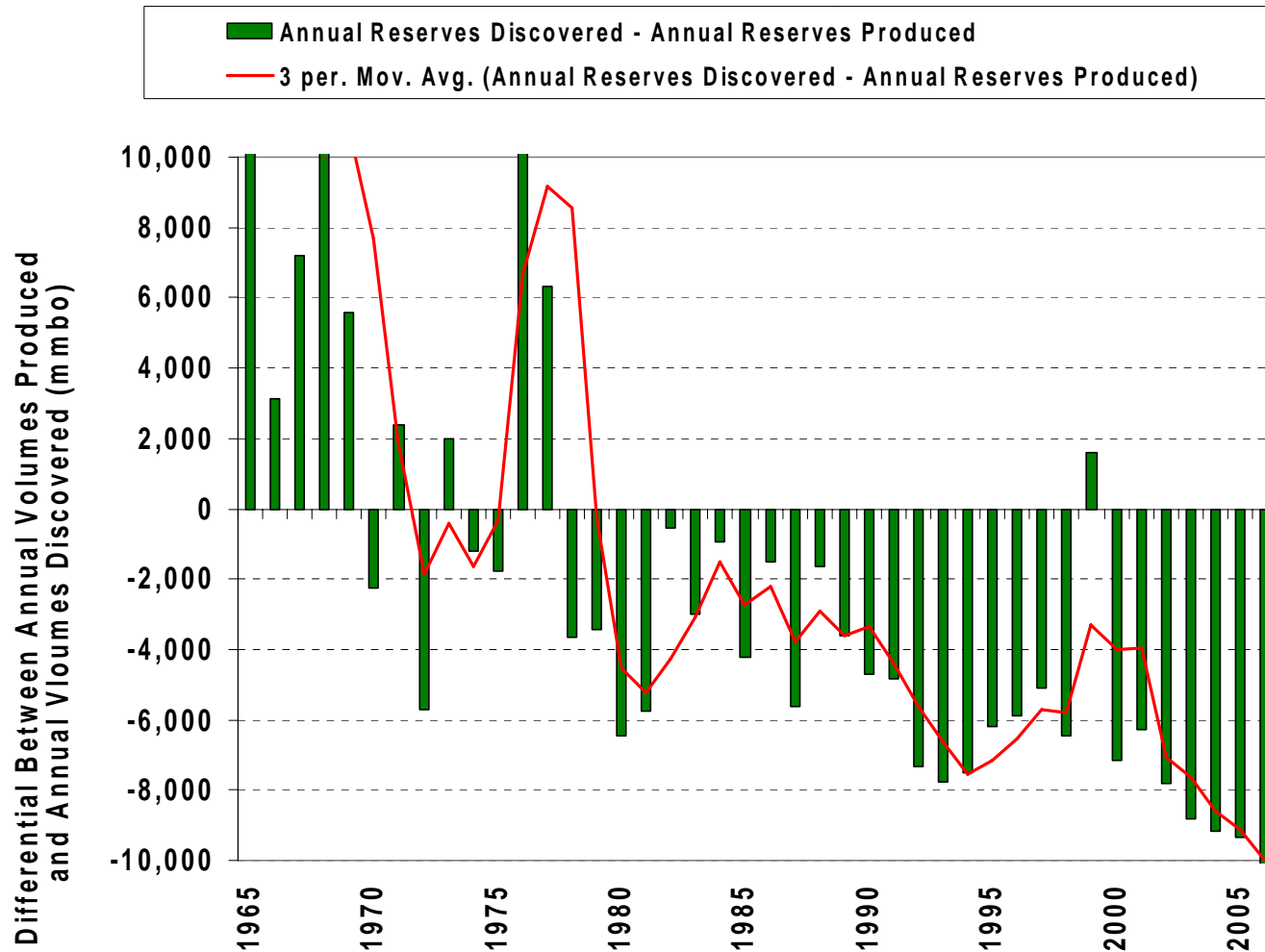


OPEC Historical Reserve Reporting (OPEC)



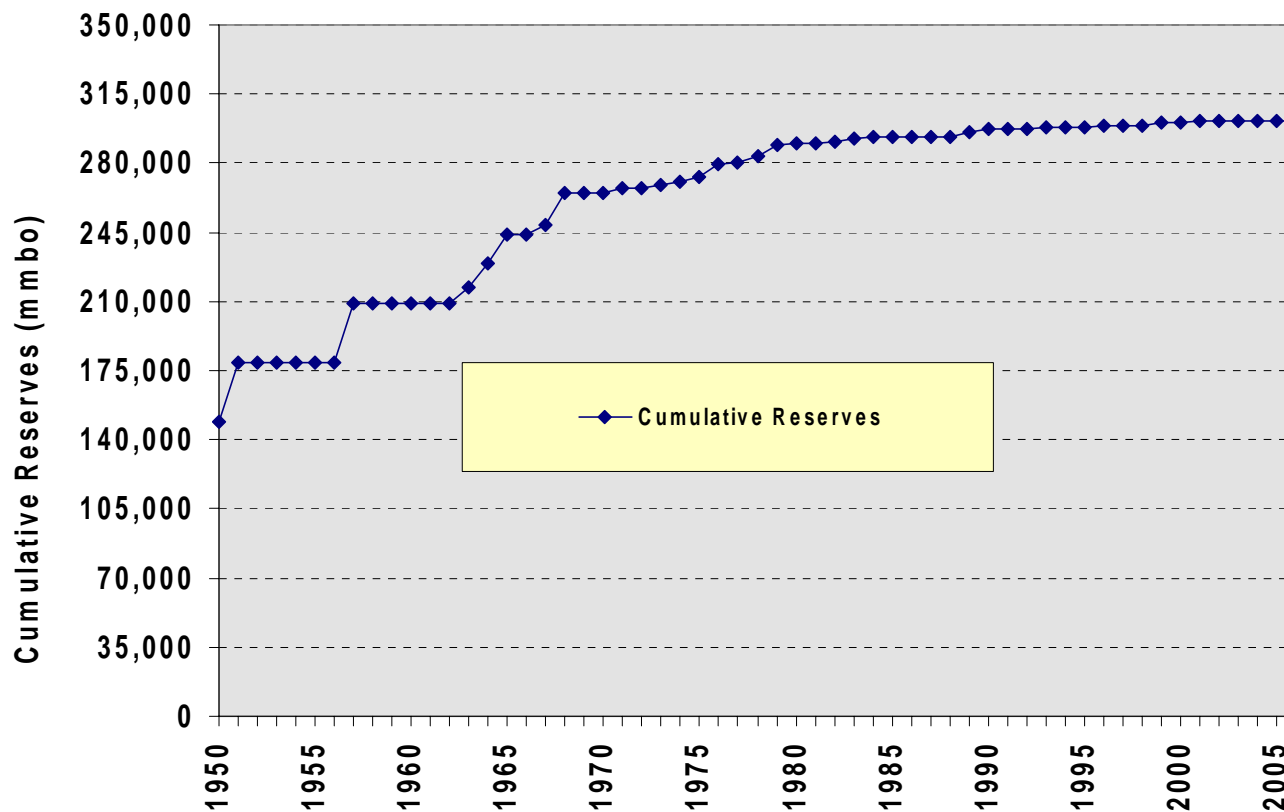
The Gulf members of OPEC do not lower reserve estimates as they produce. They have a stated policy of adding reserves through adjustments to reservoir assumptions to exactly offset reserve depletion through production

OPEC Historical Annual Crude Production Balance (OPEC)



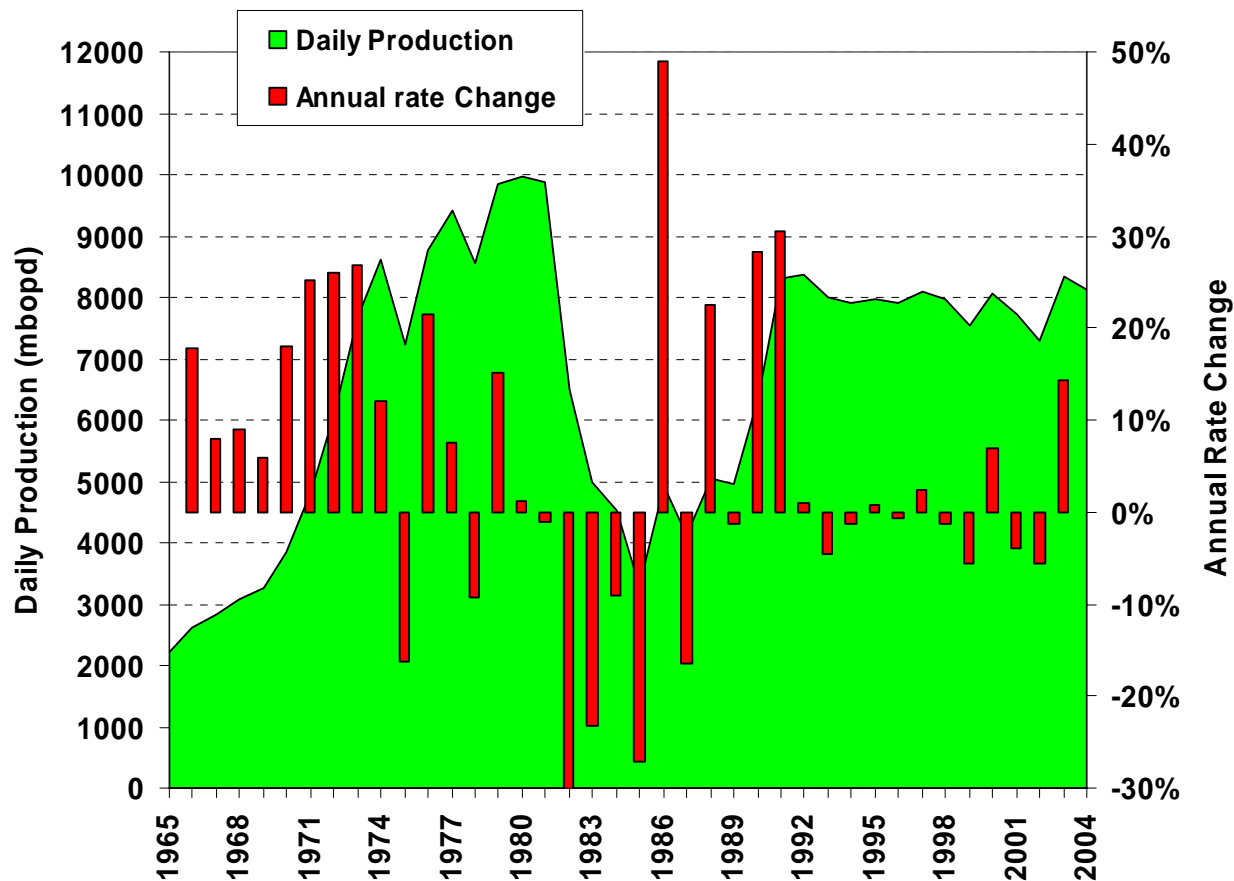
Like all other areas of the world, PFC Energy's data analysis indicates that Global OPEC crude production is currently exceeding volumes discovered.

Historical Saudi Reserve Additions



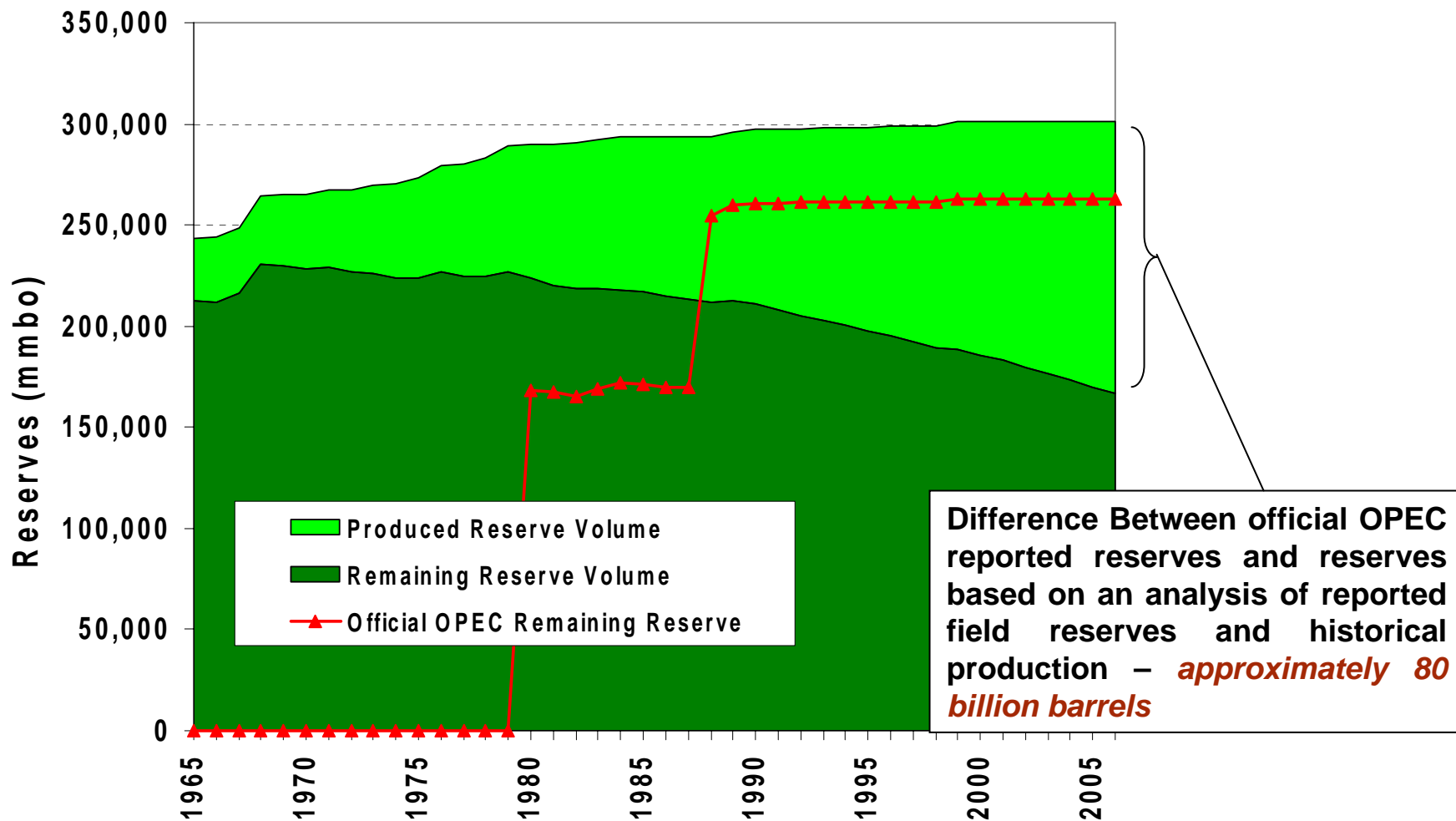
This is a creaming curve for Saudi. This is a view of reserve addition history over time based on the currently reported P1 and P2 reserves for all fields. For example, the fields discovered as of 1960 in aggregate had reserves of just over 200 billion barrels (as reserves are reported today).

Historical Saudi Production

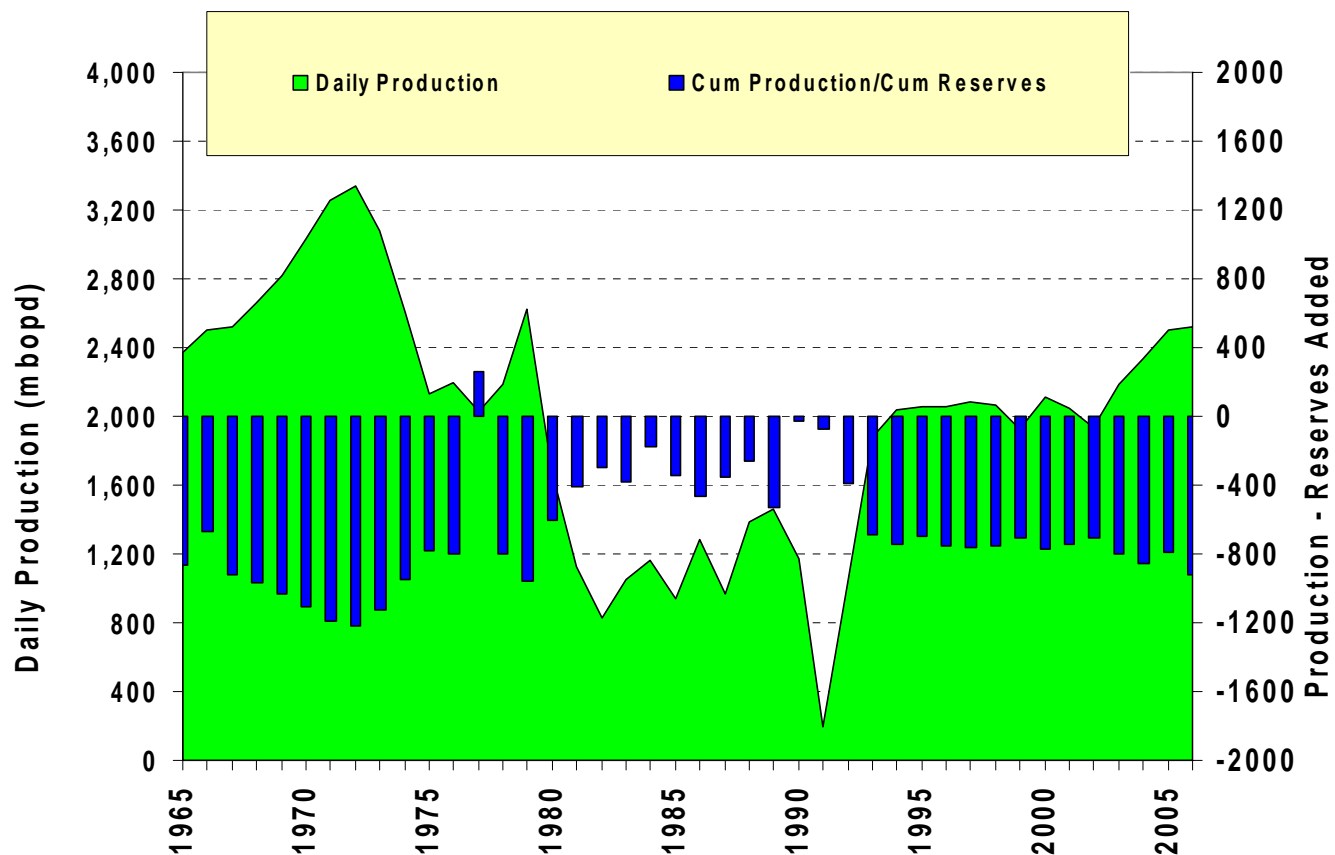


The above is a production history for Saudi Arabia based on PFC's current production database.

Historical Saudi Production and Depletion

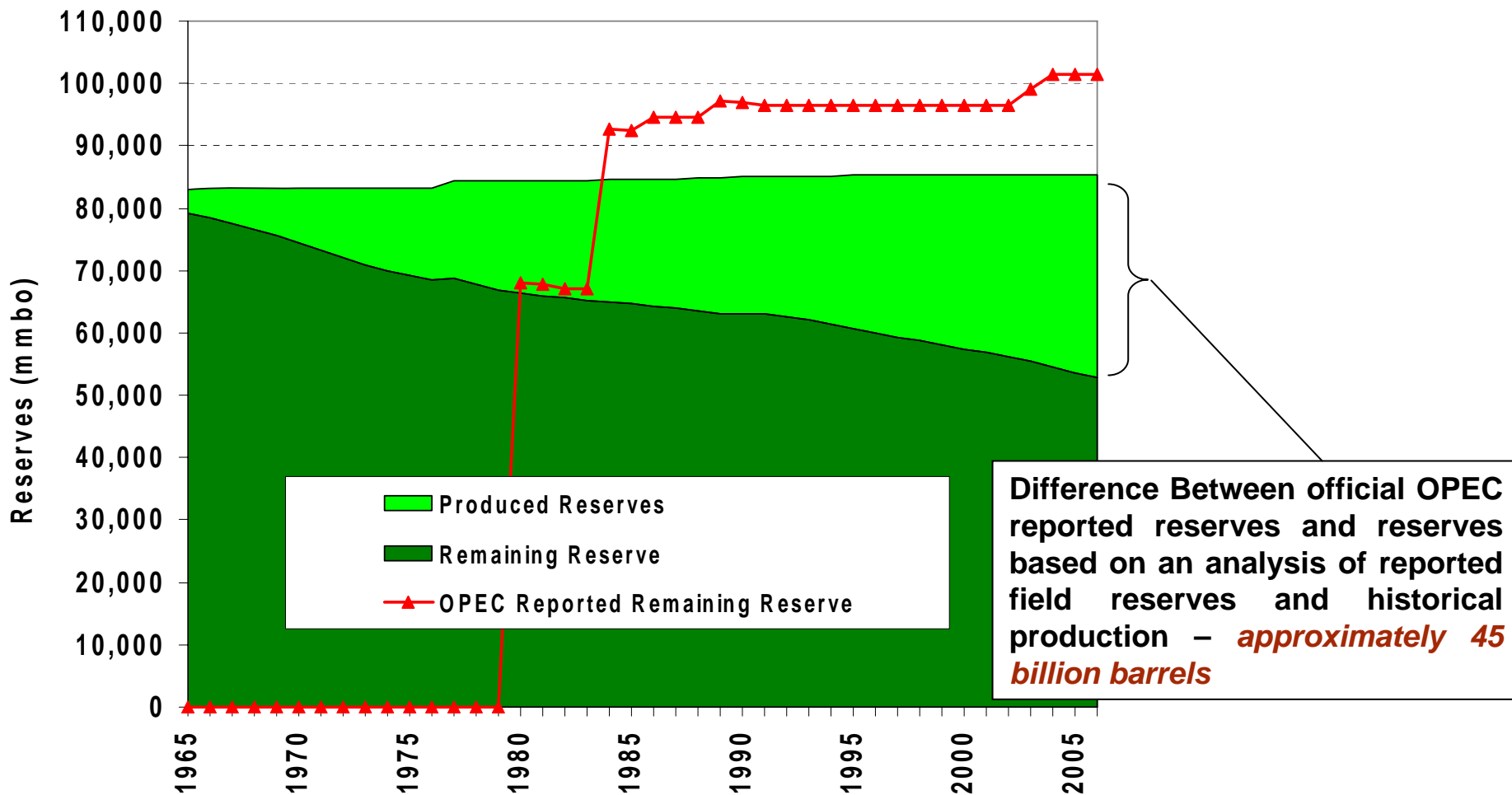


Historical Kuwaiti Production

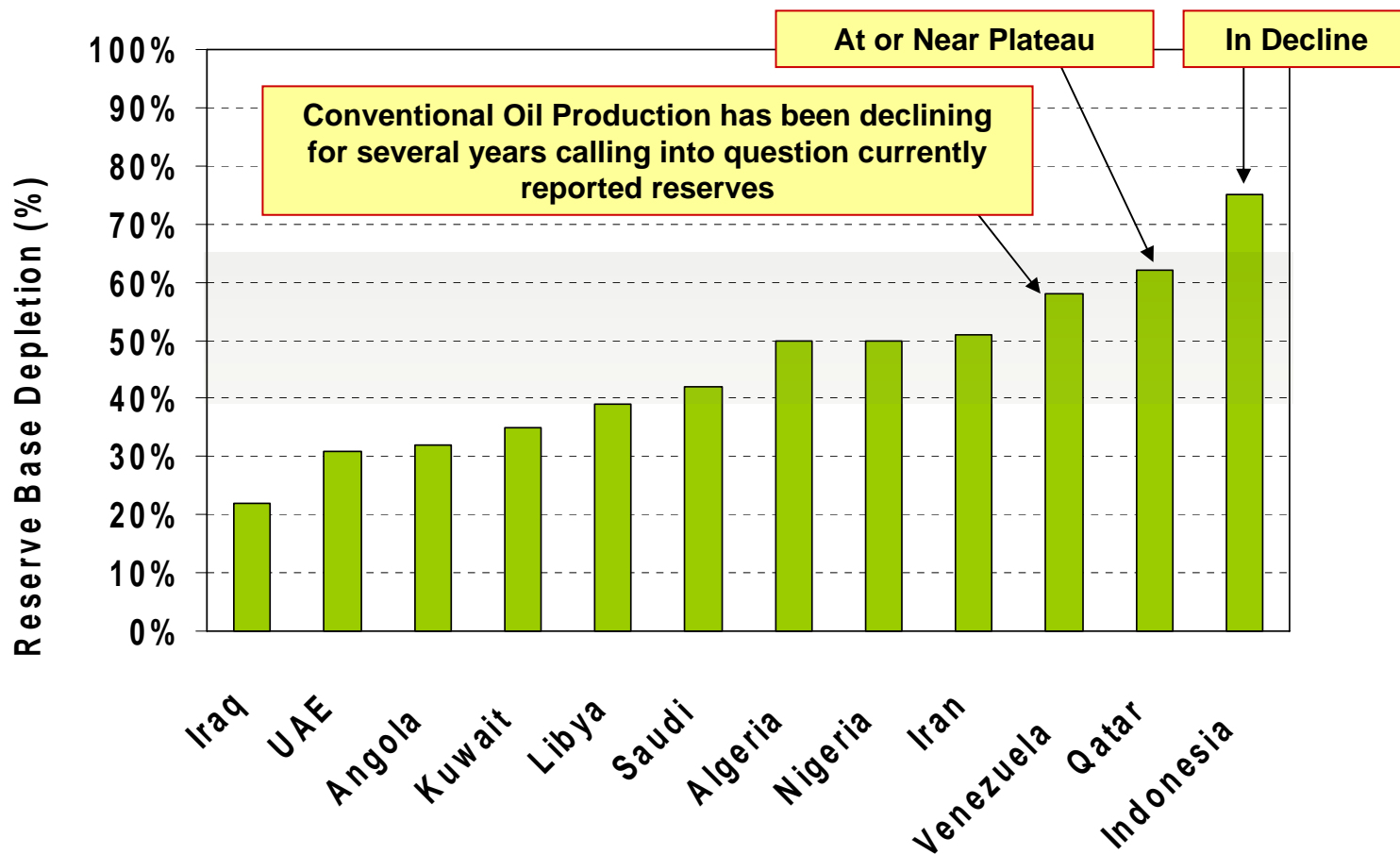


The above is a production history for Kuwait based on PFC's current production database.

Historical Kuwaiti Production and Depletion

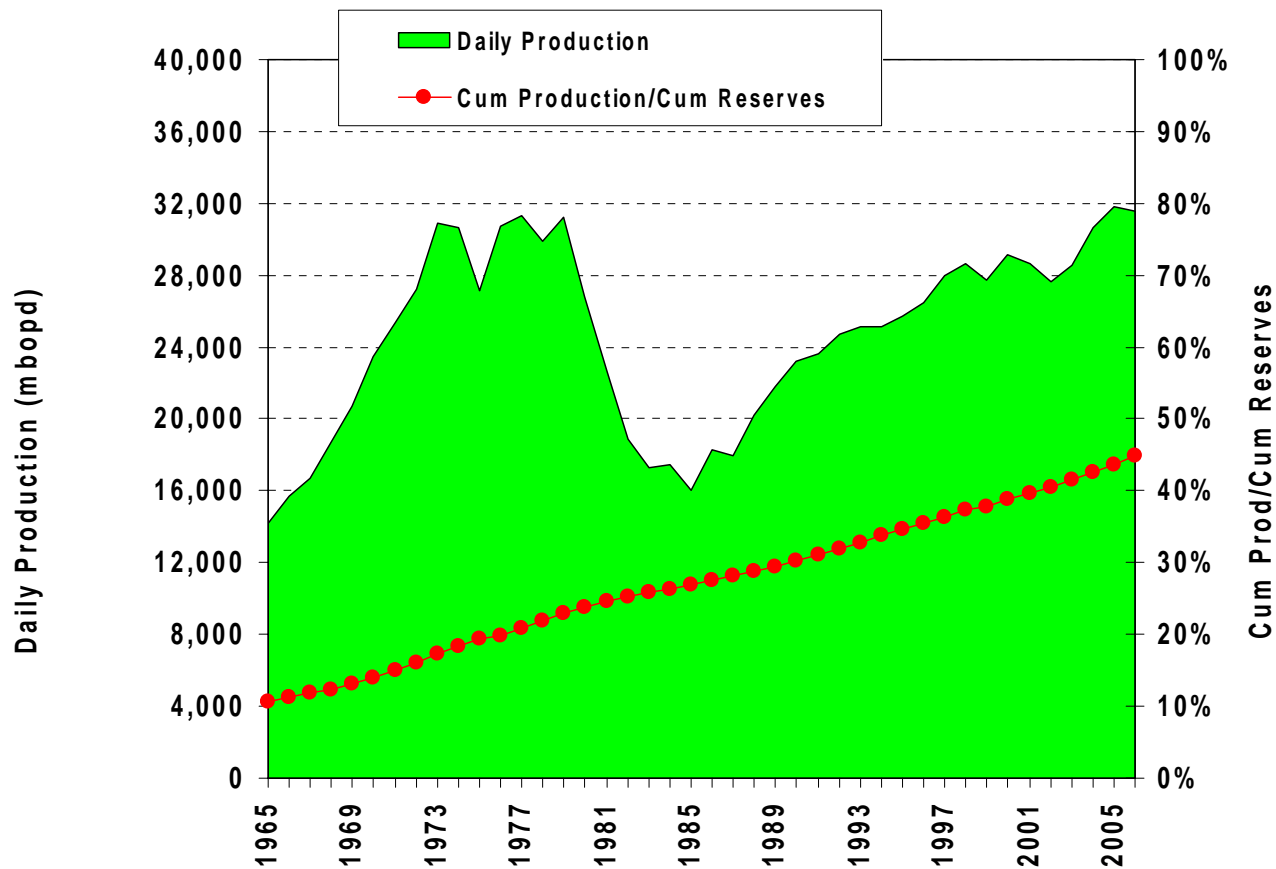


Historical Production and Depletion Levels (OPEC)



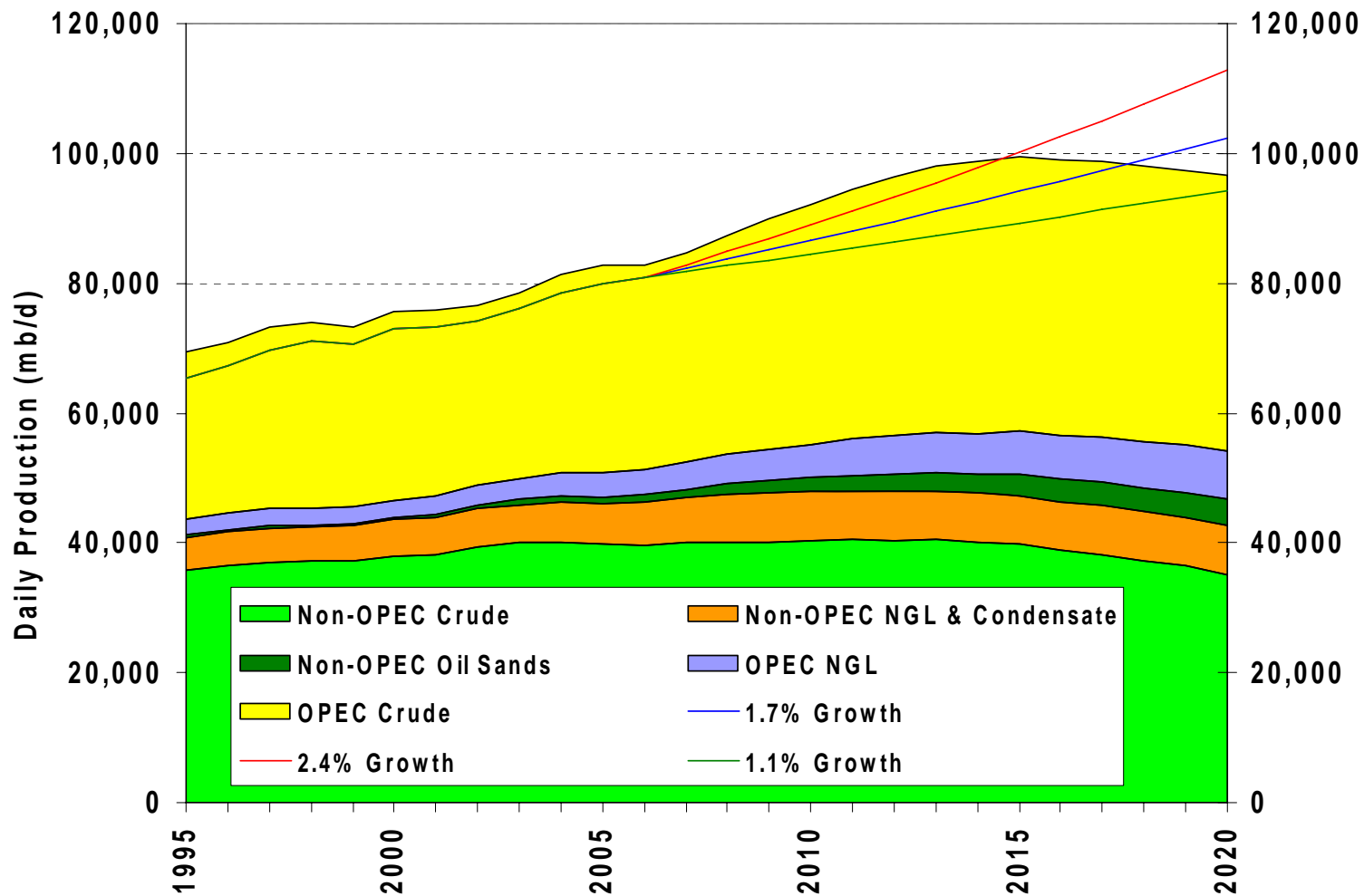
OPEC as a whole is depleting but some countries are depleting faster than others

Historical Production and Depletion Levels (OPEC)



Based on our analysis OPEC as a whole has produced approximately 45 percent of all reserves discovered in OPEC to date. Understanding whether or not this is correct is critical in understanding what future world production capacity will be.

Unconstrained OPEC Production Will Peak Under 100 Million Barrels Per Day



Given a continuation of recent trends in exploration results (field sizes, success rates, etc. and recovery factors):

- 1. In spite of high oil prices, Non-OPEC production growth has been very limited with the exception of the FSU. This trend is likely to continue through this decade.**
- 2. Oil exploration in the last 10 years (with a few exceptions like Angola, Sudan, Mauritania, Brazil) has been much less successful than in previous decades. Since 1990 reserve replacement in non-OPEC countries of most regions has been less than 35 percent.**
- 3. Every year, in every region (including OPEC), the world produces more oil than it finds. It is only logical to conclude that inevitably this will lead to dwindling supplies. *Our current view is that absent significant improvements in recovery technologies, exploration results, or a sharp increase in exploration spending, global non-OPEC liquid hydrocarbon production rate will struggle to grow beyond 2010 and may in fact start to decline.***

4. Non-OPEC production growth between now and the end of this decade will rely heavily on production growth in Kazakhstan, Azerbaijan, Russia, Brazil, and several miscellaneous smaller producers. *The real unknown here is to what degree production from these countries will fill and exceed the void left by production declines in other Non – OPEC countries.*
5. If demand continues to grow beyond 2010 and if Non-OPEC production capacity plateaus or falls, OPEC will have to make up the difference resulting in an inevitable increase in dependency on OPEC sources.



Strategic Advisors in Global Energy

PFC Energy consultants are present in the following locations:

- ▶ **Bahrain**
- ▶ Beijing
- ▶ Buenos Aires
- ▶ Calgary
- ▶ **Houston**
- ▶ **Kuala Lumpur**
- ▶ **Lausanne**
- ▶ London
- ▶ Mumbai
- ▶ New York
- ▶ **Paris**
- ▶ San Francisco
- ▶ **Washington, D.C.**

Main regional offices are shown in blue.

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- For each country reserve additions (field by field) have been documented along with production history
- A decline is modeled for the producing base using current withdrawal rates and remaining reserve estimates for fields in the existing production base (an additional 15-20% volume has been added to the current estimates of P1+P2 to account for possible higher recoveries)
- All new discoveries with a development plan are documented and probabilistically modeled to add to the producing base
- All undeveloped discoveries without a development plan are modeled using country average peak rates, decline rates, development concepts, etc. and added to the producing base
- Probabilistic expected value models are built which assume that field sizes, success rates, etc. (documented since 1990) continue over the next two decades and production from these EVA models are modeled to be added to the producing base