



PFC Energy's Global Crude Oil and Natural Gas Liquids Supply Forecast

**Strategic Advisors
in Global Energy**



September 2004

Key Messages

- 1. The world is not in imminent danger of running out of oil, but certain countries/regions are depleting much faster than others. This will cause a shift in the geographic dominance of production sources.**
- 2. In spite of high oil prices, Non-OPEC production has been stagnant with the notable exception of the FSU. This trend is likely to continue through this decade.**
- 3. Exploration results in the last 10 years (with a few exceptions like Angola, Sudan, Mauritania) have been much less significant than in previous decades. Without a significant reversal of this trend, Non-OPEC production is likely to peak just after 2010 and begin a long term decline.**

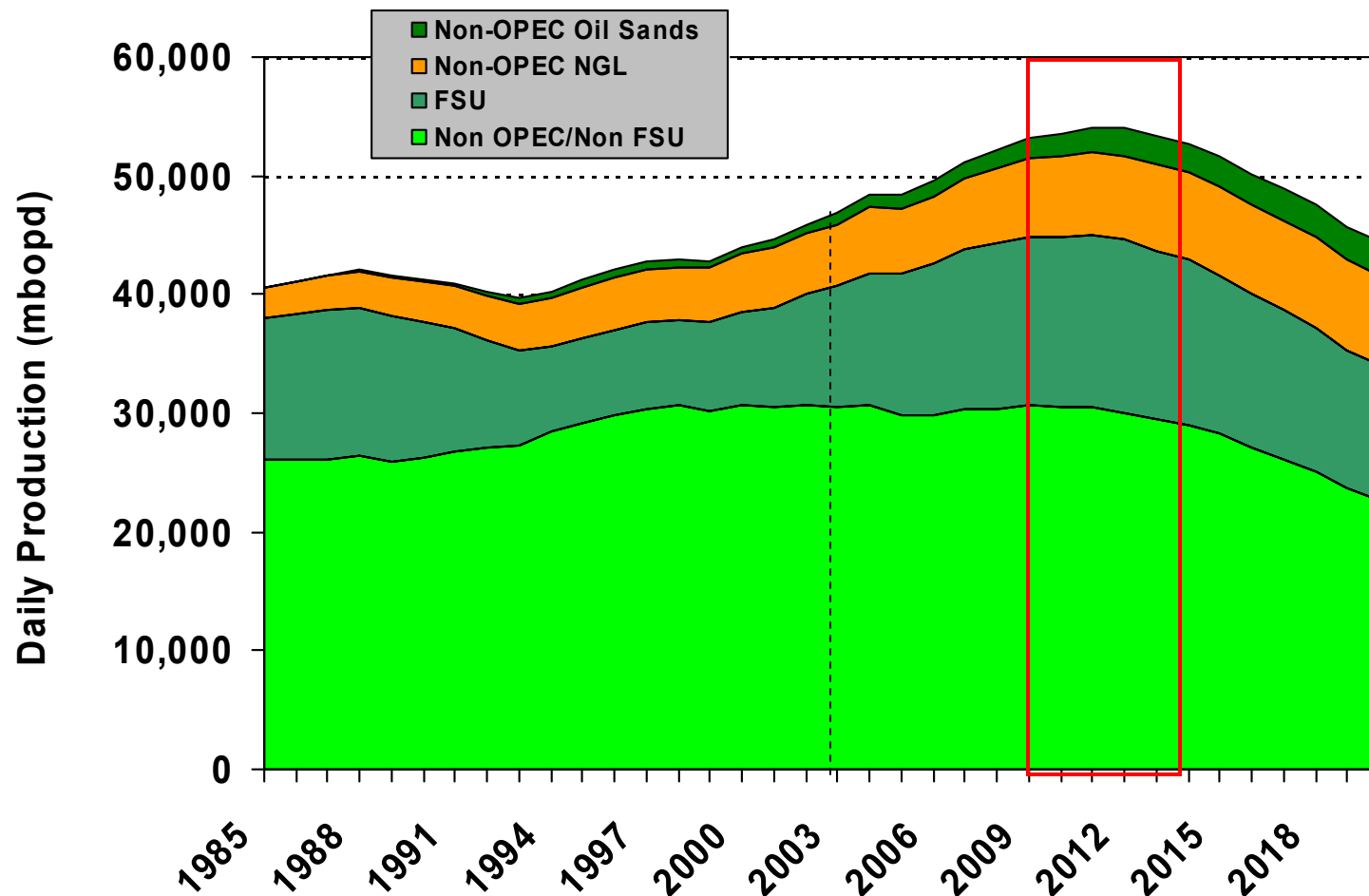
Key Messages

5. 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.
6. As demand continues to grow beyond 2010 and Non-OPEC production capacity plateaus or falls, OPEC will have an increasing burden to make up the difference resulting in an inevitable increase in dependency on OPEC sources.
7. OPEC production capacity and reserves will suffer from the additional strain and some models suggest that even OPEC will struggle to fill the differential between Non-OPEC supply and global demand beyond 2015-2020.

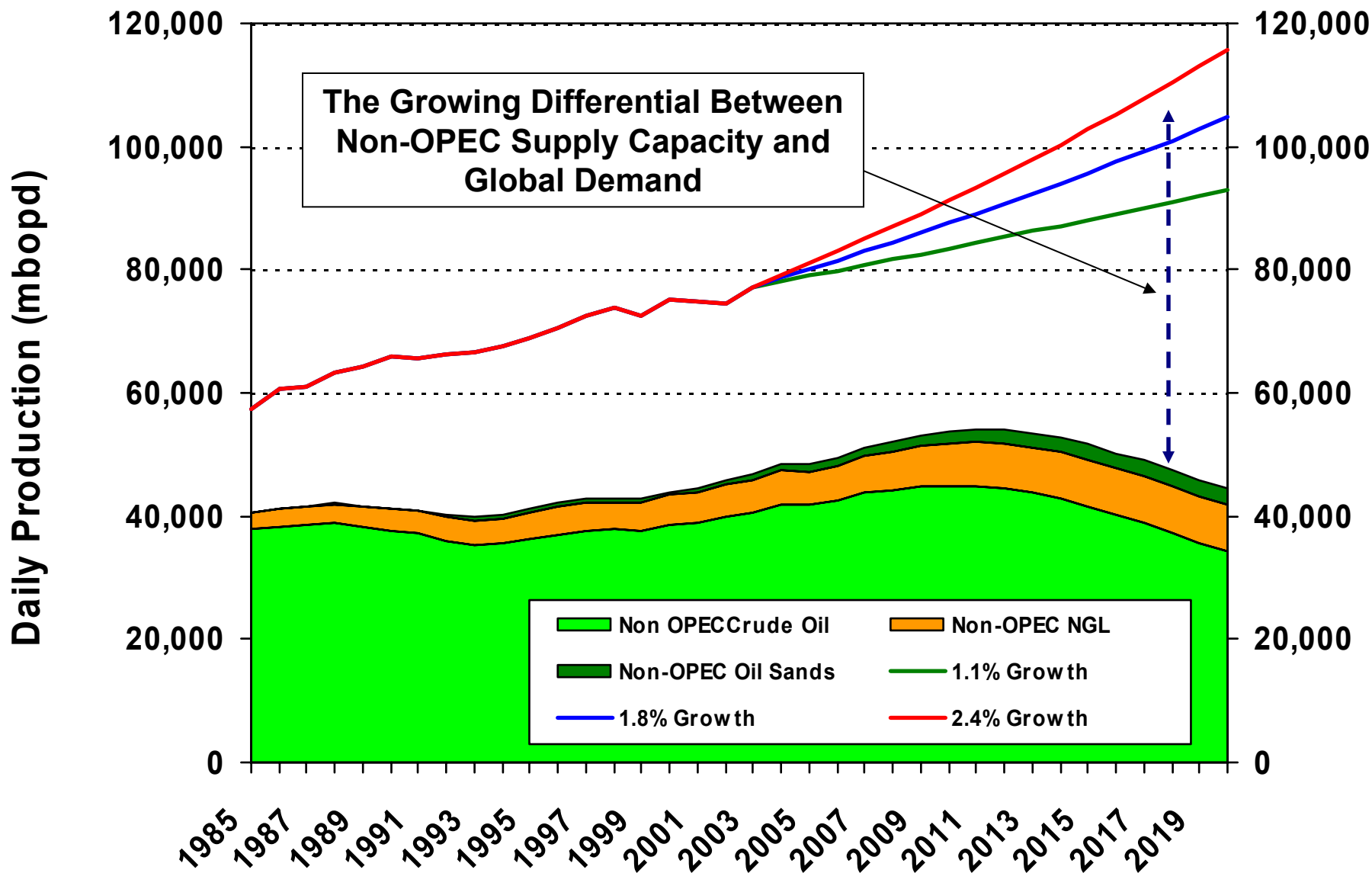
Non-OPEC Supply Forecast

Assumes Exploration Reserve Additions Typical of the Last 15 Years

This production profile is based on a model which takes into account known discovered oil, historical production, all known (large and small) discoveries that are undeveloped, likely future exploratory drilling, trends in discovery sizes, and decline rates.

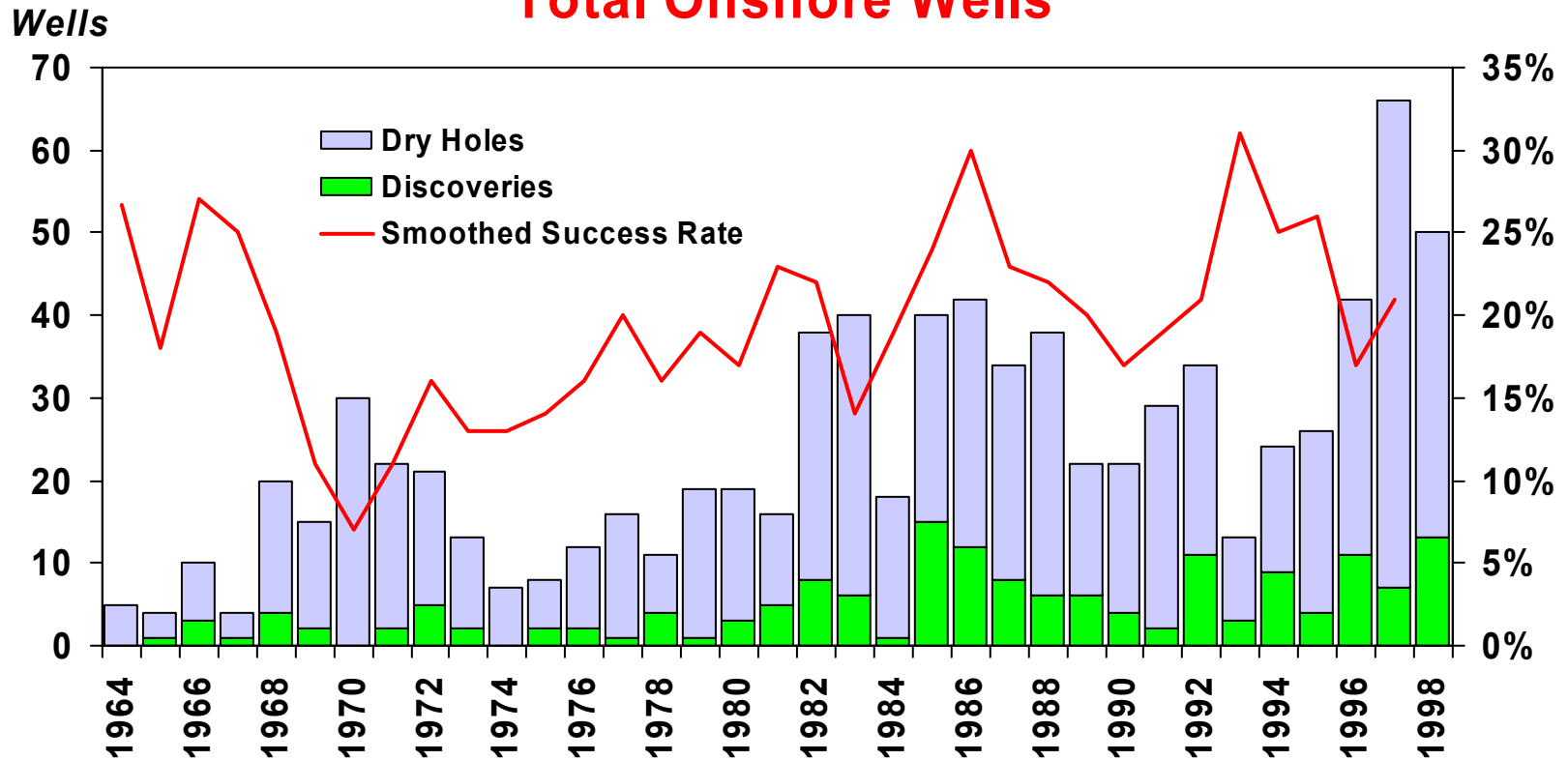


The Problem - The Expected Growing Gap Between Global Demand and Global Non-OPEC Supply in the Next Decade



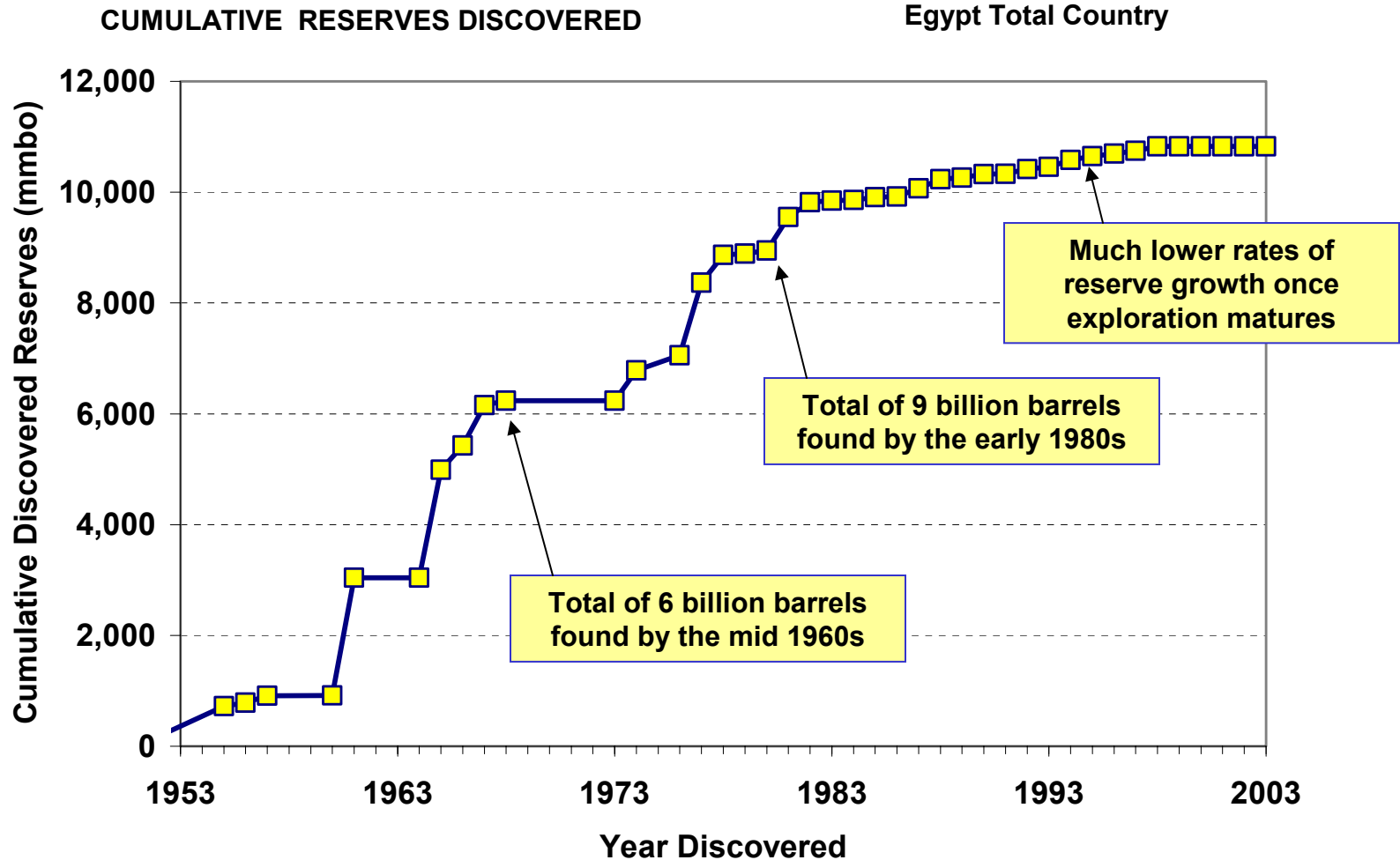
Egypt – A Typical Life Cycle for an Oil Producing Country

Total Onshore Wells



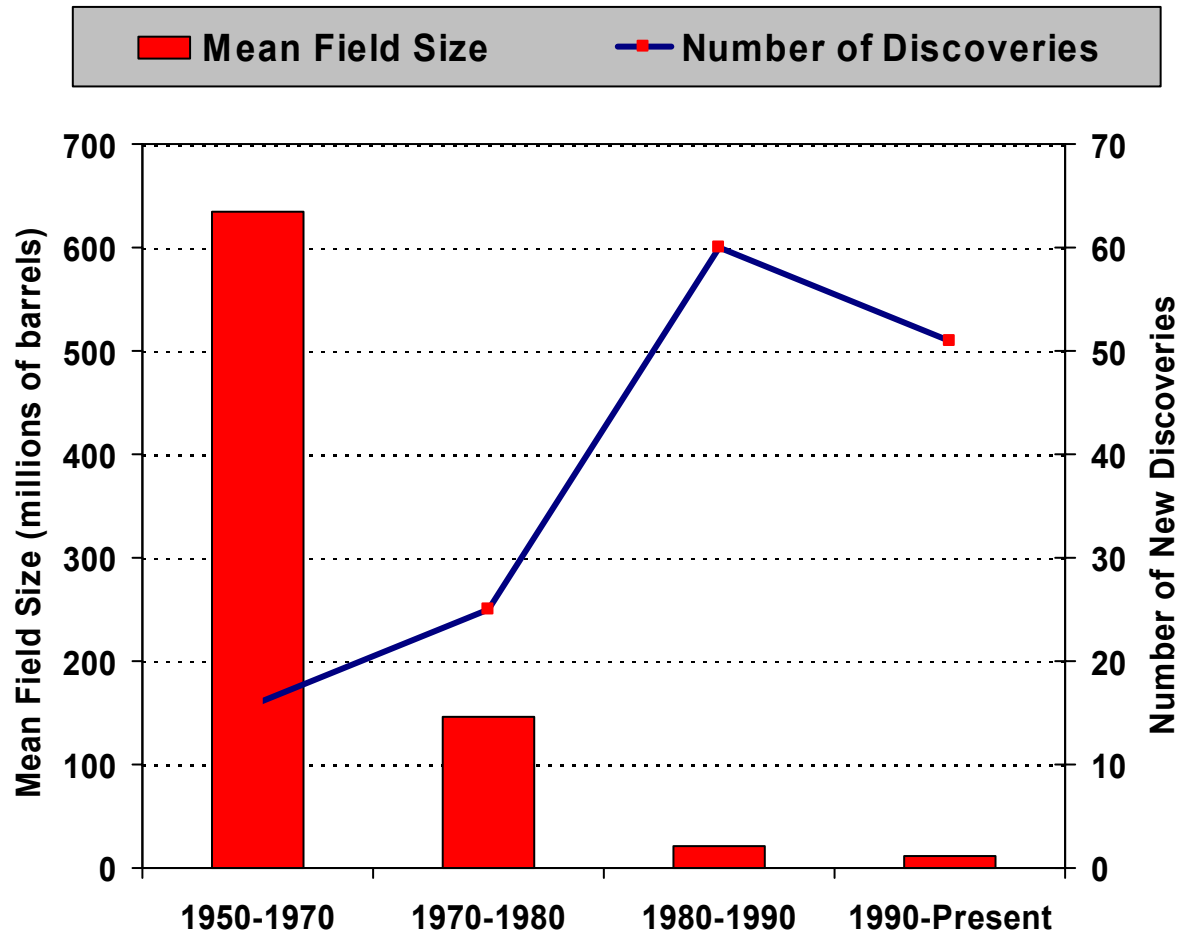
Exploration usually begins with a play concept which if successful (results in oil discoveries) leads to increasing numbers of wells over time – *generally speaking the percentage of exploration wells which are discoveries does not change much over time*

Egypt – A Typical Life Cycle for an Oil Producing Country



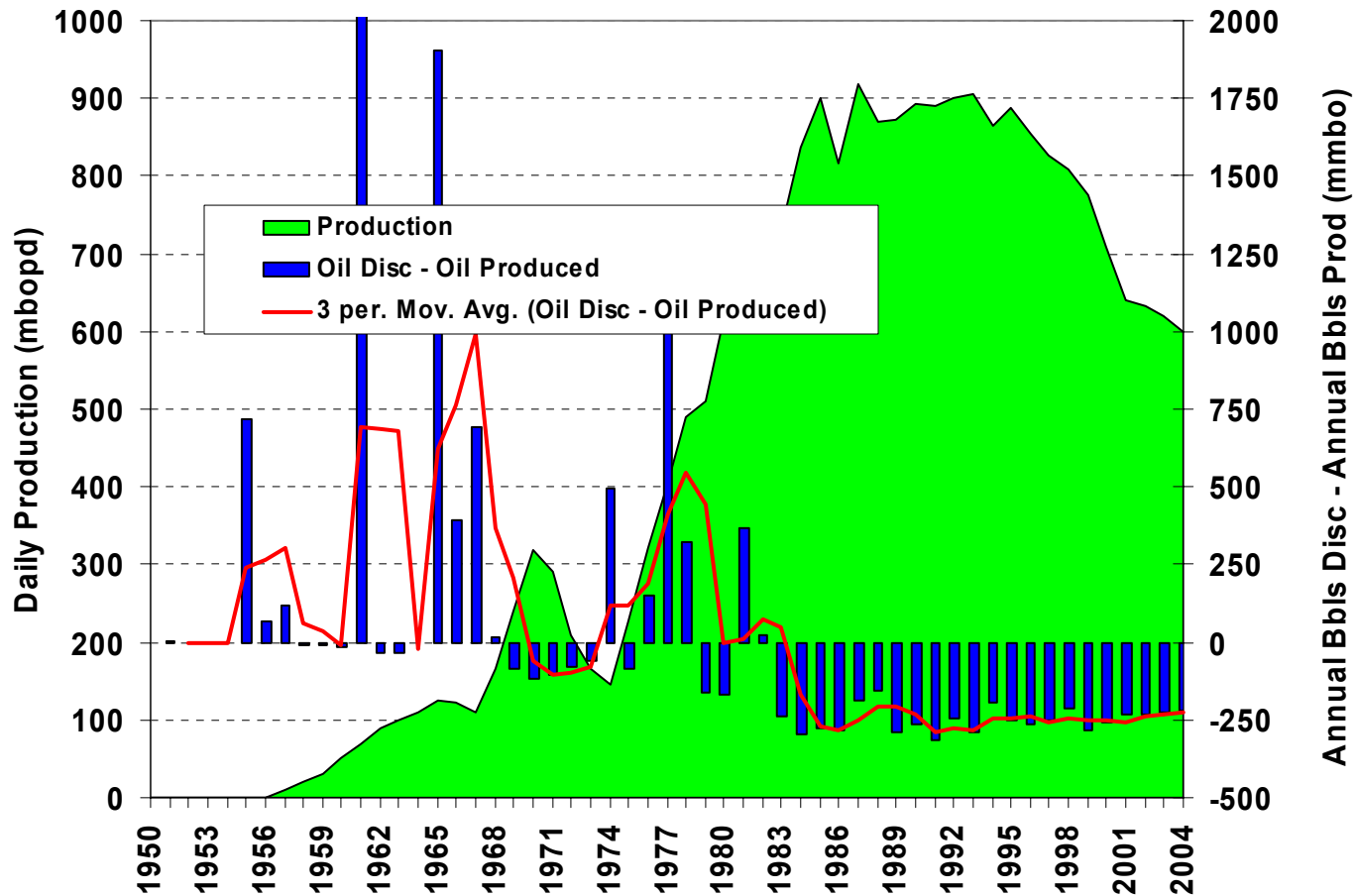
Typically large reserve growth occurs in the early years with large steps followed by smaller steps and much lower rates of reserve additions in the later years

Egypt – A Typical Life Cycle for an Oil Producing Country



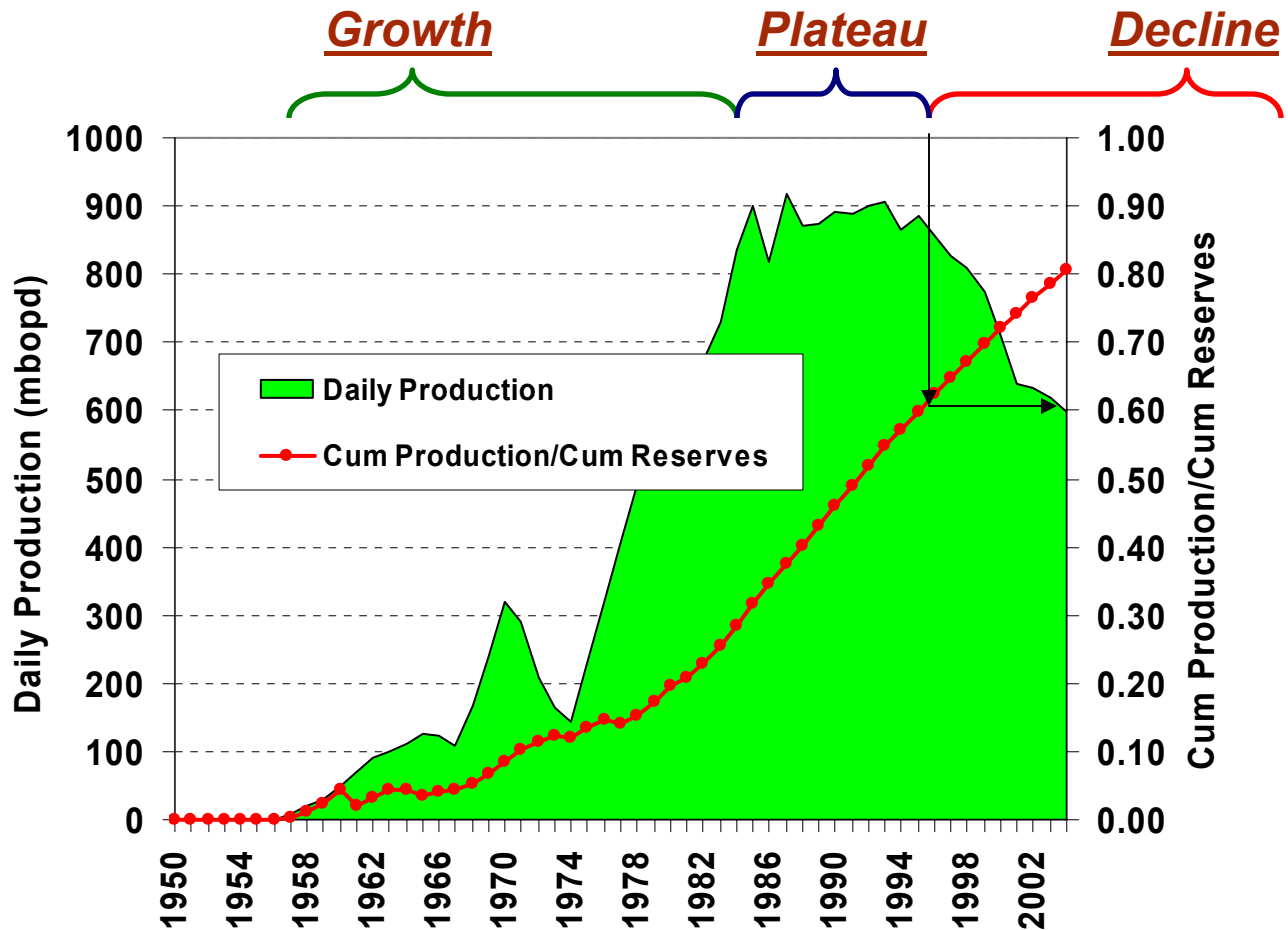
In most cases as exploration matures field sizes drop but the numbers of actual discoveries increase – *even though there are often more new fields in recent years, the much smaller field sizes has the net effect of much lower rates of reserve additions*

Egypt – A Typical Life Cycle for an Oil Producing Country



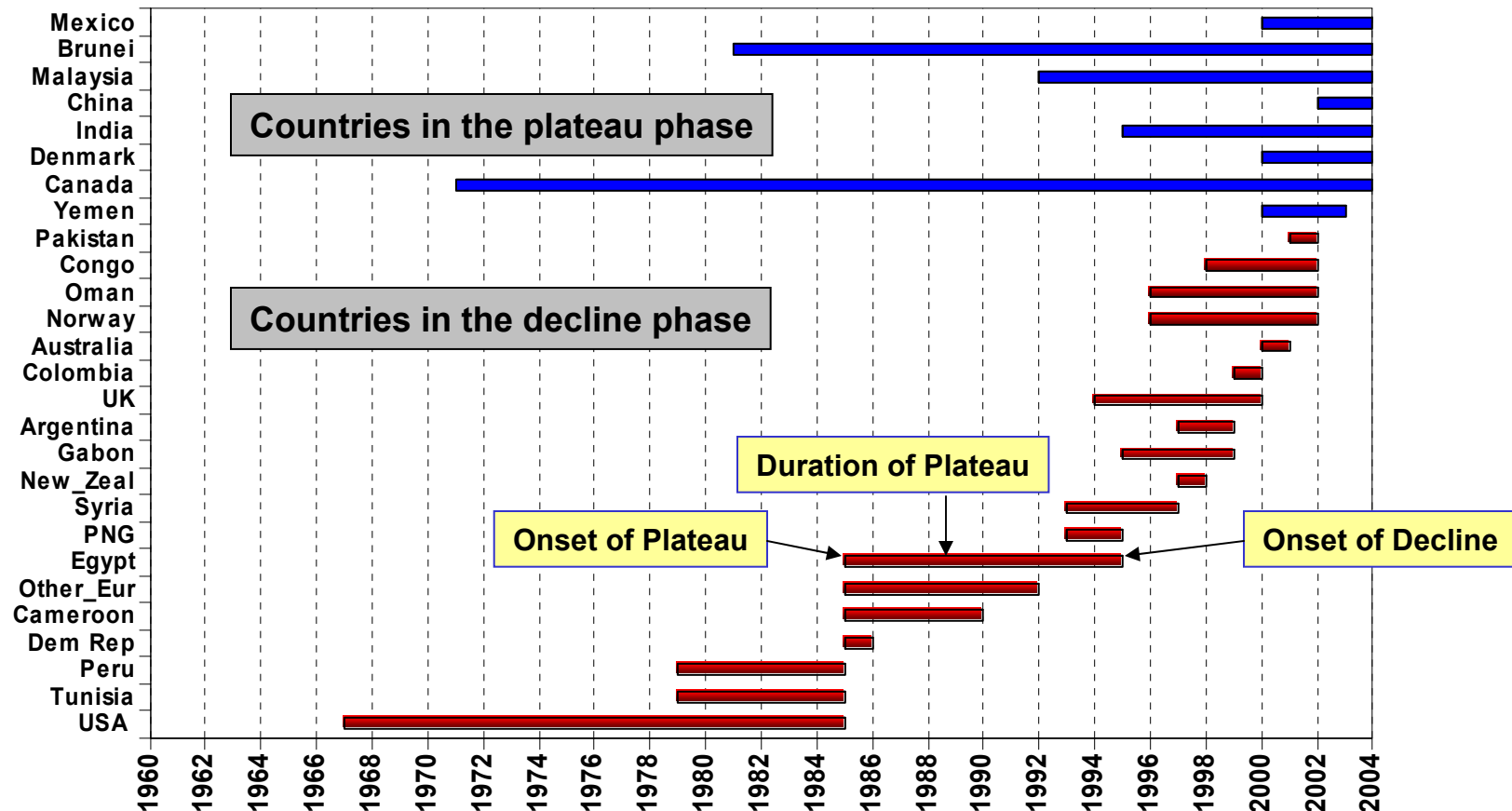
As reserve additions fall and production rates increase countries evolve from having net a positive annual reserve balance to a negative annual petroleum balance – *in the case of Egypt there have been 20 consecutive years where 250 mmbo more oil is produced than discovered every year*

Egypt – A Typical Life Cycle for an Oil Producing Country



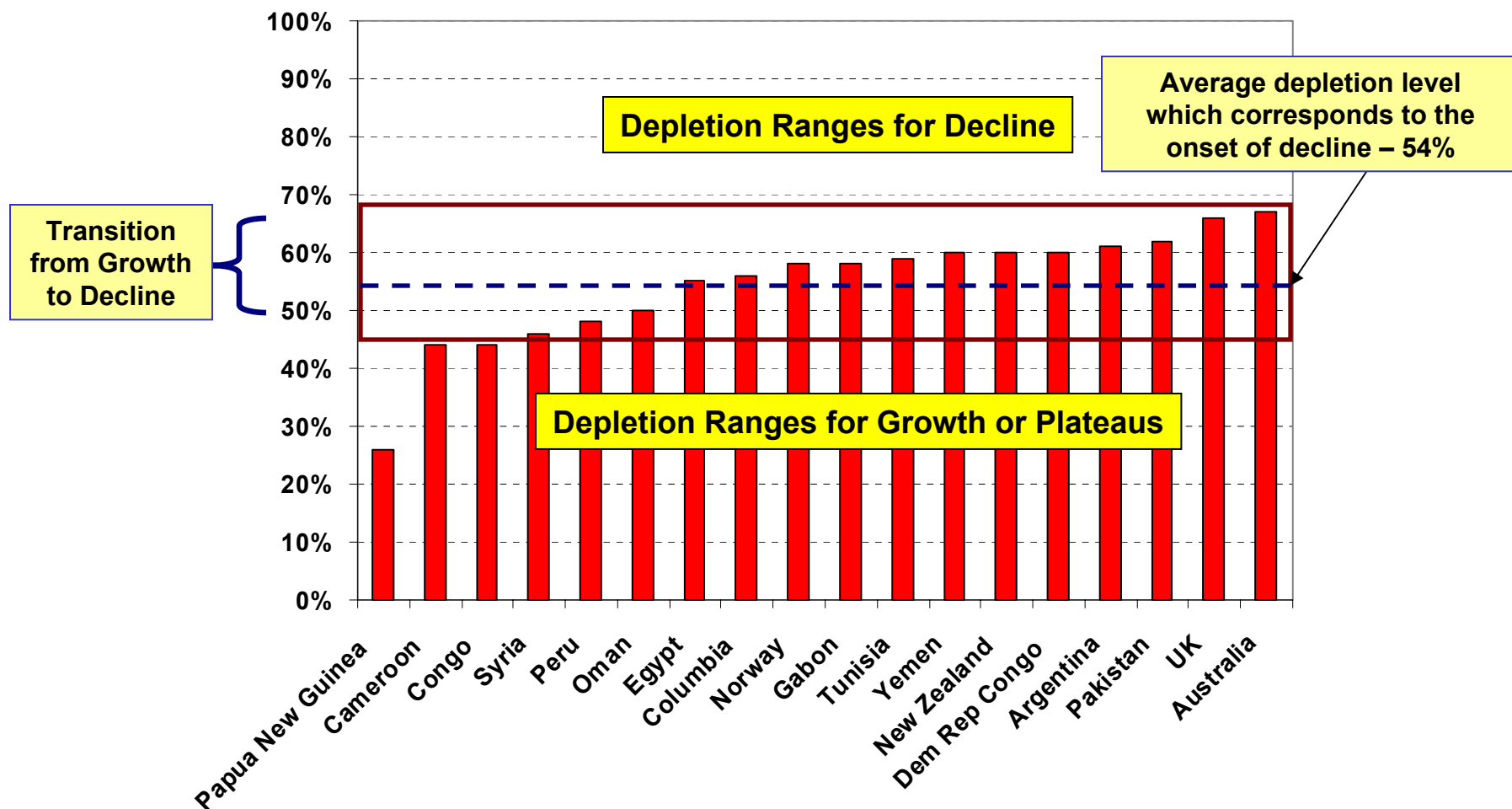
Once large discoveries are no longer made and production rates increase, depletion levels (percentage of oil discovered that has been produced) accelerate – *this depletion history has been mapped for every major oil and most minor producing countries*

Non-OPEC Countries that are Either in Decline or Currently in a Plateau



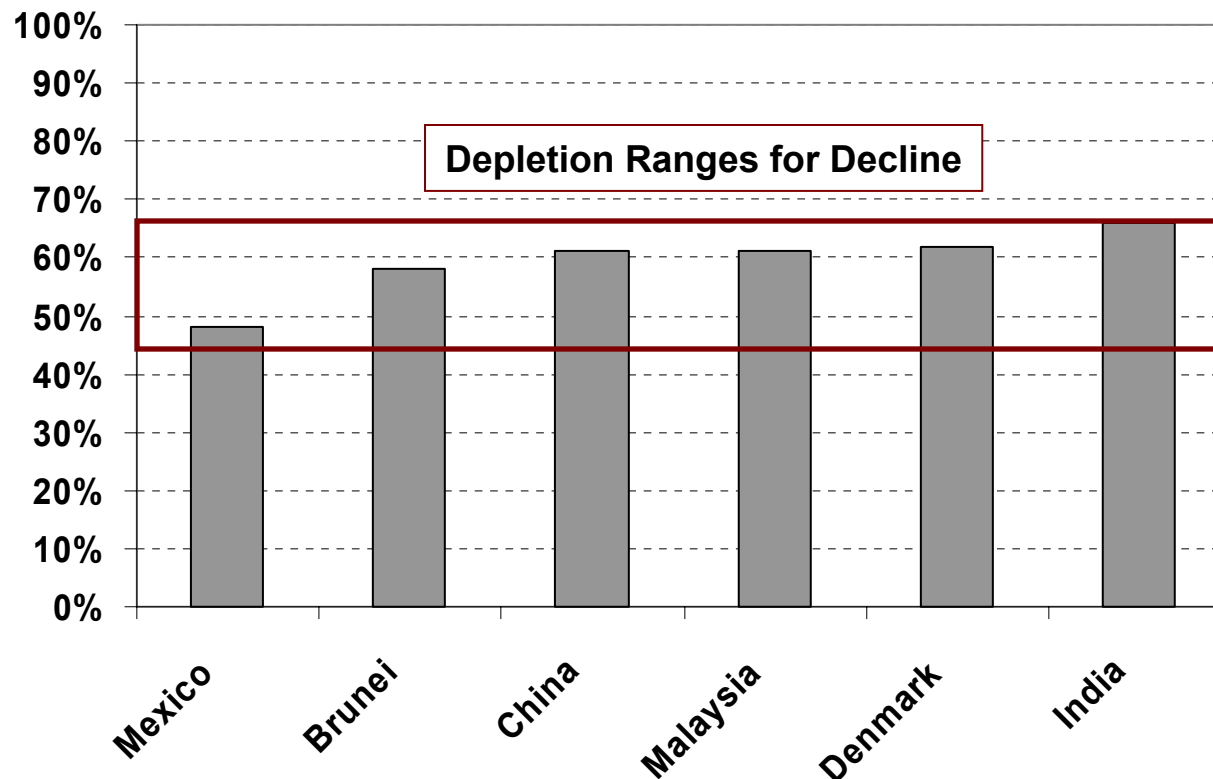
The above bars show the onset and duration of documented production peaks or plateaus – *tracking country life cycle shows an acceleration of the number of countries passing from peak to decline*

Non-OPEC Countries that are in Decline



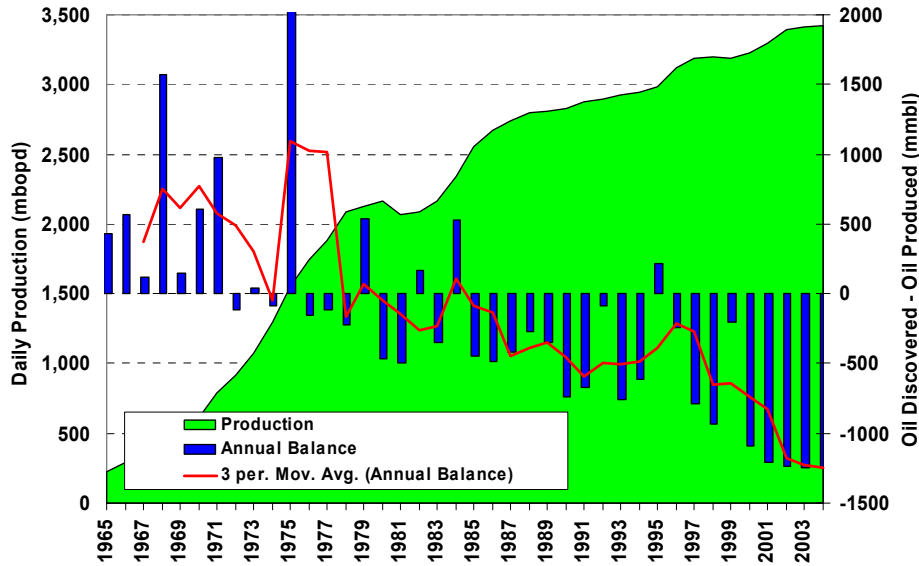
The above bars shows the depletion level at the transition from peak/plateau to decline – *tracking depletion level is a good way to anticipate the cessation of growth and the onset of decline*

Non-OPEC Countries that are in Plateau



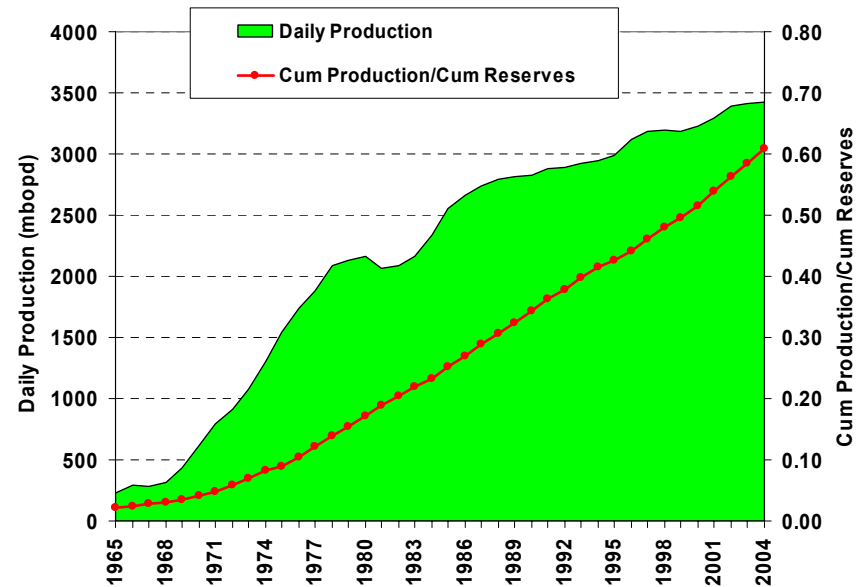
The above bars shows the depletion level of several producers which have reached a production plateau – *several significant producers are rapidly approaching critical (60 – 65%) depletion levels which typically signal the onset of production declines*

China - Non OPEC Country in Plateau but are Declines Likely in the Near Term?

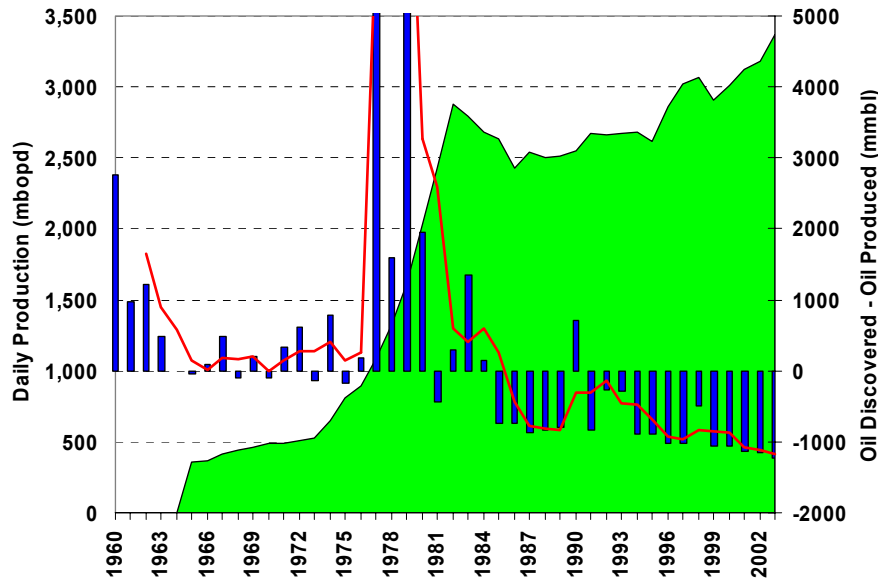


China's production volumes have exceeded new discovered volumes for all but 4 years since 1975.

China's depletion level has reached 60% and production levels have gone flat over the last 3 years.

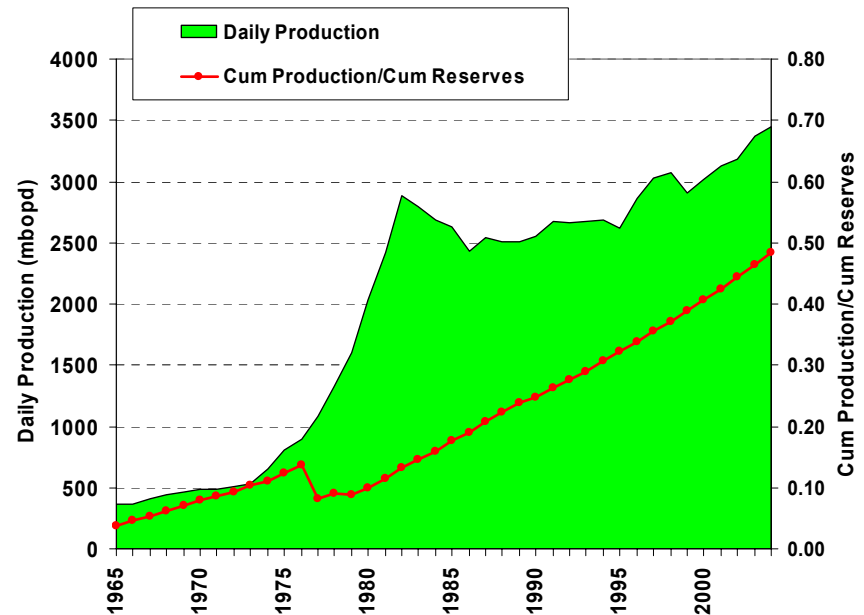


Mexico – Non-OPEC Country in Plateau but are Declines Likely in the Near Term?

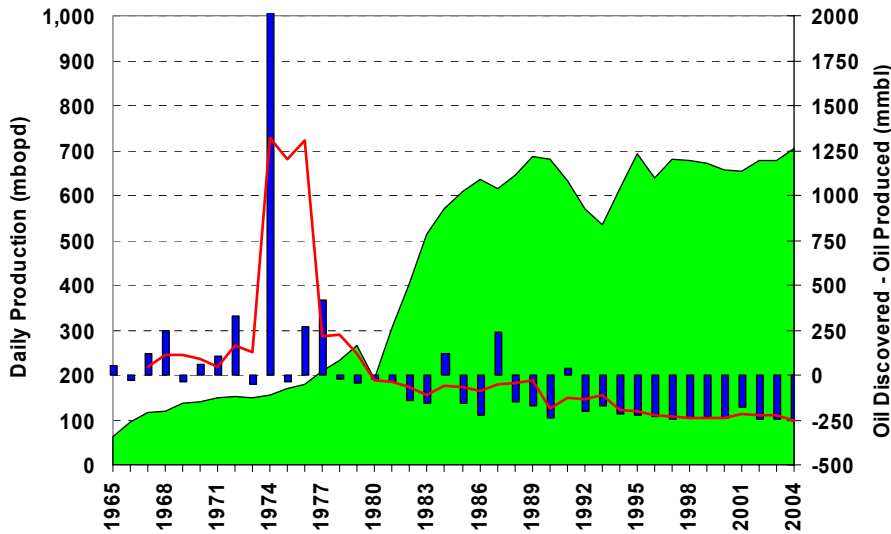


Mexico's production volumes have exceeded new discovered volumes for all but 1 year since 1984.

Mexico's depletion level has reached 50% although production levels have continued to increase over the last few years – *based on current rates 60% depletion would likely occur in 2008, however the Mexican Government has stated that absent significant new discoveries in the deepwater GOM, 14% declines are expected to start in 2006.*

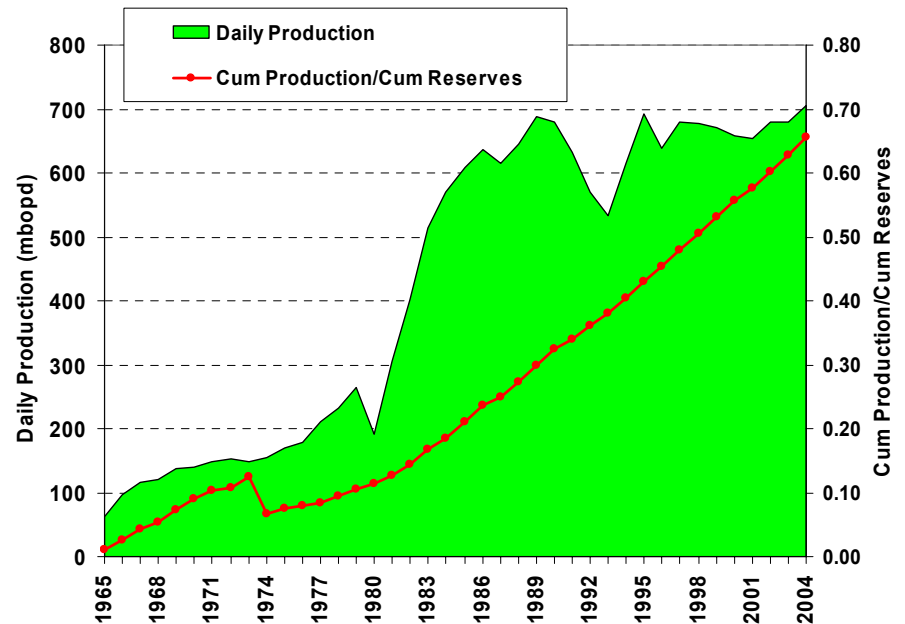


India - Non OPEC Country in Plateau but are Declines Likely in the Near Term?

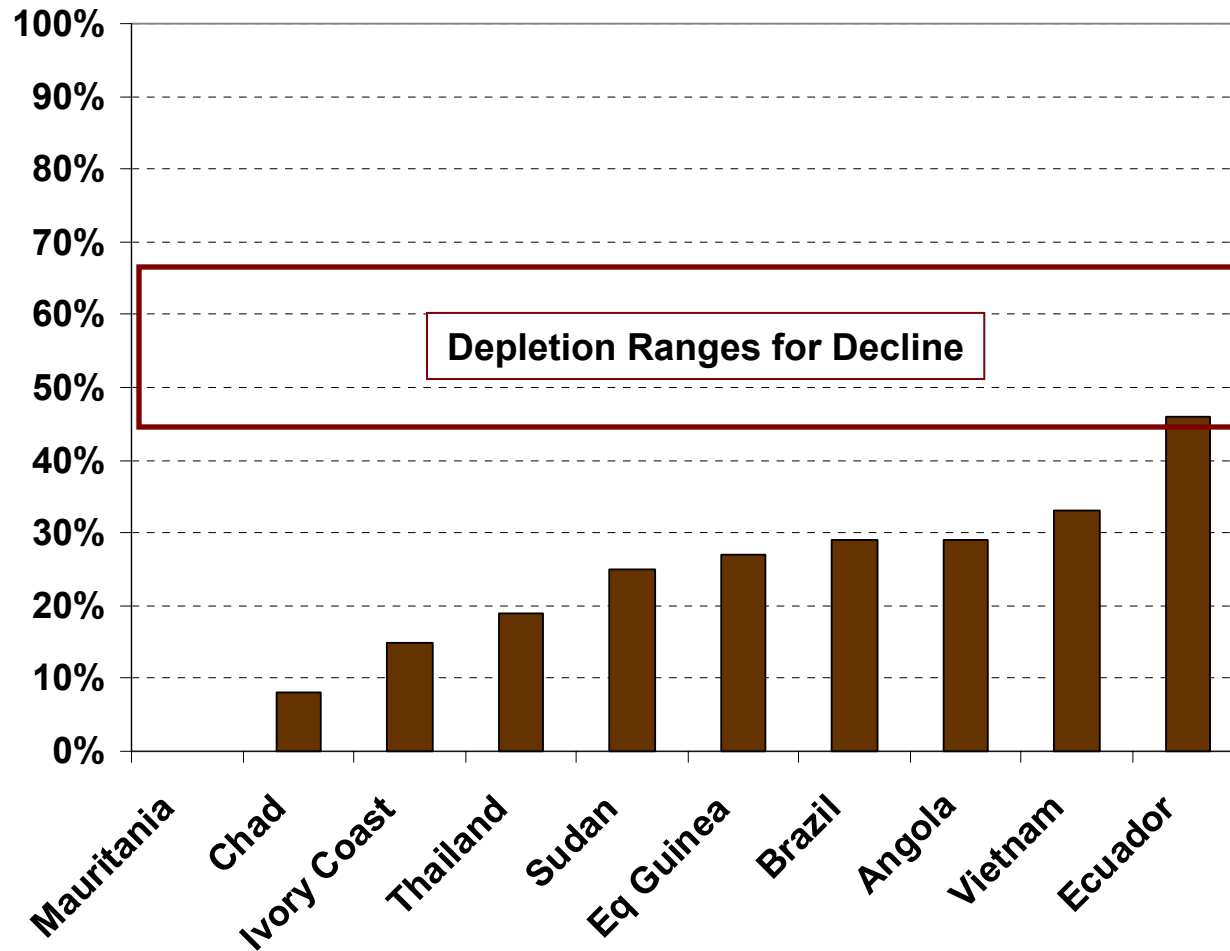


India's production volumes have exceeded new discovered volumes for all but 3 years since 1980.

India's production levels have been relatively flat since the mid 1990s as depletion levels have continued to increase – *current depletion is estimated at 65% which would imply that near term declines should begin unless reserves have been somewhat underestimated.*

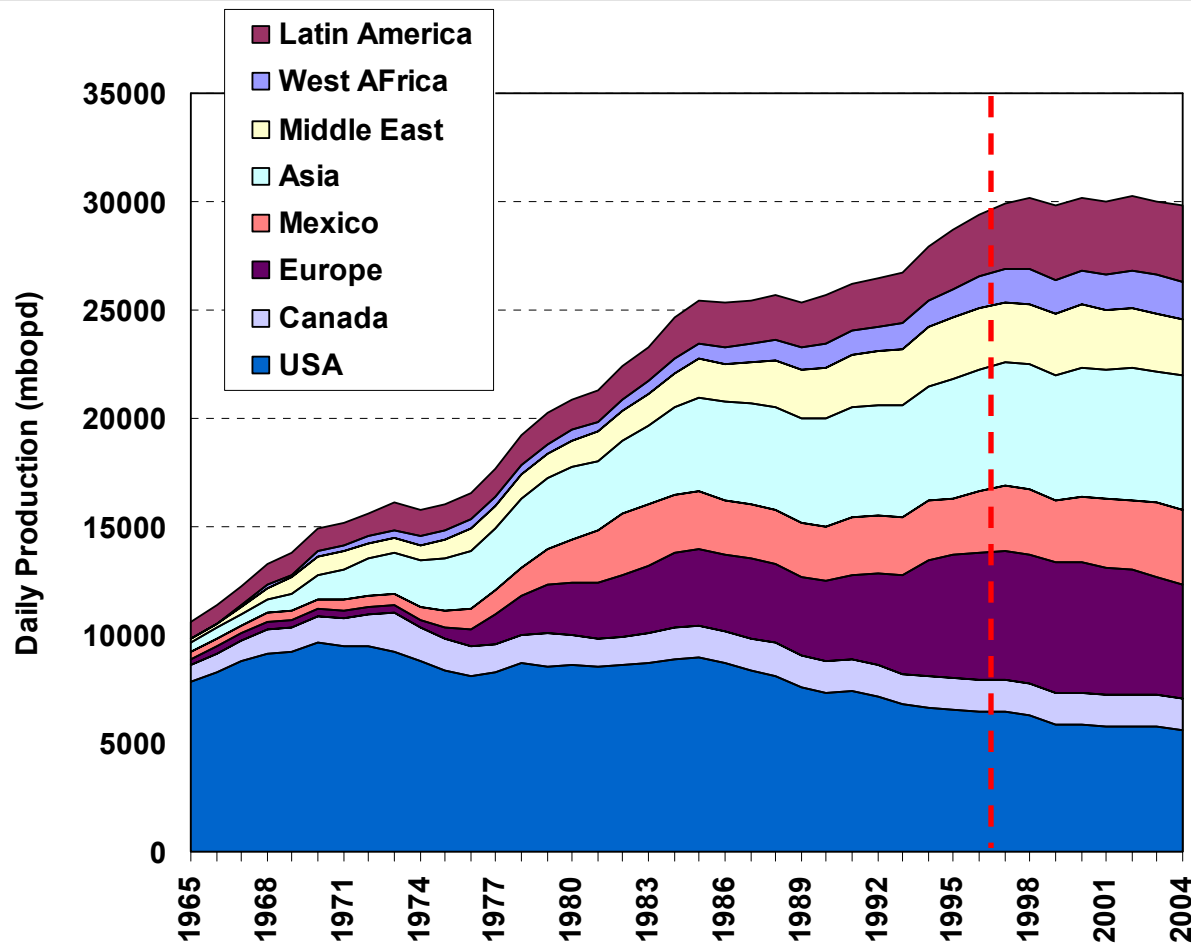


Non-OPEC, Non-FSU Countries with Production Growth Profiles



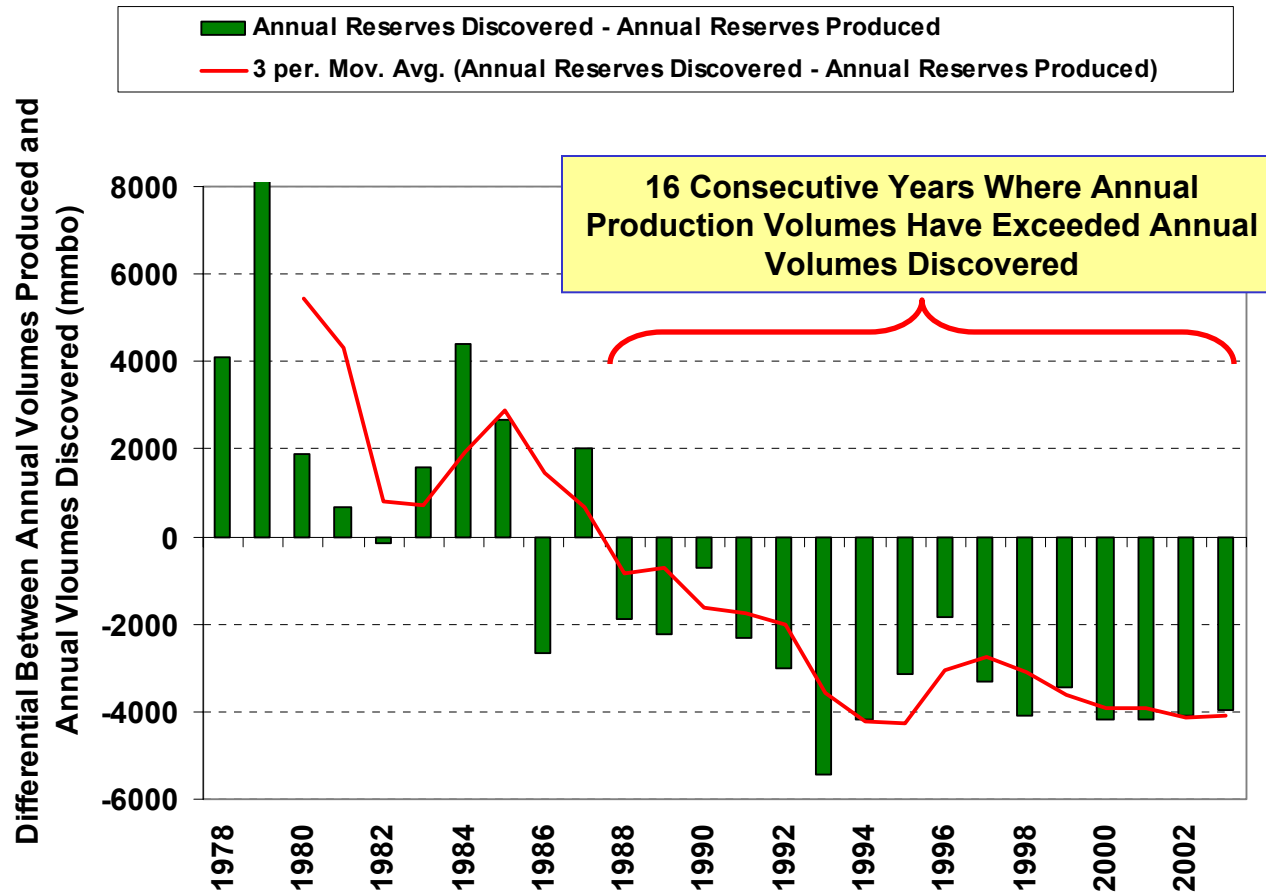
The above bars shows the depletion level of several producers which have new discoveries and are considered very likely to increase production – Azerbaijan, Kazakhstan and Russia are also expected to have growth profiles

Historical Crude Production (Excluding OPEC, FSU, Natural Gas Liquids and Canadian Oil Sands)



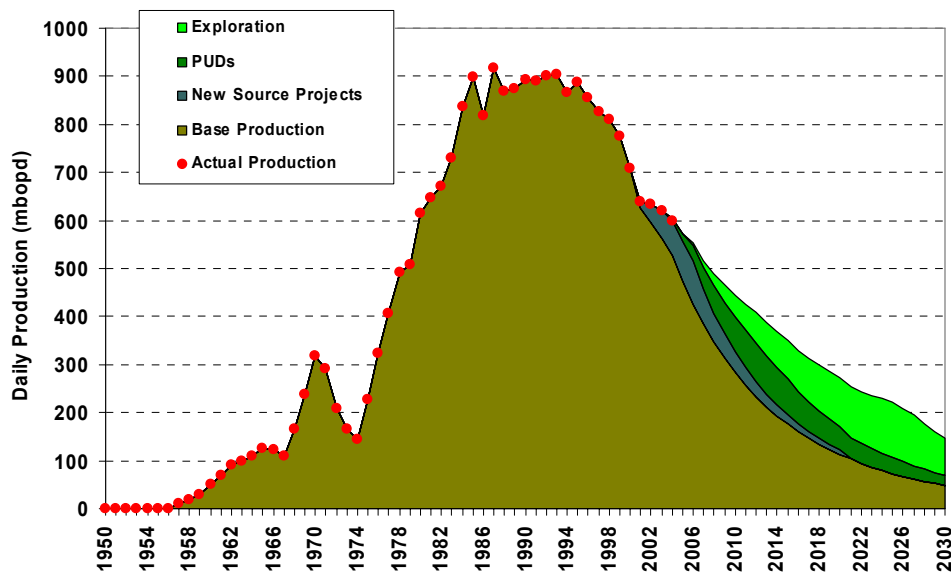
Several key producing regions have reached or exceeded the critical depletion point of 50-60% which typically marks the onset of production decline. It is worth noting that production gains from large new projects have not increased the aggregate production capacity of these regions for about 8 years.

Annual Crude Production Balance (Excluding OPEC, FSU, Natural Gas Liquids and Canada)



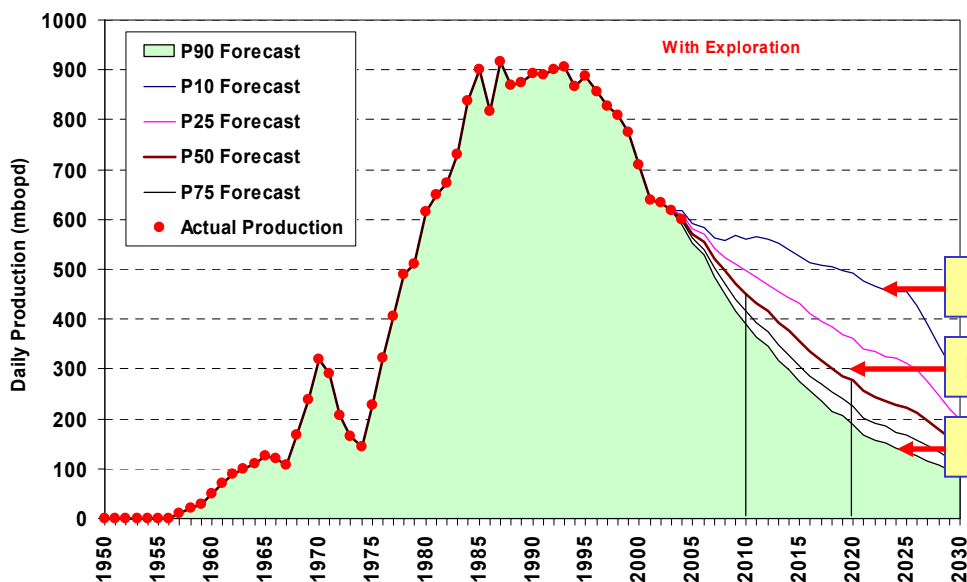
PFC Energy's data analysis indicates countries within this block of production have in aggregate been producing up to 4 billion more barrels each year than they have been finding through exploration since the mid 1980s.

Egypt – Modeling Different Reserve Categories



Reserves for each country are separated and modeled independently. Each category is modeled probabilistically, using country typical, peak rates, decline rates, announced project schedules, historical drilling levels, recent field size distributions, and commercial thresholds.

Egypt is a good example where if we assume another 10 years of exploration results similar to the last 10 years, the incremental volumes are small relative to historical rates.



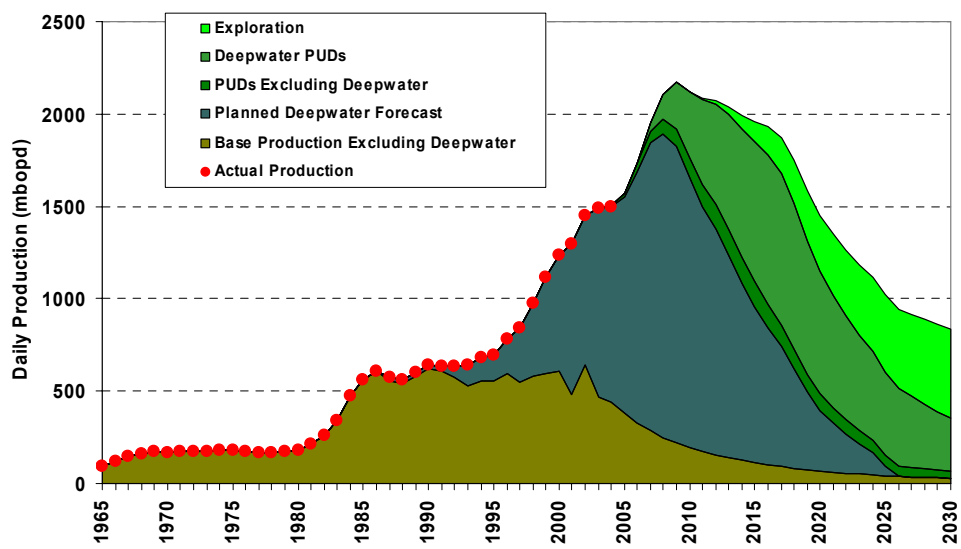
Modeled production uncertainty for each reserve category is combined to create production probability ranges for each country.

Low probability that production will exceed this level

Most likely production path

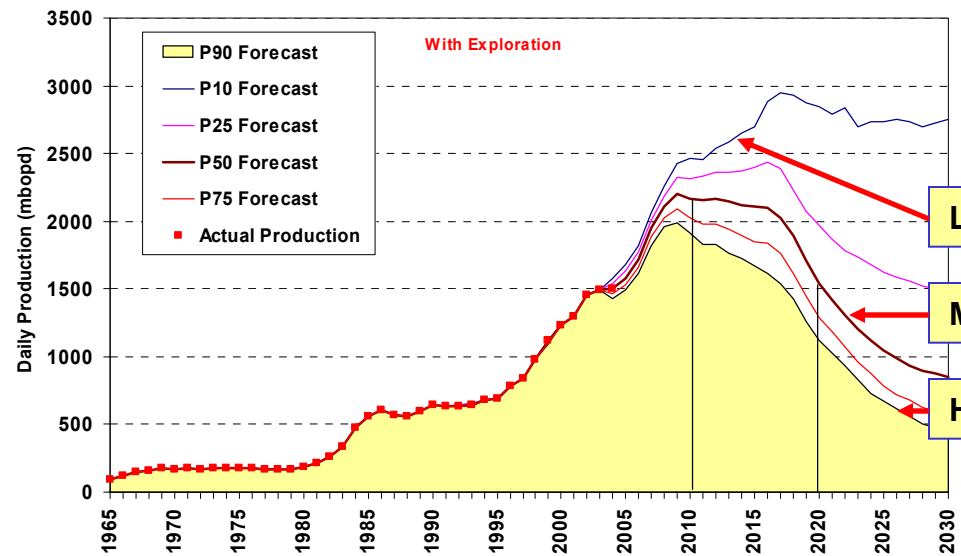
High probability that production will exceed this level

Brazil – Modeling Different Reserve Categories



Reserves for each country are separated and modeled independently. Each category is modeled probabilistically, using country typical, peak rates, decline rates, announced project schedules, historical drilling levels, recent field size distributions, and commercial thresholds.

Brazil is a good example where if we assume another 10 years of exploration results similar to the last 10 years, the incremental volumes could be very significant relative to historical rates.



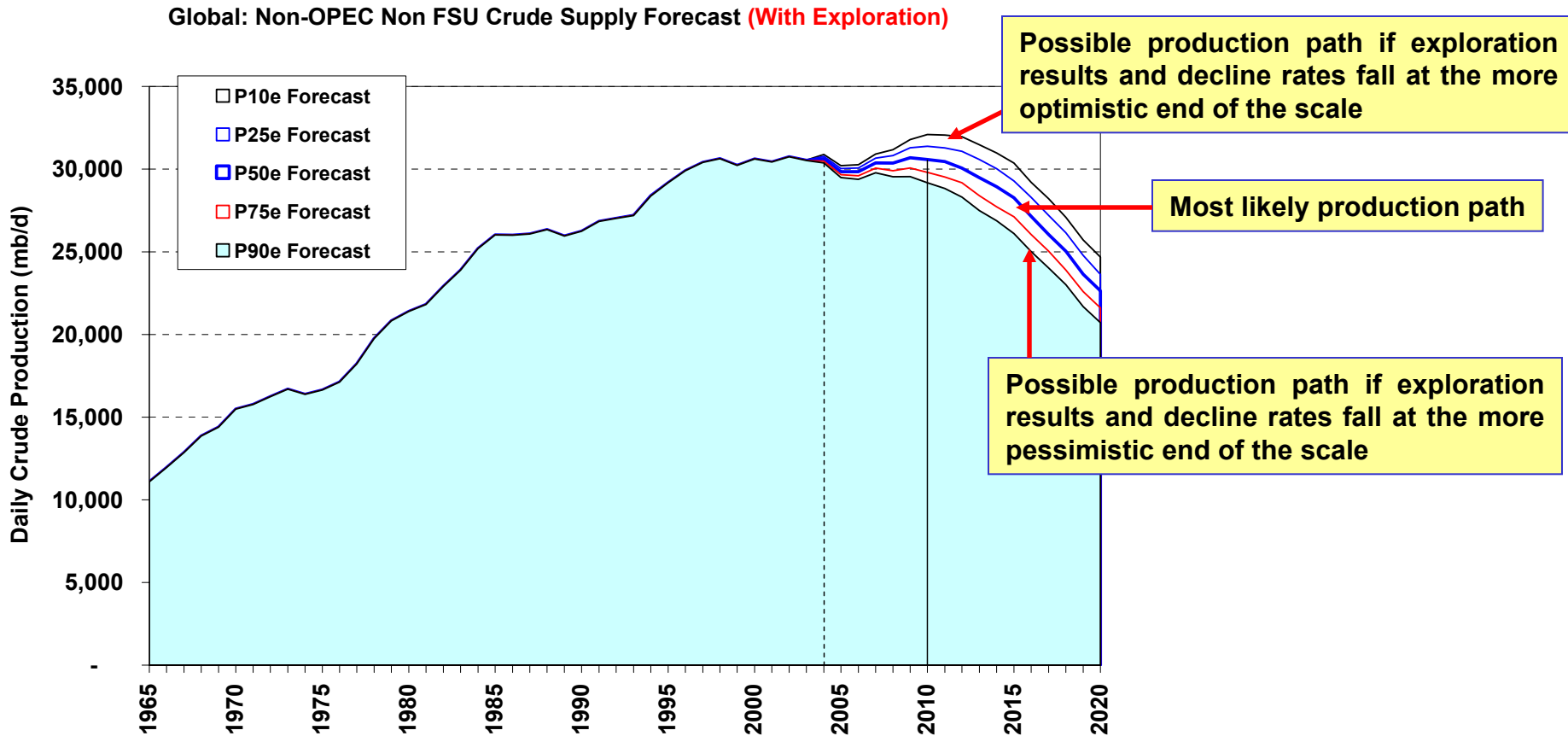
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Low probability that production will exceed this level

Most likely production path

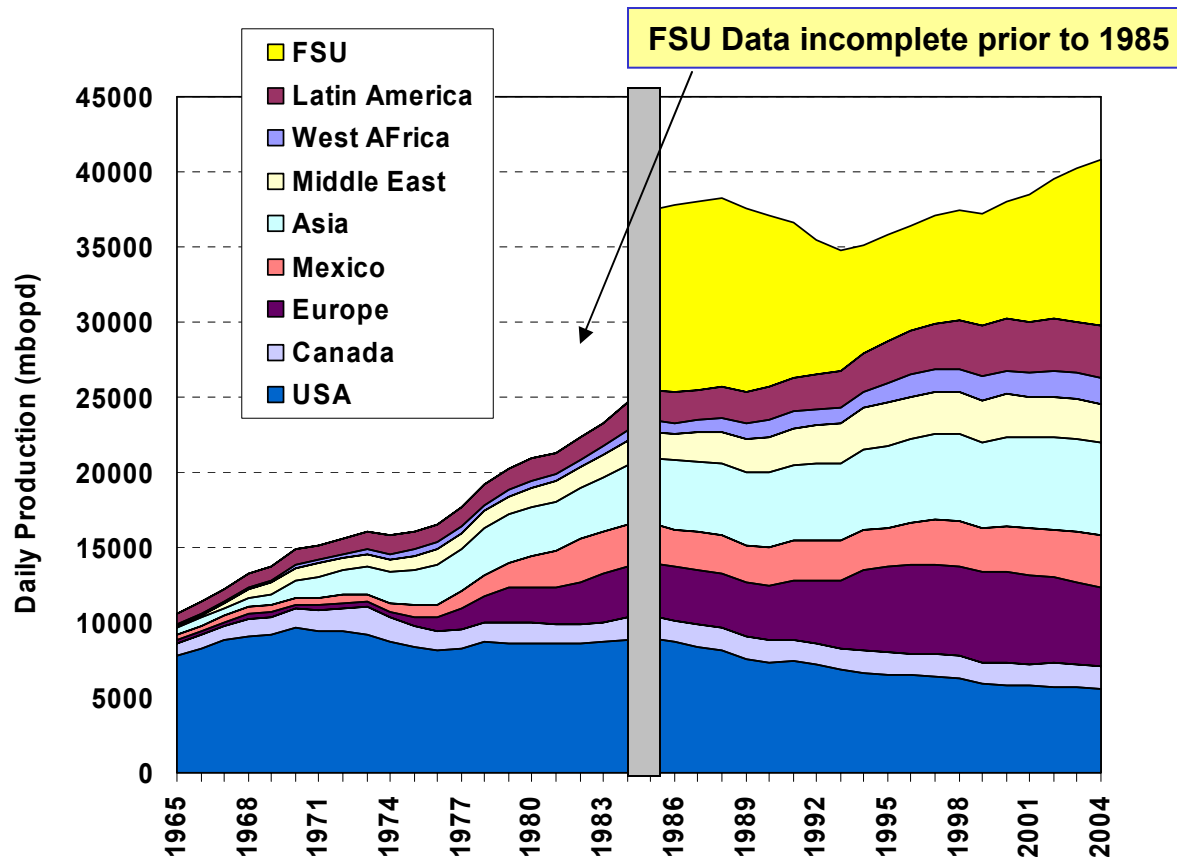
High probability that production will exceed this level

Crude Oil Production Forecast with an Exploration Component (Excluding OPEC, Natural Gas Liquids, FSU, and Canadian Oil Sands)



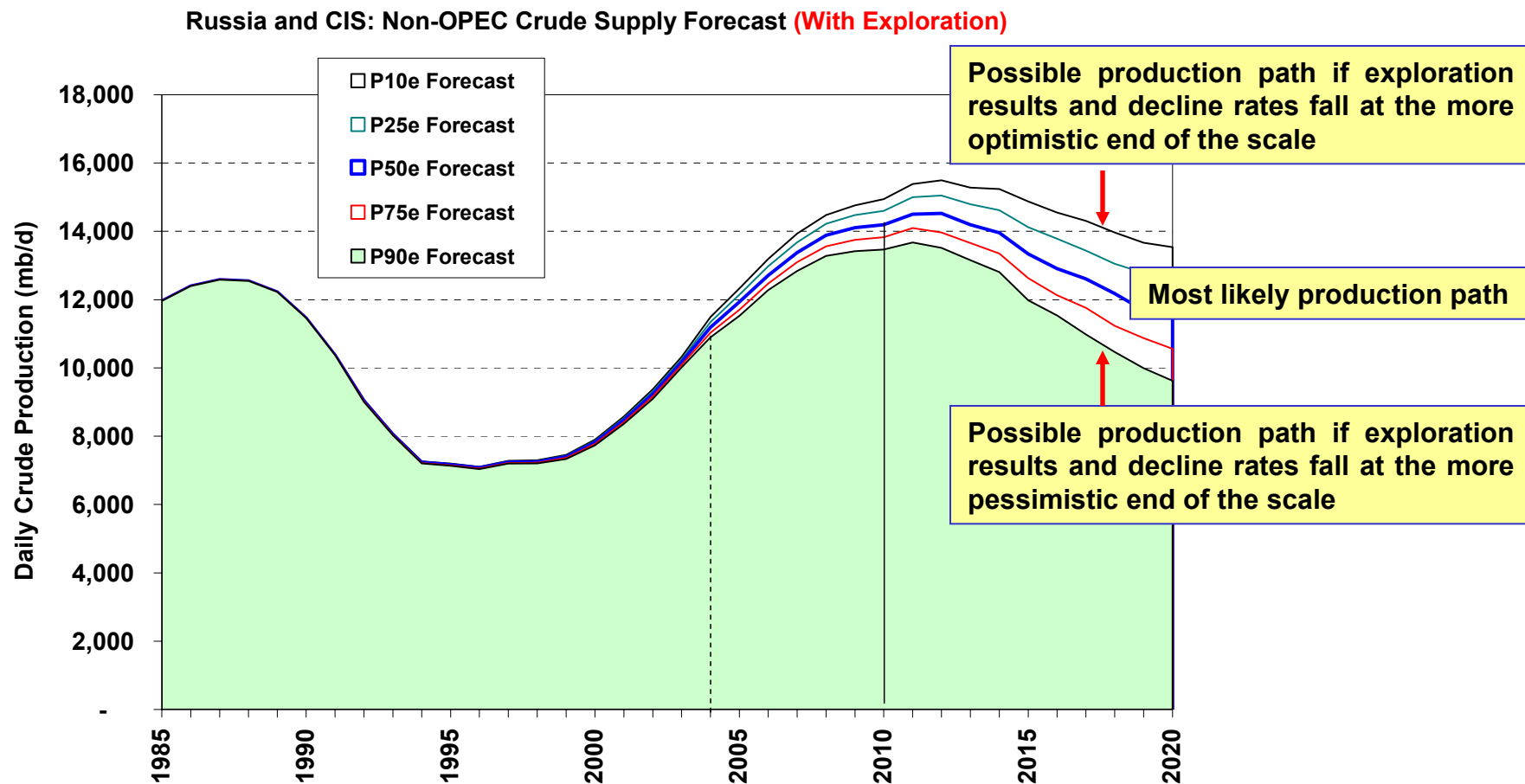
PFC Energy's models suggest that the flat trend noted since the late 1990s is very likely to continue through the end of this decade with production declines beginning in the early part of the next decade – *going forward it is possible that for a few years production could increase before declines start in the next decade or it is possible that production could start a gentle decline sooner*

Historical Crude Production (Excluding OPEC, Natural Gas Liquids and Canadian Oil Sands)



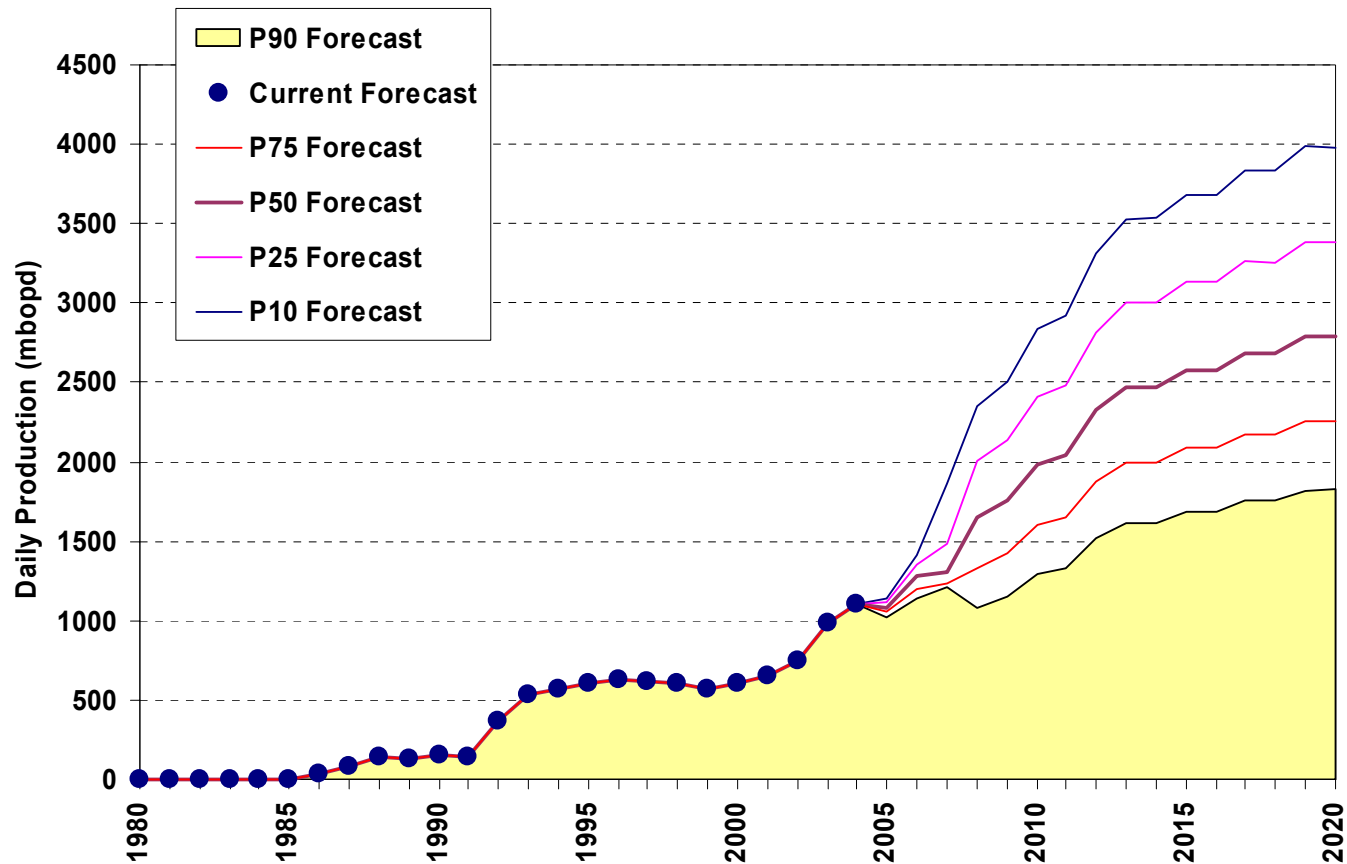
Post 1998 Non-OPEC conventional crude oil production growth was largely driven by growth in the FSU and specifically Russia.

FSU Crude Oil Production Forecast with Exploration



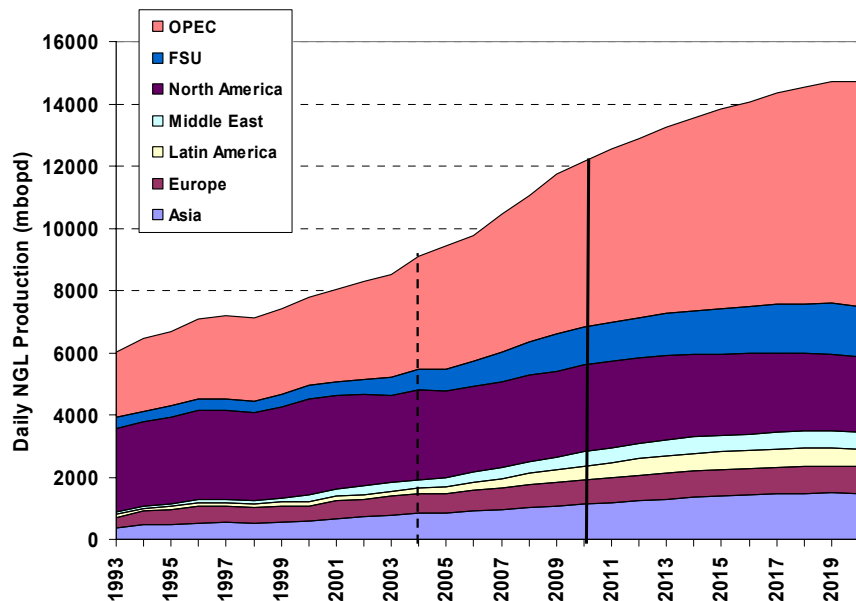
PFC Energy's models suggest that FSU production could grow through the end of this decade (peaking at about 14 million barrels per day), however the increasing level of reserve base depletion will inevitably result in production declines in the next decade.

Production Forecast from Canadian Oil Sands

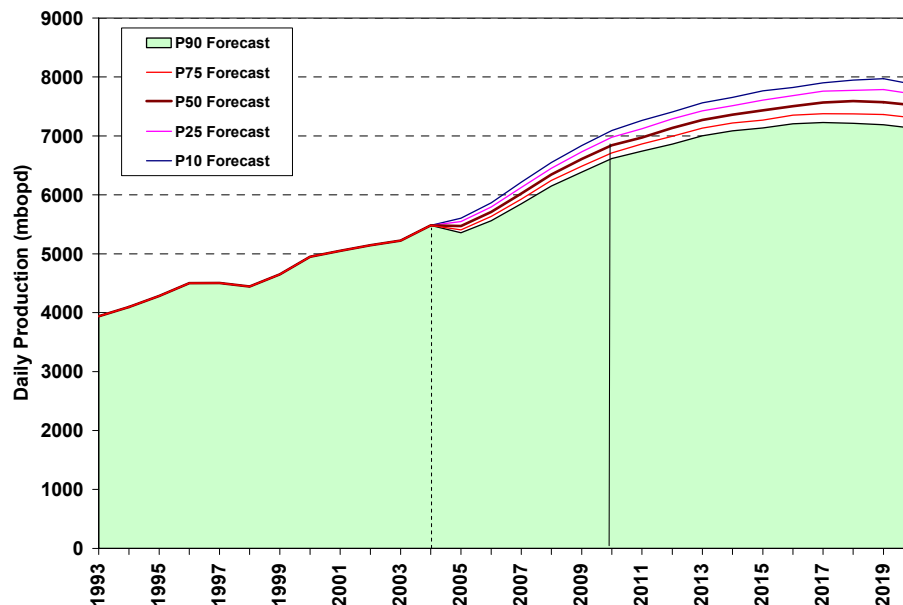


A review of various project proposals suggests that in an optimistic case Canadian Oil Sand production could quadruple by 2020 although the Canadian Government has stated the most likely case is a doubling of production by 2012 and continued growth beyond

NGL Production Forecast

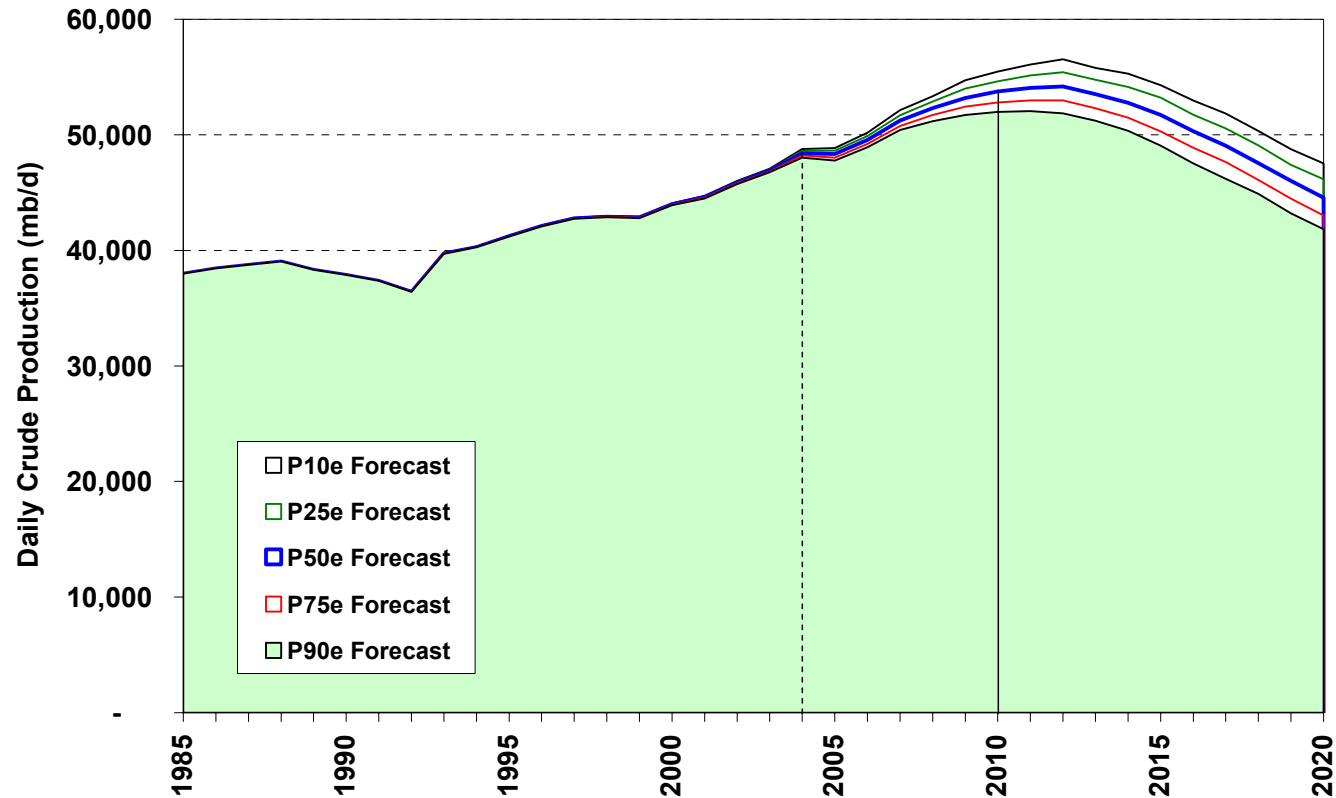


NGL Production will grow as large scale global gas projects are built to supply growing demands for natural gas. Much of the NGL growth is located within OPEC group countries like Qatar, UAE, Nigeria and others.



Global Non-OPEC Total Liquids with Exploration

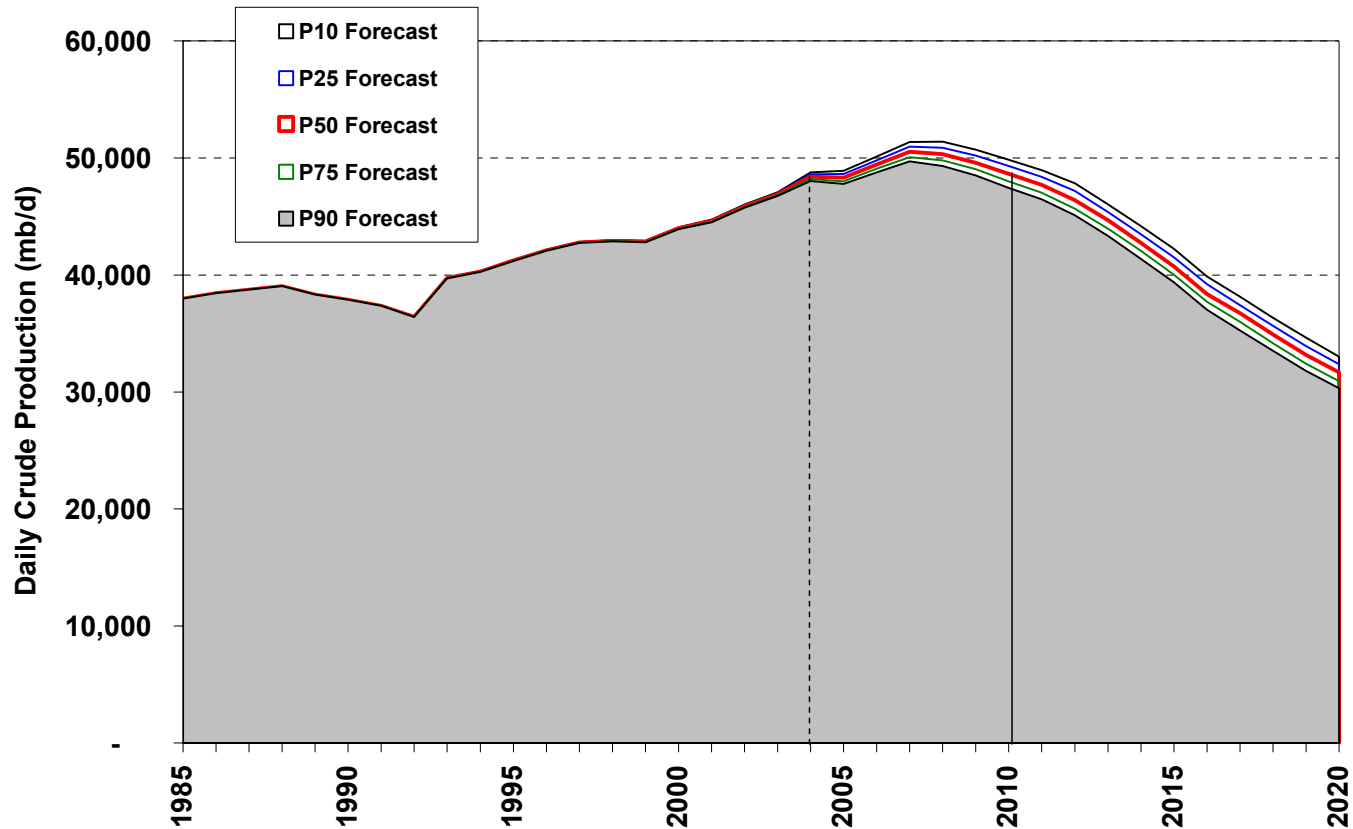
Global: Non-OPEC All Liquids Supply Forecast (With Exploration)



A combined forecast of Non-OPEC crude as well as Non-OPEC natural gas liquids and Canadian Oil Sand production suggests that production will grow to between 52 and 55 million barrels per day with declines beginning in the early to middle part of the next decade.

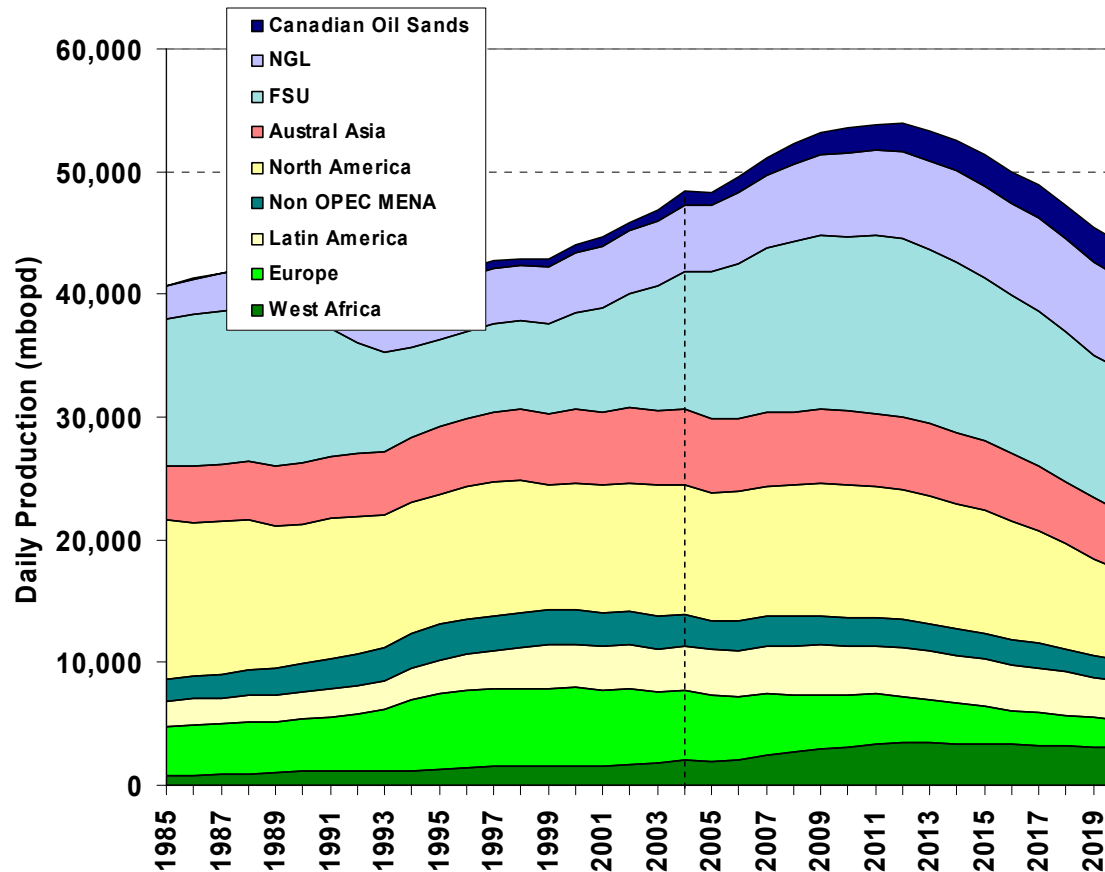
Global Non-OPEC Total Liquids without Exploration

Global: Non-OPEC All Liquids Supply Forecast (Without Exploration)



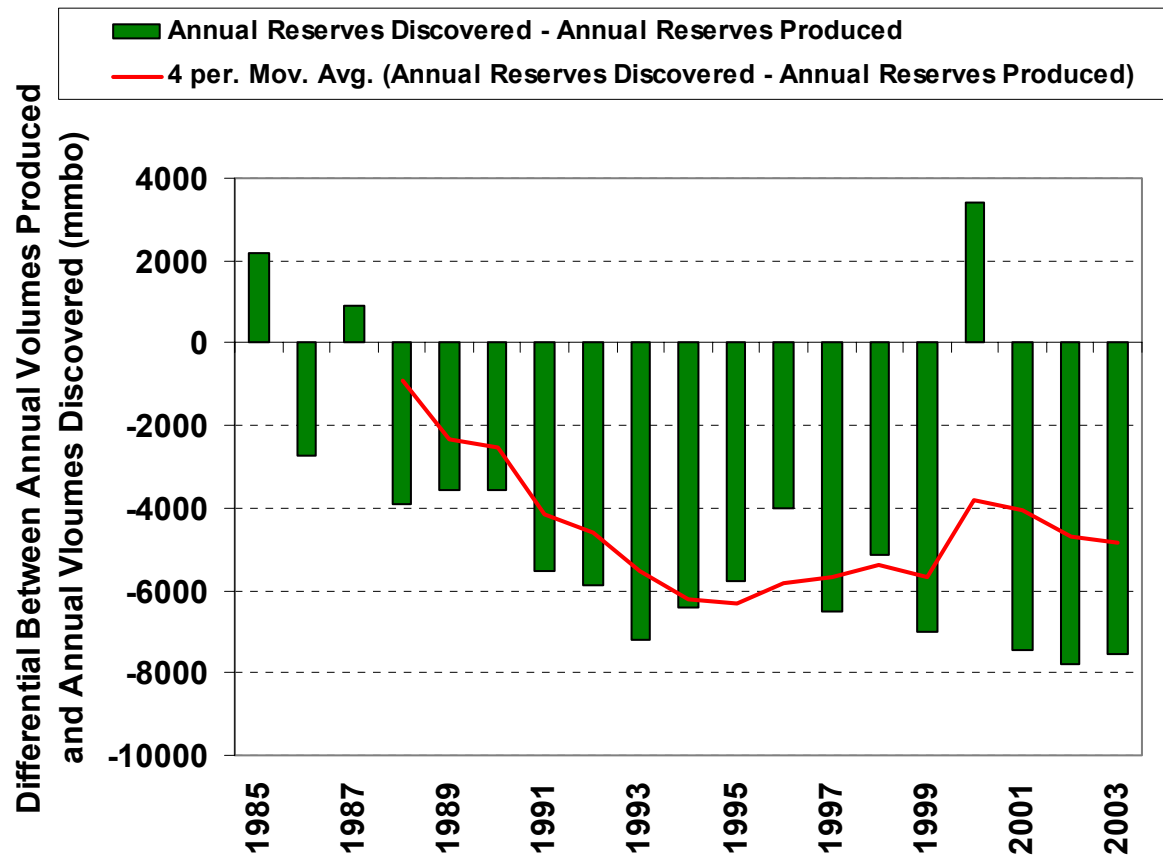
There are forecasts out there or coming out which argue that the peak is already here or very close – *most forecasts do not build in an exploration component which has been attempted in PFC Energy's methodology*

Global Non-OPEC Total Liquids with Exploration



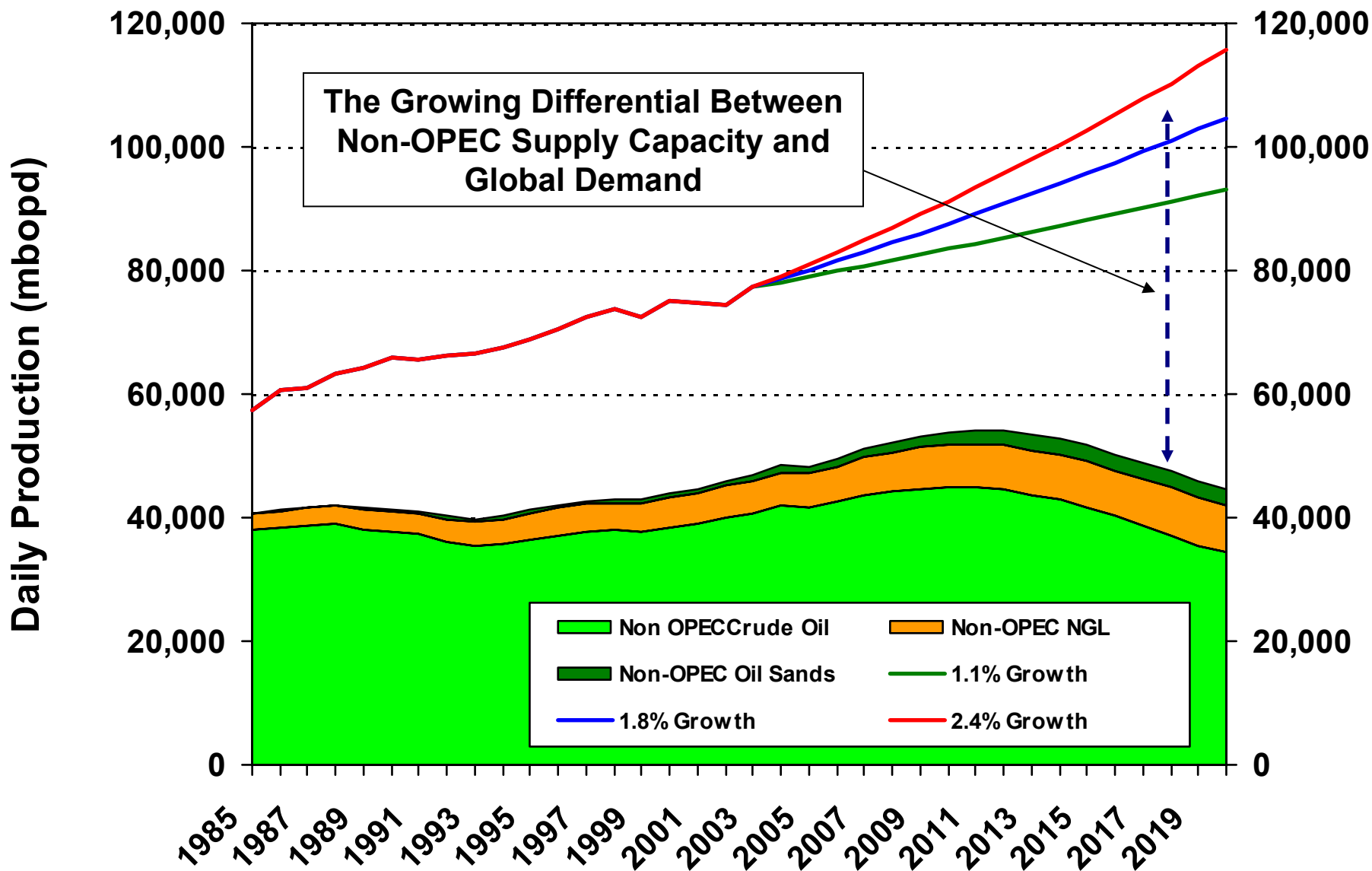
A combined forecast of Non-OPEC crude as well as Non-OPEC natural gas liquids and Canadian Oil Sand production suggests that production will grow to between 52 and 55 million barrels per day with declines beginning in the early to middle part of the next decade.

Annual Crude Oil Production Balance (Excluding OPEC, NGL and Canadian Oil Sands)



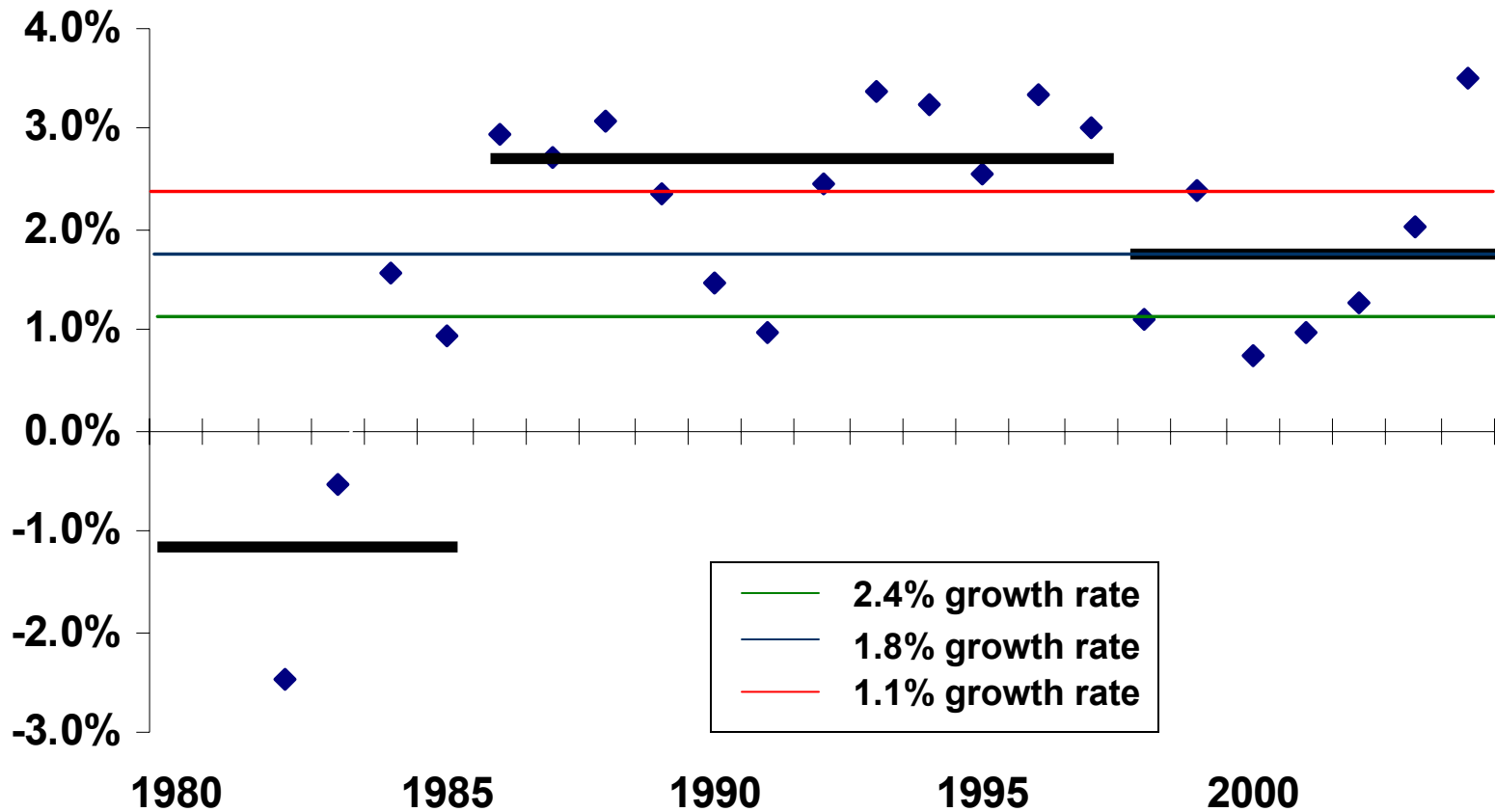
PFC Energy's data analysis indicates that Global Non-OPEC crude production is currently exceeding volumes discovered by as much as 8 billion barrels per year – *this continuing depletion of the reserve base will ultimately lead to the inability to continue growing production*

The Problem - The Expected Growing Gap Between Global Demand and Global Non-OPEC Supply

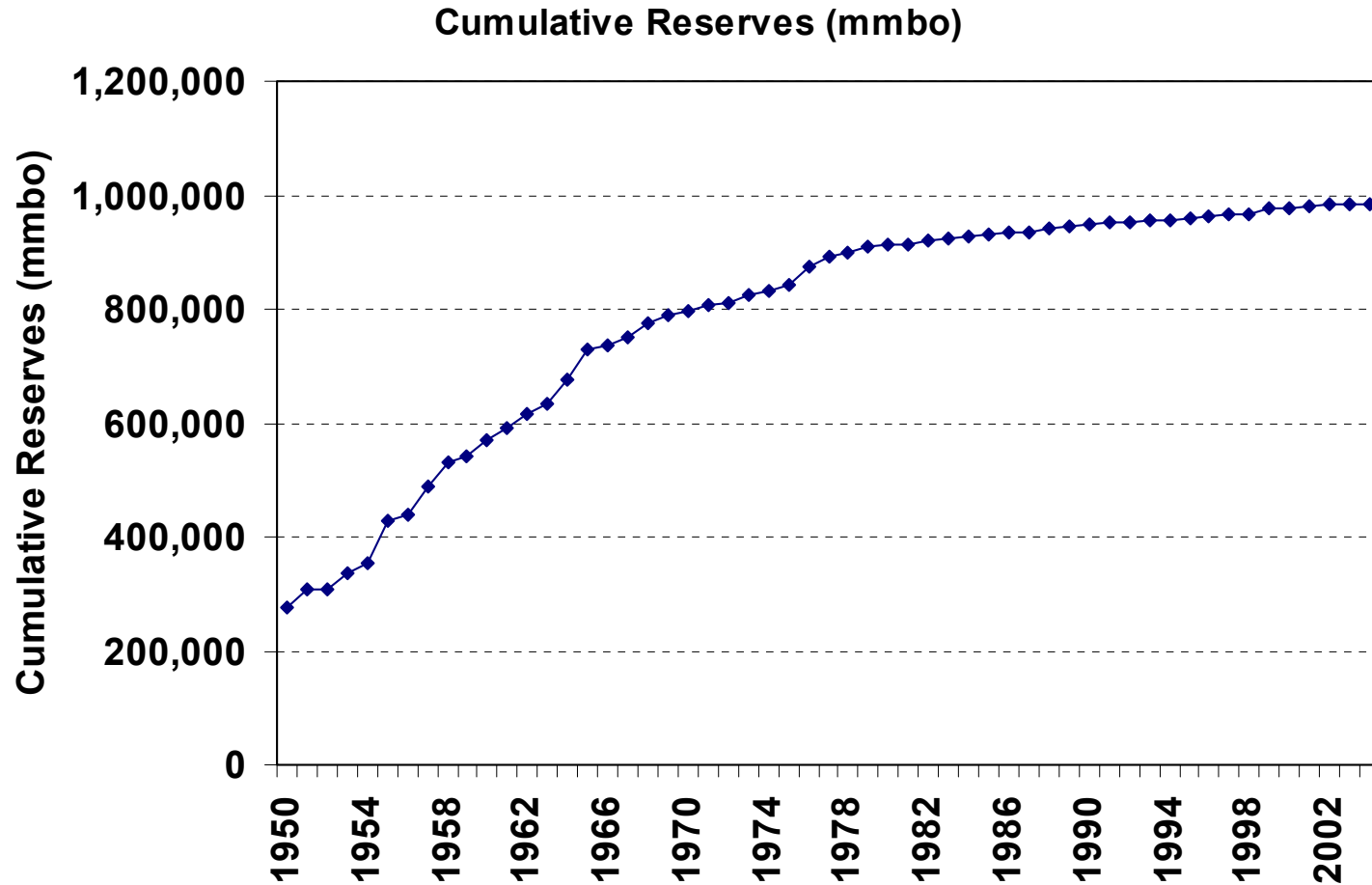


Global Demand Trends

PFC demand scenarios in historical context: demand (excluding the FSU) grew by 1.7% between 1980 and 2004

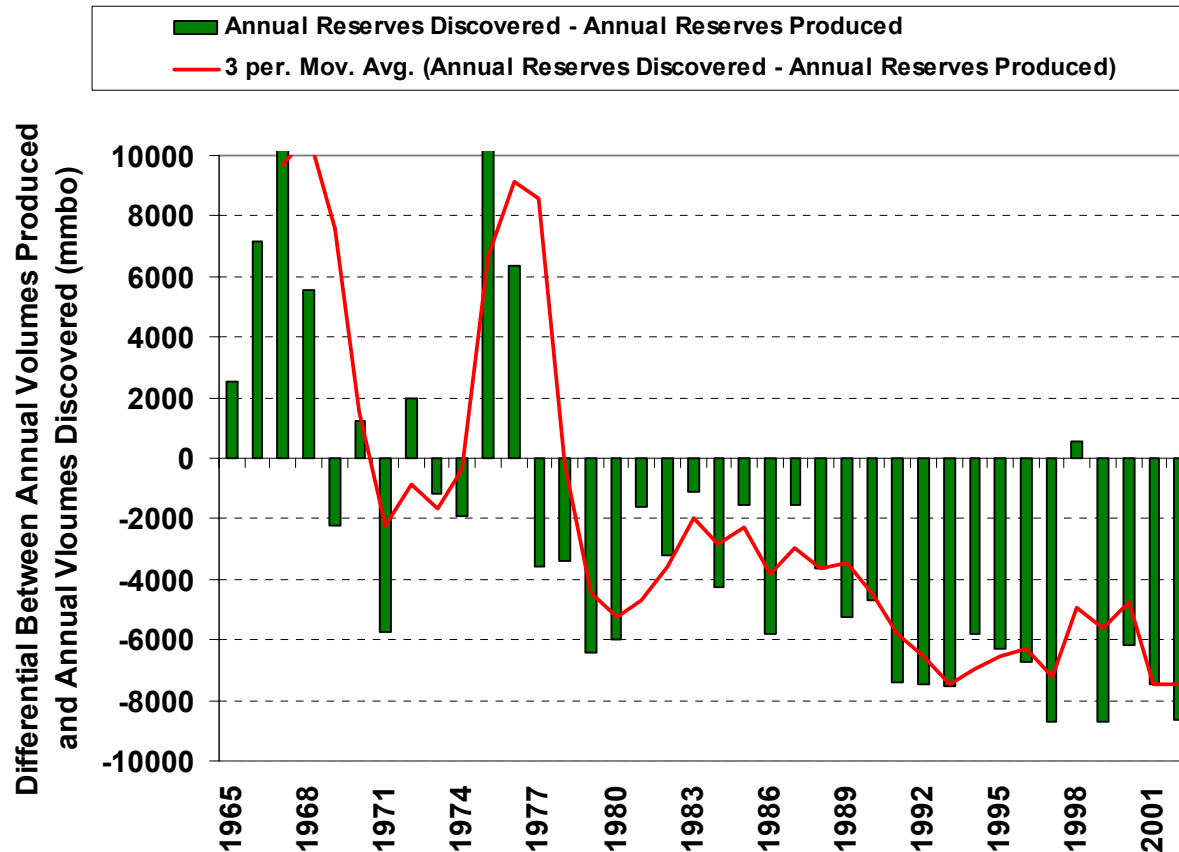


OPEC Creaming Curve



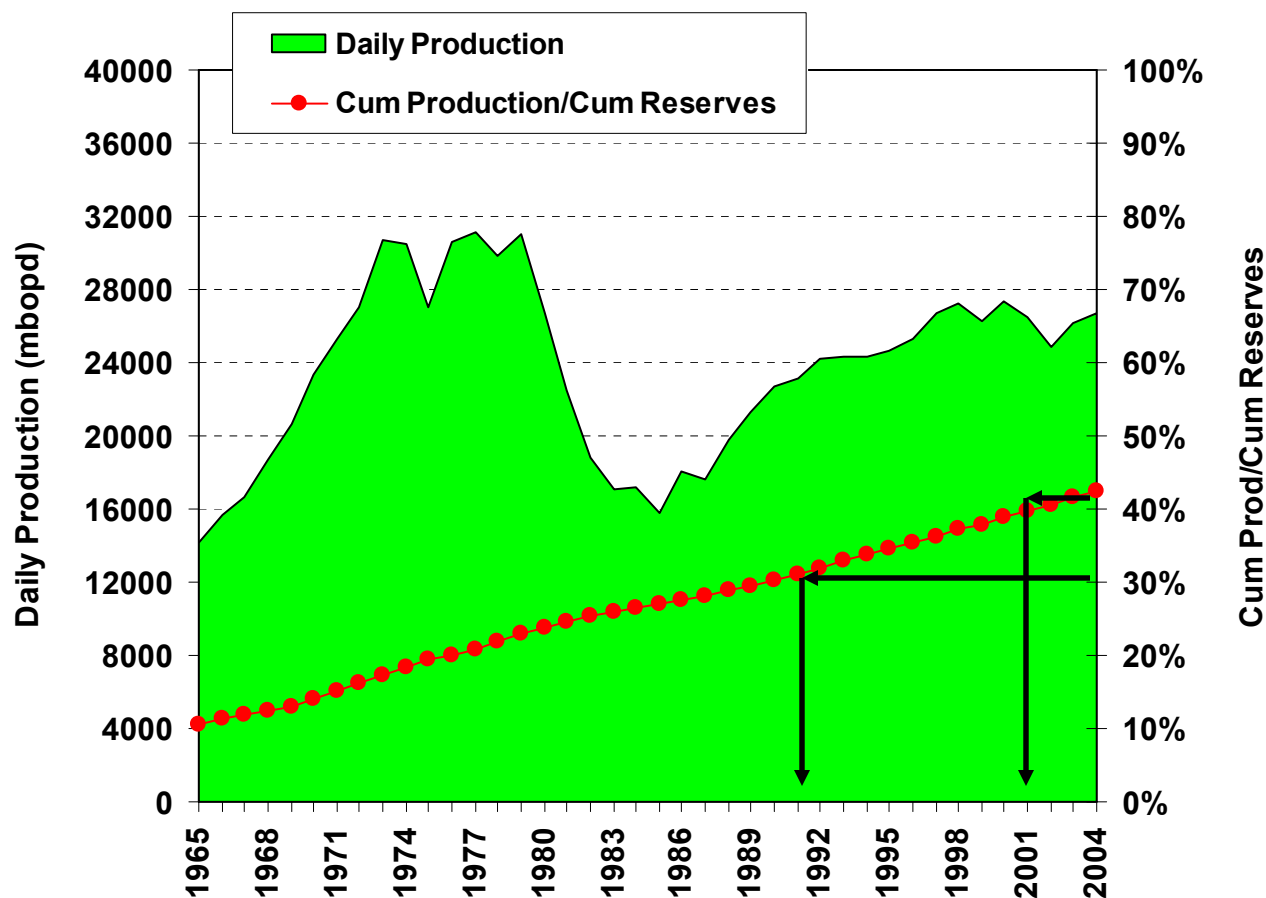
OPEC's creaming curve is no different from creaming curves for other basins, countries, or regions – *hundreds of new fields were discovered during the period 1975 to Present but like other areas they are considerably smaller than fields discovered in years prior*

OPEC Historical Annual Crude Production Balance (OPEC)



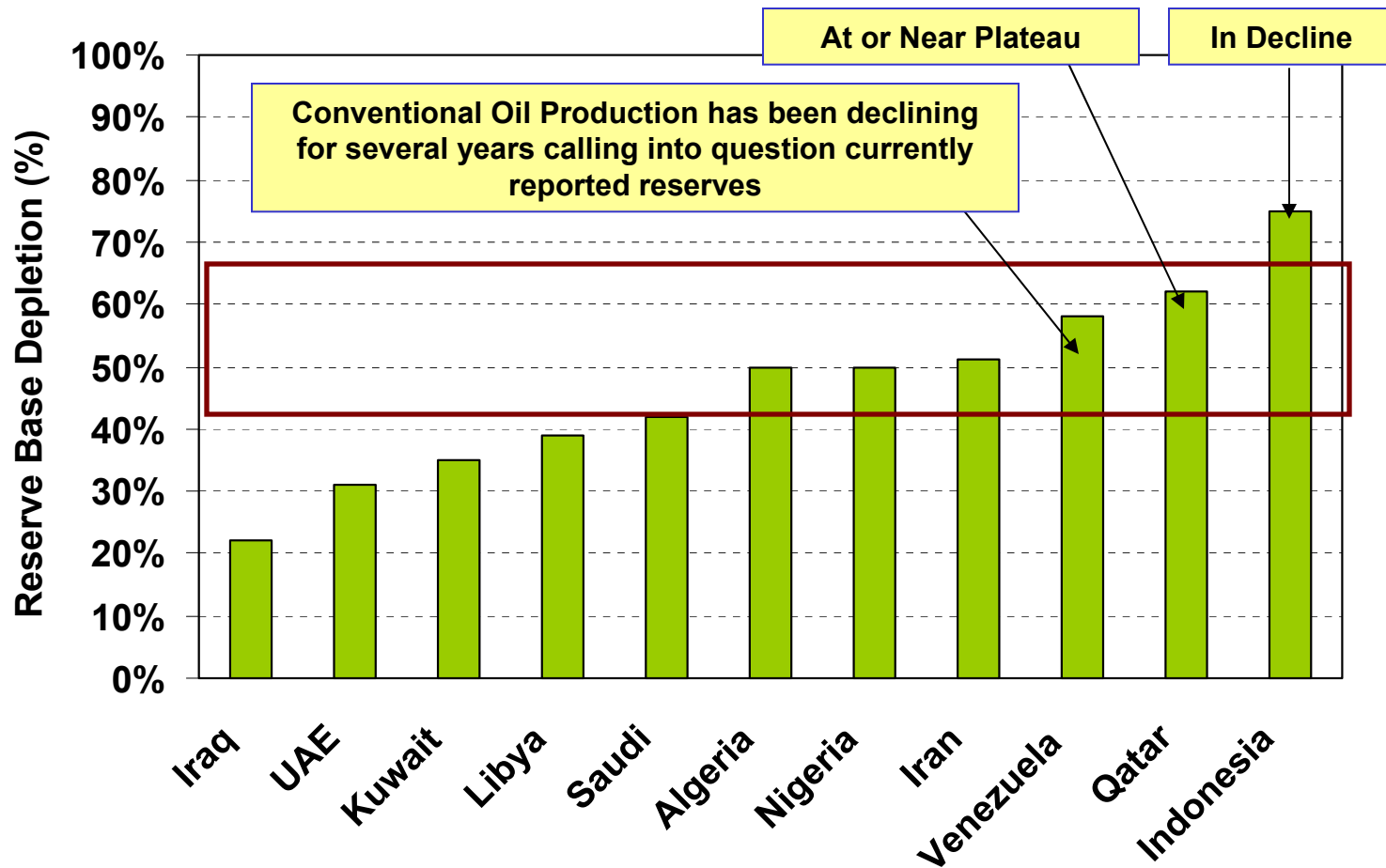
Like all other areas of the world, PFC Energy's data analysis indicates that Global OPEC crude production is currently exceeding volumes discovered. OPEC specifically is producing about 8 billion barrels per year more than it has been finding.

Historical Production and Depletion Levels (OPEC)



OPEC as a group is depleting at a rate of about 1% per year, even taking into account new discoveries – *during the 1990s reserves likely depleted by another 10 percentage points*

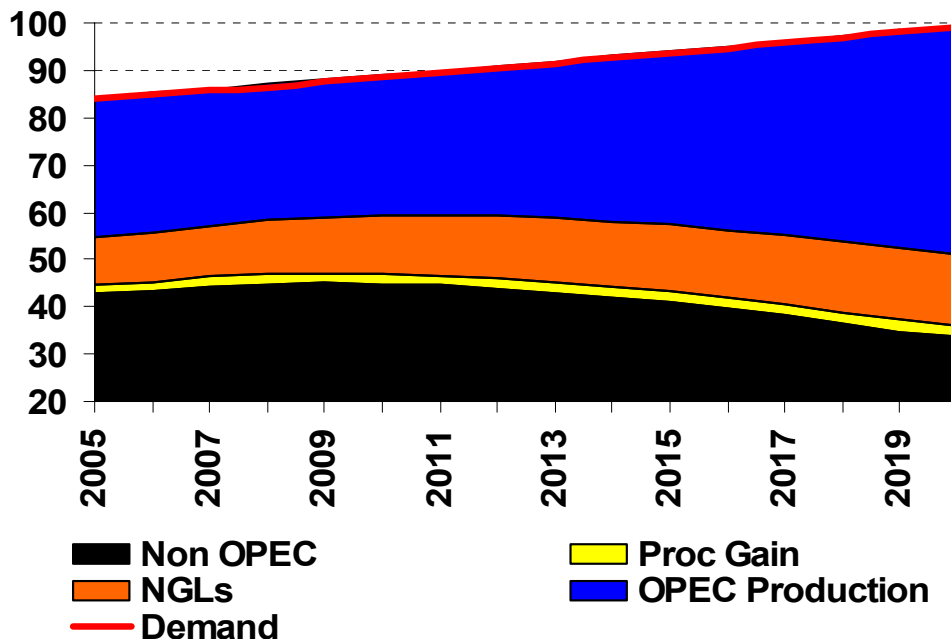
Historical Production and Depletion Levels (OPEC)



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

When Is The Tipping Point in a Low (1.1%) Demand Growth Scenario?

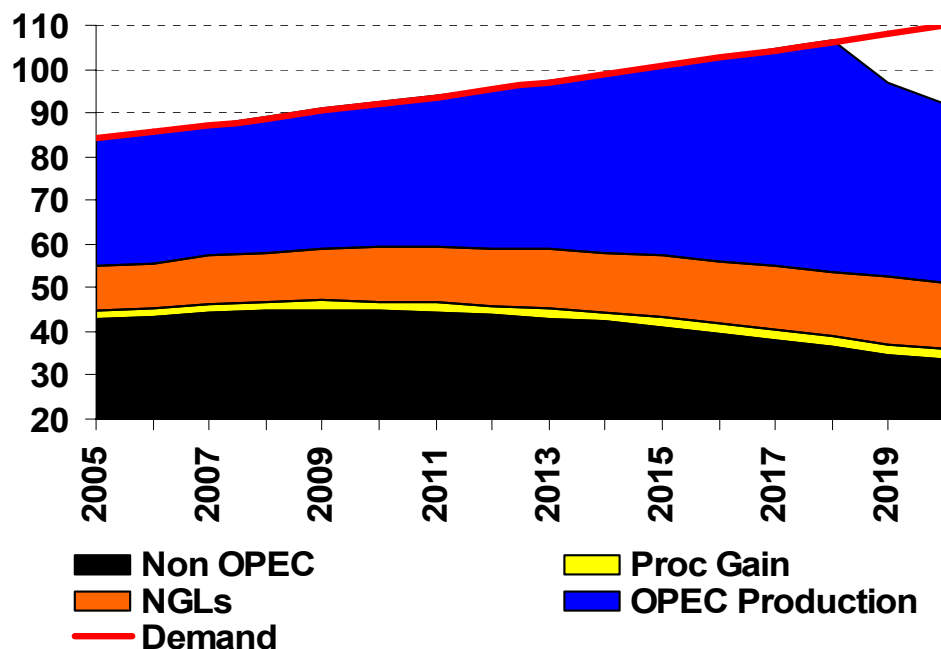
In a low demand growth scenario, as in all demand growth scenarios, OPEC will see a growing market share as non OPEC liquids production falls in the latter part of the next decade. Based on estimates of remaining OPEC reserves and persistent negative annual petroleum balances, there will come a time when OPEC production will not be able to fill the growing gap between demand and non-OPEC production capacity. ***In a low demand growth scenario, OPEC production will likely meet global demand in the through the end of the next decade but not beyond 2025.***



Global Supply and Demand; million b/d

When Is The Tipping Point in a Base Case (1.8%) Demand Growth Scenario?

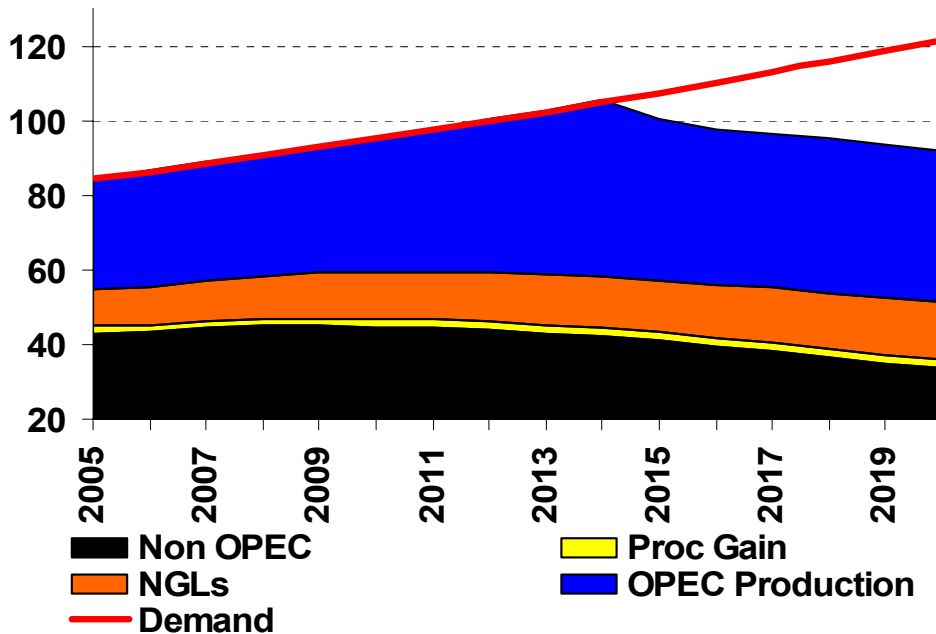
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Global Supply and Demand; million b/d

When Is The Tipping Point in a High (2.4%) Demand Growth Scenario?

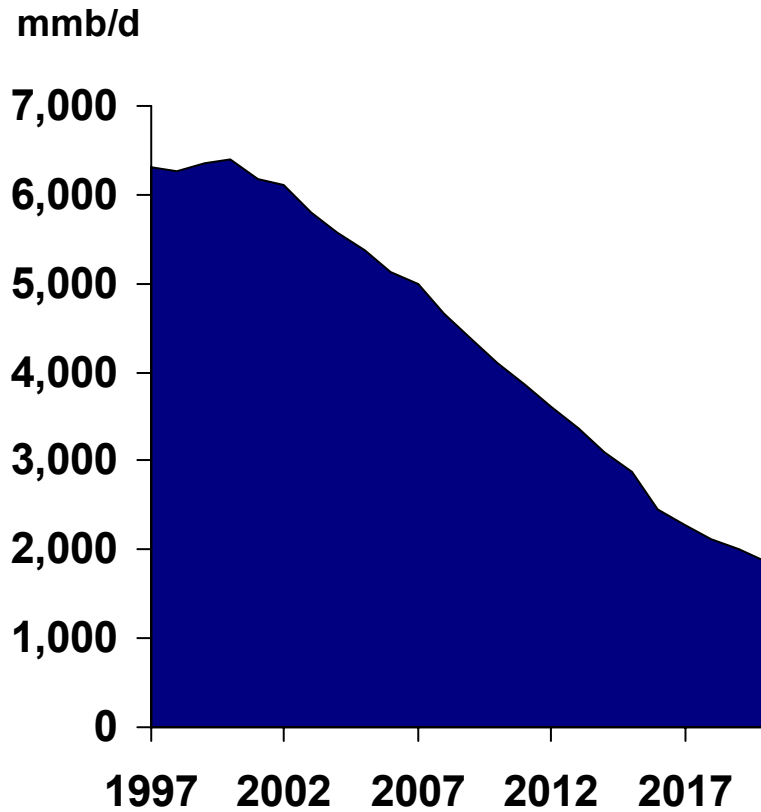
In a high demand growth scenario, as in all demand growth scenarios, OPEC will see a growing market share as non OPEC liquids production falls in the latter part of the next decade. Based on estimates of remaining OPEC reserves and persistent negative annual petroleum balances, there will come a time when OPEC production will not be able to fill the growing gap between demand and non-OPEC production capacity. ***In a high demand growth scenario, OPEC production will likely not be able to meet global demand as early as the middle part of the next decade.***



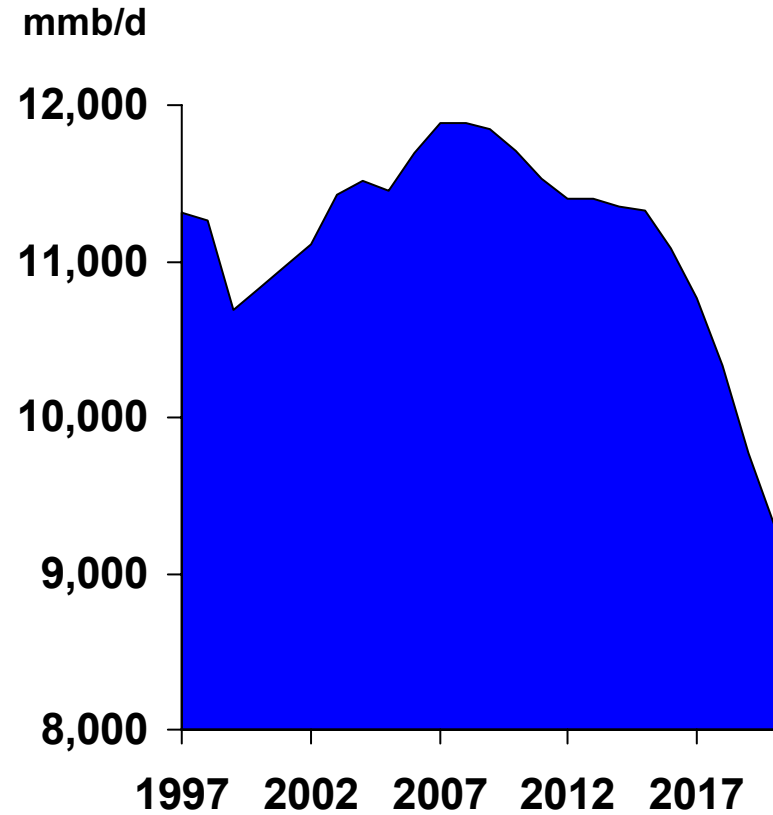
Global Supply and Demand; million b/d

Production Declining In The OECD Countries

Europe

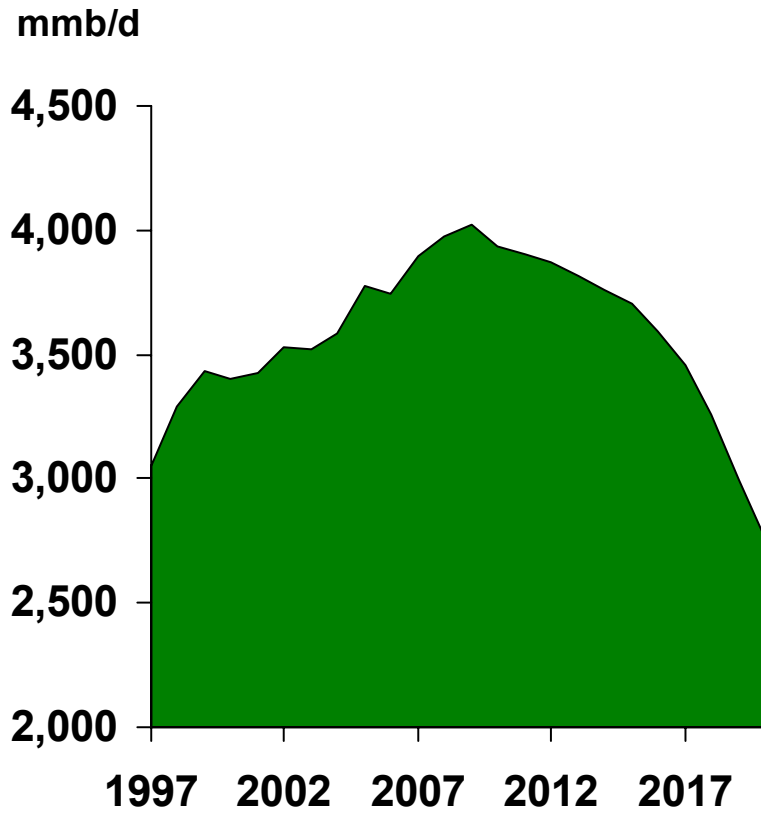


North America

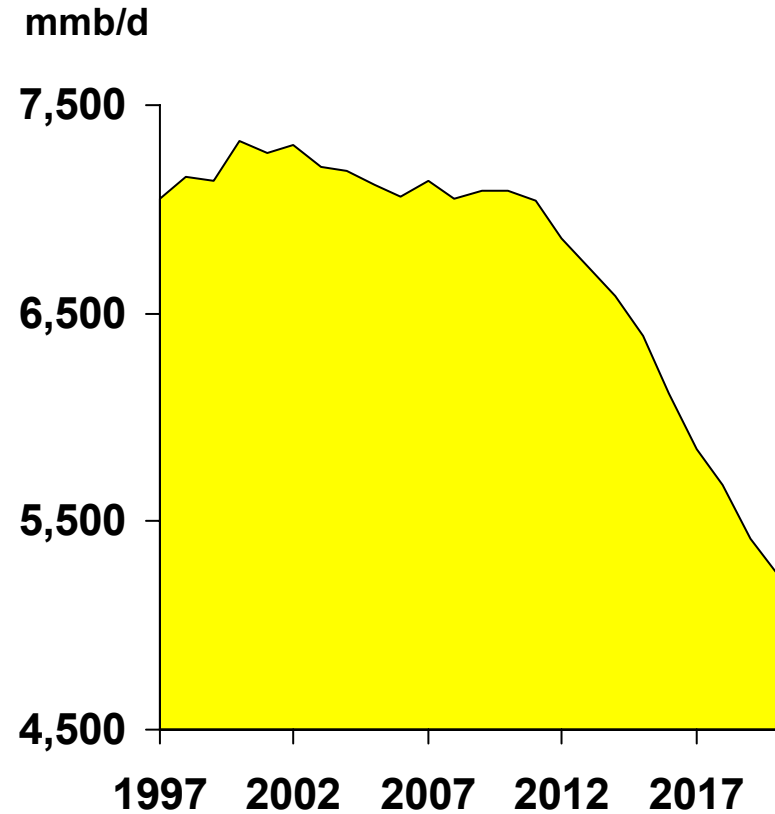


Latin America And Asia Not Keeping Up

Latin America

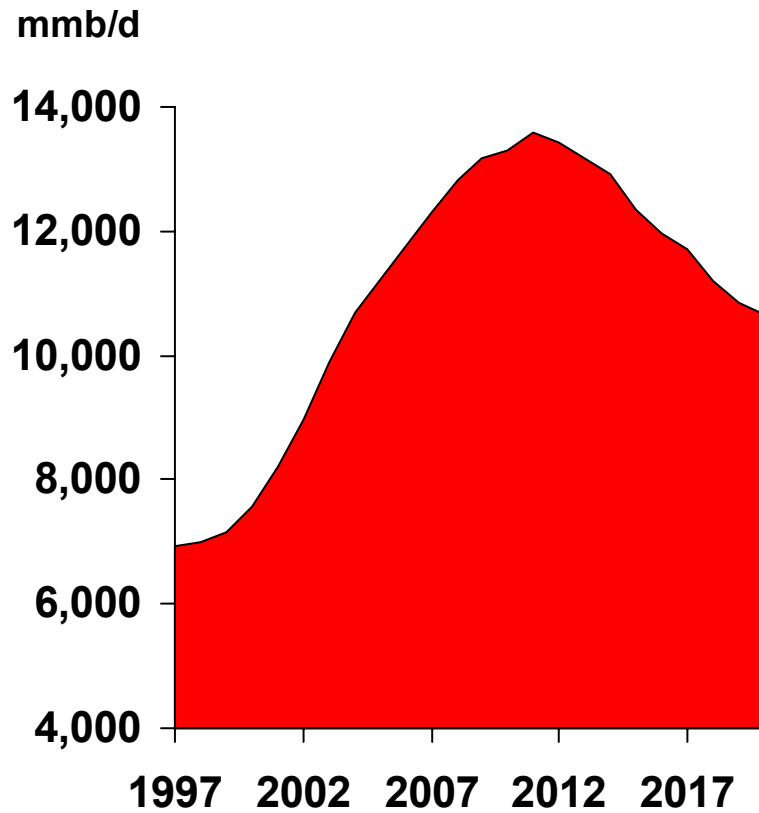


Asia

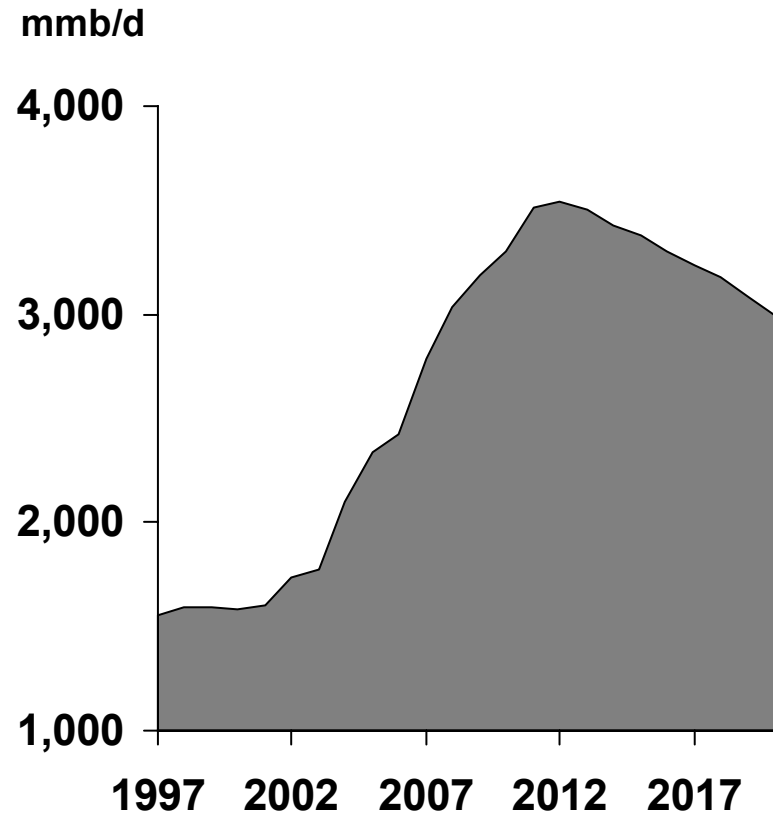


Increasing Dependency From Less Stable Areas

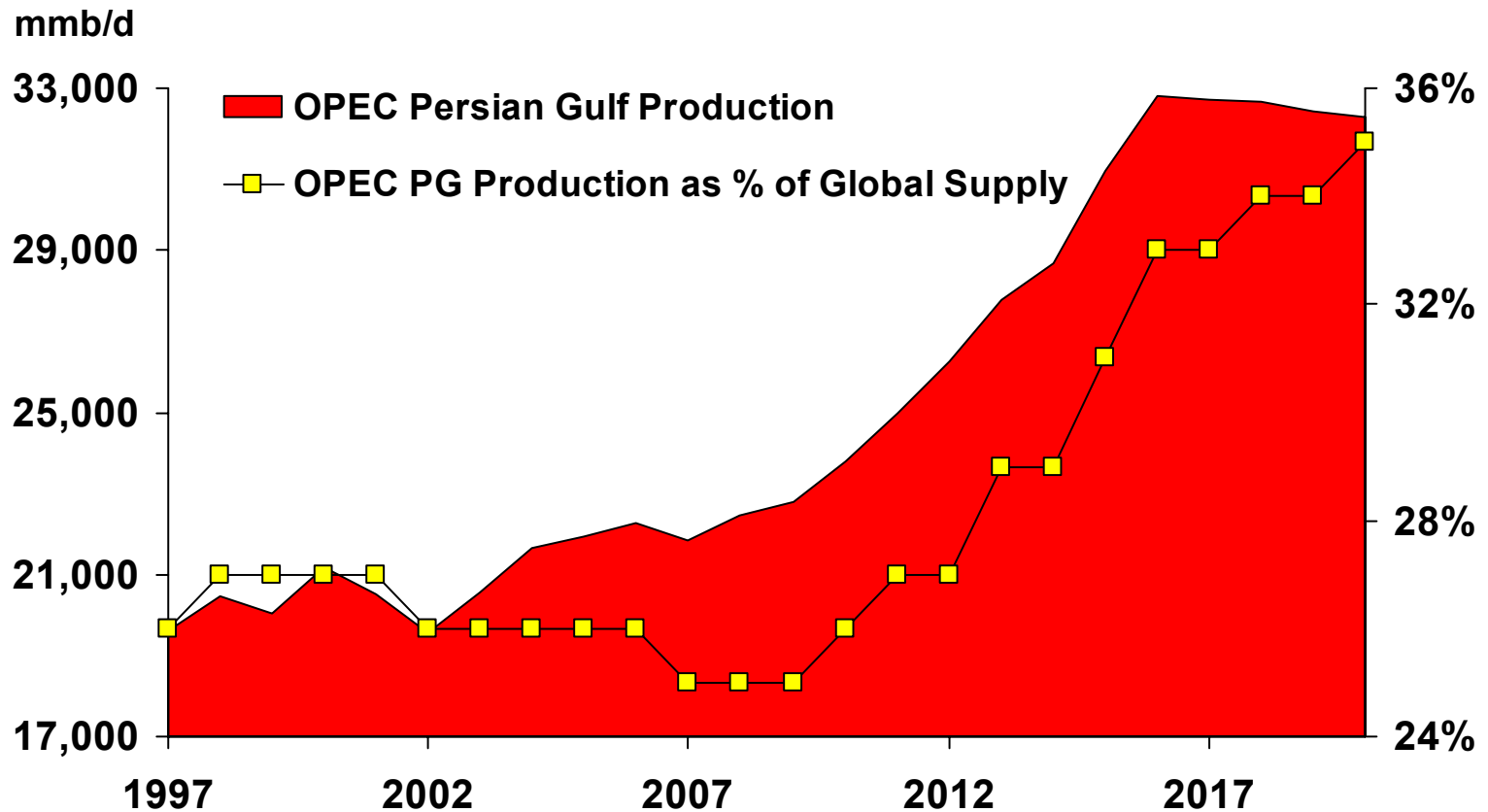
FSU



West Africa



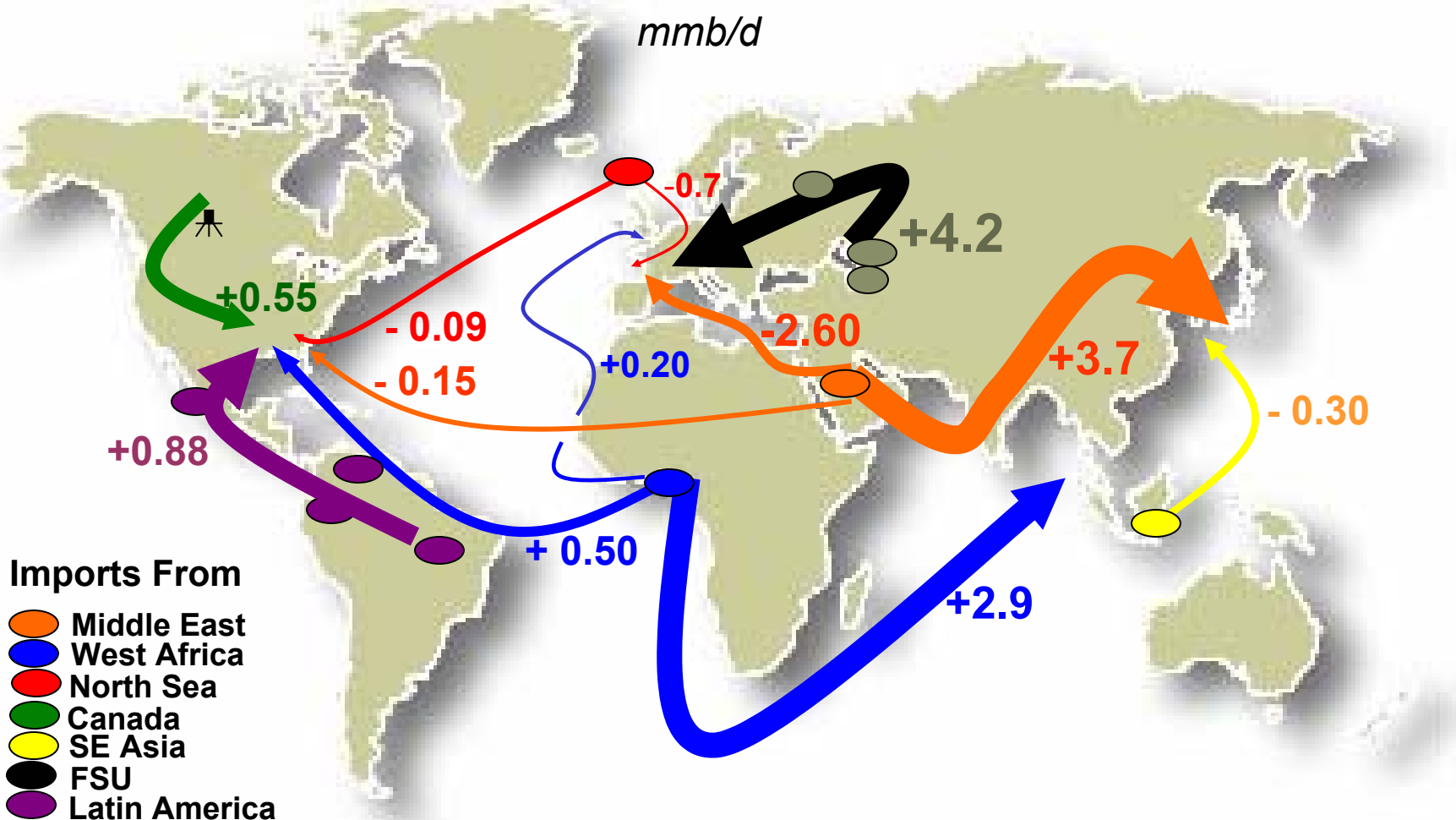
The Persian Gulf Can Grow Production



Increasing Dependency From Less Stable Areas

2010-1997 Delta Growth in Crude Flows For Selected Consuming Regions

mmb/d

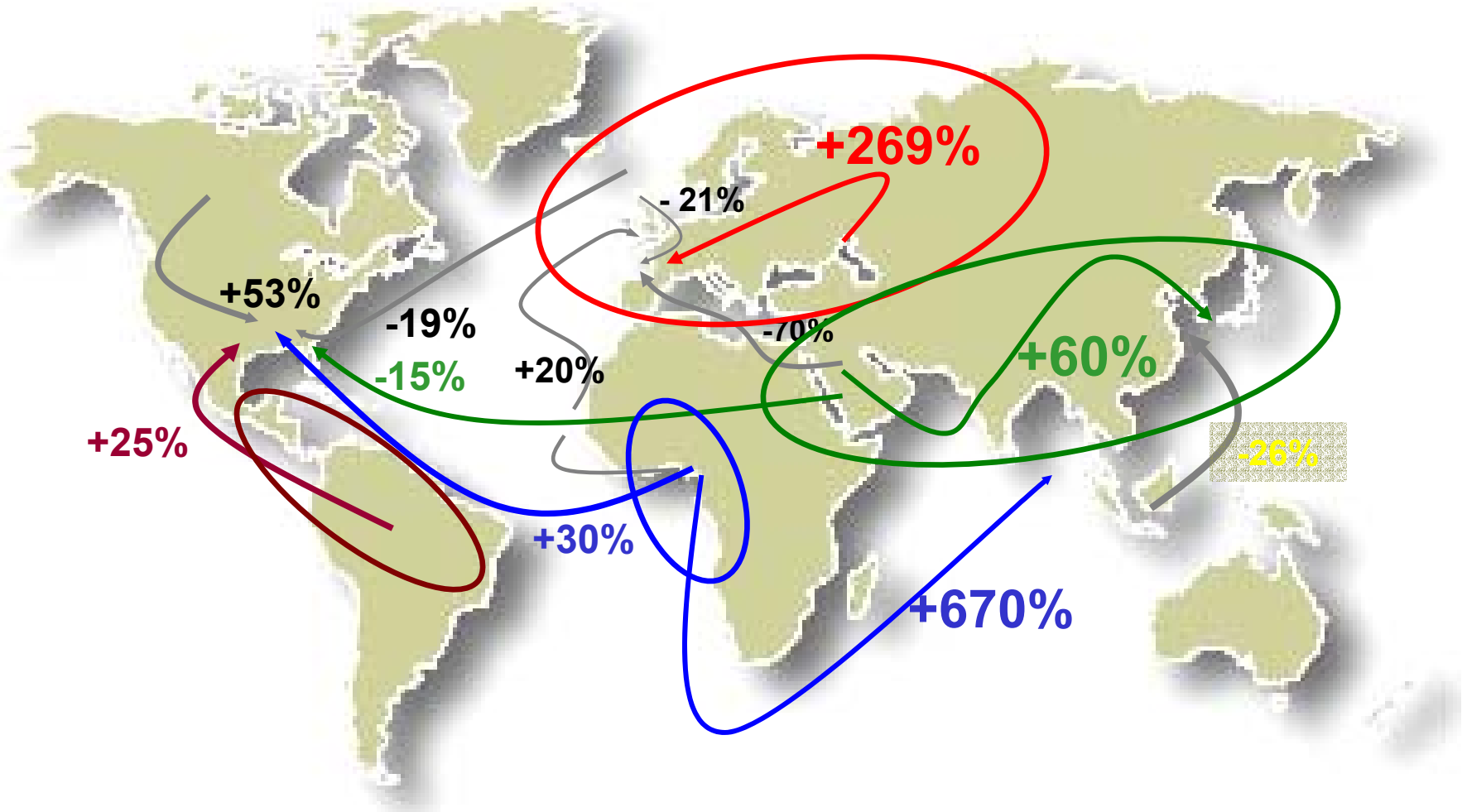


Do Not Include The Totality of Suppliers. Only the Most significant flows are shown.

The Map Includes Exports from Canada, Latin America, Middle East, North Sea, West Africa, West Africa, FSU to Selected Regions

Supply Fears Due To Concentrated Exports

2010-1997 World Flows % Change To Selected Consuming Regions

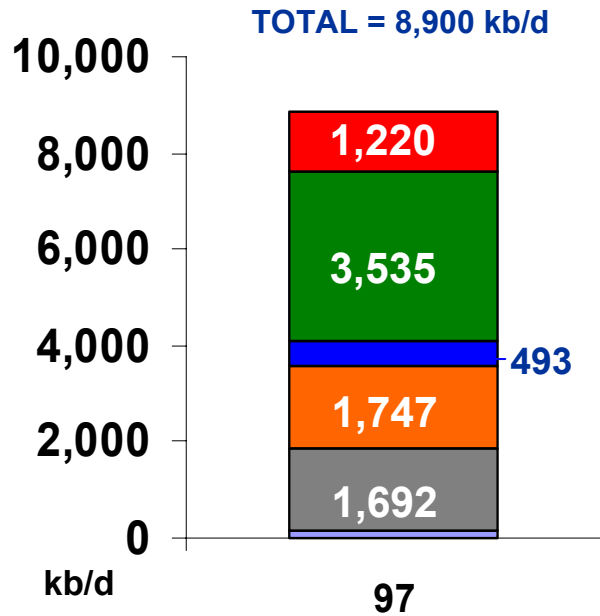


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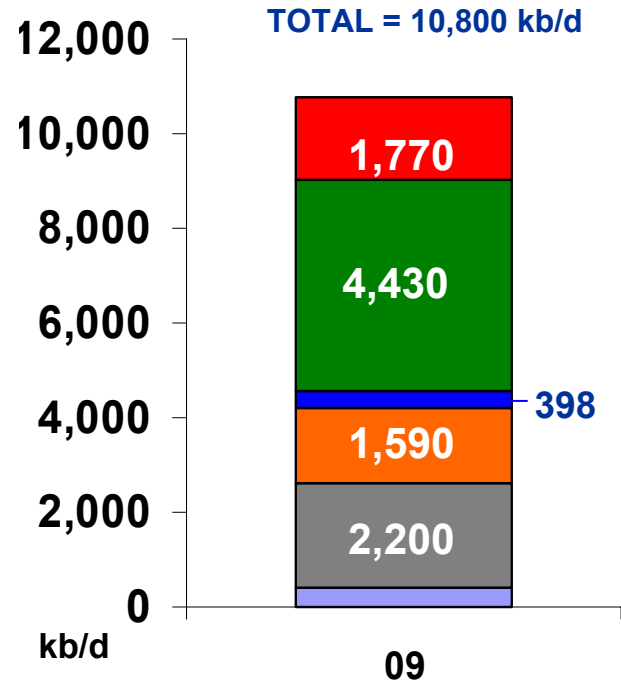
Crude Flows To The US

Exports To The US From Selected Suppliers 1997



- Canada
- Latin America
- NWE
- Middle East
- West Africa
- Others

Exports To The US From Selected Suppliers 2010

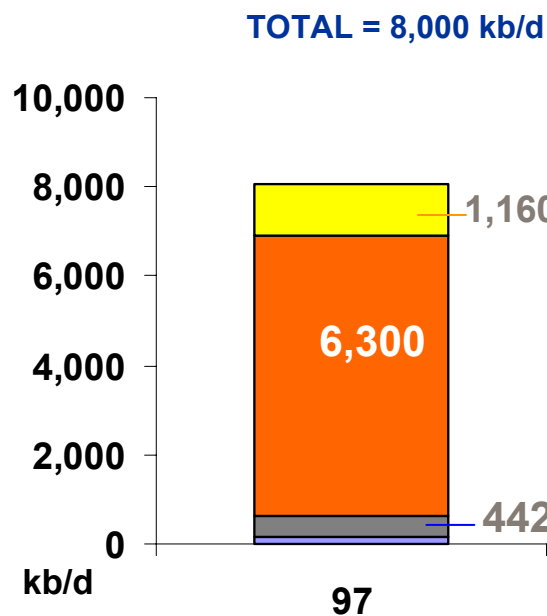


Crude Flows To Asia¹

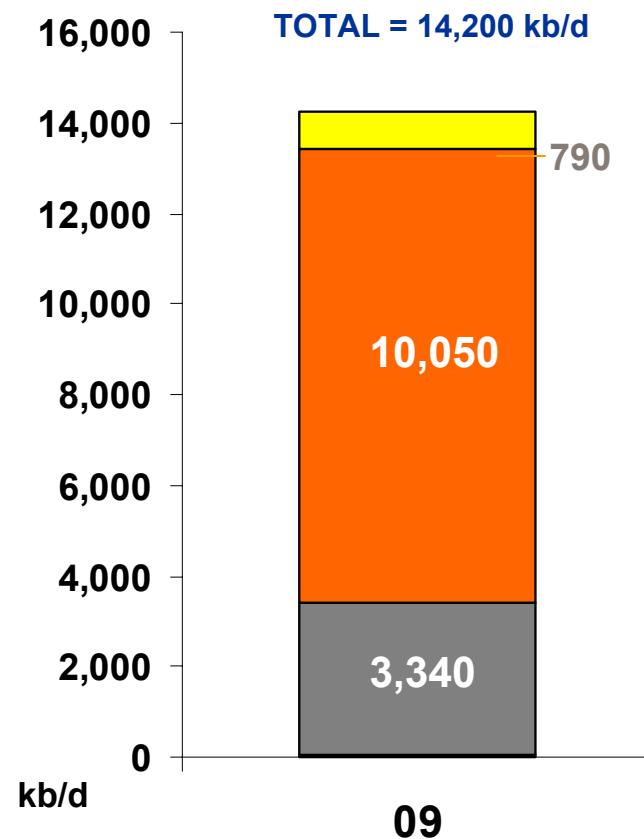
Exports To Asia¹ From Selected Suppliers
1997



Exports To Asia¹ From Selected Suppliers
2010



- SE Asia
- Middle East
- West Africa
- Others



1. Asia = China, Japan, Korea, India

Price Implications

- **The excess capacity that existed after 1985 has now disappeared**
- **Who is willing to recreate a capacity cushion in the world oil market?**
 - Iran, Russia, Venezuela, Iraq
 - Kuwait, UAE, Saudi Arabia
- **Between 2005 and 2008, both West Africa and the FSU will bring large projects on line, creating a window of vulnerability for oil prices (depending on the demand scenario)**
- **In the medium term, if the key producers do not build excess capacity (beyond the 1.5 million b/d that Saudi Arabia appears to be willing to maintain),**
 - prices will move structurally higher,
 - and face greater volatility
- **The oil market does not work well without a supply safety net**

Strategic Implications

- Higher volumes and higher prices will bring back large financial surpluses to the Middle East and the Persian Gulf.
- The new-found wealth will alter the present strategic relationship with the US: despite louder calls for reforms from the US, the region will spend its way out of reforms, and the regimes will have the opportunity to use their financial might to co-opt and divide the different interest groups.
- The US will face more competition from emerging strategic players to secure access to oil.
- There is no alternative to dependence on Middle Eastern oil, but there will be alternatives to oil.
- Managing demand becomes a key strategic issue for the US



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