



Recent Trends in Exploration Results and the Implication for Future Petroleum Liquids Supply

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Key Messages

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

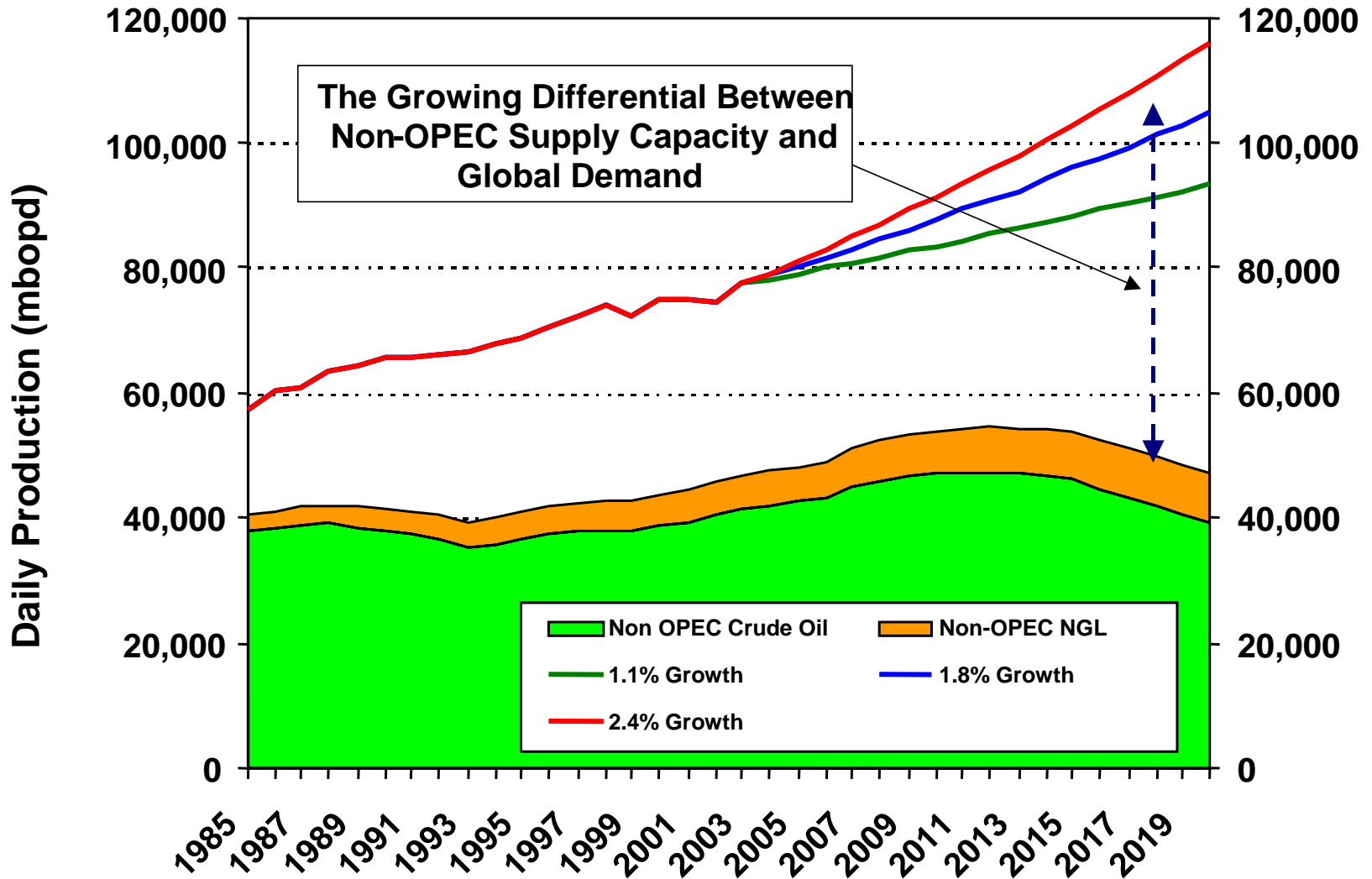
- 1. In spite of high oil prices, Non-OPEC production growth has been very limited with the exception of the FSU. This trend is likely to continue through this decade.**
- 2. Oil exploration in the last 10 years (with a few exceptions like Angola, Sudan, Mauritania) has been much less successful than in previous decades. Since 1990 reserve replacement in non-OEPC 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 Angola, 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. As 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.
6. 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.

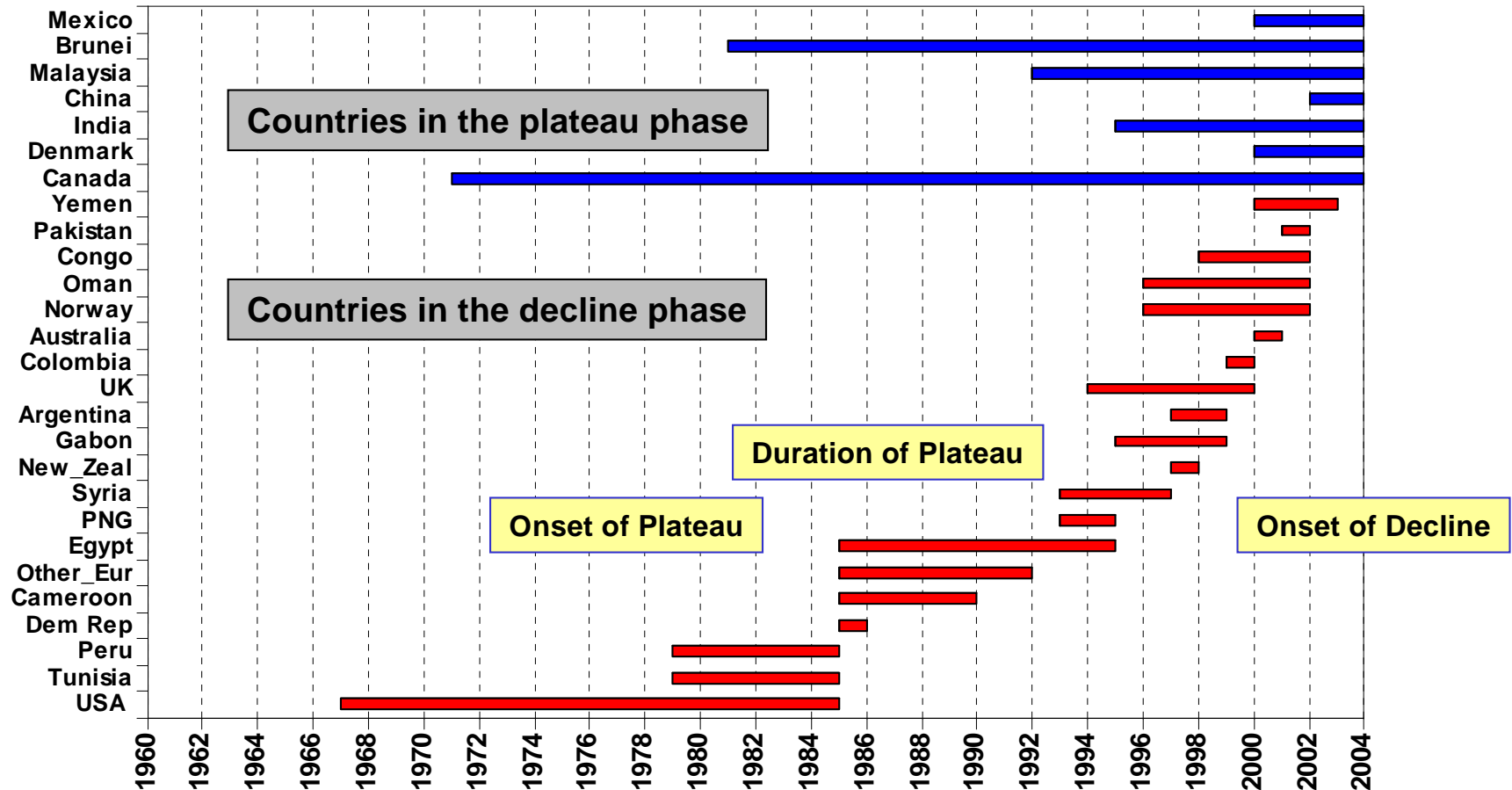
- For each country reserve additions (field by field) have been documented along with production history
- A decline is modeled for the producing base using current withdrawal rates and remaining reserve estimates for fields in the existing production base (an additional 15-20% volume has been added 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

- The Non OPEC group of countries is not running out of oil
- The message in this presentation is that there are going to be significant challenges to growing Non OPEC petroleum liquids production rate beyond 55 million barrels per day in the early part of the next decade, without a dramatic improvement in reserve additions through exploration

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

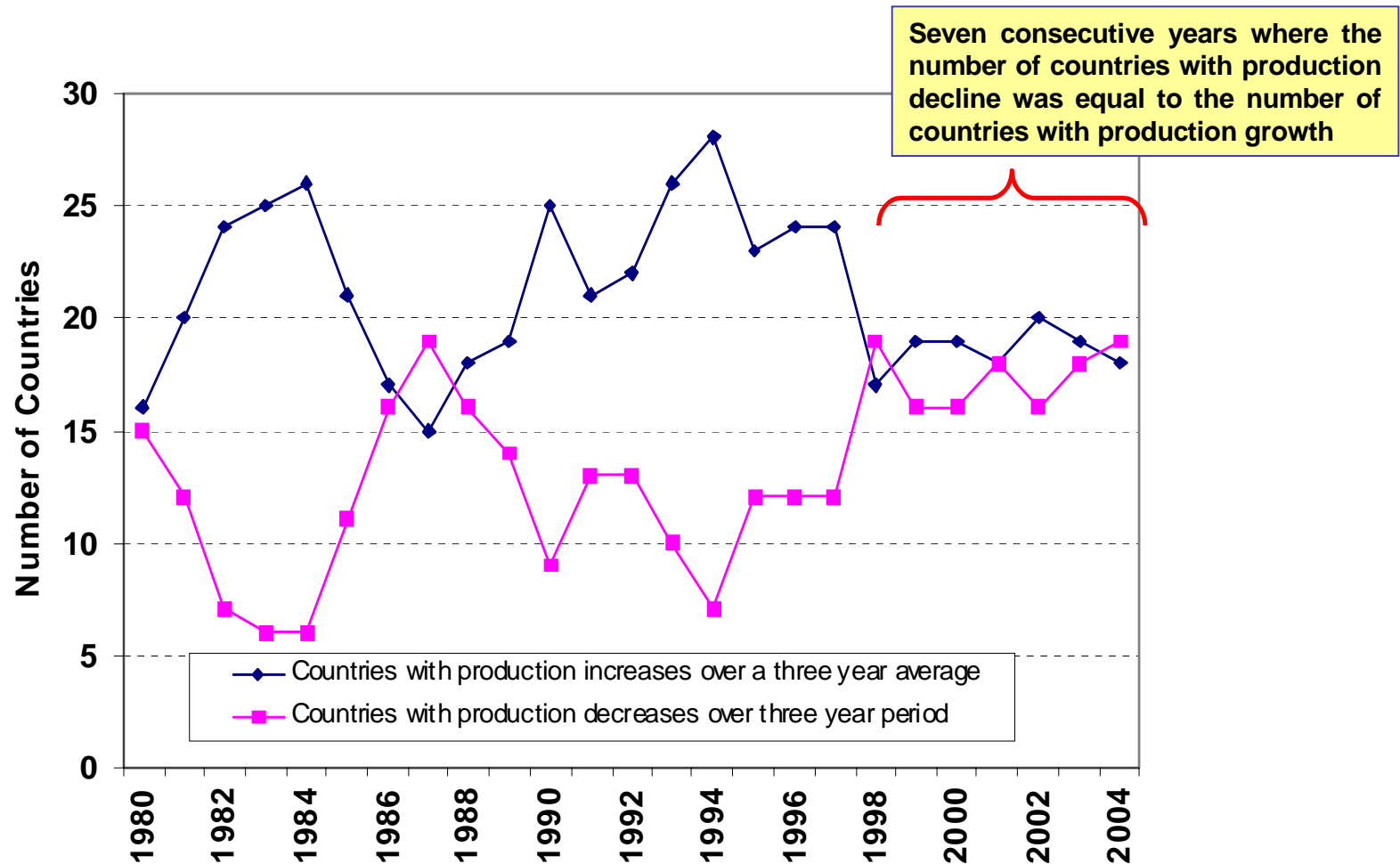


Non-OPEC Countries that are Either in Decline or Currently in a Plateau



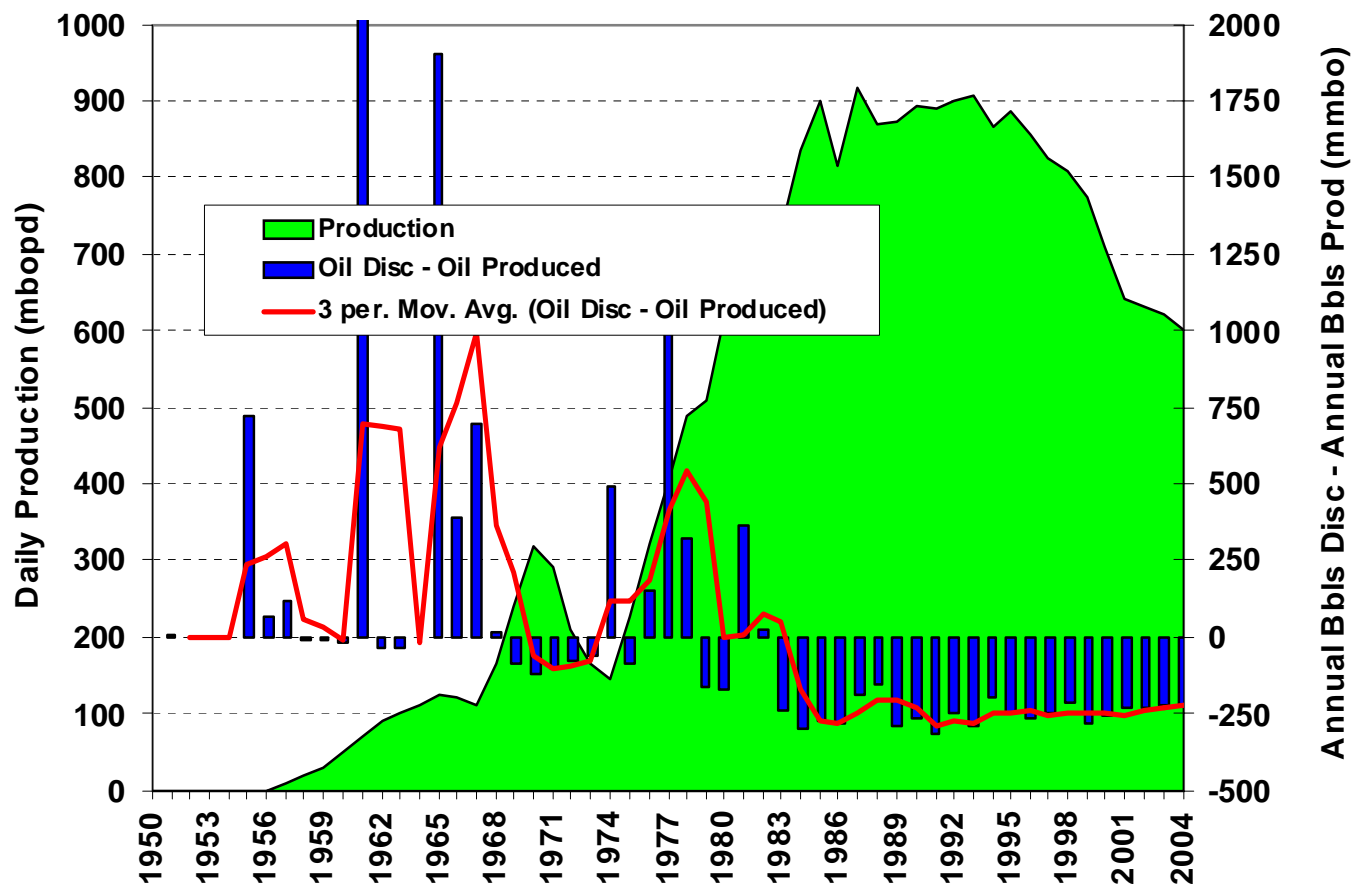
The above bars show the onset and duration of documented production peaks or plateaus – *tracking country life cycle shows an acceleration of the number of countries passing from peak to decline*

Countries Growing Production Versus Countries Declining



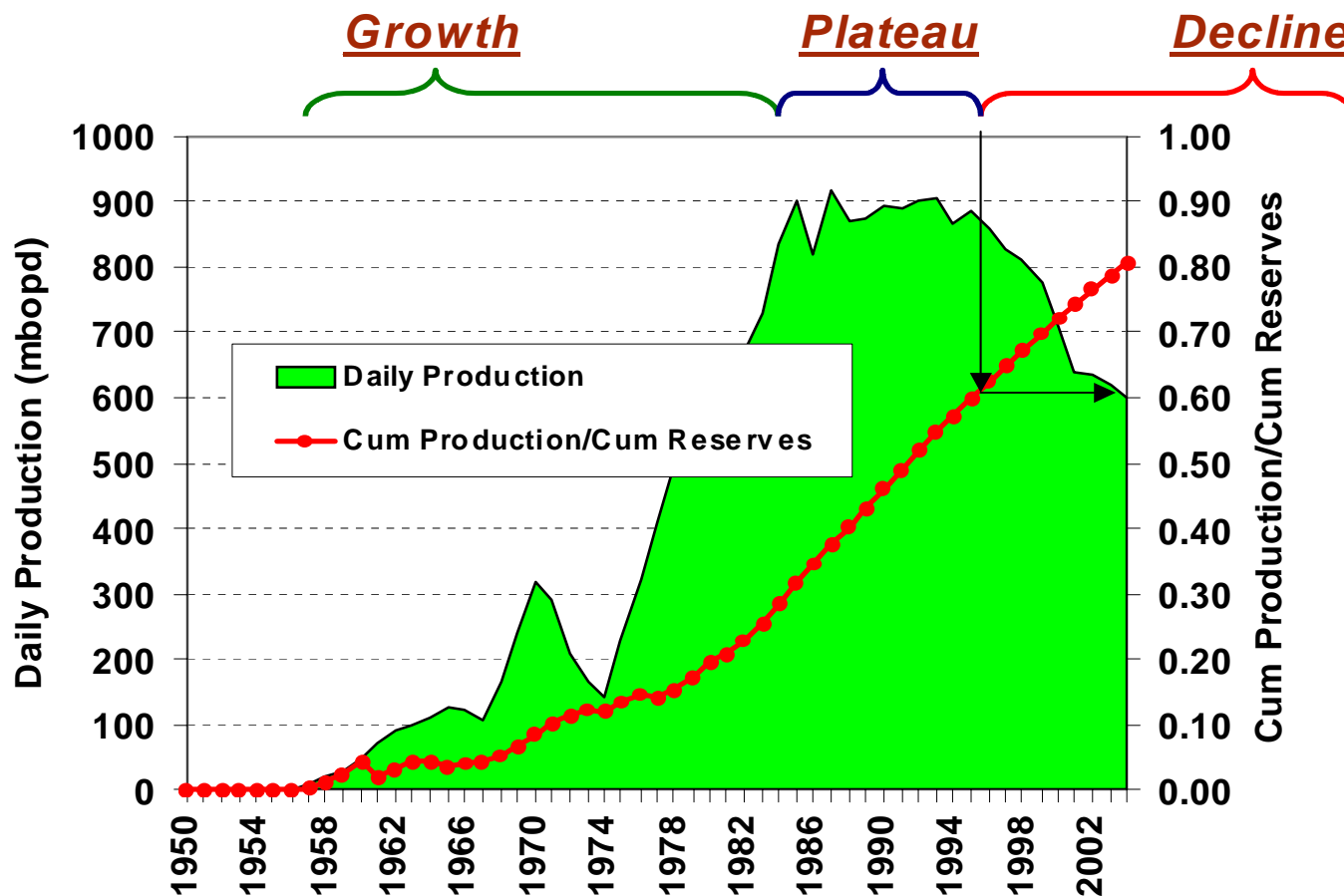
PFC Energy's data analysis indicates that for the last 7 years the number of significant producing countries with production declines is roughly equal to the number of countries with production growth.

Egypt – A Typical Life Cycle for an Oil Producing Country



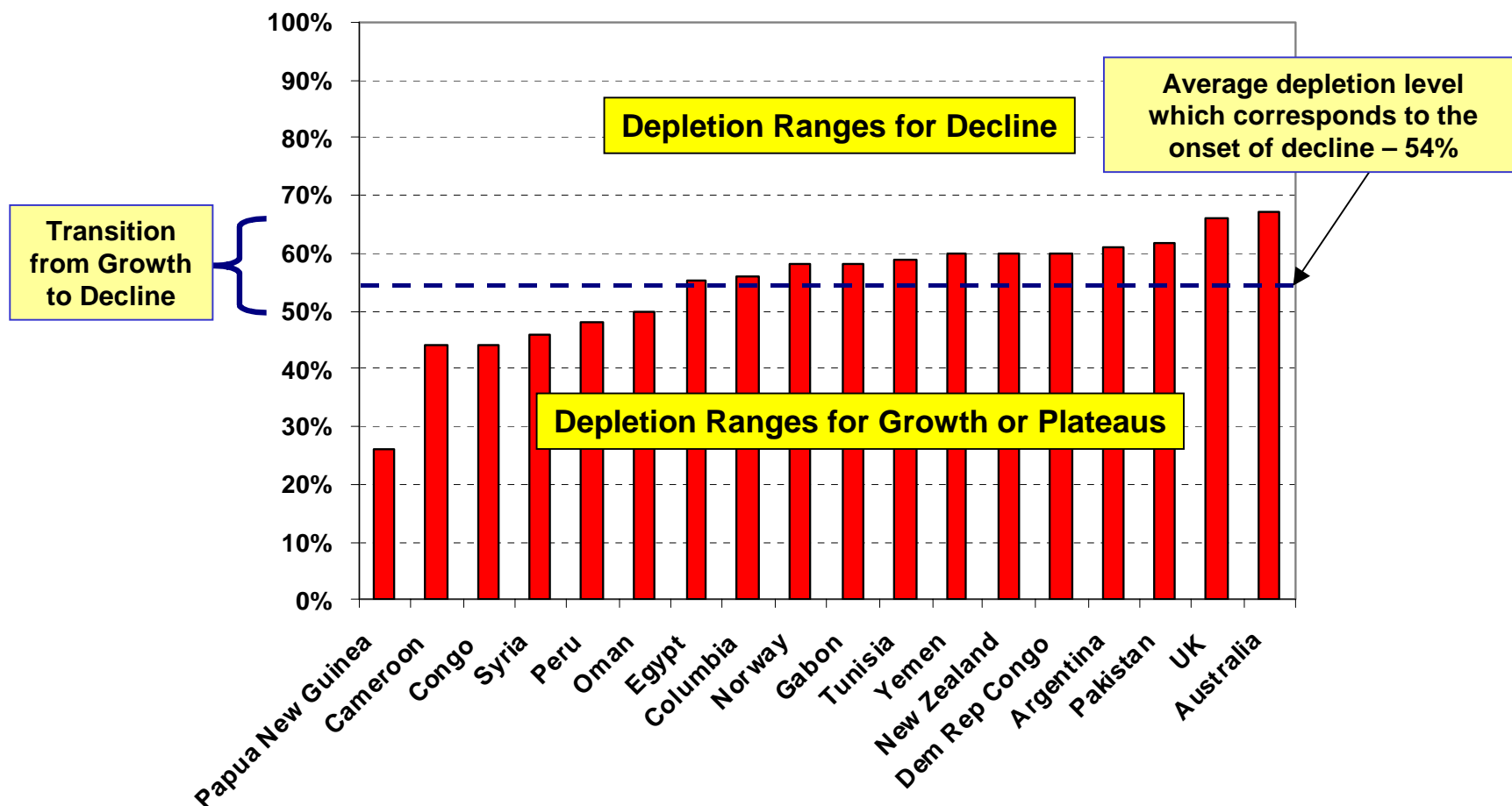
As reserve additions fall and production rates increase countries evolve from having net a positive annual reserve balance to a negative annual petroleum balance – *in the case of Egypt there have been 20 consecutive years where 250 mmbo more oil is produced than discovered every year*

Egypt – A Typical Life Cycle for an Oil Producing Country



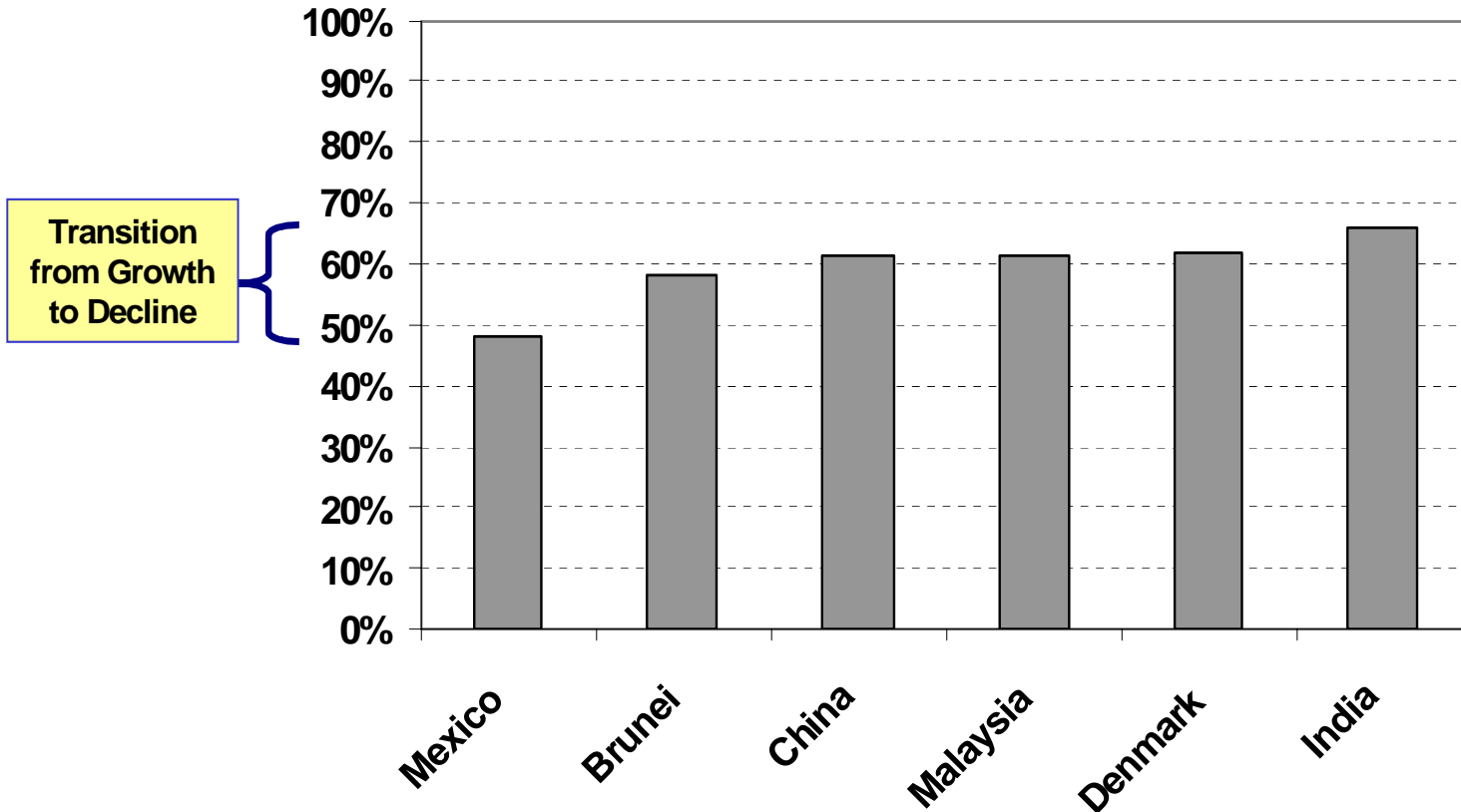
Once large discoveries are no longer made and production rates increase, depletion levels (percentage of oil discovered that has been produced) accelerate – *this depletion history has been mapped for every major oil and most minor producing countries*

Non-OPEC Countries that are in Decline



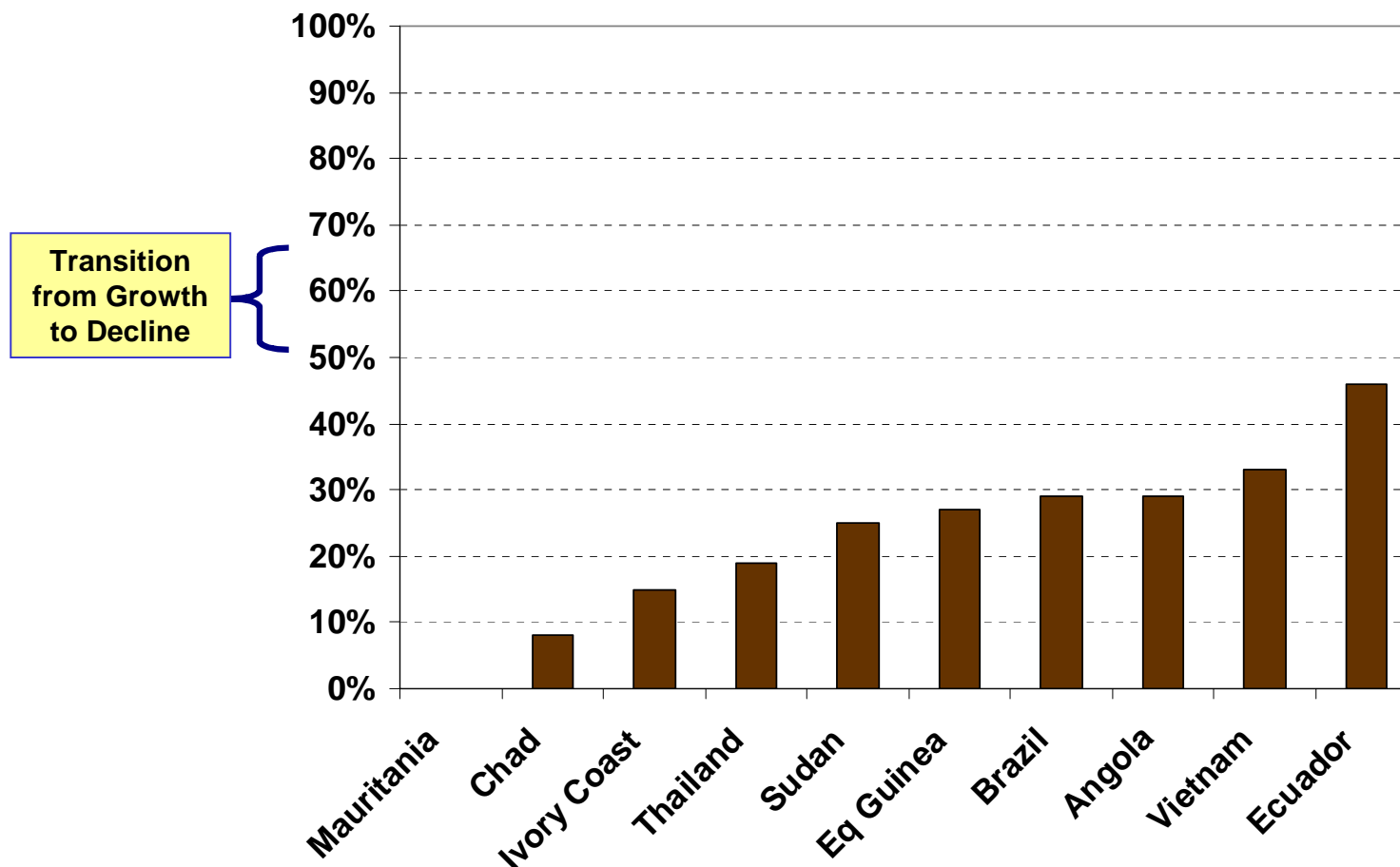
The above bars shows the depletion level at the transition from peak/plateau to decline – *tracking depletion level is a good way to anticipate the cessation of growth and the onset of decline*

Non-OPEC Countries that are in Plateau



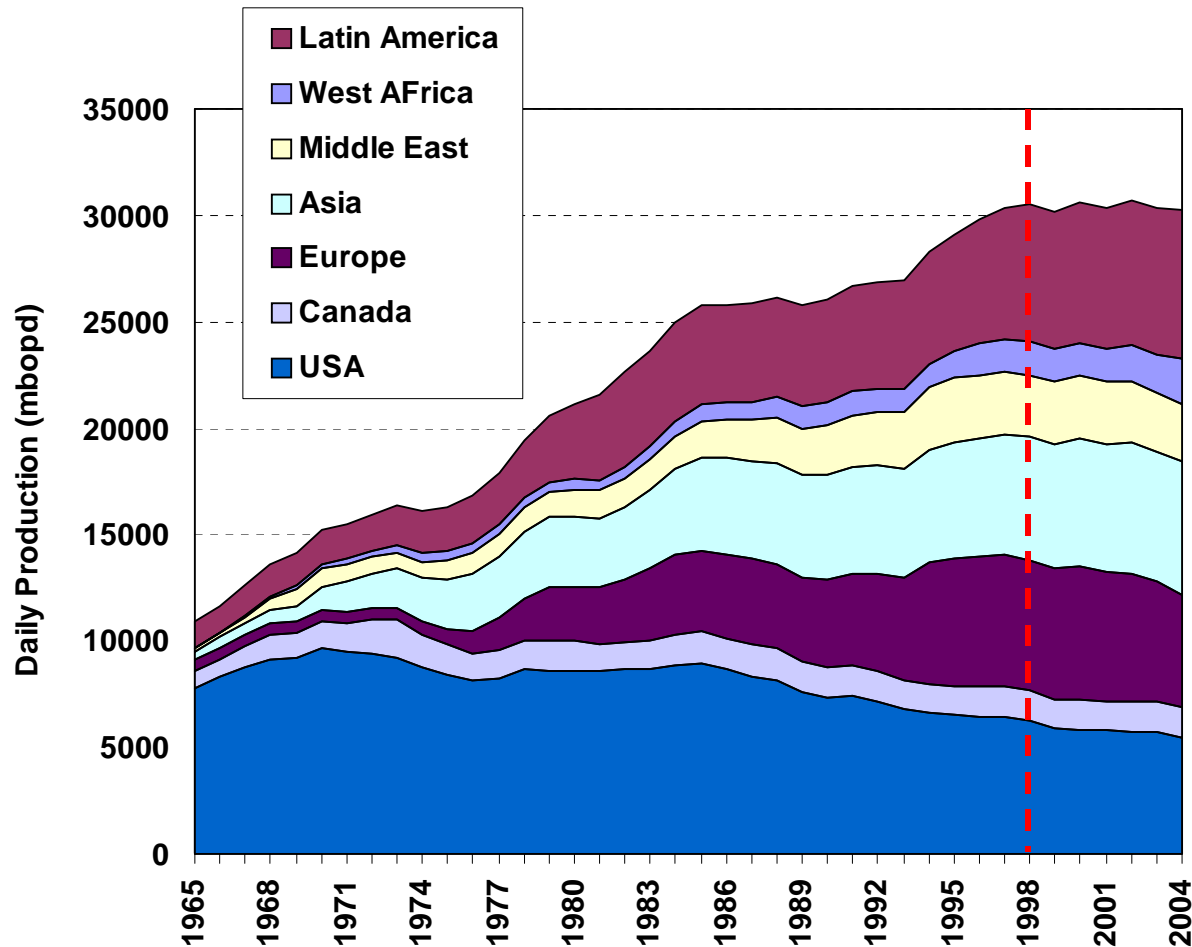
The above bars shows the depletion level of several producers which have reached a production plateau – *several significant producers are rapidly approaching critical (60 – 65%) depletion levels which typically signal the onset of production declines*

Non-OPEC Non-FSU Countries with Production Growth Profiles



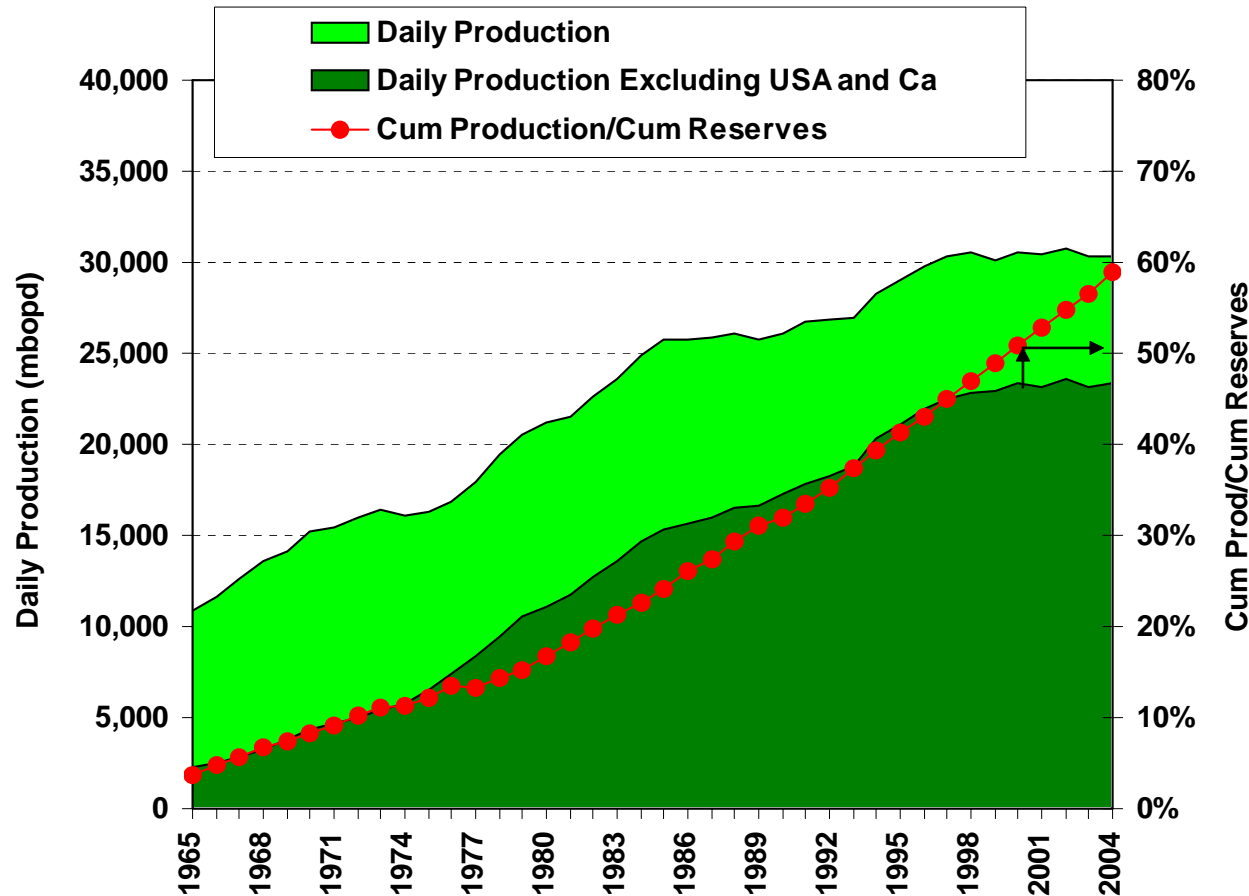
The above bars shows the depletion level of several producers which have new discoveries and are considered very likely to increase production

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



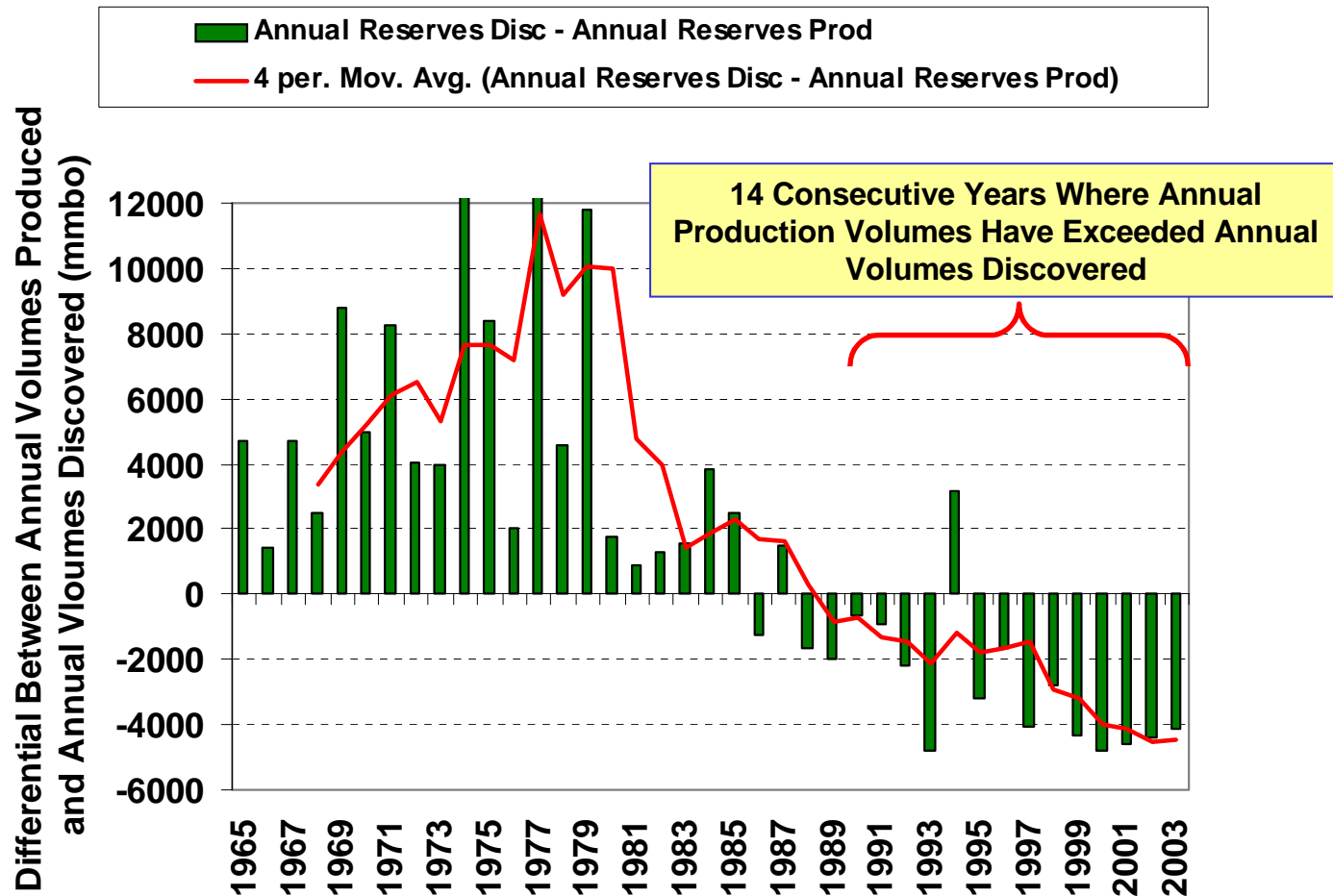
Several key producing regions have reached or exceeded the critical depletion point of 50-60% which typically marks the onset of production decline. It is worth noting that production gains from large new projects have not increased the aggregate production capacity of these regions for about 8 years.

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



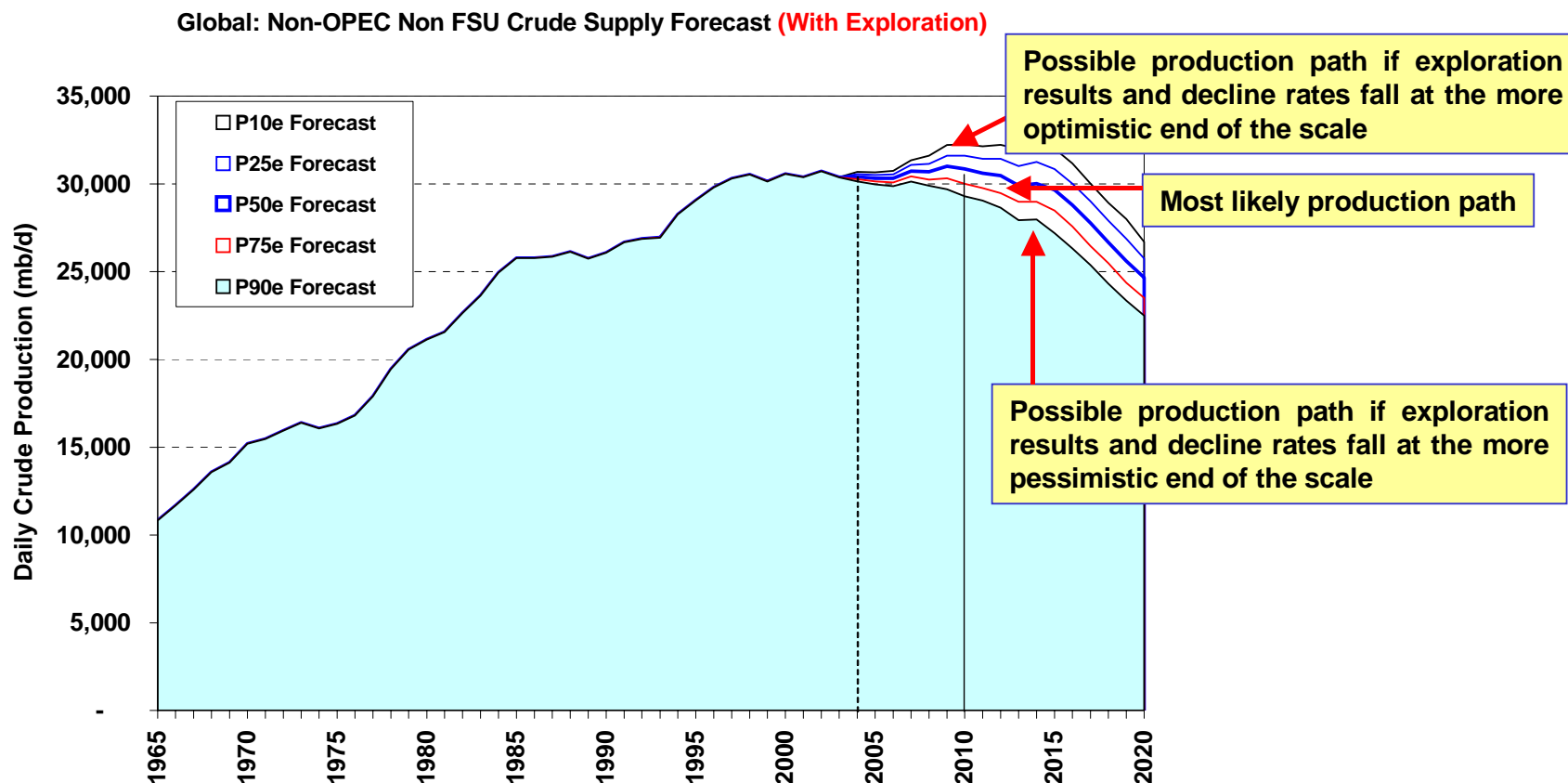
Several key producing regions have reached or exceeded the critical depletion point of 50-60% which typically marks the onset of production decline. It is worth noting that production gains from large new projects have not increased the aggregate production capacity of these regions for about 8 years.

Annual Non OPEC Crude Production Balance (Excluding FSU, USA, and Canada)



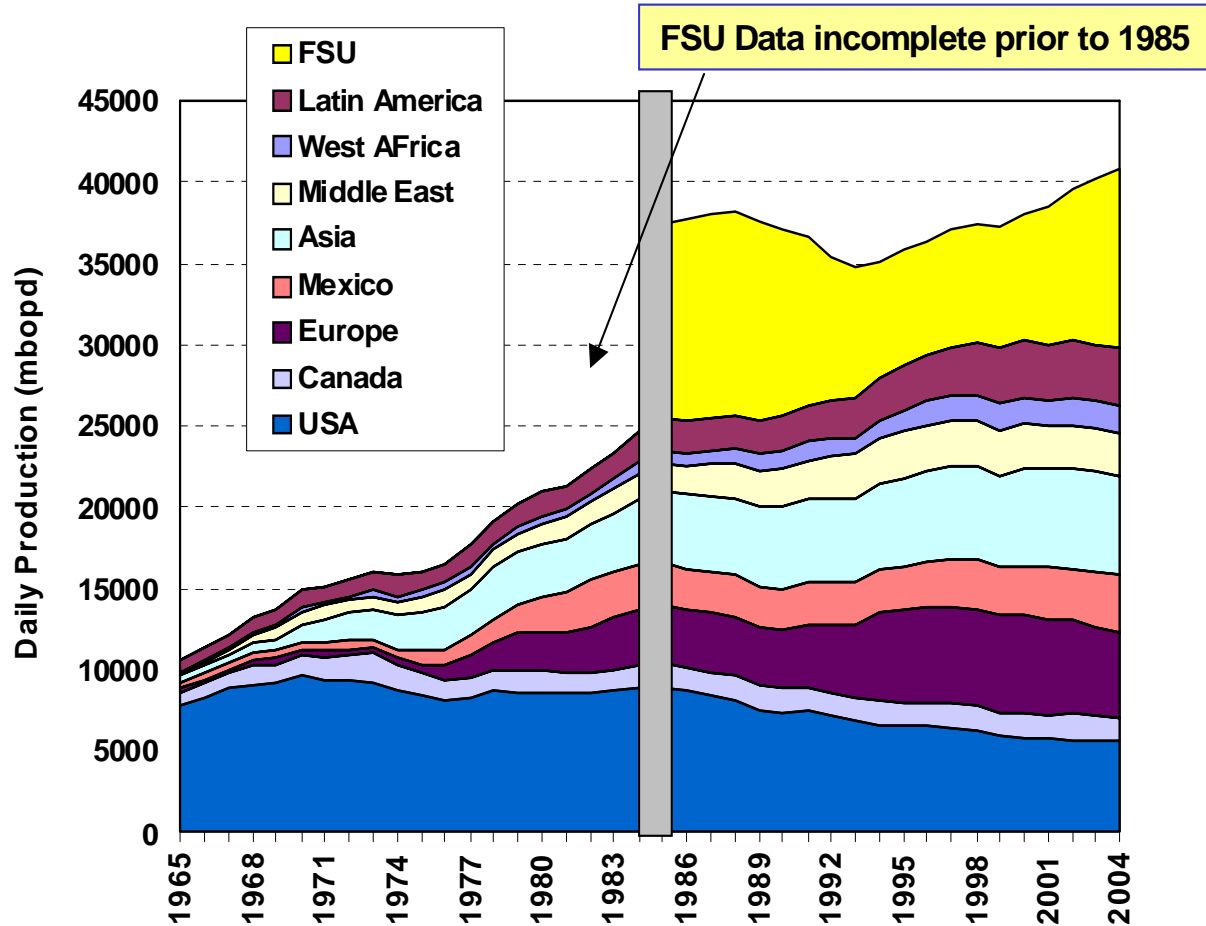
PFC Energy's data analysis indicates countries within this block of production have in aggregate been producing up to 4 billion more barrels each year than they have been finding through exploration since the mid 1980s.

Non OPEC Crude Oil Forecast with an Exploration Component (Excluding 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*

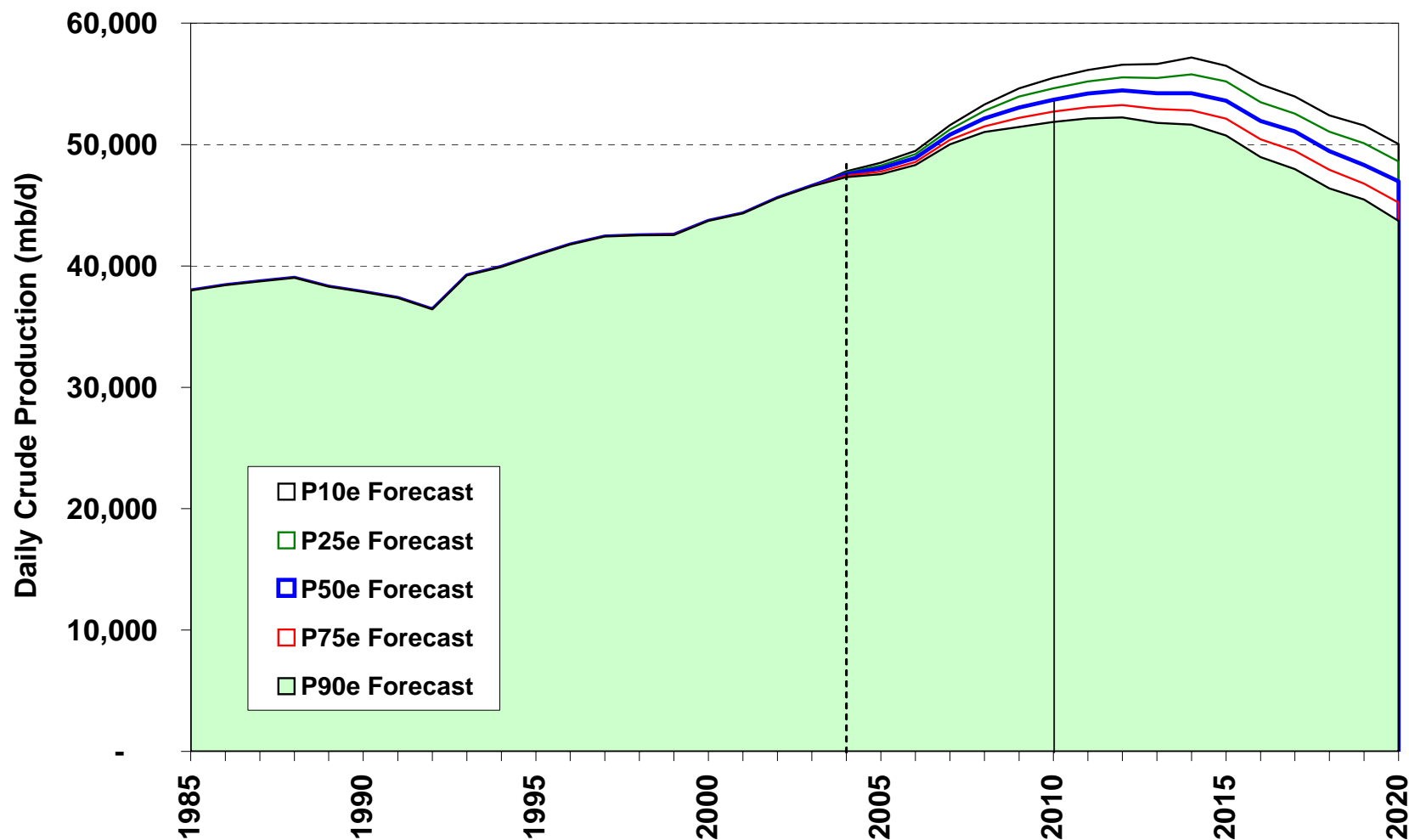
Historical Crude Production (Excluding Natural Gas Liquids and Canadian Oil Sands)



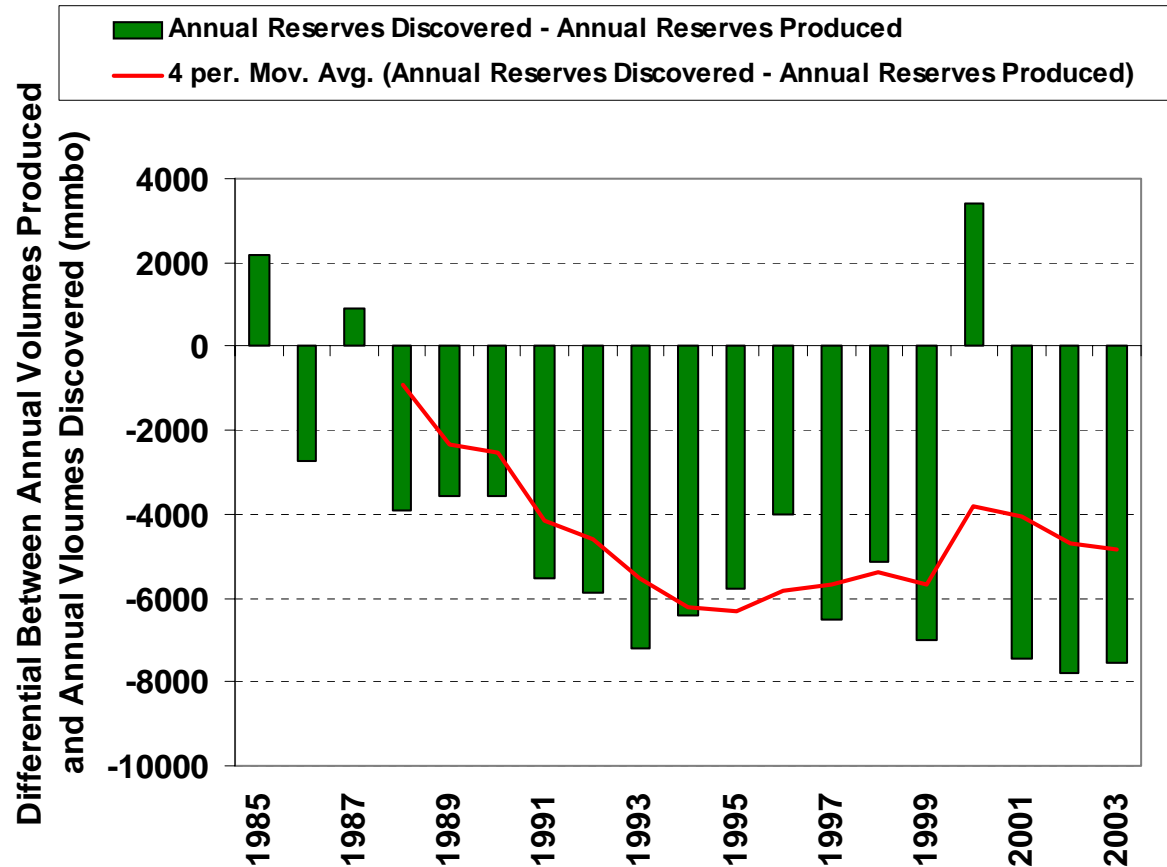
Post 1998 Non-OPEC conventional crude oil production growth was largely driven by growth in the FSU and specifically Russia.

Non OPEC Crude Oil and NGL Production Forecast with an Exploration Component (includes Canadian Oil Sands)

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

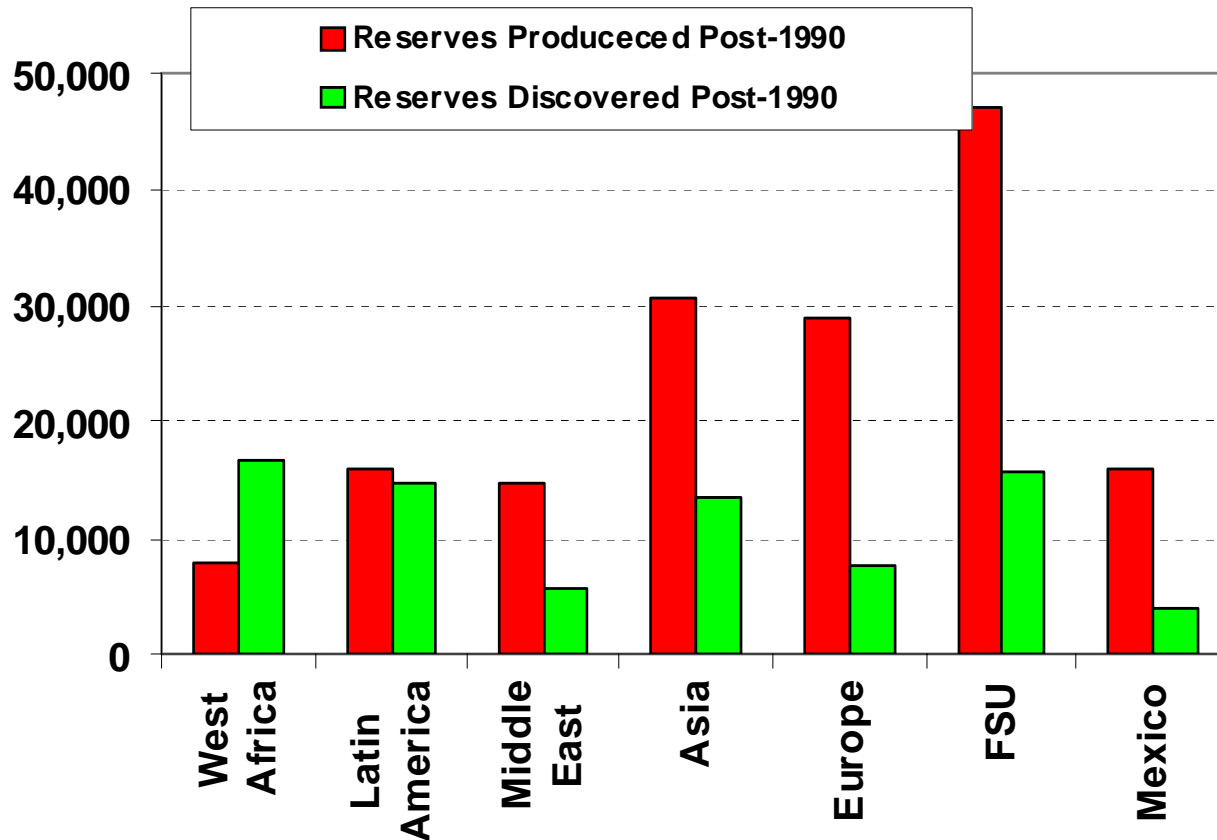


Non OPEC Annual Crude Oil Production Balance (Excluding USA, Canada, and Canadian Oil Sands)



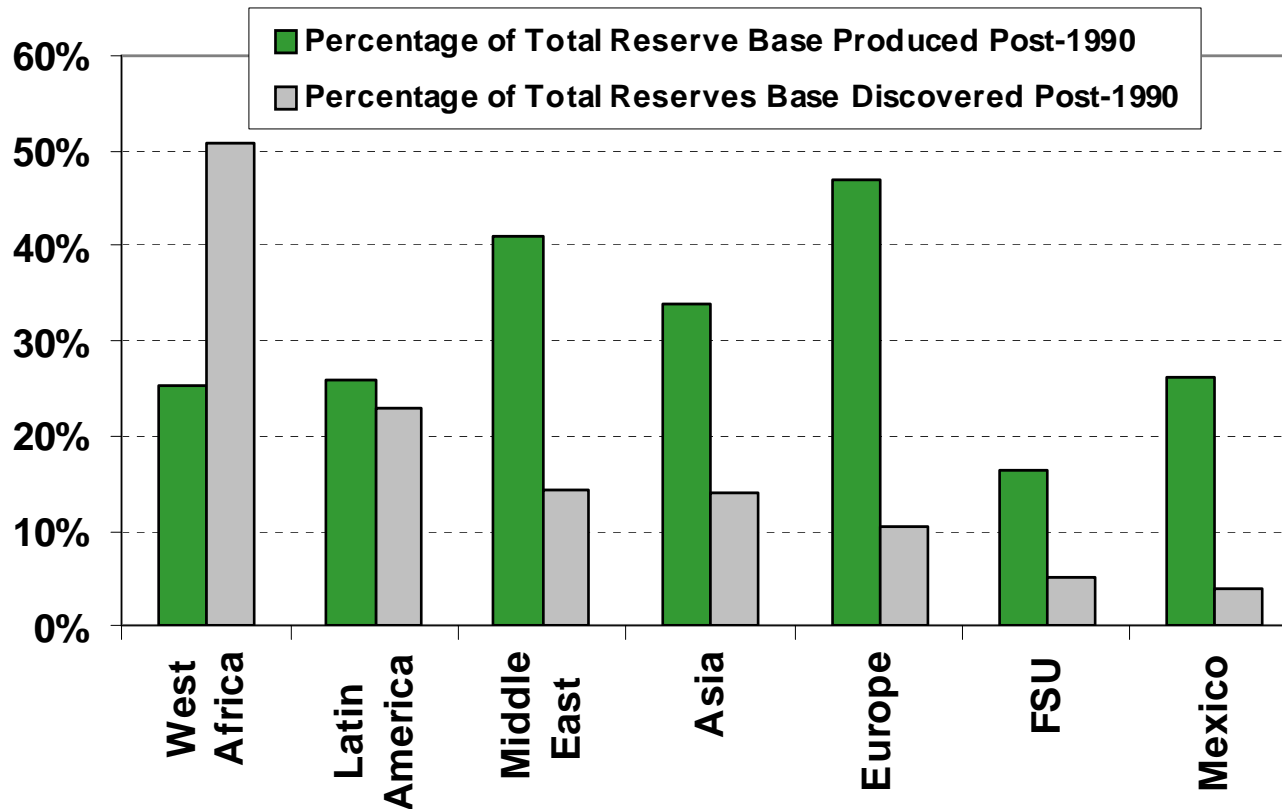
PFC Energy's data analysis indicates that Global Non-OPEC crude production is currently exceeding volumes discovered by as much as 8 billion barrels per year – *this continuing depletion of the reserve base will ultimately lead to the inability to continue growing production rate*

A Comparison of Reserves Discovered Versus Reserves Produced Since 1990



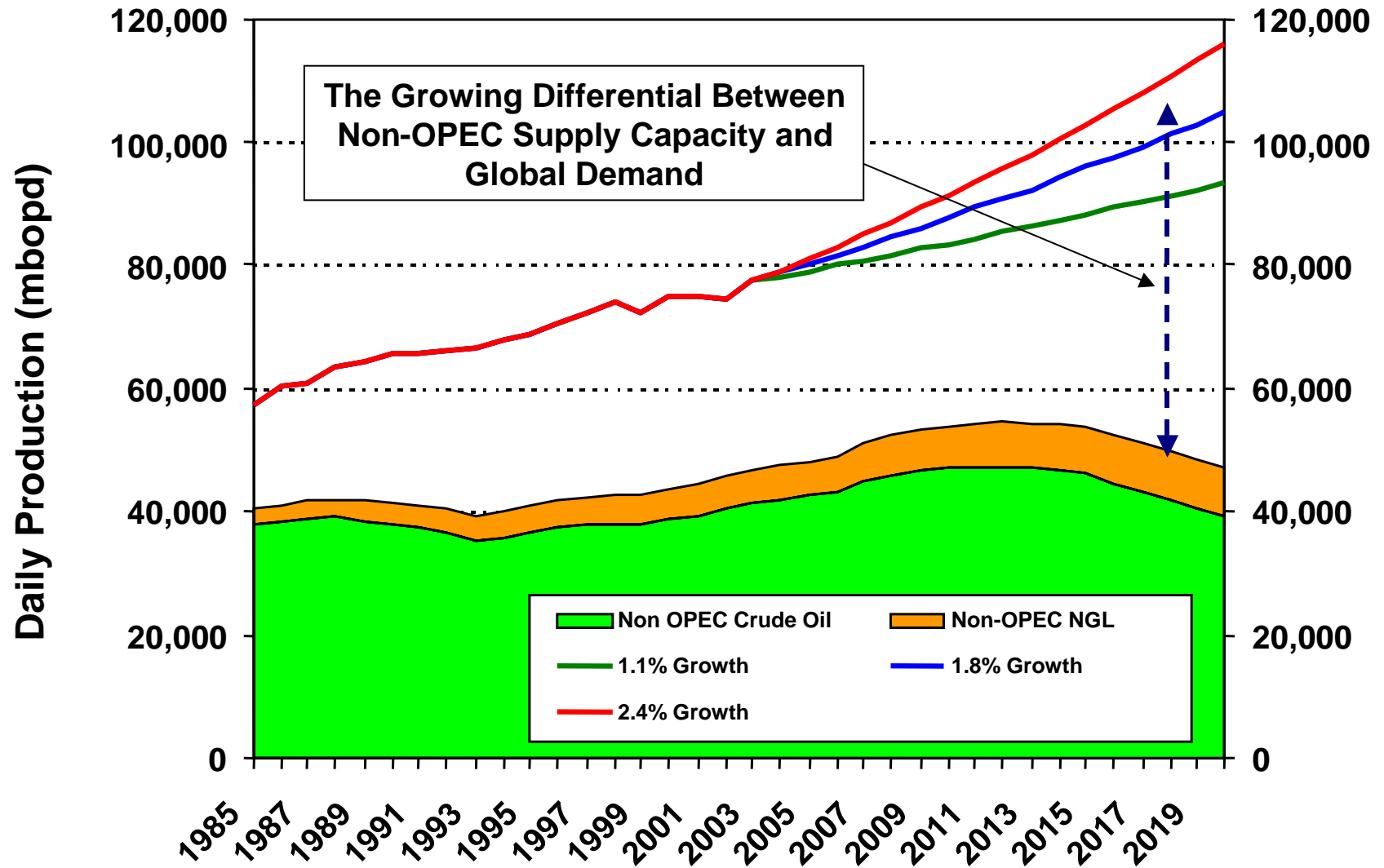
PFC Energy's data analysis indicates that most regions of the world have cumulatively produced more oil than they have found during the period 1990 to present – *this continuing depletion of the reserve base will ultimately lead to the inability to continue growing production rate*

Significant Percentages of Regional Reserve Bases Were Produced Post 1990



The above chart shows how significant production growth since 1990 has hit these regional reserve bases – *for example in the case of non-OPEC Middle East, 40% of all reserves discovered through history were produced since 1990 while discoveries during that period accounted for only 15% of all reserves ever discovered.*

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



Concluding Comments

- With the last 20 years of growing consumption and negative annual liquid balances (producing more than we find) it is possible to model a non-OPEC production peak on the horizon (2010-2015).
- The real unknown as we sit here today is to what extent high oil prices might drive a surge in exploration spending or the development of enhanced oil recovery and whether or not these factors will have a significant impact on this looming non-OPEC peak
- If non-OPEC peak oil early in the next decade is a real possibility then clearly OPEC will have a more dominant role in world crude oil markets - *if some of the more pessimistic views of OPEC reserves is reality then it is difficult to model a world where oil production exceeds 100 million barrels a day*

1. We rely on the belief that high prices will drive much higher exploration activity, there will be at least a larger number of smaller fields discovered – maybe some new large plays emerge, higher costs will drive higher oil recovery factors, and OPEC really does have the large reserve base it reports – *if all of this happens then peak oil and all of the problems that are associated with it may not confront us in the near term*
2. We hope for the above but start planning for the possibility that we will be facing a world that it not necessarily energy constrained in the next decade, but might have physical constraints on the growth of crude oil and other petroleum liquids *production rate*



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