

Strategic Advisors in Global Energy

Global Hydrocarbon Liquids Supply Forecast

Executive Summary

PFC Energy – ASPO6 Conference

17 September 2007



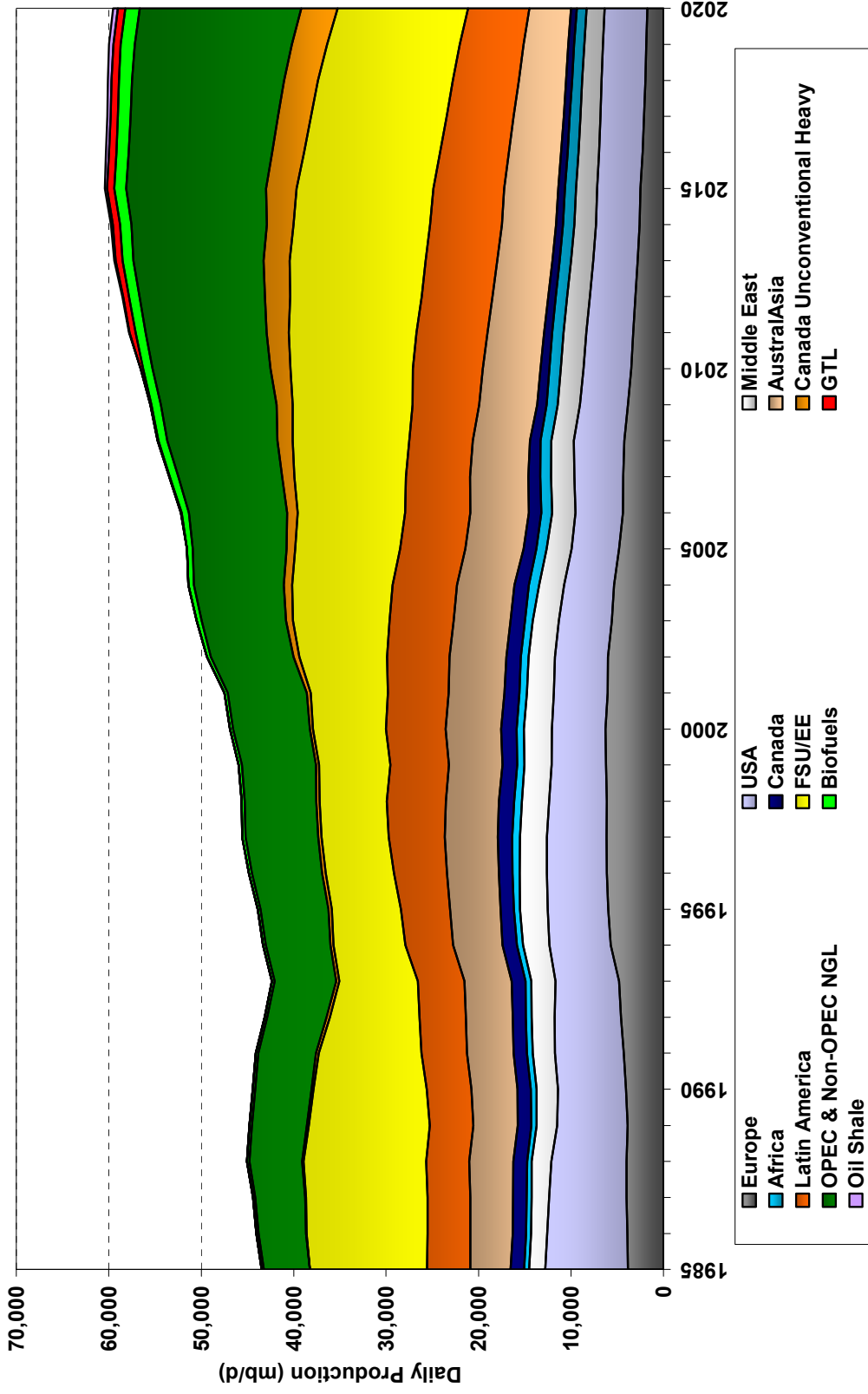
Key Messages

- 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.
- 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.
- 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.*
- 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.*
- 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.

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

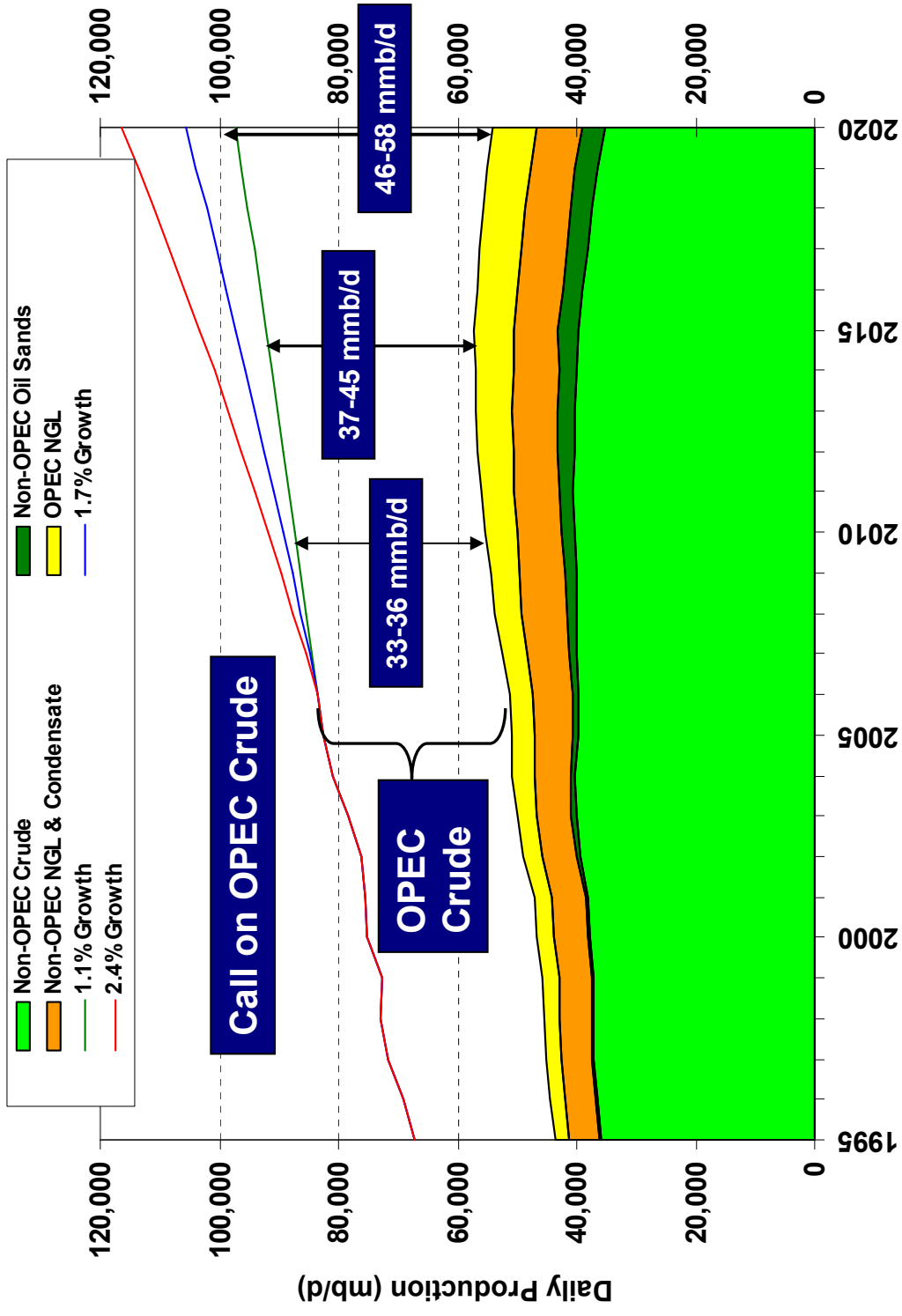


Global Non-OPEC Liquids & OPEC Non-Quota Liquids Supply Forecast (With Exploration)

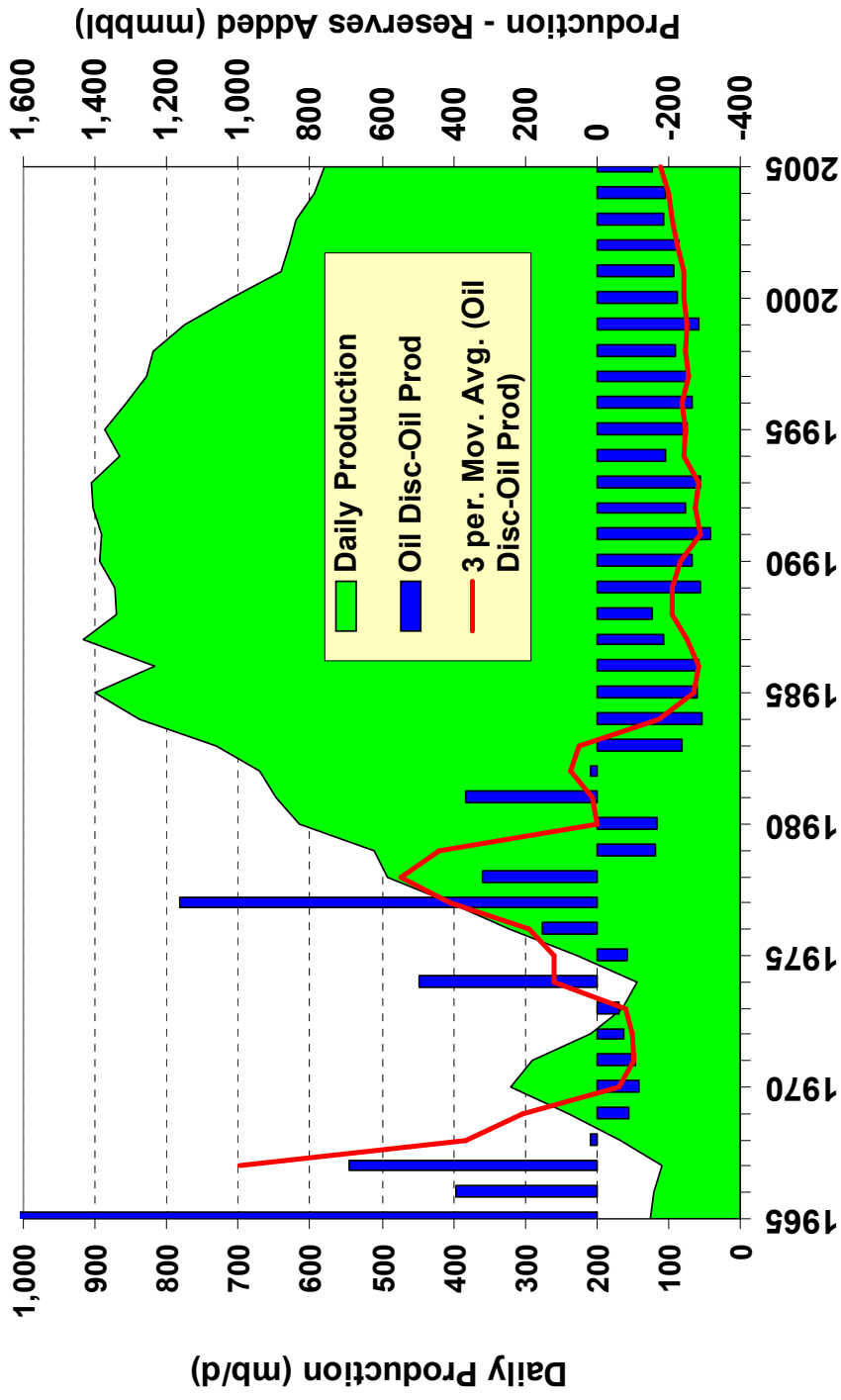


A combined forecast of Non-OPEC liquids and OPEC non-quota liquids suggests that production will grow to just around 60 million barrels per day by 2015.

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

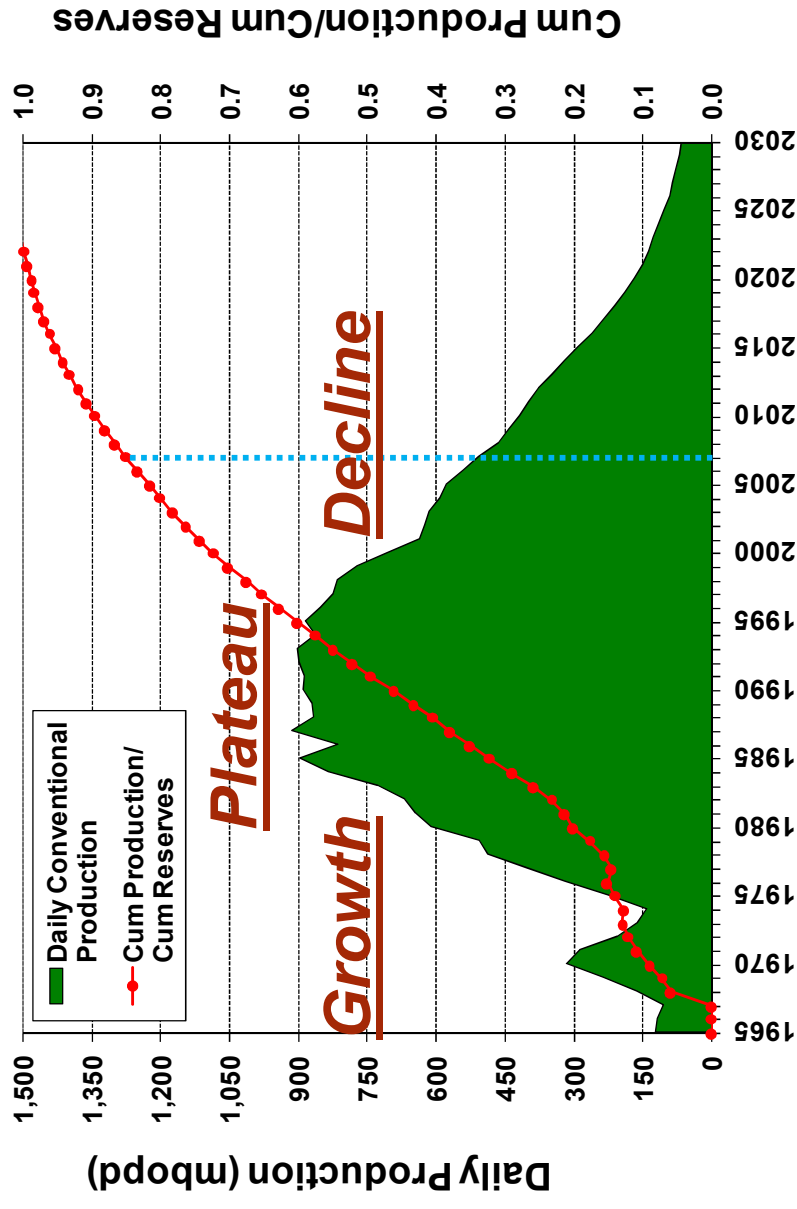


Egypt – A Typical Life Cycle for an Oil Producing Country



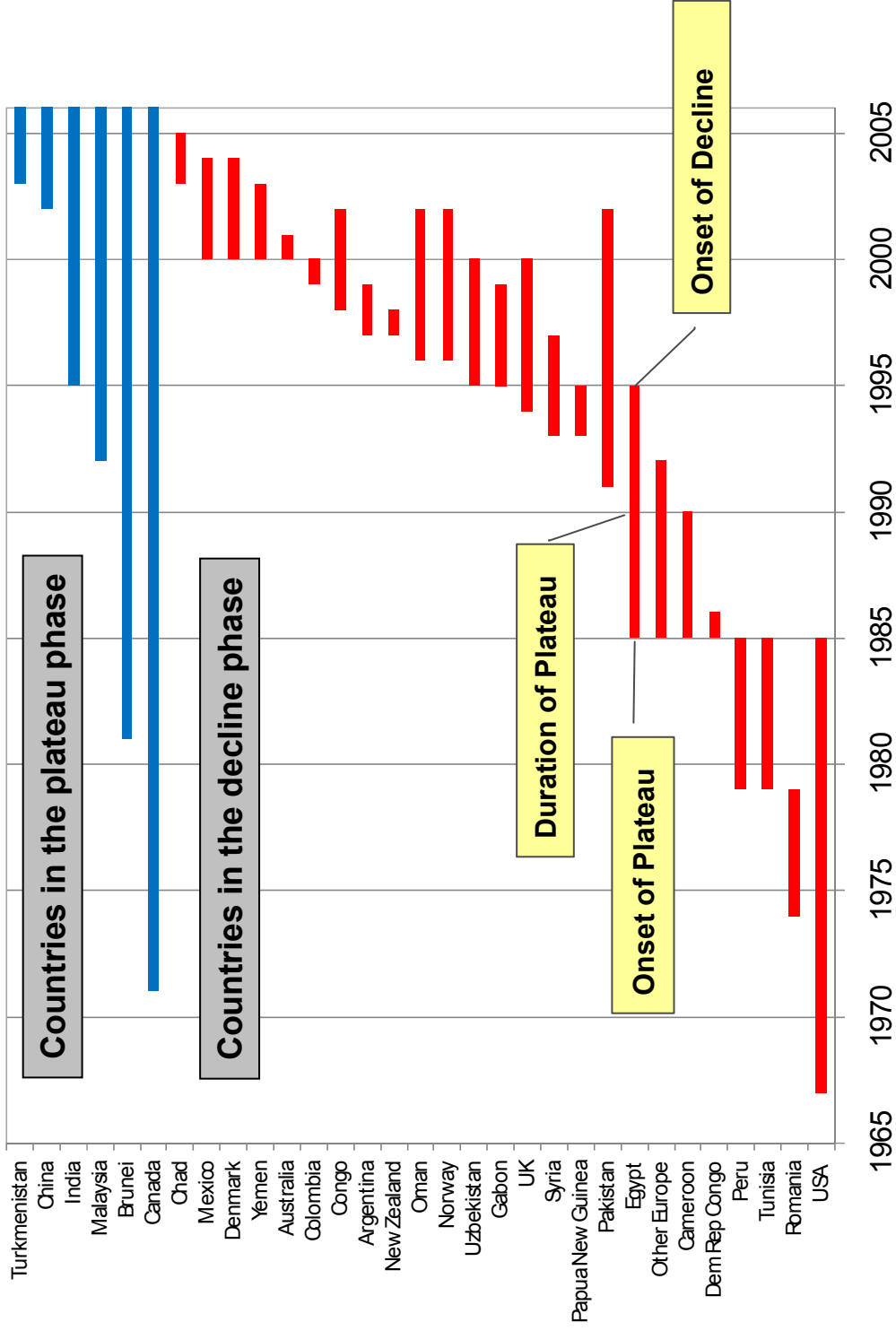
As reserve additions fall and production rates increase, countries evolve from having net a positive annual reserve balance to a negative annual petroleum balance – *in the case of Egypt there has been 20 consecutive years where 250 mmbbl more oil is produced than discovered every year*

Egypt – A Typical Life Cycle for an Oil Producing Country



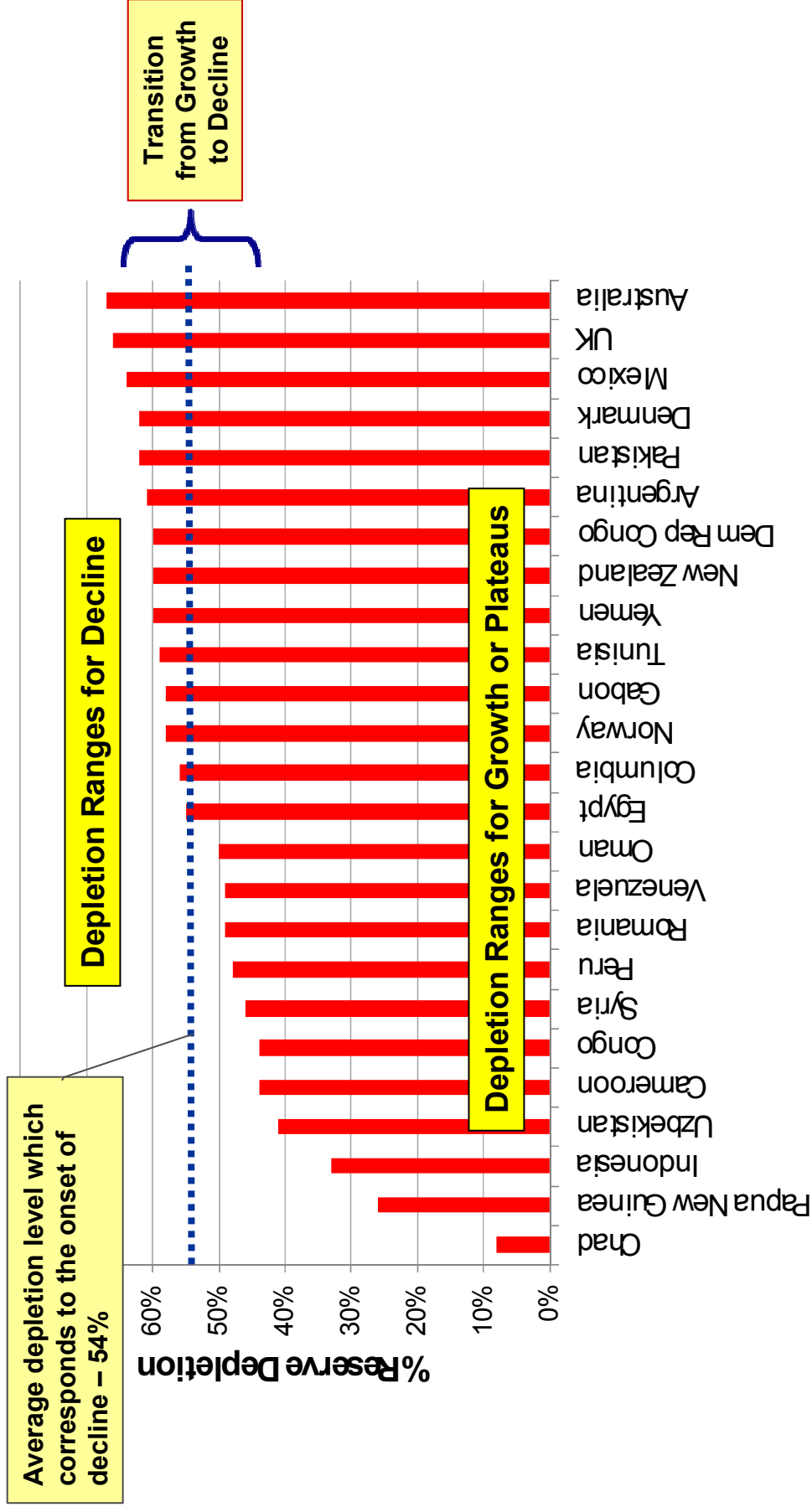
Once large discoveries are no longer made and production rates increase, depletion levels (percentage of oil discovered that has been produced) accelerate – *this depletion history has been documented for every major and most minor oil producing countries*

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*

Outlook for Non-OPEC Crude Production:

Excluding FSU and Unconventionals

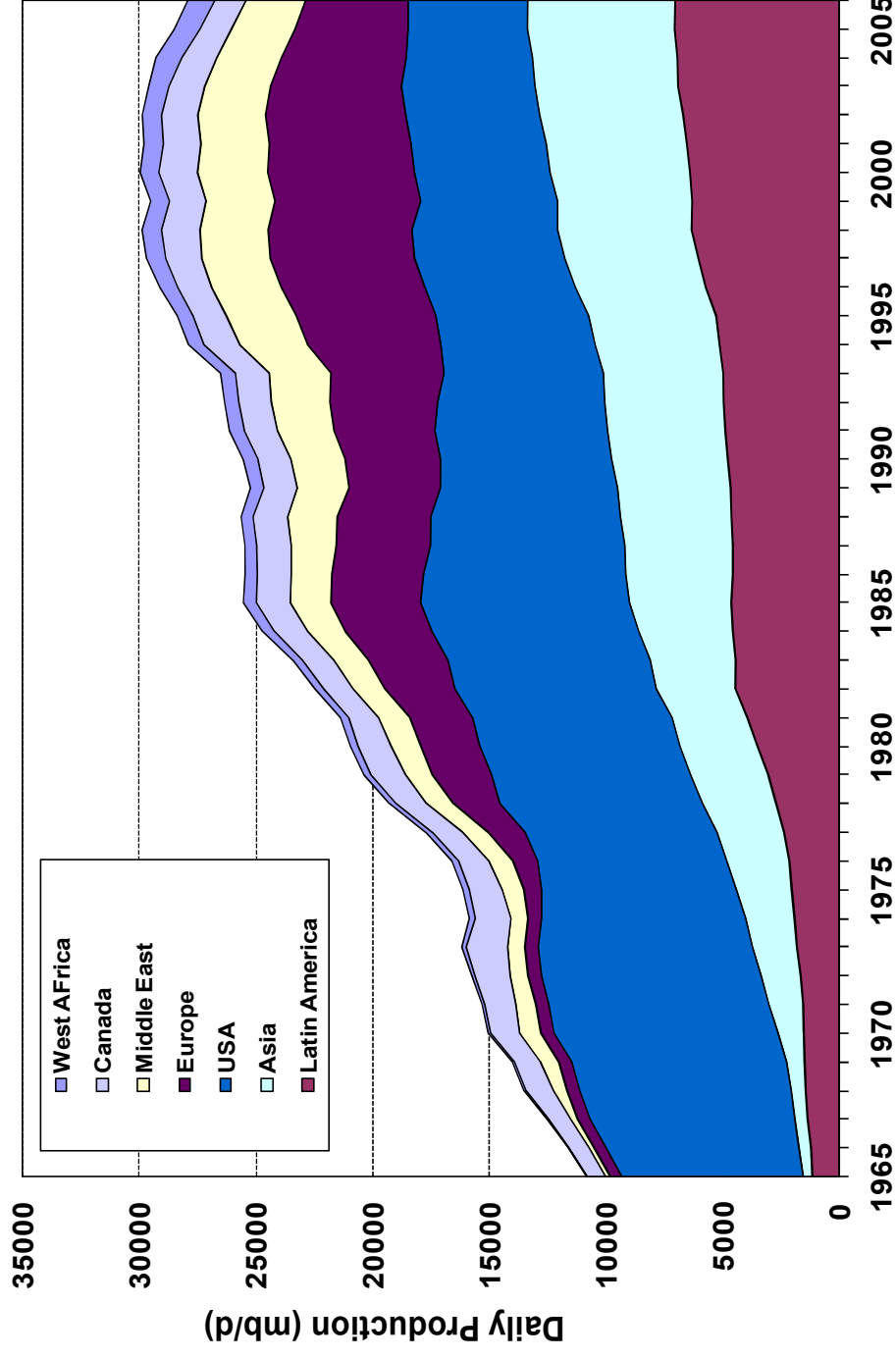
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Conventional Non-OPEC and Non-FSU Production Key Messages



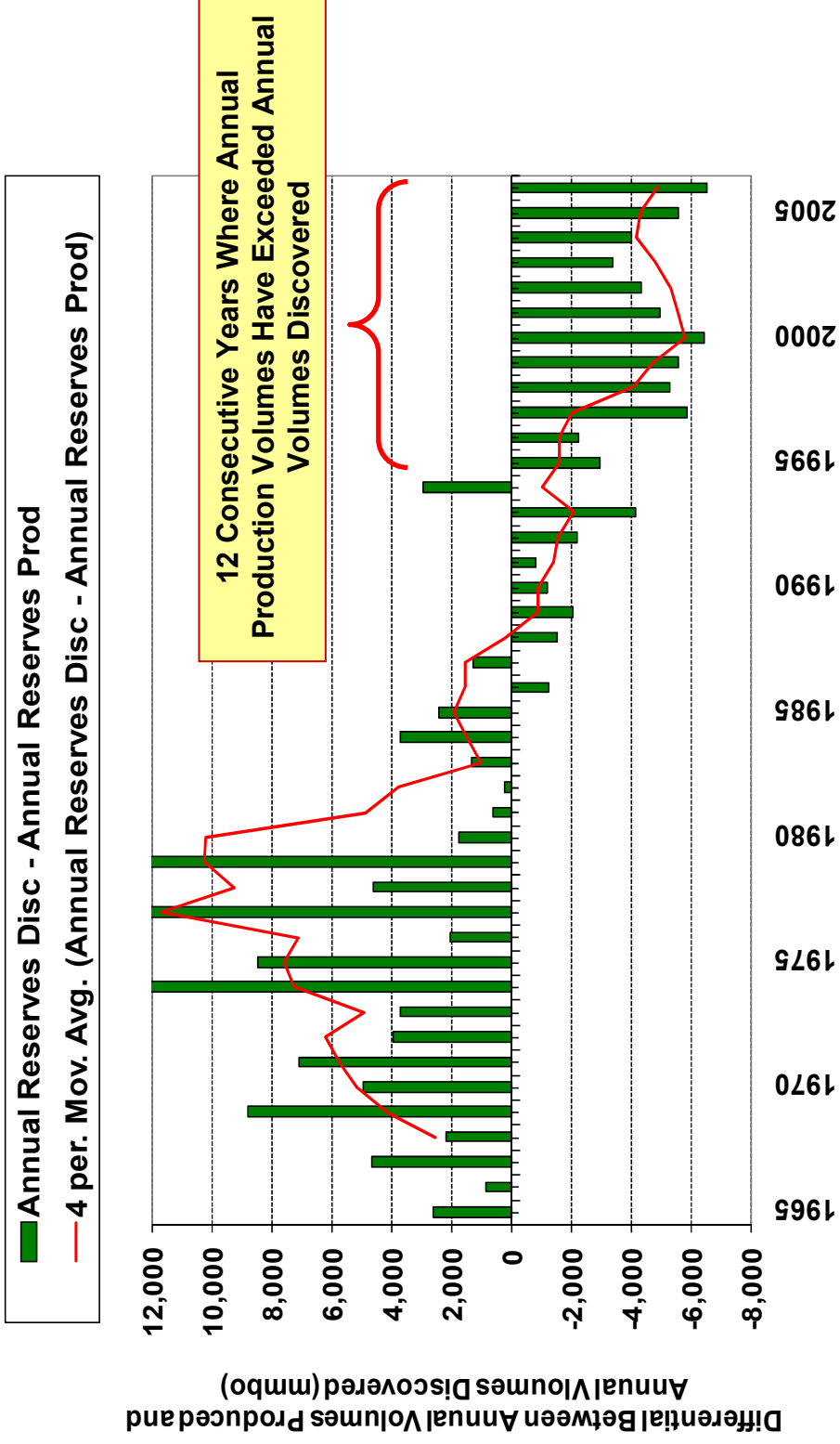
- Production from this group of regions was flat for six years and is now in decline.
- A comparison of discovered and produced volumes suggests that this region has been running a negative oil balance (producing more reserves than new reserve additions from exploration) since the late 1980s – *current production volumes exceed new volumes discovered by 4.0 billion barrels per annum*
- Production growth stopped once depletion levels reached approximately 50% with current depletion levels approaching 60%.
- If over the next two decades, exploration reserves are discovered at rates similar to those experienced since 1990, then production should stay slightly above 20 mmb/d through the year 2015 – *models do suggest that even with new fields coming on stream, it is unlikely that there will be significant production growth*

Historical Non-OPEC Crude Production (excluding FSU, NGLs and Unconventional Heavy Oil)



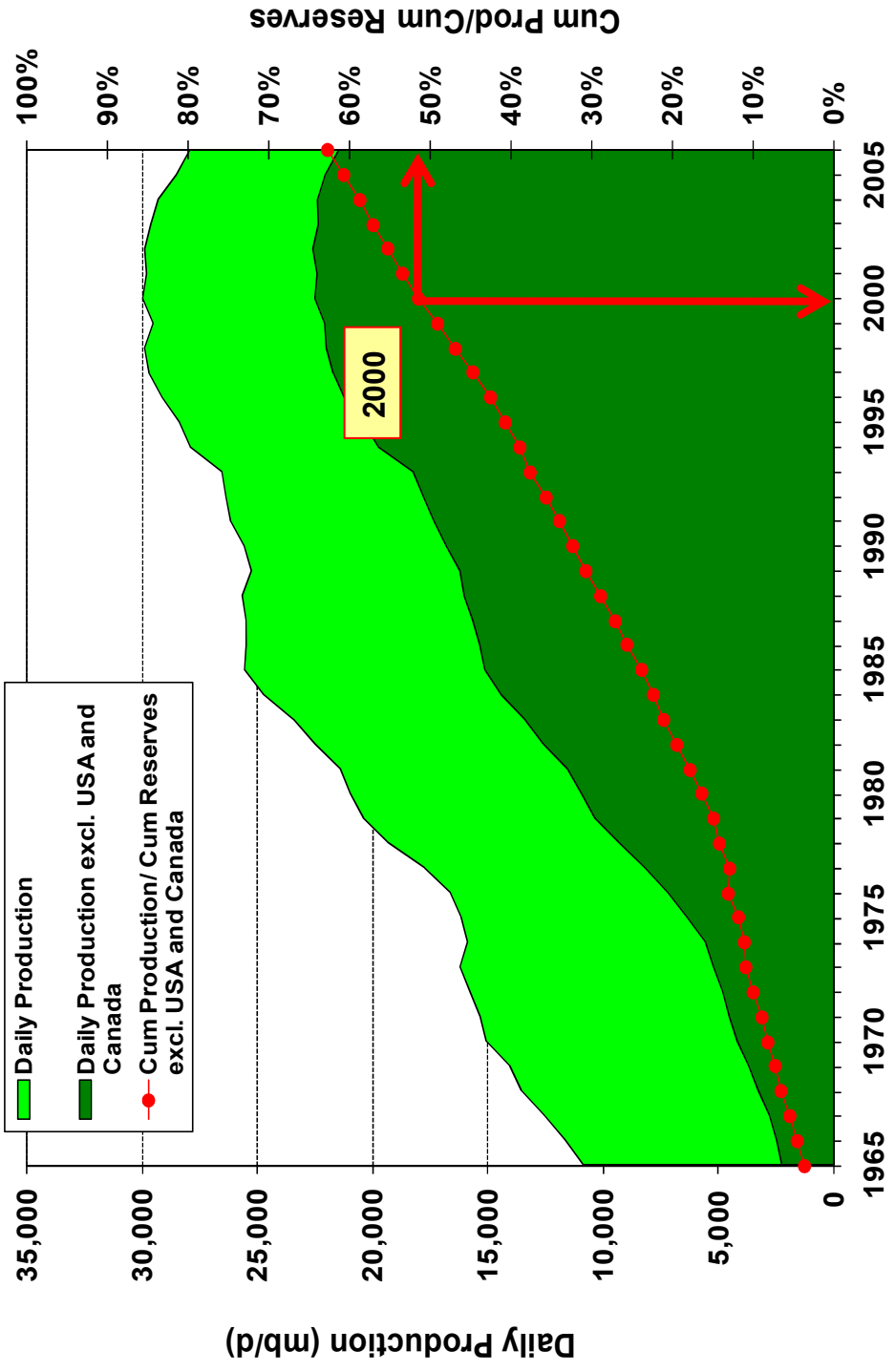
Several key producing regions have reached or exceeded the critical depletion point of 50-60%, which typically marks the onset of production decline. Production gains from new projects have not increased the overall production.

Annual Non-OPEC Crude Production Balance (excluding FSU, USA, and Uncon. Heavy Oil)

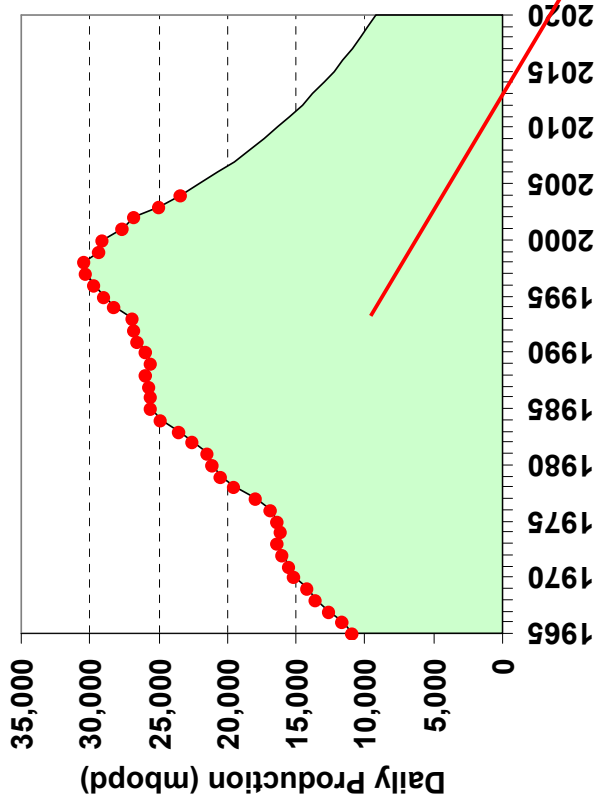


PFC Energy's analysis indicates that countries within this group have, in aggregate, been producing 4-5 billion barrels each year more than they have been finding through exploration since the mid-1990s.

Non-OPEC and Non-FSU Crude Production and Depletion Curve (excluding Uncon. Heavy Oil)

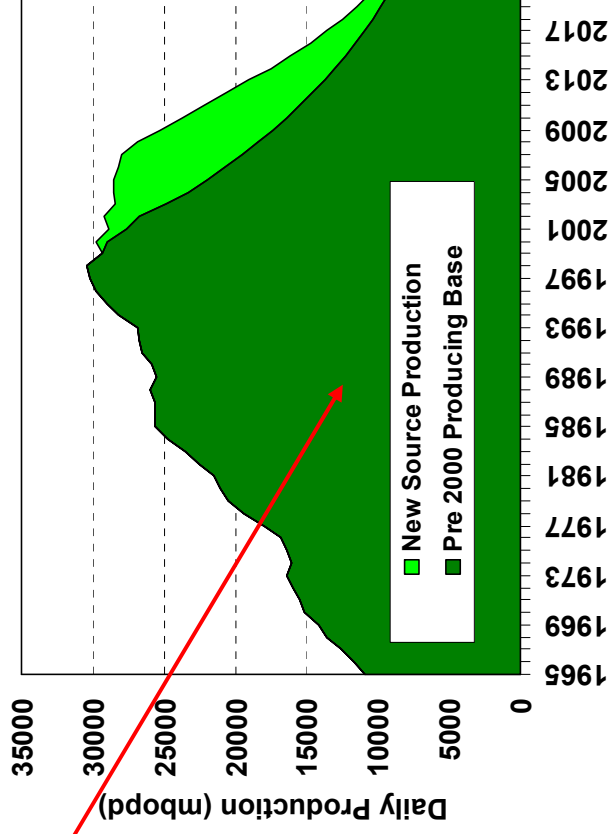


Non-OPEC and Non-FSU New Incremental Prod. Can Not Offset and Overcome Base Prod. Declines

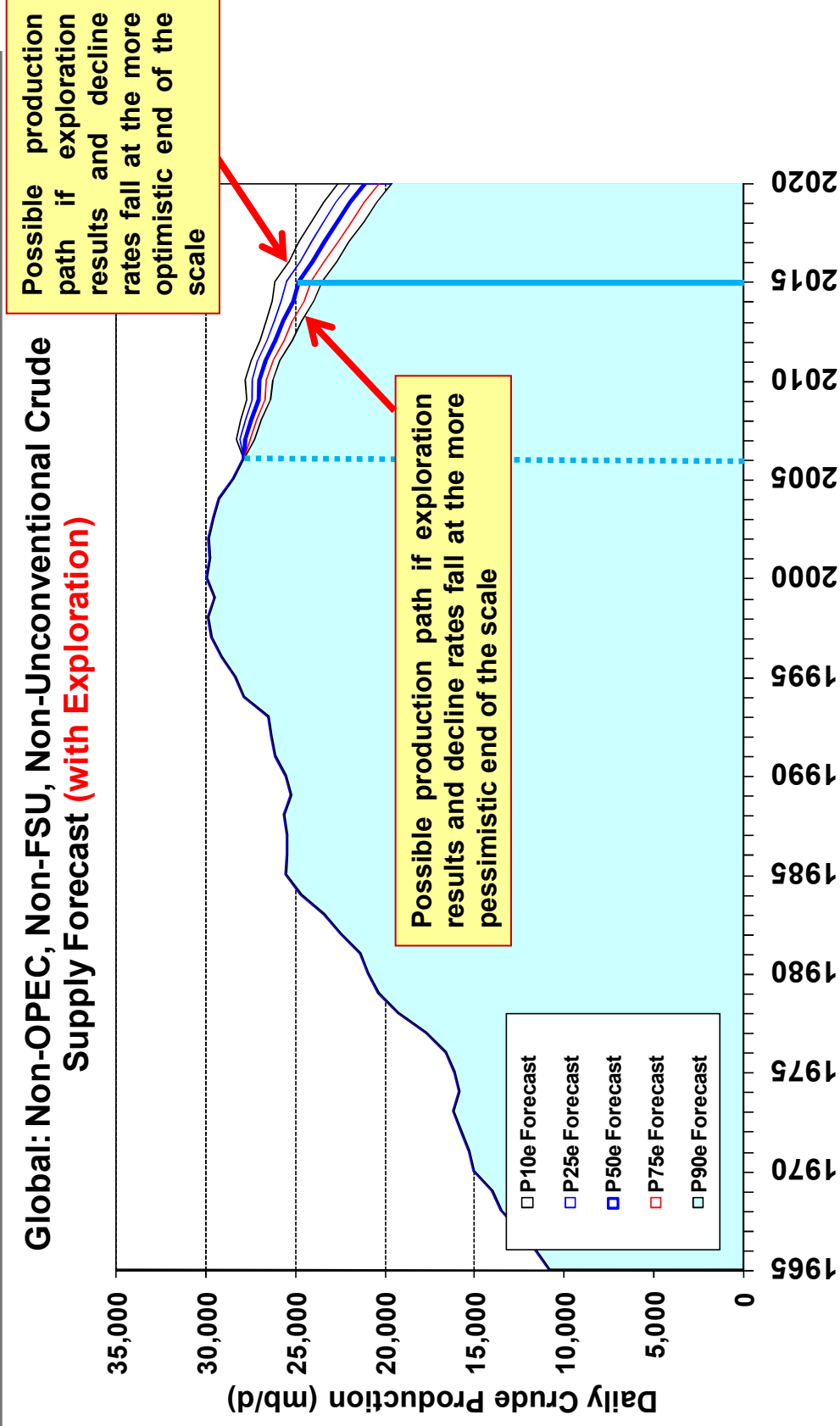


Production from the base onstream prior to the late 1990s has been declining at an average rate of 4% - a forward looking rate versus cumulative production model (using the P1+P2 total reserve volume) suggests that the reserve base producing nearly 30 million barrels per day in the year 2000 will be producing less than 10 million barrels by 2020.

Known new source projects including all commercial deepwater projects that are either developed, sanctioned, or likely to be commercial will only be able to support a flat production profile due to steep decline of the underlying base.



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



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.

Regional Crude Supply Forecast: FSU / Eastern Europe

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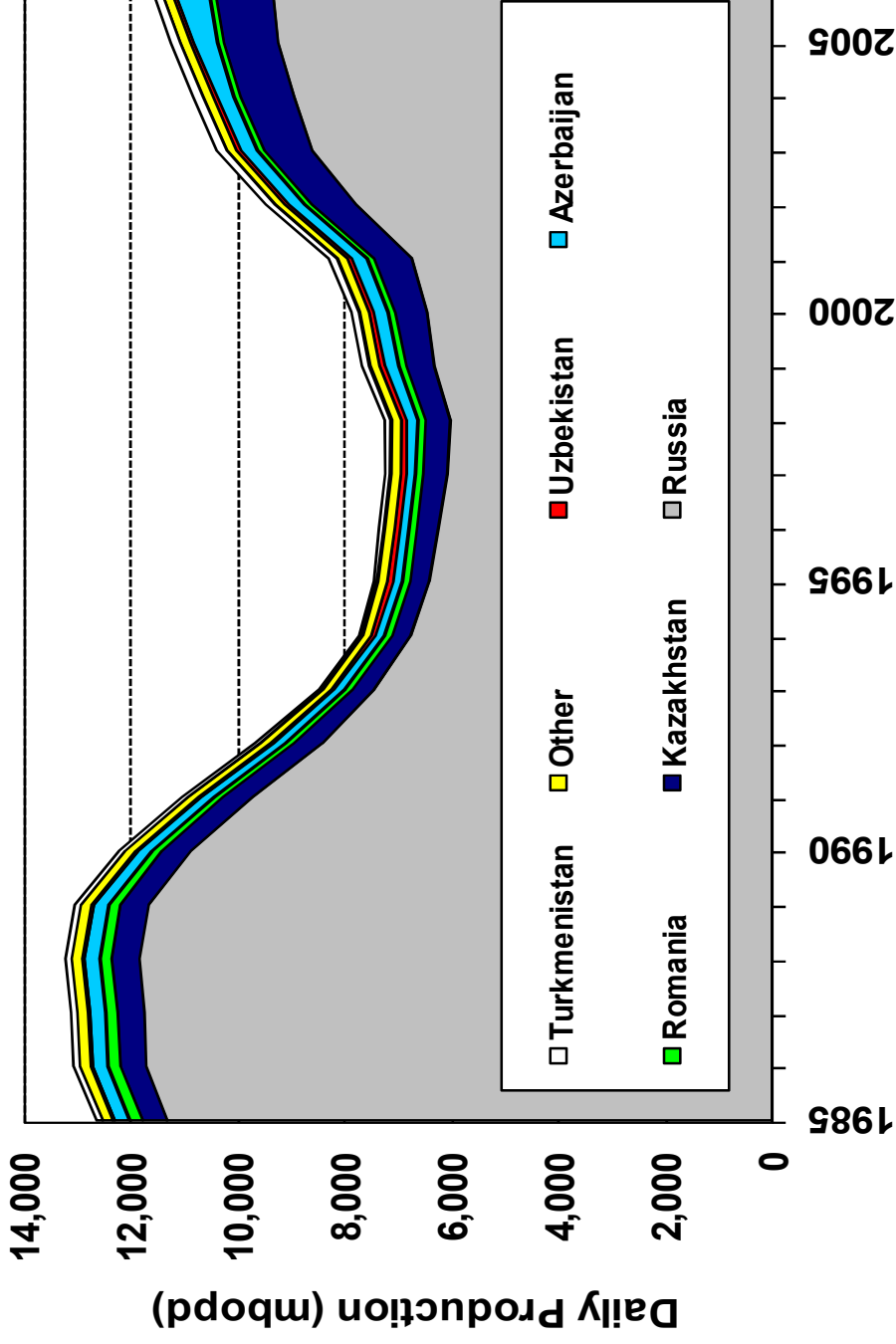
Countries in FSU-EE: Russia, Kazakhstan, Turkmenistan, Uzbekistan, Azerbaijan, Romania, Ukraine, Belarus, Slovakia, Czech Republic, Hungary, Poland, Kyrgyzstan, Tajikistan, Georgia, and other Baltic countries

FSU / Eastern Europe Key Messages



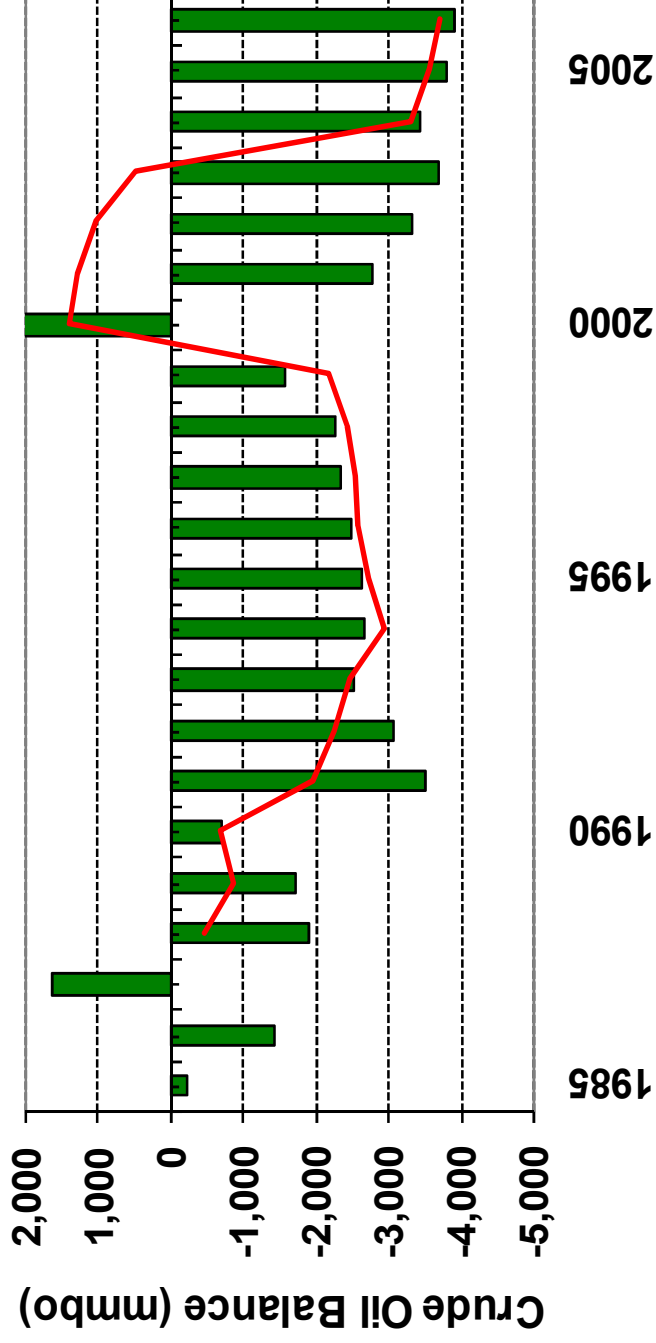
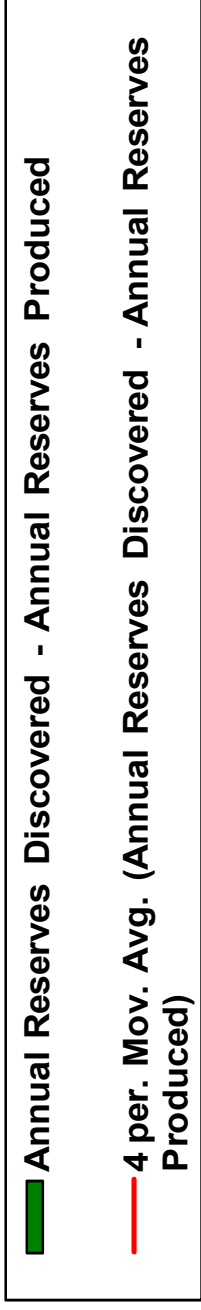
- Regional production dominated by Russia, yet Kazakhstan and Azerbaijan will continue to grow. Given a recent trends in exploration, the production level could reach 13 to 16 mmb/d by 2015.
- Production growth is expected to increase significantly over the next 5 to 10 years due to a string of new projects in Kazakhstan and Azerbaijan, and the development of East Siberia in Russia.
- A comparison of discovered and produced volumes suggests that the region ran a negative oil balance i.e., producing more than discovering new reserve, since the late 1980s - **current production volumes exceed new volumes discovered by around 4.0 billion barrels**
- It is estimated that regional crude oil depletion level are approaching 50%.

FSU / Eastern Europe Crude Oil Production



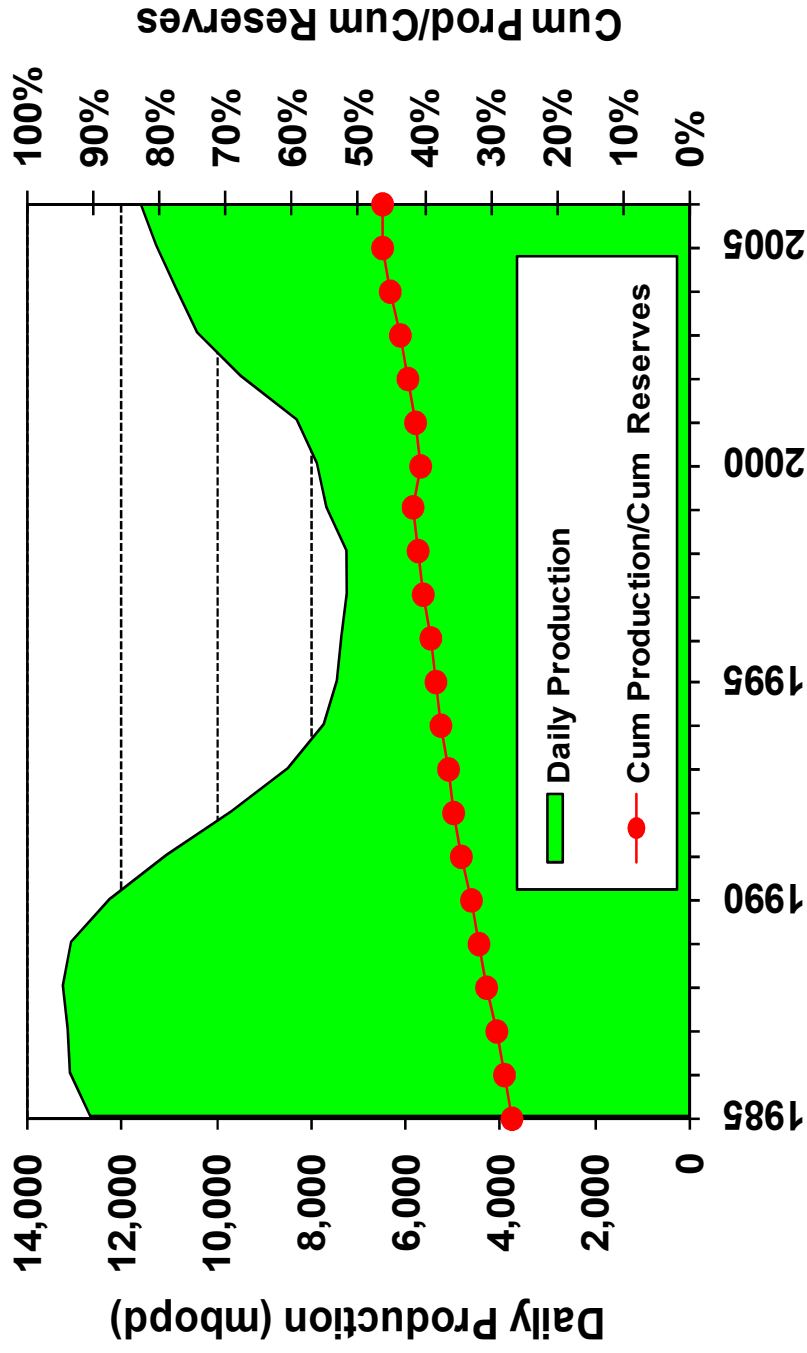
Historical production in the FSU – EE region has been dominated by Russia, which is currently producing ~9,600 mbopd – **surpassing Saudi Arabia as the largest global oil producer**

FSU / Eastern Europe Crude Oil Balance



Apart from the discovery of Kashagan in 2000, countries in this region have been producing more crude oil than they have been discovering annually since the late 1980's.

FSU / Eastern Europe Crude Oil Depletion



The FSU – EE region has depleted greater than 45% of its initial recoverable oil reserve base.

East Siberia: Huge Growth Potential due to Number of Large Undeveloped Fields*

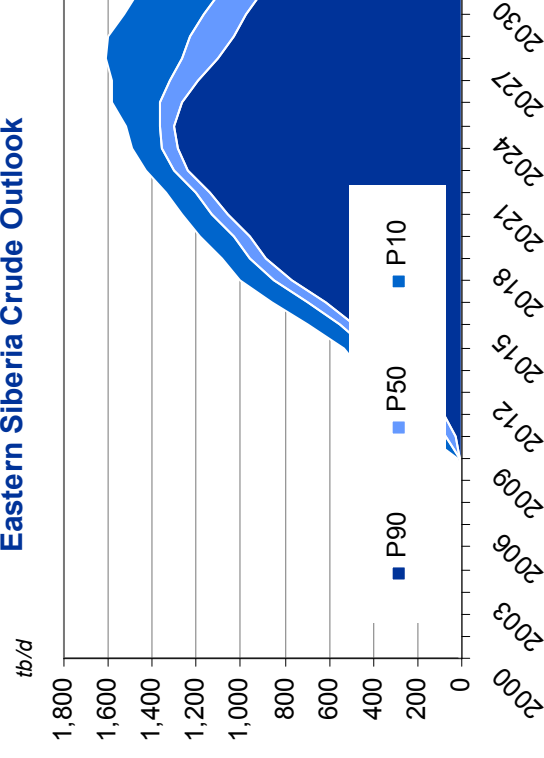


Proved & Probable Reserves			
Field Name	License-Owner	Oil, mmbbl	Gas, bcf
Chayandinskoye	Undistributed	367	43,822
Chulakanskoye	Evenk Energy Co.	150	643
Sanarskoye	Rosneft	132	0
Mogdinskoye	Rosneft	147	565
Vostochno-Sugdinskoye	Rosneft	440	1,483
Vankorskoye	Rosneft	1,959	2,712
Tympuchikanskoye	Sibneft	125	473
Tukolano-Svetlaninskoye	Slavneft	327	1,363
Chambinskoye	Slavneft	740	0
Kuyumbinskoye	Slavneft	1,100	n/a
Verkhne-Chonskoye	TNK-BP	1,478	3,373
Sobinskoye	Gazprom	147	5,580
Yurubcheno-Tokhomskeye	VSNNK	1,740	13,678

Major new source field start-up times	
Kuyumbinskoye	2009
Vankor	2010
Talakanskoye	2010
Verkhne-Chonskoye	2013
Vankor Satellites	2014
Vostochno-Sugdinskoye	2016
Chambinskoye	2016
Yurubcheno-Tokhomskeye	2018
Tukolano-Svetlaninskoye	2020
Srednebotuobinskoye	2020
Chayandinskoye	2020

- Timely field start-ups add to East Siberian output throughout forecast period.
- Under the base case (P50), East Siberian oil production would exceed ESPO 1st stage capacity (600 kb/d) in 2016 but East Siberian oil output will be not be sufficient for 1st Stage ESPO until 2015-2016

Eastern Siberia Crude Outlook

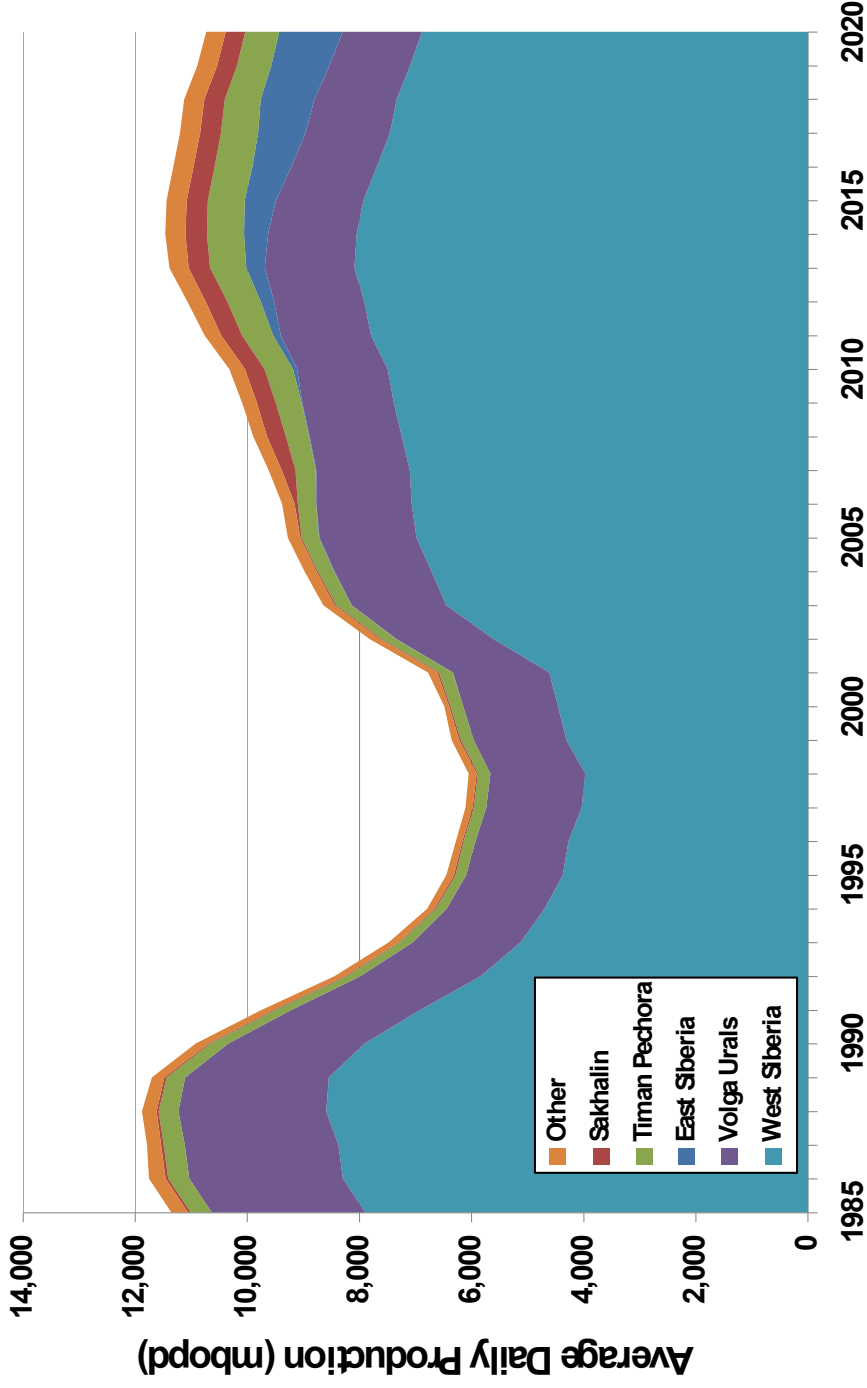


*fields containing over 100 mmbbl

Russia: Primary Producer Containing 3 Major Basins with Remaining Growth Potential



Russia Crude Forecast by Basin - with Exploration

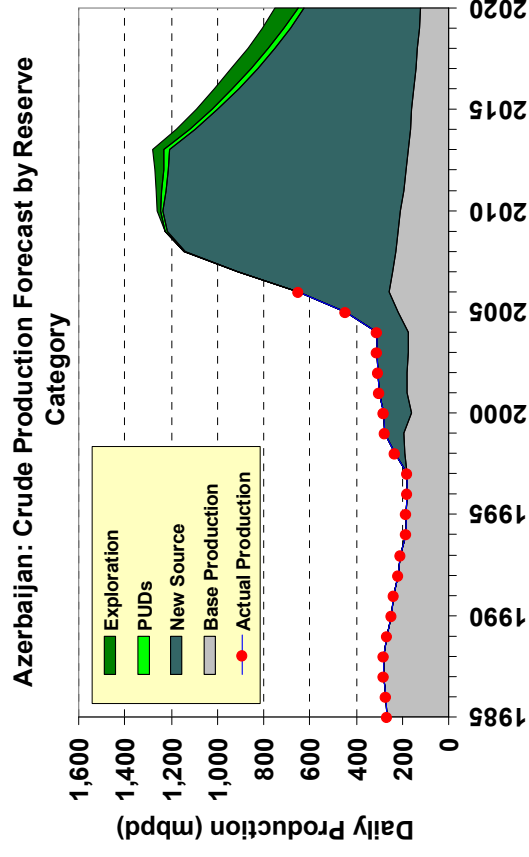
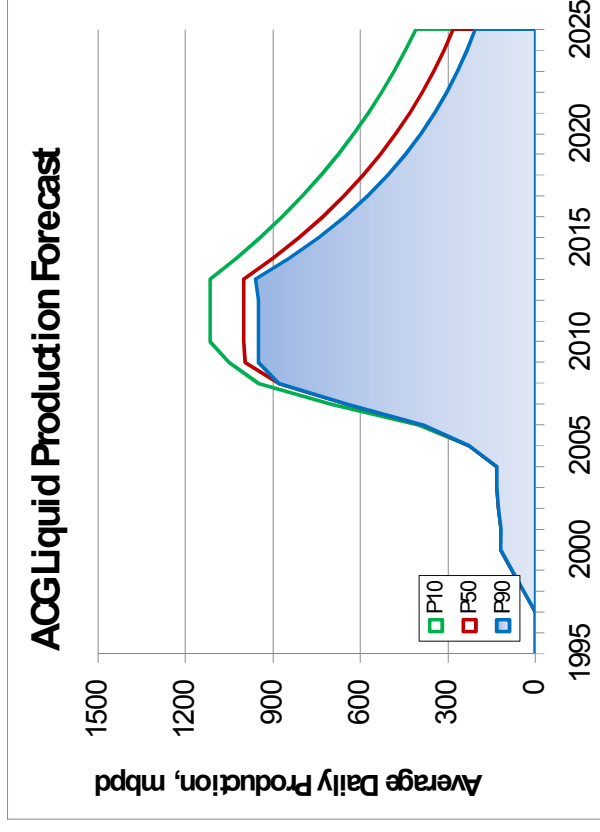


Due to the enormity of the reserve base in West Siberia, there is still a significant amount of potential crude production growth in the basin.

Azerbaijan: ACG the Main Driver for Future Growth



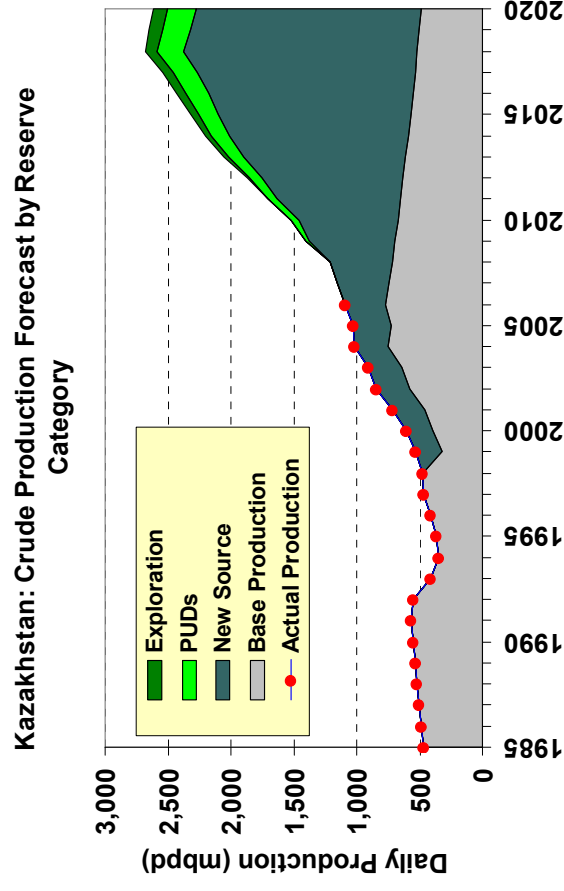
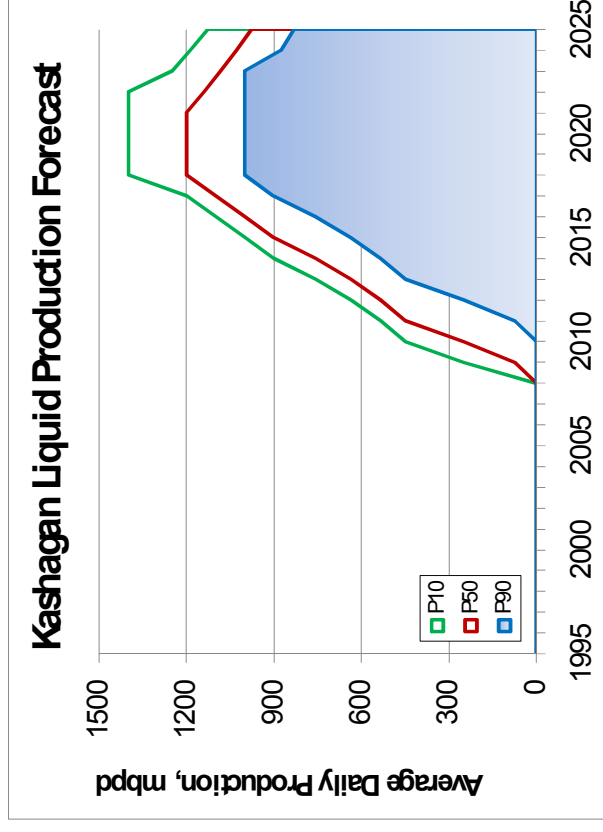
- Partners:**
 - BP* 34.1%, Chevron 10.3%, Inpex 10%, Socar 10%, Statoil 8.6%, ExxonMobil 8%, TPAO 6.8%, Devon 5.6%, Itochu 3.9%, Delta Hess 2.7%
- Gross production is expected to reach 1 mmb/d after Phase 3 development is completed.
- In 2010, production from ACG will comprise approximately 85% of total crude production from Azerbaijan.
- Total crude production from Azerbaijan will peak at 1.2 to 1.4 mmb/d towards the end of this decade, and plateau in that range for ~7 years before declining.



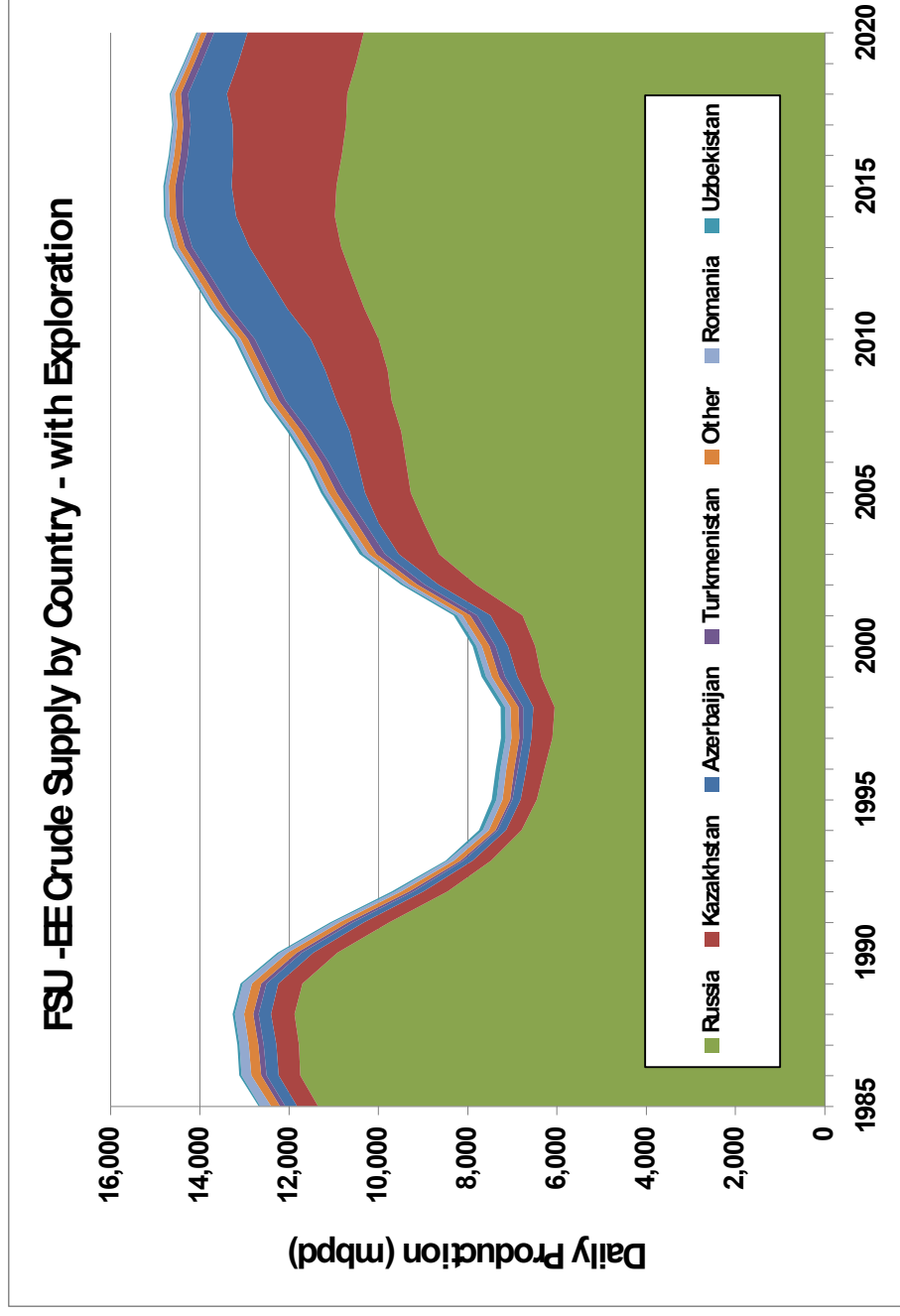
Kazakhstan: Kashagan the Main Driver for Future Growth



- **Partners:**
 - Eni* 18.52%, TOTAL 18.52%, Shell 18.52%, ExxonMobil 18.52%, ConocoPhillips 9.26%, Inpex 8.33% KazMunaiGaz 8.33%
- **Production delays caused by project economics make start date variable.**
- **Kashagan gross recoverable reserves range from 9 to 13 billion barrels.**
- **Overall production in Kazakhstan will increase dramatically over the next ten years to a peak of 2.5 to 3.0 mmb/d.**



FSU-Eastern Europe: Crude Supply by Country

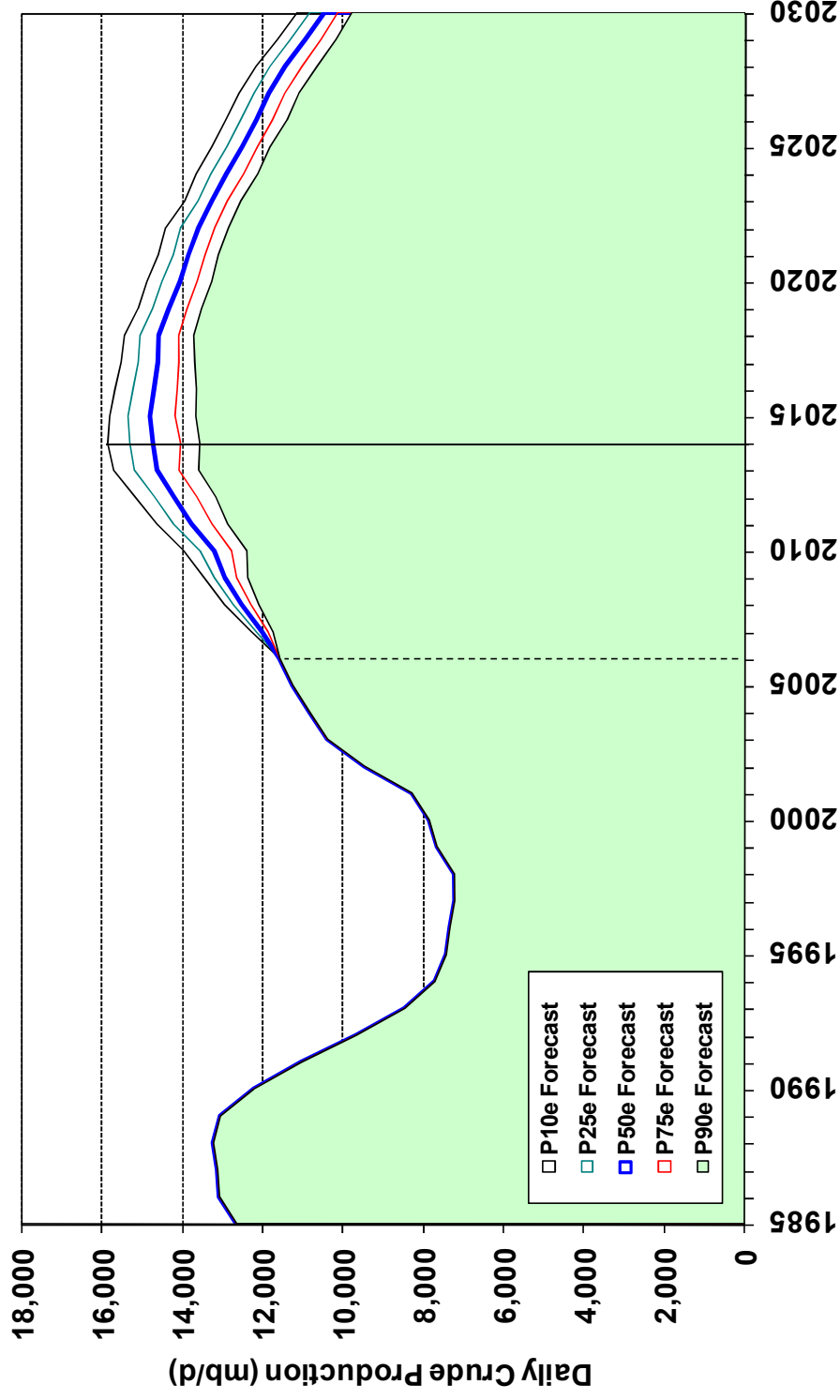


There could be 1,500 to 2,500 mbpd of crude production growth in the FSU – EE by 2015 due to new projects and exploration potential in Azerbaijan, Kazakhstan, and Russia.

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 mbpd by the middle of the next decade.

Outlook for Unconventional Heavy Oil: ***Canada & Venezuela***

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Unconventional Heavy Oil Key Messages

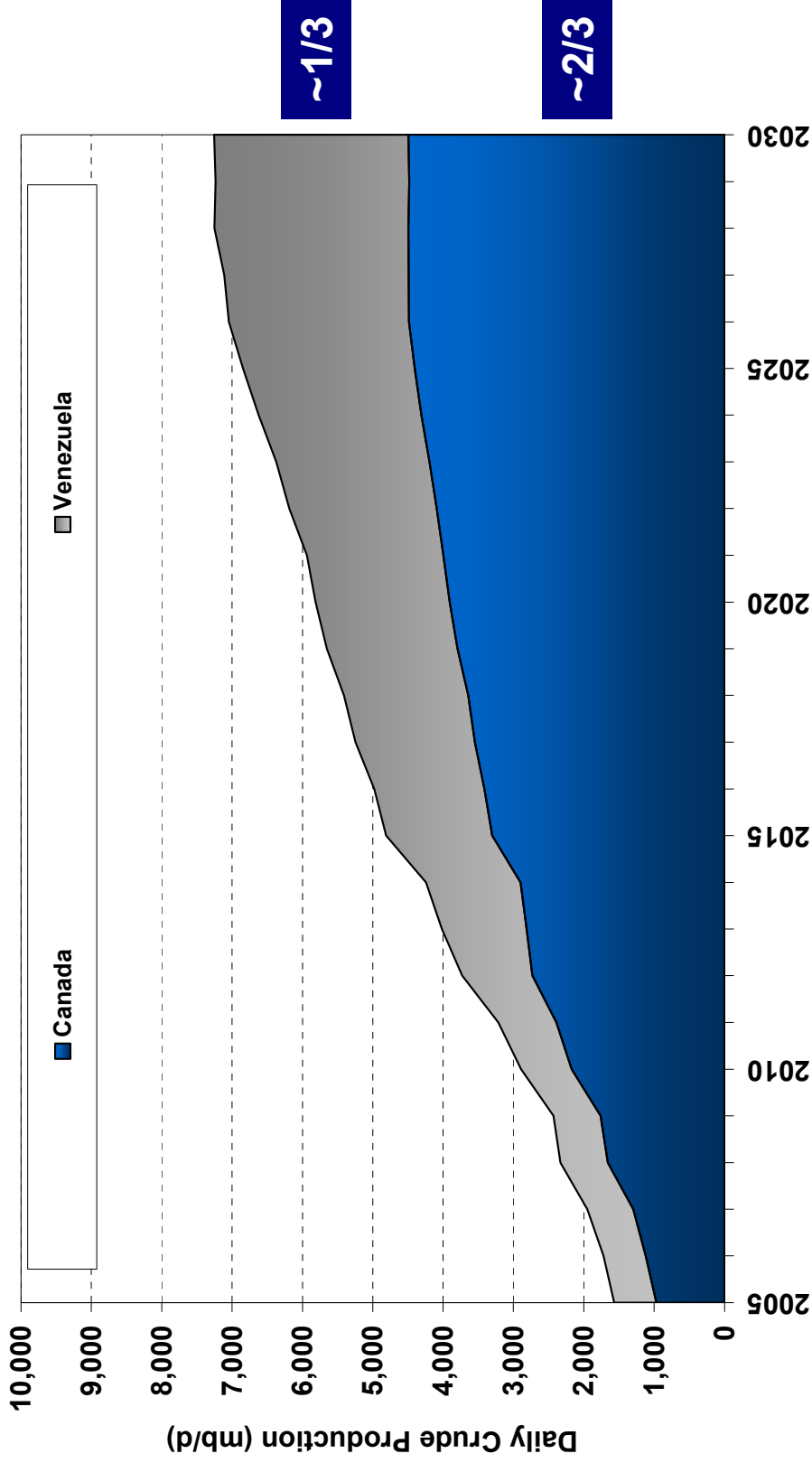


- Total unconventional heavy oil production in 2006 was ~1.7 mmb/d, but this is expected to increase to ~ 5 mmb/d in 2015.
- Canada produces ~65% of total unconventional heavy oil production, while Venezuela produces ~35%.
- Being a large and sustainable reserve base, unconventional reserves have attracted significant investment yet there are potential future constraints.
- **Potential Project Management Constraints:**
 - Costs
 - Labor Availability
 - Materials
 - Politics
- **Potential Production Growth Constraints:**
 - Environmental
 - Pipelines
 - Availability of Gas and Diluent

Regional Distribution of Heavy Oil Forecast



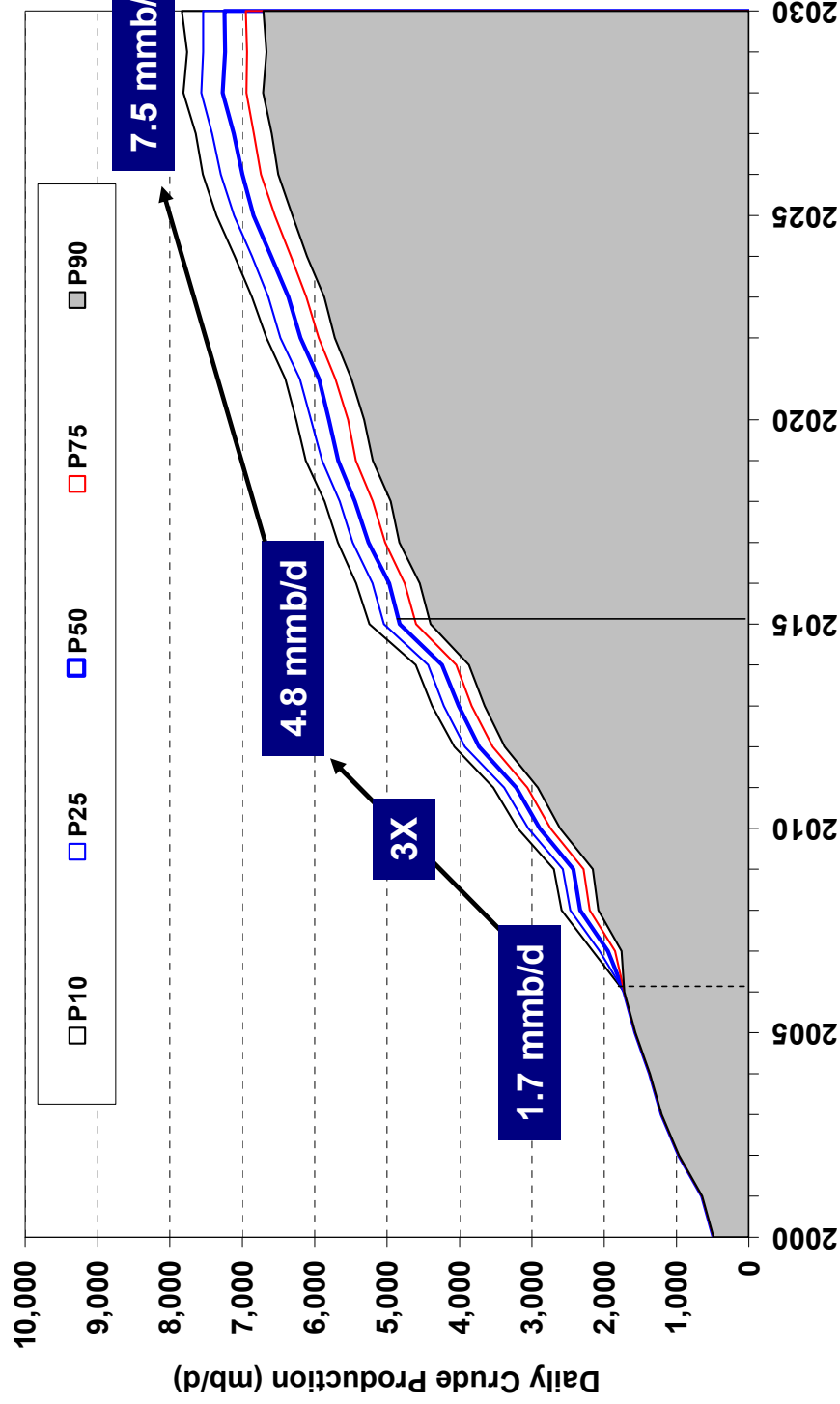
Global Unconventional Crude Supply Forecast



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.

Unconventional Heavy Oil Forecast

Global Unconventional Crude Supply Forecast

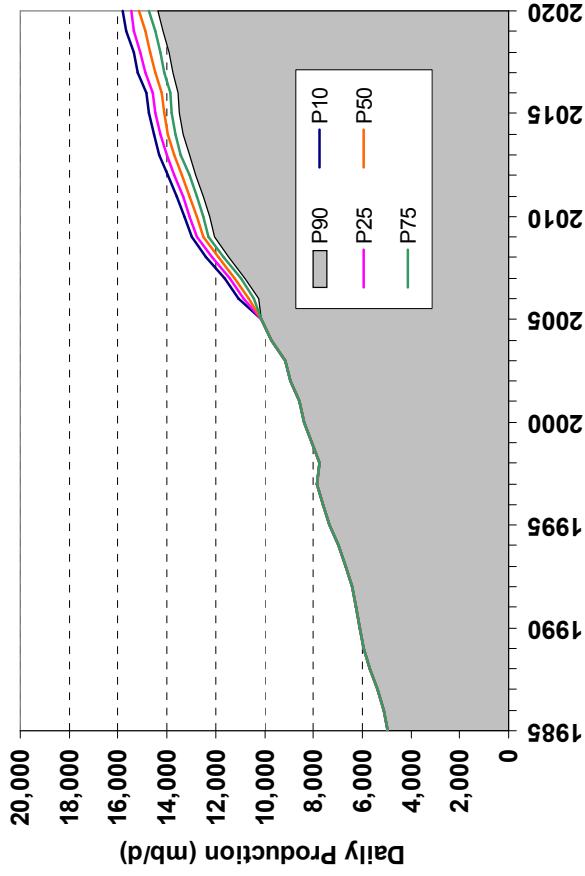


- 2006 total unconventional heavy oil production was ~1.7 mmb/d
- 2015 total unconventional heavy oil production is expected to reach ~4.8 mmb/d

Natural Gas Liquid Production Forecast

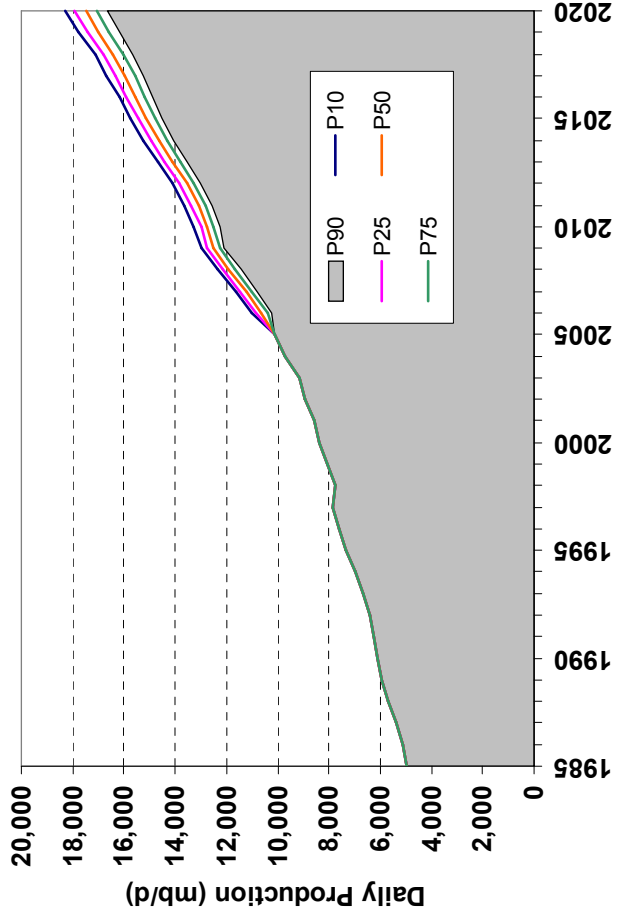


Global NGL Production Forecast (Without Exploration)



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.

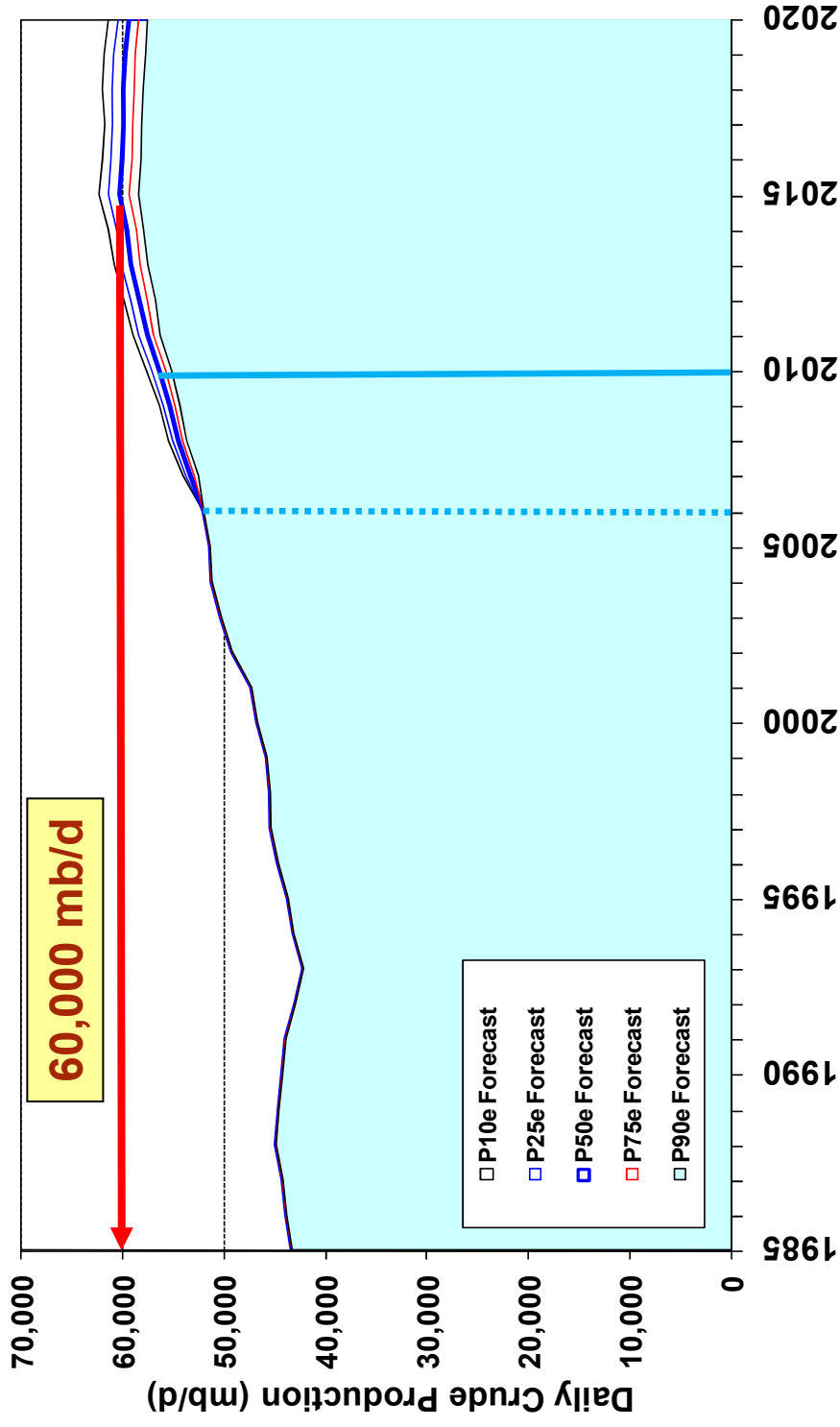
Global NGL Production Forecast (With Exploration)



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.

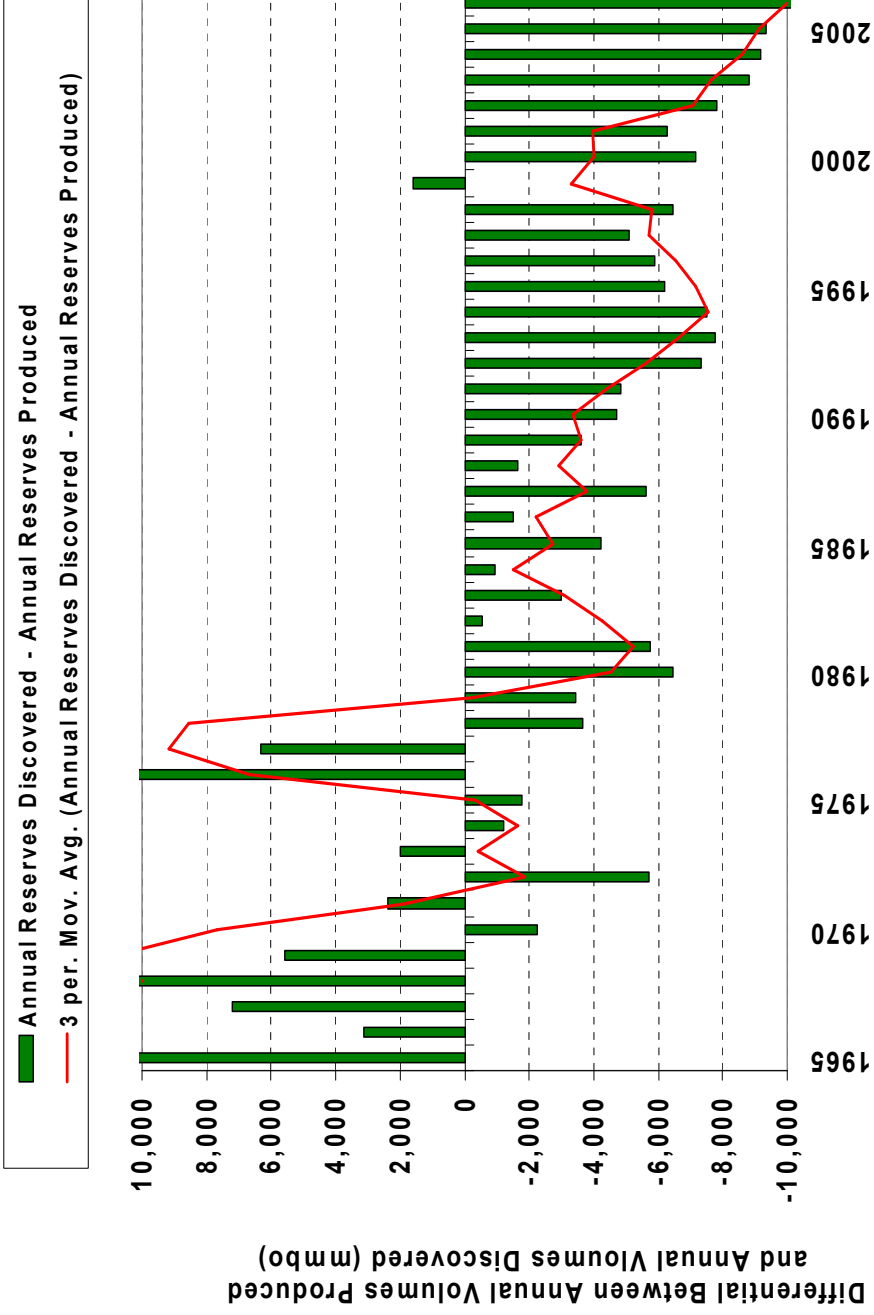
OPEC Outlook

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Concerns With OPEC Reserves

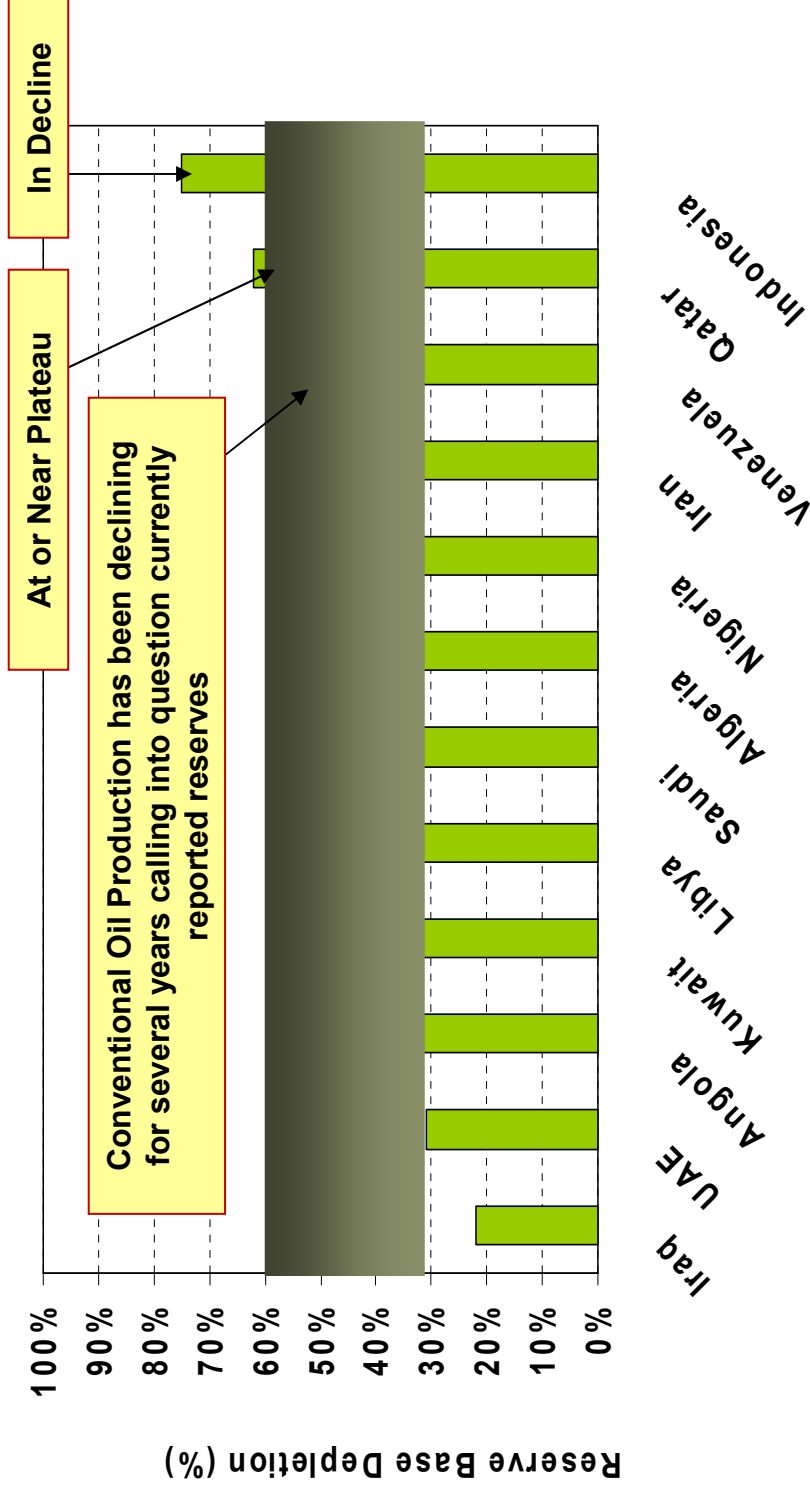
- The real issue here is that we really do not know what several key OPEC countries reserves really are because there is no way to independently verify them as we can in most non-OPEC countries where you have foreign companies doing the exploration and development.
- The shape and style of these country's 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.
- 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.**

OPEC Historical Annual Crude Production Balance (OPEC)



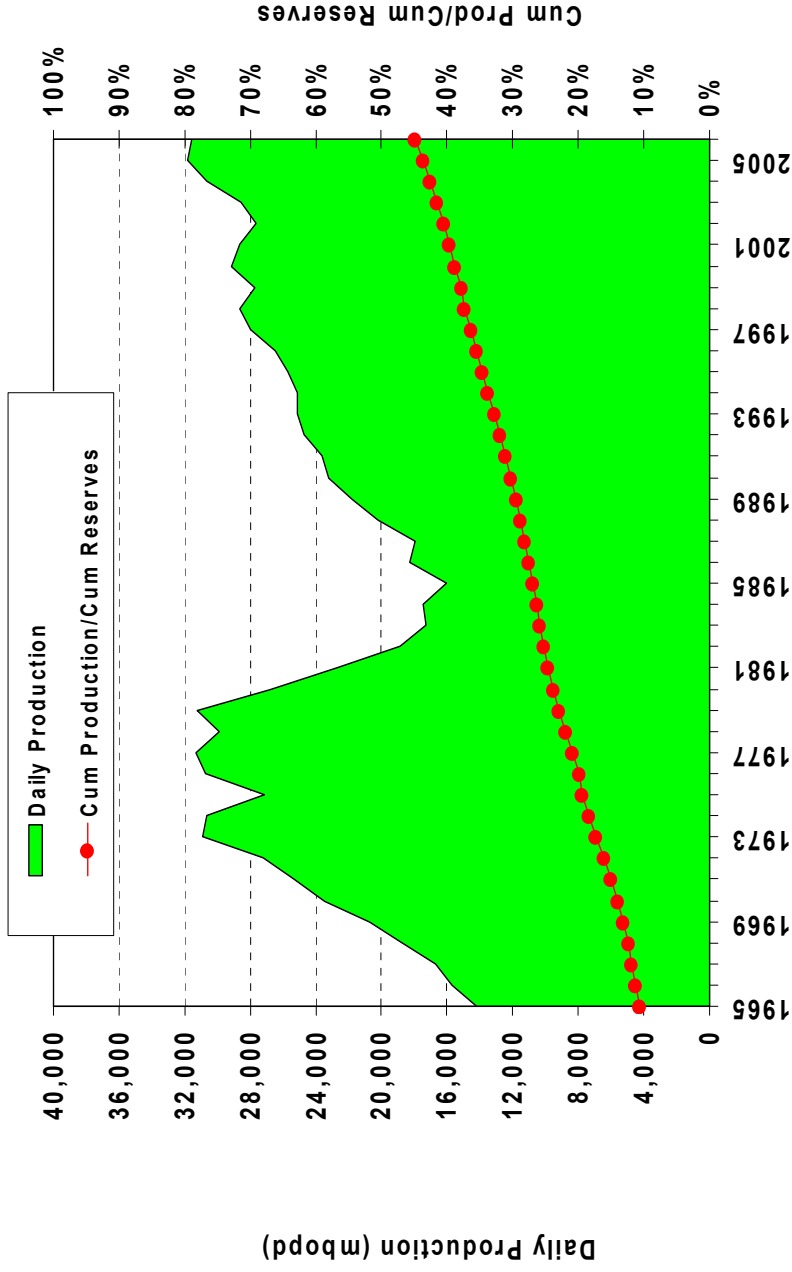
Like all other areas of the world, PFC Energy's data analysis indicates that Global OPEC crude production is currently exceeding volumes discovered.

Historical Production and Depletion Levels (OPEC)



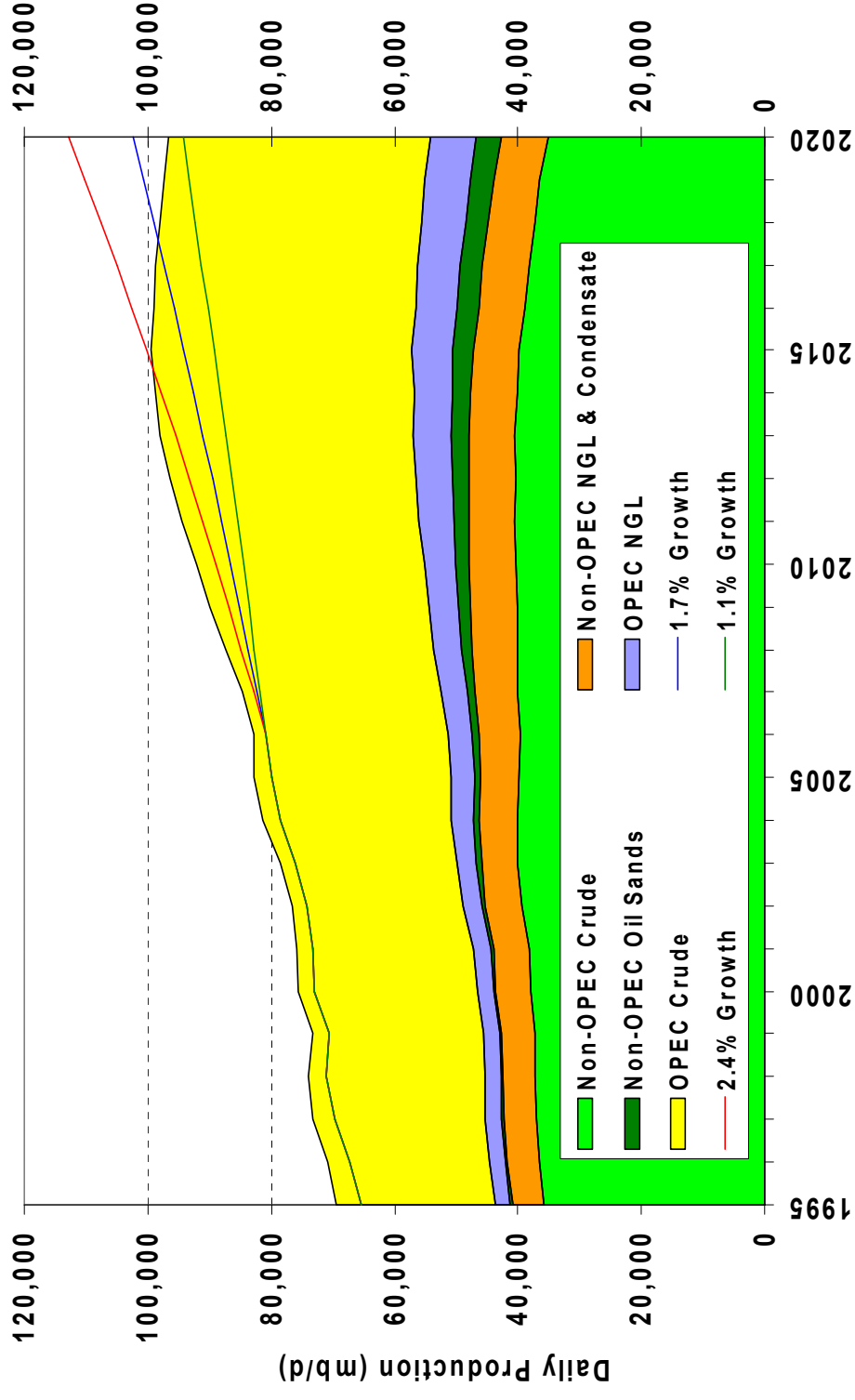
OPEC as a whole is depleting but some countries are depleting faster than others

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





Strategic Advisors in Global Energy

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- ▶ Calgary
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