

Global Energy Scenarios Report

Oil Business-as-Usual and the Green Case

for Dr. Vlasios Voudouris

The Struggle

No Regrets

**2011 - 2035
Scenario
Assignment**

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OIL SCENARIOS

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OIL SCENARIOS

EXECUTIVE SUMMARY

Two different global oil consumption scenarios were run, the “Struggle” which describes business as usual in the oil market and a second scenario, “No Regrets”, this scenario models improved vehicle efficiency standards. On the global oil production side ten possible scenarios were run to 2035. This work was performed to advise ZeeBee Oil to estimate the impact of vehicle efficiency standards on global oil demand by 2035. And to compare this with the likely production forecast and to establish how this compares with both oil consumption scenarios.

The key driver of oil consumption is vehicle use, whose growth is underpinned by both population and income increases. From 2000 vehicle numbers have increased from 751 million to 1 billion in 2010 and are forecast to increase to 2 billion by 2040. Under the Struggle, global oil consumption is forecast to grow slowly from its current demand of 32 million barrels a day by an average of 0.75% per annum over the next 22 years. In 2035 global oil consumption will be 38.4 million barrels a day. Under the No Regrets scenario, global oil consumption is forecast to even more slowly at an average of 0.35% per annum over the next 22 years, a more than 50% reduction. In 2035 global oil consumption will be 34.8 million barrels a day.

The future of global oil production sees global oil supply been maintained, which with rising Chinese oil demand keeping pressure on oil prices. Continued US\$100+ a barrel oil price will encourage high extraction cost oil sources such as oil sands, shale oil and deep water oil fields.

This reduction is achieved through governments implementing fuel efficiency standards for motor vehicles, greater adoption of electric and alternative fuel vehicles.

OIL SCENARIOS

BACKGROUND AND METHODOLOGY

This section will discuss the approach used to model oil consumption and production.

BACKGROUND

The Client, “Zeebee Oil” a world major oil supplier engaged Team Global, a world leading energy consultancy to advise on the impact of vehicle efficiency standards on oil consumption forecasts and thus the global oil demand/supply balance. To achieve this we will forecast two (2) oil consumption scenarios. The base case, is the business as usual forecast called, the “Struggle”. This forecast sees the growth in oil consumption continue on its current path. The second scenario is titled, “No Regrets”, this scenario models the impact of vehicle efficiency standards on oil consumption forecasts.

Under the No Regrets scenario, global oil consumption is forecast to even more slowly at an average of 0.35% per annum over the next 22 years, a more than 50% reduction. In 2035 global oil consumption will be 34.8 million barrels a day. This reduction is achieved through governments implementing fuel efficiency standards for motor vehicles, greater adoption of electric and alternative fuel vehicles.

On the global oil production side ten possible scenarios were run to 2035. The global oil market is forecast to remain buoyant with demand rising under and production remaining flat.

METHOD

The base case, the Struggle, is compared with the No Regrets scenario. Analysis of global oil consumption and production for oil will first be put in the context of leading consumers and producers of oil, including:

- United States of America
- Russia
- China
- Global

For each of the three countries investigated, key drivers are identified behind the growth in natural gas consumption for each country and of the ten production scenarios.

United States of America

BACKGROUND ON COUNTRY



The United States has a total population of 317.8 million, from 2014 according to the US Census and the population clock. This makes it the third-most populous country in the world. It is expected that the United States population will increase by about 20% from 2012 to 2035. And energy use is forecast to grow by only 12%, with energy use per capita declining by 8% from 2012 to 2040, according of the US Department of Energy. The United States is the world's largest consuming of oil and the third-largest petroleum producer, with more than 500,000 producing wells and approximately 4,000 oil and natural gas platforms operating in U.S. waters.



United States of America

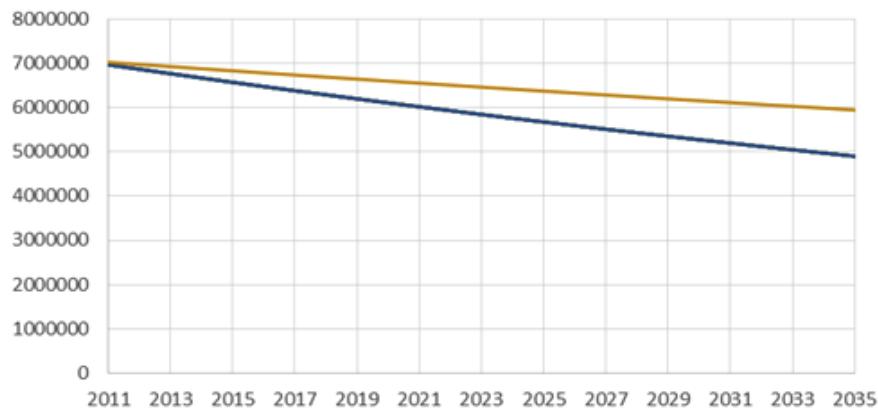
DRIVING FORCES FOR OIL DEMAND FOR STRUGGLE AND NO REGRETS

The transportation sector dominates demand for petroleum and other liquids in the US. Within the sector there is a shift from motor gasoline, which loses more than share of the total transportation, to distillate, which gains about 10% of the total). Usage of compressed natural gas and LNG in vehicles is increasing. Consumption of petroleum and other liquids increases in the industrial sector, but decreases in all the other end-use sectors. In general, U.S. oil production rates depend on resource availability and advances in technology: the costs of drilling and operating those wells, and the revenues they generate. Since 2005 shale oil and shale gas are playing more and more important role in the energy mix of US.

Oil consumption in US started moving sideways-to-downward around the time of the 2008 financial crisis. The same development is expected to follow in the future. Main factors and drivers of these development will be: increasing importance of energy efficiency, rising gasoline prices, improving car efficiency, economic recession, rising unemployment.

Americans are buying hybrid and electric vehicles, and manufacturers are engineering traditional gasoline engines to be more fuel-efficient. The biggest component of contraction in US oil demand is vehicle miles traveled (VMT) being declining. The past five years have seen the longest sustained period of non-growth of vehicle miles travelled (VMT) in US history. The reason for this are rising gasoline prices.¹

US Oil Demand “No Regrets” vs “The Struggle”



As production of conventional oil is declining heavily, this pushes prices of oil higher and high prices are driving demand down. With domestic demand staying more or less flat over the past few years and declining slightly in the future, America's role in driving global oil demand is diminishing.²

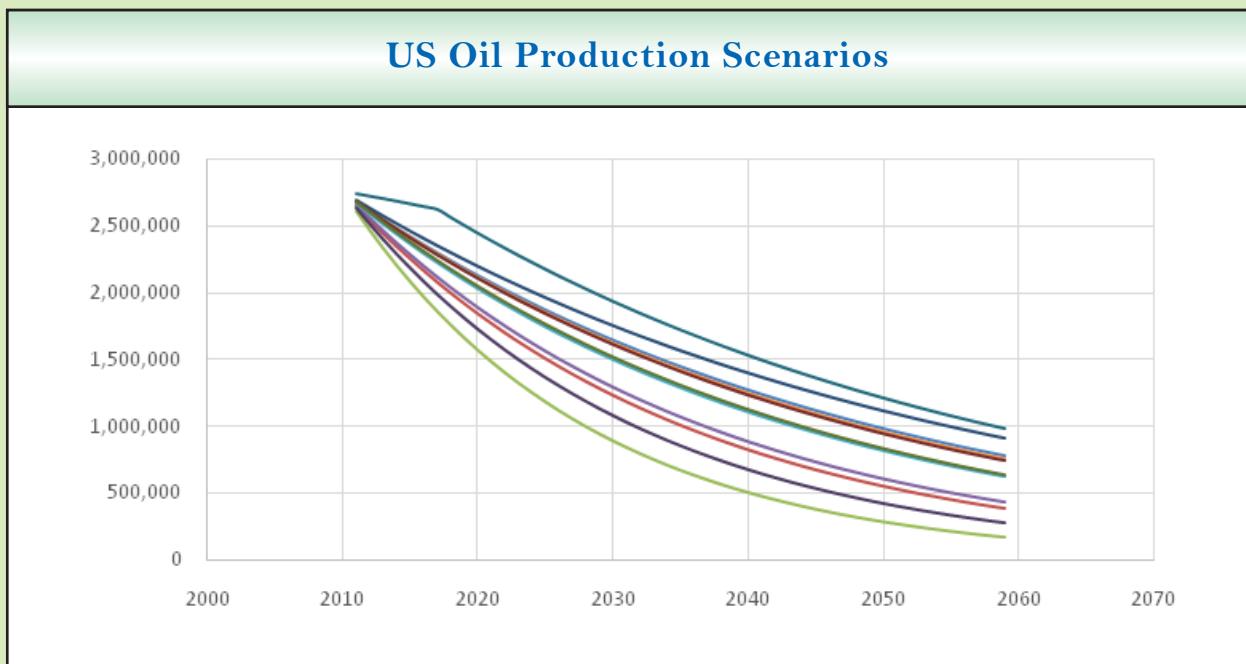
1. <http://oilprice.com/Energy/Crude-Oil/Peak-Oil-Demand-Peak-Oil-Didnt-Go-Away-it-Just-Changed-its-Name.html>

2. <http://www.fool.com/investing/general/2013/12/01/the-2-biggest-drivers-of-global-energy-demand.aspx>

United States of America

DRIVING FORCES FOR OIL PRODUCTION

Oil in the US had its peak in 1970, at 534 million tones, from which it fell to 305 mt in 2008, the year of the turnaround. The subsequent rise to 490mt (990,000 barrels a day) in 2013 corresponds to a staggering 64% increase. The main production growth driver will be shale oil and drilling efficiency —other conventional sources are projected to remain static or continue to decline. The growth is expected to decline by the 2020s. Most probably, the country will still be importing quantities of oil for the foreseeable future. U.S. shale oil /tight oil requires high prices to be profitable, along the lines of \$85 to \$90 a barrel.



Oil production is projected to stay more or less stable on the shale wave, at least until 2020 but at a much slower rate than in the recent few years, but the experts don't see the country to become self-sufficient. After 2020, the oil shale revolution is seen to be exhausted and output starts to decline.

United States of America

DRIVING FORCES FOR OIL PRODUCTION PEAK/ PRODUCTION POINT

The oil peak in the US was seen by experts in 1970, a slight increase in production thanks to shale oil happened between 2005 and 2013. The main driver for the future development of oil production and demand is the price for crude oil and for gasoline. The price for oil is important as shale oil becomes profitable at the price level \$85-\$95 per barrel and gasoline price is important as car fuel and corresponds with the vehicle miles travelled (VMT). US oil imports are expected to fall nearly 75% between 2012 and 2035.

CONCLUSION FOR OIL FUTURES

Oil is expected to be the slowest growing of the major fuels to 2035. US oil consumption is projected to decline over the next years due to efficiency measures, rising prices for petroleum products and other economical factors.

RUSSIA

BACKGROUND ON RUSSIA



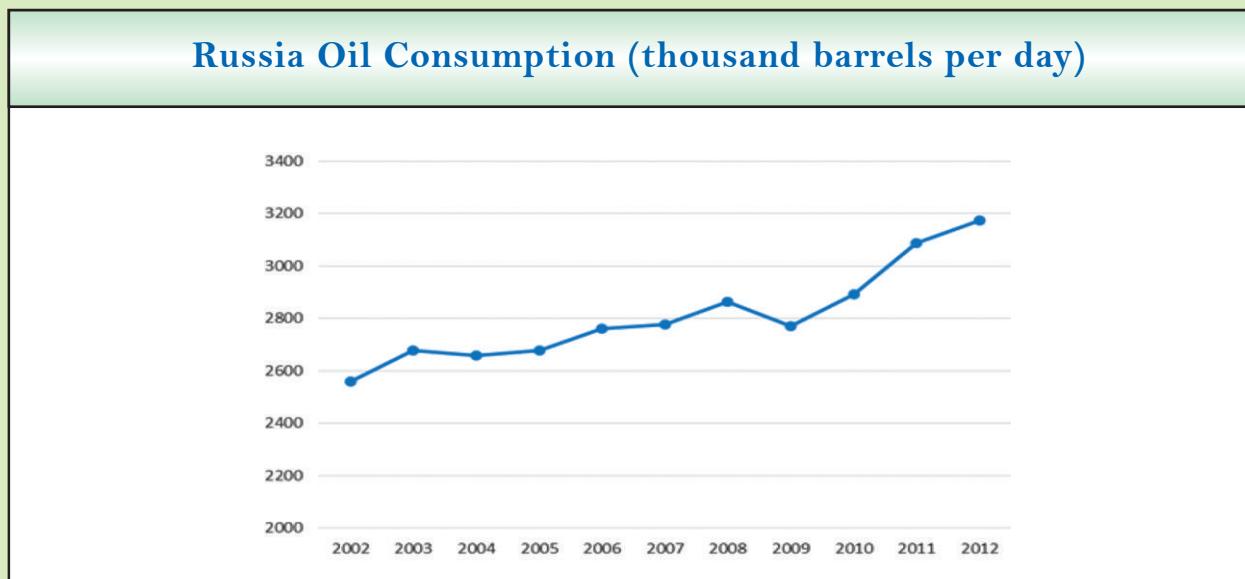
Russia population declined from 1991 to 2009 about 5%. Only last 3 years Russia population increases about 0.4% each year. Accordingly to WEO-2013 Russia population is projected to decline 0.4% every year from 2011 to 2035.



RUSSIA

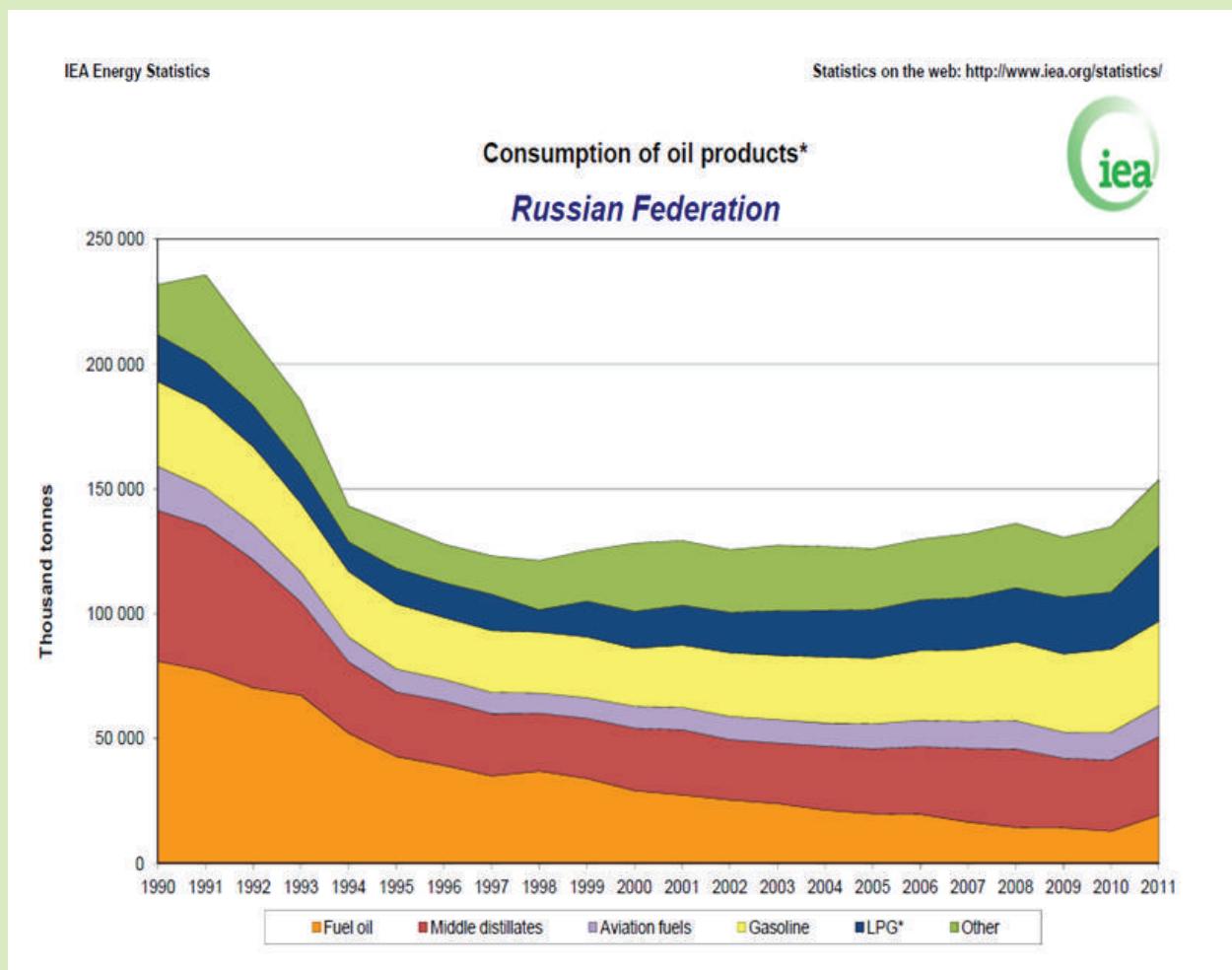
DRIVING FORCES FOR OIL DEMAND FOR THE STRUGGLE AND NO REGRETS

In terms of oil consumption, Russia is number five after US, China, Japan and India. Russia consumes 3.6% of world oil consumption, between India – 4.2% and Saudi Arabia 3.1%. In 2012, Russia consumed 147.5 million tons (or 3174 thousand barrels per day). During last ten years, the average oil consumption in Russia slightly increased.



RUSSIA

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The share of Fuel oil decreased during last twenty years from 1994 to 2011 more than twice. This drop in Fuel oil consumption was substituted by gas. The share of gasoline considerably increased as well as the share of LPG and Middle distillate, that shows the growth of fossil fuel operated transport in Russia during last twenty years.

The value for Motor vehicles (per 1,000 people) in Russia was 271.00 in 2009 and 202.00 in 2004. Therefore, the growth of the value of Motor vehicles per 1000 people during last yearswas about 7% per year.

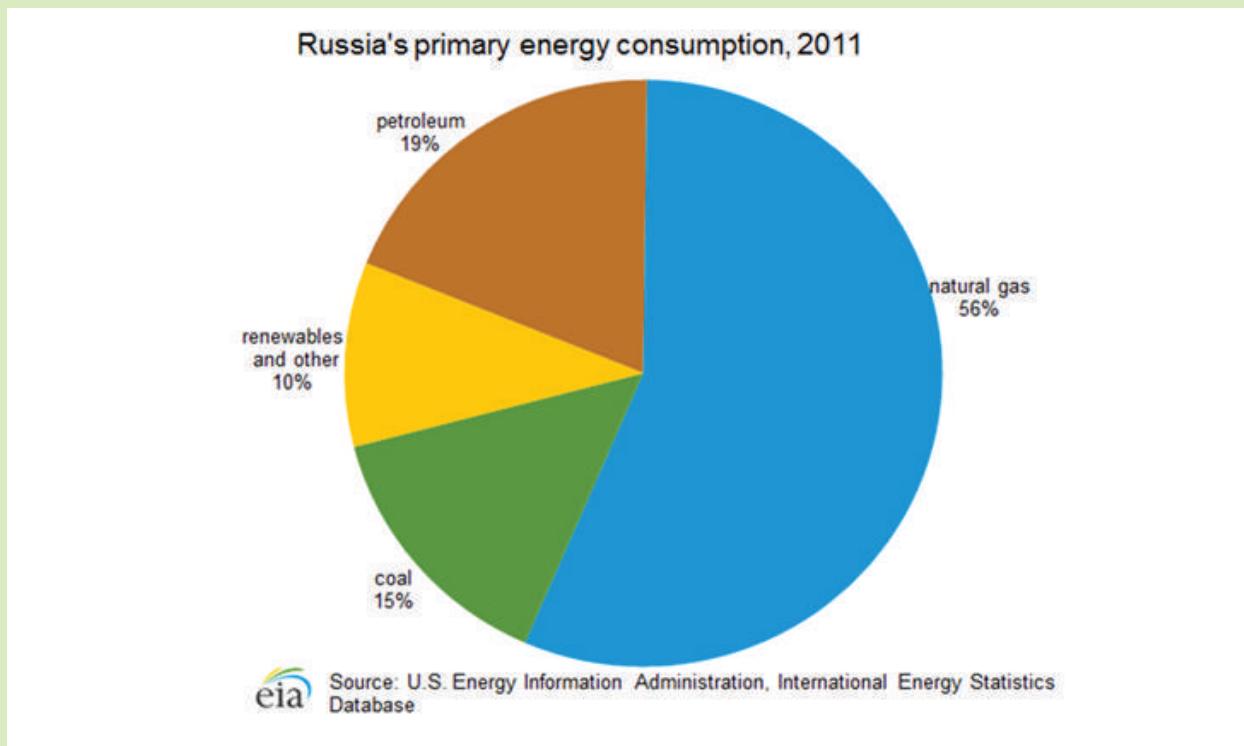
RUSSIA

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Oil consumption by sector in Russia:

Transport	57%
Petrochemical feedstock	26%
Agriculture/forestry/fishing	4.7%
Residential	5.4%
Industry	3.4%
Commercial and Public Services	2.4%

In average, Oil in 2012 was 19% of Russia's primary energy consumption. Prior to 2011, gas had been gaining share in Russia's primary energy use, rising from 38% in 1985 to 56% in 2010. However, 2012 was the 2d year in a row of gas losing market share. Ten years of growing gas prices have started to impact consumer choices.



Russia's economy is highly dependent on its hydrocarbons, and oil and gas revenues account for more than 50% of the federal budget revenues.

RUSSIA

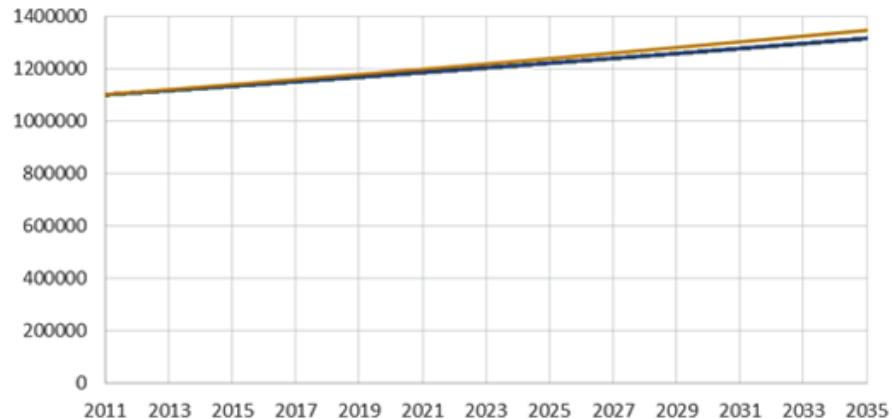
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During last ten years, the average oil consumption in Russia has increased only slightly. The same development is expected to follow in the future. Major factors and drivers of this development will be:

- Considerable motor vehicle per 1000 people growth (around 7% per year)
- Improvement of living standards
- Possible future population growth, which we see last 3 years
- Government position to restrain gasoline price in low level compare with Europe. This policy does not offer an incentive to save oil/product from oil consumption.

As can be seen by the graph comparing “No Regrets” and “The Struggle”, the impact of efficiency on overall Russian oil demand is negligible. As shown on the graph below there is limited difference between a “No Regrets” and “The Struggle” future over the period 2011 to 2035.

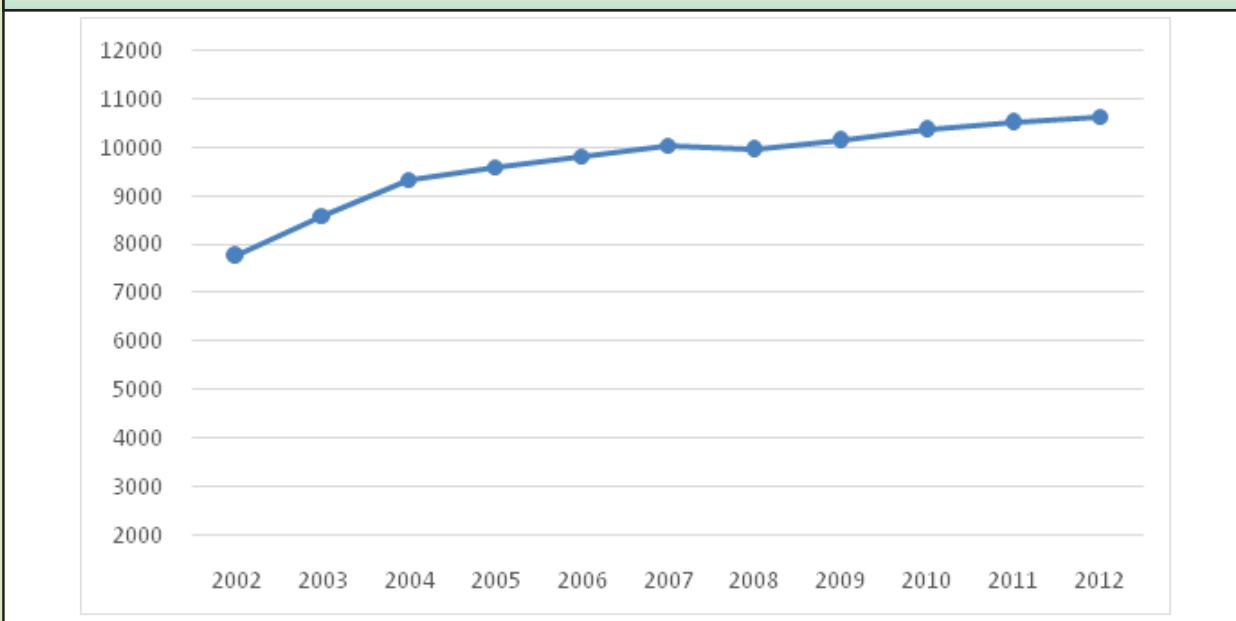
Russia Oil Demand “No Regrets” vs “The Struggle”



DRIVING FORCES FOR COUNTRY OIL PRODUCTION

In terms of oil production, Russia is number two after Saudi Arabia. Russia produces 12.8% of world oil production, between Saudi Arabia – 13.3% and US 9.6%. In 2012, Russia produced 526.2 million tons (or 10643 thousand barrels per day). During last ten years, the average oil production in Russia increased.

Russia. Oil production. (thousand barrels per day)



Most of Russia's resources are located in Western Siberia, between the Ural Mountains and the Central Siberian Plateau and in the Volga-Urals region, extending into the Caspian Sea. Eastern Siberia holds some reserves, but the region has had little exploration.

Most of Russia's oil production continues to originate in West Siberia, notably from the Priobskoye and Samotlor fields. The Sakhalin group of fields in the Far East only contributes about 3% of Russia's total production, although it has yet to fulfill the expectation that it would contribute significantly to Russia's total oil production. In the longer term, however, Sakhalin, along with the untapped oil reserves in Eastern Siberia and the Russian Arctic, may play a larger role. The Russian sector of the Caspian Sea and the undeveloped areas of Timan-Pechora in northern Russia also may hold large hydrocarbon reserves. A number of new projects are in development, but these new projects may only offset declining output from aging fields and not result in significant output growth in the near term. The use of more advanced technologies and the application of improved recovery techniques are resulting in increased oil output from existing oil deposits. Fields in the Western Siberian Basin produce the majority of Russia's oil.

RUSSIA

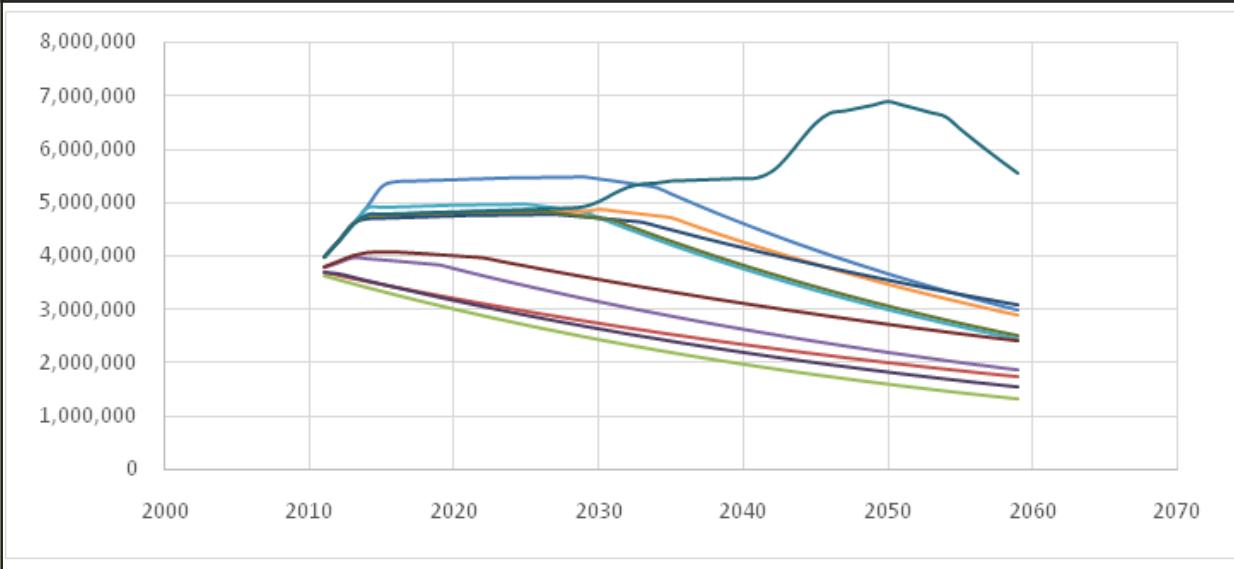
RUSSIA'S OIL PRODUCTION BY REGION, 2012

Region	Thousandbbl/d
Western Siberia	6,422
Urals-Volga	2,312
Krasnoyarsk	368
Sakhalin	283
Komi Republic	259
Arkhangelsk	249
Irkutsk	201
Yakutiya	133
North Caucasus	64

Only 28% of the oil produced in Russia is consumed inside Russia and 72% is exported outside the country. More than 80% of Russia's oil is exported via the Transneft pipeline system, and the remainder is shipped via rail and on vessels. Russia's pipeline network is nearly completely owned and run by the state-run Transneft.

In 2010, 75% of oil was exported to Europe (Germany, Netherland, Poland, Northern Europe, Baltic counties) and 15% of crude oil was transported to Asia. The share of Asian import from Russia considerably grew from 3% in 2001 to 15% in 2010.

Russia Oil Production Scenarios



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During last ten years, the average oil production in Russia increased. The same development is expected to follow in the near future till 2017 and then oil production is expected to stop growing and more probably will start slight declining. Most of Russia's oil production continues to originate in West Siberia. A number of new projects (Sakhalin, East Siberia, Arctic, and Caspian Sea) are in development, but these new projects may only offset declining output from aging fields and not result in significant output growth in the near term. The use of more advanced technologies and the application of improved recovery techniques are resulting in increased oil output from existing oil deposits. All new relatively large fieldssuch as East Siberia, Sakhalin, Arctic regions need huge investments, tax breaks. These fields in these areas are challenging and expensive to develop, particularly under the current tax and tariff system. Therefore major factors and drivers of oil production in Russia are:

- New oil field development
- Investment in the development of new production capacities
- Oil price
- Internal consumption growth
- Tax breaks in development new oil fields
- New tax policy in oil industry, tax on oil company profit instead of oil duty. This will cause that government will have less control on oil industry.

RUSSIA

DRIVING FORCES FOR PEAK OIL PRODUCTION PEAK/ PRODUCTION POINT FOR “STRUGGLE AND NO REGRETS”

Oil production in Russia is expected to grow over the next several years. During the period 2017-2019 oil production is expected to stop growing and start to decline. The main reason of this is declining output from aging fields in West Siberia, and the inability to bring on more productive oil fields to make up for the shortfall.

CONCLUSION FOR OIL FUTURES

Russia will remain an oil exporter in the long term, even after the oil peak post 2019. Russian oil consumption whilst steadily rising is only some 30% of current production. Under “The Struggle” and “No Regrets” there is little difference in consumption growth of Russian oil.

BACKGROUND ON CHINA



China is the world's most populous nation with 1,349,585,838 as at July 2013. China is the world's second-largest consumer of oil and fourth quarter of 2013, China actually became the largest global net importer of oil. China holds 24.4 billion barrels of proven oil reserves (Oil and Gas Journal, 2013). In this region, China has seen the fastest growth in oil consumption, a 249% increase from 91.7 million tons to 320 million tons.

Ever since China became a net importer of oil in 1993, its net crude oil import increased from 2.2876 million tons to 117.32 million tons in 2004, growing by 14.38 million tons or 63.6% every year. Its crude oil import dependency has kept rising, reaching 40.2% in 2004, and is estimated to top 60% by 2020.



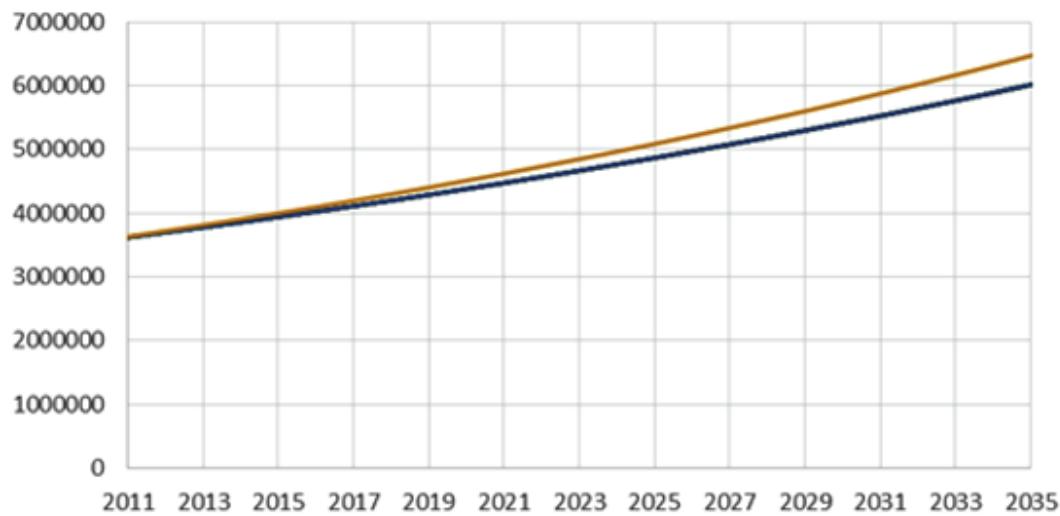
DRIVING FORCES FOR COUNTRY OIL DEMAND FOR STRUGGLE AND NO REGRETS

Substantial oil demand growth and geopolitical uncertainties have increased pressure on China to import greater volumes of oil from a wide range of sources. China made up nearly a third of global oil demand growth in 2013 (US Energy Information Administration 2013). China's oil demand has doubled since 2000 from 1.25 million barrels a day to 2.5 millions barrels a day in 2012. Continued growth in China's oil demand hinges on several factors; such as domestic economic growth and trade, transportation sector shifts and refining capabilities.

The key driver of oil demand is auto population. Monthly auto sales in China exceeded the US market for the first time in 2013 (International Business Times, March, 2014). China vehicle sales from risen from 2 million sales in 2002 to 8 million in 2013, and projections that this will rise to 50 million by 2050. Passenger vehicles consumed 25.8% of transport oil in 2000, this is projected to rise to 75.7% by 2030 and 80.3% by 2050. (Argonne National Laboratory, 2006).

In a bid to ameliorate the growth in its oil demand the government introduced the first ever fuel consumption standards for passenger vehicles in 2004. The standard established fuel consumption standards for motor vehicles which set the maximum fuel consumption at 2020 is 5 L/100km. This will not compensate for the increase in auto ownership and auto miles driven.

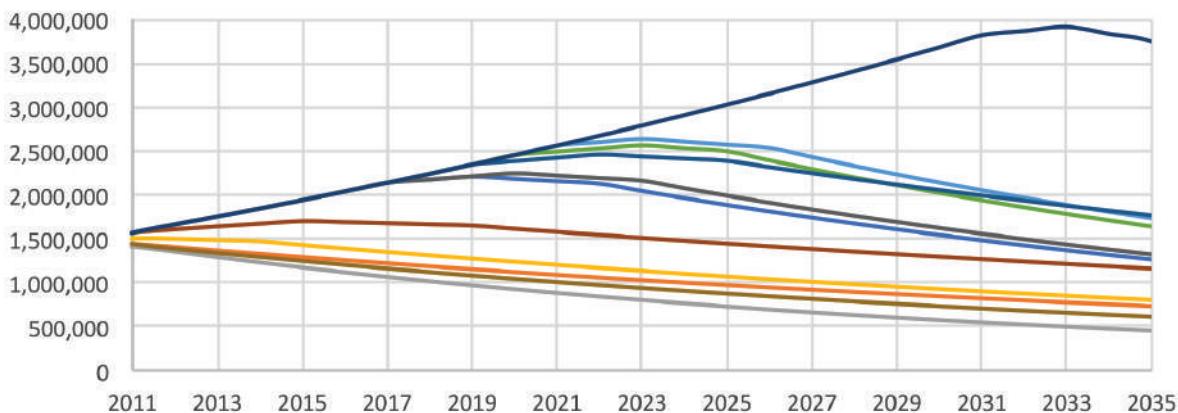
China Oil Demand "The Struggle" v "No Regrets"



DRIVING FORCES FOR COUNTRY OIL PRODUCTION

China's current producing oil fields are mature and are prone to decline. CNPC's Daqing field, located in the Northeast, is one of China's oldest and most prolific fields, constituting 19% of China's overall production. In 2012, Daqing produced about 800,000 bbl/d of crude oil, according to FGE's most recent estimate, and has maintained this level for the past decade after declines of more than 1 million bbl/d. Sinopec's Shengli oil field near the Bohai Bay produced about 550,000 bbl/d of crude oil during 2012, making it China's second-largest oil-producing field. The use of EOR in these fields has been able to slow decline rates. EIA forecast most of the growth over the long term is from non-petroleum liquids such as gas-to-liquids, coal-to-liquids, kerogen, and biofuels, as crude oil production remains relatively flat.

China Oil Production “the Struggle”



DRIVING FORCES FOR COUNTRY OIL PRODUCTION PEAK/ PRODUCTION POINT

China's peak oil production is predicted to most likely to occur in the period of 2020 to 2023. China has many mature fields that have been heavily exploited since the 1960s, and their output is expected to decline within the next decade China's oil and liquids production (US Energy Information Administration 2013). Chinese current crude oil production capacity is located onshore, while 19% of crude oil production is from shallow offshore reserves. New offshore production, enhanced oil recovery (EOR) of older onshore fields, and small discoveries in existing basins are the main contributors to incremental production increases. China's NOCs are investing a great deal in EOR techniques such as water injection, polymer flooding, and steam flooding, among others, to offset oil production declines from these mature, onshore fields. However, all this effort will only see minor growth in oil production until the peak production occurs near 2020. China will remain reliant on oil imports.

CONCLUSION FOR OIL FUTURES

China is currently the second largest importer of oil in the globe, with just over 50% of US imports. The "No Regrets" consumption forecast for China shows that efforts to improve efficiency are futile in the wake of consistent and strong growth in oil consumption, driven principally by auto sales growth and population and auto miles driven.

BACKGROUND ON THE WORLD



The total population of the World in 2012 exceeded 7,153,000,000 . The UN projects that the world population will rise to 8.7 billion by 2035, which is a 31% increase over its levels in 2012 . Global economic output reached \$US71 trillion in 2012 and GDP per person averaged \$US7,178 and is forecast to rise by 3% per annum to 2035.



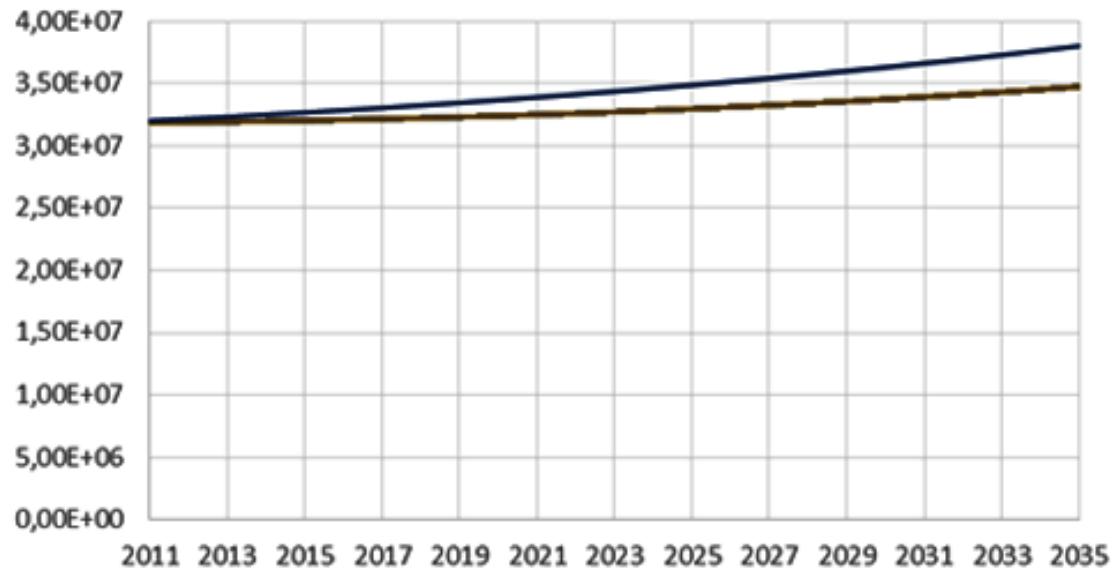
World Population Prospects: The 2008 Revision Population Database Archived 7 April 200 at WebCite

DRIVING FORCES FOR OIL DEMAND FOR THE STRUGGLE AND NO REGRETS

The demand side of peak oil over time is concerned with the total quantity of oil that the global market would choose to consume at various possible market prices and how this entire listing of quantities at various prices would evolve over time. Total global quantity demanded of world crude oil grew an average of 1.76% per year from 1994 to 2006, with a high growth of 3.4% in 2003–2004. After reaching a high of 85.6 million barrels per day in 2007, world consumption decreased in both 2008 and 2009 by a total of 1.8%, despite fuel costs plummeting in 2008. Despite this lull, world quantity-demanded for oil is projected to increase 21% over 2007 levels by 2030 (104 million barrels per day from 86 million barrels), due in large part to increases in demand from the transportation sector. From 2000 vehicle numbers have increased from 751 million to 1 billion in 2010 and are forecast to increase to 2 billion by 2040.

In terms of the drivers of oil consumption, transportation is the largest sector and the one that has seen the largest growth in demand in recent decades. This growth is related to personal-use vehicles powered by internal combustion engines. It has the highest consumption rate, accounting for approximately 55% of oil consumption worldwide as documented in the Hirsch report. Under the Struggle, global oil consumption is forecast to grow slowly from its current demand of 32 million barrels a day by an average of 0.75% per annum over the next 22 years. In 2035 global oil consumption will be 38.4 million barrels a day.

World Oil Demand “No Regrets” vs “The Struglle”



2 BP, Statistical Review of World Energy 2010

3 Wood, John H.; Long, Gary R.; Morehouse, David F. (18 August 2004). "Long-Term World Oil Supply Scenarios: The Future Is Neither as Bleak or Rosy as Some Assert". United States Energy Information Administration. Retrieved 27 July 2008.

4 http://en.wikipedia.org/wiki/Hirsch_report

THE WORLD

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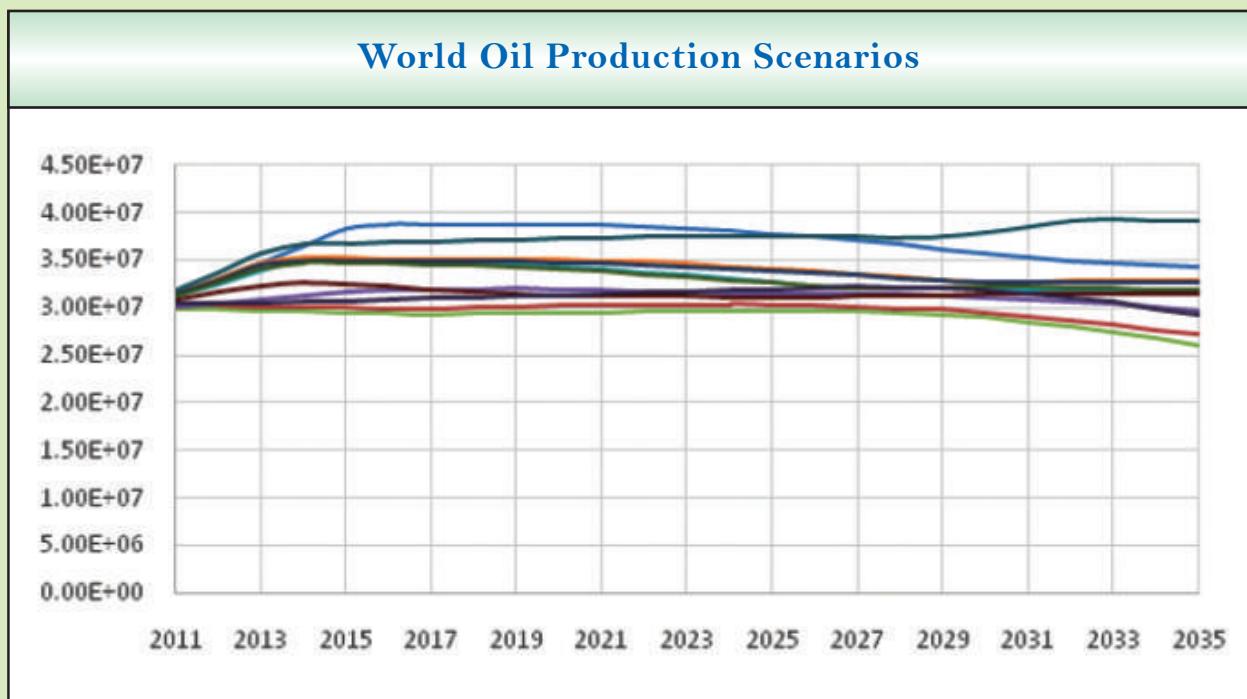
There is a titanic shift in oil consumption between the developed world and the developing world. China and India's oil consumption have a 250% and 500% increase respectively over the 22-year period. The US and Japan are forecast to reduce oil consumption by 50% and 60% respectively. The future of global oil production sees global oil supply been maintained, which with rising Chinese oil demand keeping pressure on oil prices. Continued US\$100+ a barrel oil price will encourage high extraction cost oil sources such as oil sands, shale oil and deep water oil fields.

DRIVING FORCES FOR OIL PRODUCTION

The future of world oil production can be best summed up by the following two quotes from oil executives.

"All the easy oil and gas in the world has pretty much been found. Now comes the harder work in finding and producing oil from more challenging environments and work areas." William J. Cummings, Exxon-Mobil company spokesman, December 2005

"It is pretty clear that there is not much chance of finding any significant quantity of new cheap oil. Any new or unconventional oil is going to be expensive." Lord Ron Oxburgh, a former chairman of Shell, October 2008



THE WORLD

DRIVING FORCES FOR PEAK OIL PRODUCTION PEAK/ PRODUCTION POINT

The scenario modeling indicates no clear peak oil production point, with the overall production trend been flat. This is consistent with Dr. Christoph Rühl, chief economist of BP, he argued: "Physical peak oil, which I have no reason to accept as a valid statement either on theoretical, scientific or ideological grounds, would be insensitive to prices. (...) In fact the whole hypothesis of peak oil – which is that there is a certain amount of oil in the ground, consumed at a certain rate, and then it's finished – does not react to anything.... Therefore there will never be a moment when the world runs out of oil because there will always be a price at which the last drop of oil can clear the market. And you can turn anything into oil into if you are willing to pay the financial and environmental price... (Global Warming) is likely to be more of a natural limit than all these peak oil theories combined. (...) Peak oil has been predicted for 150 years. It has never happened, and it will stay this way."

CONCLUSION FOR OIL FUTURES

The future of global oil demand and production is in demand exceeding supply, keeping positive pressure on oil prices. Continued US\$100+ a barrel oil price will encourage high extraction cost oil production sources such as oil sands, oil shale and deep water ocean. Whilst oil consumption will reduced in the developed world, rising oil consumption in the developing countries more than compensates this. A key driver of oil consumption is caused by increasing population, increasing wealth and the resulting higher car ownership and increasing vehicle miles.

5 Donnelly, John (11 December 2005). "Price rise and new deep-water technology opened up offshore drilling". Boston Globe. Retrieved 21 August 2008

6 "The Next Crisis: Prepare for Peak Oil". The Wall Street Journal. February 11, 2010.

7 "BP: Preisschwankungen werden wahrscheinlich zunehmen, Interview (in English) mit Dr. Christoph Rühl, Mittwoch 1". Euractiv. October 2008. Retrieved 11 July 2009.