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Crude Oil: Iceberg Glimpsed Off West Africa

- **Nigerian protests expose tip of the global subsidy iceberg:** The importance of Nigeria's recent attempt to remove subsidies on domestic oil consumption goes very deep and way beyond Nigeria itself – indeed, with regard to subsidies on domestic oil consumption, Nigeria is just the tip of the global iceberg. According to the IEA, direct subsidies on crude oil in 2010 amounted to \$192bn, with over 70% of this total in the world's major exporting nations.
- **Why does this matter?** It matters because subsidies on domestic oil consumption have been instrumental in driving a very material increase in domestic demand within OPEC and other oil-exporting countries over the last decade. Indeed, with the global production of crude oil stagnating at c.74mbd since 2005, the continuing increase in domestic consumption in OPEC and other major oil exporters over the second half of the last decade explains why global exports of crude oil have been on a downward trajectory since 2005.
- **Frustrated demand for crude oil since 2005:** On our reading, the rise in real oil prices since 2005 mainly reflects frustrated demand for crude oil. In the face of declining crude exports, importers have increased their consumption of other petroleum liquids with lower energy density (NGLs and bio-fuels), while all the time bidding in an increasingly competitive auction for the declining pool of global crude exports.

Real crude prices set to rise over long term to incentivize investment:

Global crude reserves remain plentiful and higher prices have recently spurred new sources of production (e.g. North America and Brazil). But with c.4mbd p.a. of new supply required just to offset natural decline rates, real prices look set to rise further over this decade to incentivize the new capacity required to prevent the frustrated demand for crude growing further in the future.

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Special Report

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#1 Executive Summary

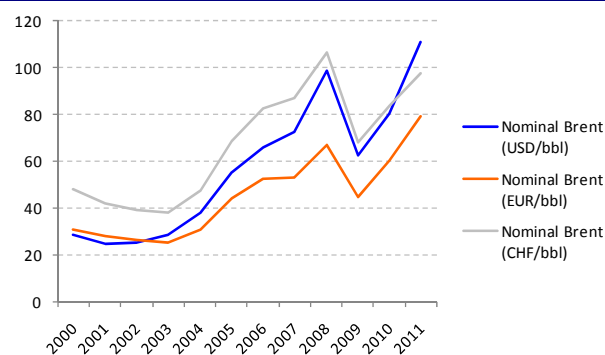
- **Nigerian protests:** Nigeria experienced a wave of protests during the first two weeks of January in response to the government's removing subsidies on imported oil products, with unions threatening to halt production only for the government then partially to re-instate subsidies.
- **Subsidies on oil at issue:** The events in Nigeria highlight a fundamental structural issue that is key to the long-term outlook for oil prices, namely the political sensitivity of subsidies on domestic consumption in the world's largest oil exporters.
- **Subsidies are concentrated in OPEC countries:** This issue goes very deep, and way beyond Nigeria – indeed, as far as subsidies on domestic oil consumption are concerned, Nigeria is just the tip of the global iceberg. According to the International Energy Agency (IEA), fossil-fuel subsidies in 2010 came to \$408bn globally (\$300bn in 2009), with subsidies on oil accounting for \$192bn of this (\$110bn in 2009). Of this total \$192bn of oil subsidies, \$121bn was in OPEC countries, and \$137bn in all major exporters combined (i.e. OPEC plus all other countries with net oil exports >100kbbd). In other words, over 70% of all direct global oil subsidies are in the world's major exporting nations.
- **Why does this matter?** It matters because subsidies on domestic oil consumption have been instrumental in driving a huge increase in demand within OPEC and other oil-exporting countries over the last decade.
- **Global demand growth since 2000 driven by Asia Pacific and Middle East:** Of the 10 countries registering the highest absolute growth in petroleum consumption (all liquids) over 2001-10, seven are either in the Asia Pacific or the Middle East, with China's demand growing the most (+4.3mbd, or +90% by 2010 versus 2000). However, the second-highest absolute increase in domestic demand was recorded by Saudi Arabia (+1.23mbd and +78%). Indeed, about two-thirds of the absolute growth in demand over the last decade came from either: (i) fast-growing Asian economies like China and India; or (ii) the Middle East. And the Middle East is home to six OPEC countries.
- **OPEC demand has increased much faster than global demand since 2000:** According to the US Energy Information Agency (EIA), 2010 global petroleum consumption (all liquids) was 10.3mbd higher than in 2000, an increase of 13%. Over the same period, OPEC's consumption increased by 2.9mbd, which at 56% was more than four times greater than the global growth rate.
- **OPEC demand growth also much higher on a per-capita basis:** Whilst OPEC's combined population has grown at almost exactly double the rate of the world population as a whole over the last decade (25.8% and 12.6% respectively), its share of global oil consumption (all liquids) has increased more quickly than its share of world population. OPEC accounted for 5.9% of the world population in 2010 compared with 5.3% in 2000, but its share of headline global oil consumption over this period increased to 9.4% from 6.8%. As a result, whilst OPEC's average consumption rose by 1.4 barrels per capita per year over 2001-10 (7.3 barrels in 2010 versus 5.9 in 2000), average consumption in the world as a whole stood still (4.6 in 2010 versus 4.58 in 2000).
- **Global exports of crude oil have been declining since 2005:** Increasing internal demand within OPEC and other major exporters has increasingly constrained global crude exports. Indeed, with global crude production stagnating at c.74mbd since 2005, the continuing increase in domestic consumption in OPEC and other major exporters over the second half of the last decade explains why global crude exports have been on a downward trajectory since 2005.
- **Yet global demand for oil continues to rise:** Consumption of all petroleum liquids – crude oil, natural-gas liquids (NGLs), and bio-fuels – has continued to rise since 2005, driven mainly by demand in (i) the larger emerging economies such as China and India and (ii) in major oil exporters. But crude oil's share in total headline liquids consumption has declined slightly since 2005.
- **Global crude production has stagnated since 2005 despite much higher prices:** The stagnation in crude output and decline in crude exports has occurred against the backdrop of higher real crude-oil prices than in 2005 in every year over 2006-11 bar one (2009, when a severe recession hit OECD demand hard).
- **Interpreting crude-oil dynamics since 2005:** We take these trends in production, exports and prices of crude oil since 2005 to indicate: (i) involuntary stagnation in output of crude oil by producers (especially over 2006-08), and (ii) frustrated demand for crude amongst importers since 2005.
- **Stagnating crude output largely involuntary:** We say that the stagnation in crude output since 2005 has been largely involuntary because real prices were on average much higher over 2006-11 than over 2003-05, and yet while crude output surged by +6.6mbd between 2005 and 2003, it has stagnated at 73-74mbd over 2006-11.

- The anomaly of prices and production since 2005:**
 So long as there is sufficient spare capacity, surging prices should lead to surging production. Yet while this happened over 2003-05, it has not happened since, and in this respect the failure of output to respond to much higher prices over 2006-08 is particularly telling.
- Frustrated demand for crude amongst importers:**
 We say that there has been frustrated demand for crude oil amongst importers since 2005 precisely because crude output has failed to respond to higher real prices, with importers increasing their consumption of other petroleum liquids (NGLs and bio-fuels) with lower energy density than crude (i.e. with fewer Gigajoules per barrel of liquid volume) over 2006-11.
- But what about distortions in importing countries?**
 Just as subsidies in oil-exporting countries are a market distortion, so too are taxes or volume mandates on alternative fuels in oil-importing countries: both distort the natural level of demand that would prevail in a free market. And to the extent that taxes and subsidized bio-fuel mandates reduce demand against business-as-usual (BAU) conditions in the oil-importing countries, they thereby reduce the incentive in oil-exporting countries to invest in new capacity. It might therefore be argued that market distortions in importing countries have in fact created frustrated *supply* on the part of exporters.
- Such policies have a big impact on crude demand:**
 The average annual OECD tax take over 2006-10 was more than seven times greater than the IEA's estimate of the amount of direct subsidies on oil in OPEC countries in 2010 (\$878bn versus \$121bn), with the most highly taxed OECD countries (EU members) having much lower per-capita oil-consumption rates than the less heavily taxed ones (Canada and the US). Meanwhile, subsidized bio-fuel mandates effectively 'crowd out' crude-oil supply in that they require a given amount of bio-fuels to be consumed even if an equivalent amount of crude oil is available more cheaply. We estimate that after adjusting for the lower energy density of bio-fuels relative to crude oil, demand for crude in 2010 was c.1.2mbd lower than it would have been without alternative-fuel mandates.
- Despite importers' policies, crude prices have risen to record real levels since 2005:** Taxes on oil consumption have been around for decades, so both producers and consumers have been used to dealing with the market distortions they create for a very long time and nothing has really changed in this regard since 2005. Regarding mandates, while we estimate

that bio-fuels displaced an average 900kbd per year of crude oil supply over 2006-10 (again, after adjusting for the lower energy density of bio-fuels relative to crude oil), this is not a large number when set against the 73-74mbd of annual crude production over this period. Most tellingly of all, though, given that crude-oil prices have been much higher on average in real terms over 2006-11 than over the first half of the decade, we do not think it is plausible to argue that there has not been enough demand globally since 2005 to incentivize a supply-side response. As a result, we would say that crude prices have risen to all-time real highs since 2005 *despite* the distortions created by taxes and alternative-fuel mandates in importing countries rather than because of them.

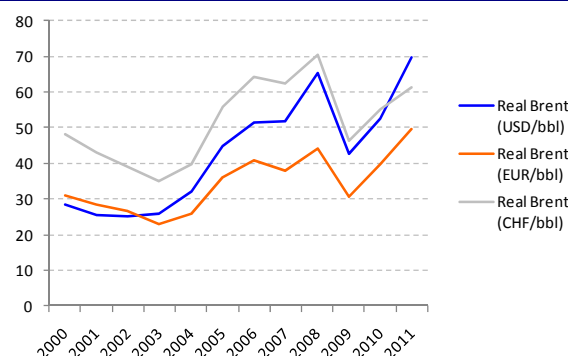
- Frustrated demand for crude driving prices since 2005:** We think the rise in real crude prices since 2005 mainly reflects stagnating global crude output and rising domestic crude demand in major exporters, trends which together have led to a diminishing pool of crude exports and an increasingly competitive auction for a share of this pool over 2006-11.

Figure 1: Nominal Brent crude prices 2000-2011



Source: Bloomberg, Deutsche Bank

Figure 2: Real Brent crude prices 2000-2011 in constant 2000 US Dollars, Euros and Swiss Francs



Source: Bloomberg, World Bank, Deutsche Bank

■ **Rising crude prices not just a 'weak-dollar' effect:**

The fact that the dollar has weakened versus the Euro and the Swiss Franc since 2000 is sometimes adduced to explain rising oil prices. However, whilst crude prices have indeed risen less in nominal and real Euro and Swiss-Franc terms than they have in dollar terms over the last decade (Figures 1 and 2), they are nonetheless higher in real terms in all three currencies: 28% and 11% higher in Swiss Francs since 2000 and 2005 respectively, 62% and 39% in Euros, and 144% and 56% in US Dollars.

■ **Real crude prices to rise further in long term:**

Global reserves of crude oil remain plentiful and higher prices and ongoing technology advances have spurred new sources of crude production in the last two to three years (especially noteworthy since 2008 is rising US and Canadian production). However, given the natural decline rates of existing fields (the world needs c.4mbd per year of new production just to stand still) and the difficulty of reforming subsidies in major exporters (as the case of Nigeria demonstrates), huge investments in new capacity will be required globally in coming years to ensure that the frustrated demand for crude does not increase further. In our view, this points to a continuing increase in real crude prices over time.

■ **The wild cards are Iraq (supply) and energy efficiency (demand):**

Of particular importance to prices over the next decade will be: (i) the extent to which Iraq can deliver on its huge potential for boosting crude output and exports (Iraq's production costs are much lower than those of, say, Canadian oil sands, but political factors have so far prevented this potential from being realized); and (ii) the extent to which importing countries can exploit the huge potential of energy efficiency and thereby reduce their dependence on imported crude oil (with crude prices at record real highs, their incentive is greater than ever).

■ **Our 2012-15 forecasts imply rising real oil prices:**

Figure 3 sets out our current oil-price forecasts to 2015, which are all in nominal terms, and Figure 4 the breakeven inflation rates on five-year, 10-year, and 30-year US Treasury maturities. Our nominal-price forecast for Brent crude in 2015 is \$125/bbl, which implies compound growth of 4% per year against the current market price of \$111/bbl. Our 2015 nominal Brent price forecast therefore implies an annual increase in real terms of 2.2%, 1.9% or 1.7% respectively, depending on whether one is looking at the inflation-adjusted yields on five-year, 10-year, or 30-year US treasuries respectively.

Figure 3: DB crude-oil price forecasts, 2012-15 (\$/bbl)

	WTI (USD/bbl)	Brent (USD/bbl)	World GDP growth
Q1 2012E	104	114	
Q2 2012E	105	115	
Q3 2012E	105	115	
Q4 2012E	106	116	
2012E	105	115	3.3%
Q1 2013E	107	116	
Q2 2013E	113	120	
Q3 2013E	117	124	
Q4 2013E	115	120	
2013E	113	120	4.0%
2014E	117	123	
2015E	120	125	

Figure 4: Implied inflation rates in US-Treasury yields*

5 year	1.81%
10 year	2.10%
30 year	2.28%

Source: Bloomberg

*Calculated by subtracting the real yield of the inflation-linked maturity curve from the yield of the closest nominal Treasury maturity, giving the implied inflation rate for the term of the stated maturity.

■ **Global GDP growth key to our near-term outlook:**

If, as we expect, world GDP growth remains above 3% this year, we believe that pricing in crude-oil markets will remain firm. Indeed, there are just as many upside risks in the oil markets in 2012 as there are risks to the downside (see *Risks and caveats to our view* below).

- **Prices beyond 2015: how much higher?** The extent to which real prices will have to rise over the longer term in order to prevent the frustrated demand for crude oil observable since 2005 from being exacerbated further over time will by definition depend on how steep the ascent up the global supply curve is. As such, the rise in prices over any given period into the future will in our view depend above all on how much of the world's remaining low-cost supplies are brought to market over the period in question, (hence the importance of Iraq over the next decade, for example), and on the extent to which energy-efficiency gains can be achieved and retained.

Risks and caveats to our view: By their very nature as key economic and geo-political variables, oil prices are subject to many risks and contingencies, not all of which can be listed here.

However, as far as counterweights to the arguments put forward in this report are concerned, we would highlight two main issues in particular.

First, with regard to our current price forecasts for 2012-15, the key risk to our view is the potential for global GDP growth to slow below 3%.

In this respect, the sovereign debt crisis in the Eurozone and threat this poses to the EU's real economy remains in our view the main concern, and oil prices could therefore be particularly sensitive to the downside on any signs of a sharper-than-expected deterioration in the EU economy (our colleagues in DB's macro-research department expect the Eurozone to experience a full-year contraction in GDP of -0.5% in 2012).

Second, and with regard to the view we put forward here that real crude-oil prices will likely continue to rise over the long term, the key caveat we would enter is the potential for new sources of crude supply to surprise on the upside.

In this respect we would highlight in particular the potential for growing North American production (especially onshore US tight-oil) to accelerate more quickly than is currently being priced in by the market. In this respect, the extent to which the very rapid ramp-up in US shale gas over the last three to four years has transformed the US natural-gas market and led to a very significant and prolonged reduction in prices is a salutary reminder of how quickly energy markets can change even in very mature industries.

With regard to possible upside risks to our near-term price forecasts, we would highlight the ongoing geopolitical tension in the Persian Gulf. In our view, the risk of price spikes will remain as long as the threat of an escalation in this tension appears real, and given the long-term strategic ambitions of the key players in this region, we think the risk of an escalation in tension could last throughout 2012.

There is also potential for higher Japanese oil demand in 2012 owing to its reduced nuclear power availability.

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#2 Nigeria's subsidies in a global context

On 1 January, the Nigerian government announced the removal of subsidies on imported petrol, prompting the country's trade unions to call for a national strike, which threatened to halt oil production and exports. The Nigerian Labor Congress argued that the rise in petrol prices would feed through into inflation as most goods are transported by road and many depend on gasoline and diesel-powered generators for electricity.

After a two-week stand-off between the government and labour unions, President Jonathan announced on 16 January that he would offer to restore a partial subsidy. In response, the national labour unions suspended the strike action, and the oil union Pengassan held off on threats to halt oil and gas production as talks continue.

These events have attracted the world's attention because according to the US Energy Information Agency Nigeria is the world's eighth largest crude-oil producer (2.4mb/d of production in 2010), and the world's fourth-largest crude exporter (2.1mbd) in 2009.

And the strike and partial re-instatement of the subsidy highlight the enormous difficulty of raising subsidized fuel prices in a major oil-exporting country.

Figure 5 shows the IEA's estimate of total global subsidies on all fossil fuels in 2010 by country, ranked in order of total absolute dollars (these figures were published with the IEA's *World Energy Outlook 2011*). We have highlighted OPEC countries in blue and other major oil exporters (i.e. those with >100kbd in net crude exports in 2009 according to EIA data) in orange.

The IEA uses the price-gap methodology to define and calculate subsidies, and classifies them under two broad categories as either:

- (i) **explicit subsidies**, i.e. direct subventions from the public purse to reduce the price of fossil fuels below the price they would command in a competitive market; or
- (ii) **implicit subsidies**, i.e. where there is no direct cost to the public purse but rather an opportunity cost of selling fuel in the domestic market at a level below the prevailing international price.

Explicit subsidies are generally to be found in countries that are net importers of fossil fuels, and implicit subsidies in countries that are net exporters.

Figure 5: Global fossil-fuel subsidies, 2010 (\$bn)

	Oil	Gas	Coal	Power	TOTAL
Iran	40.9	25.5	0	14.4	80.8
Saudi Arabia	30.6	0	0	13.0	43.5
Russia	0	17.0	0	22.3	39.2
India	16.2	2.2	0	3.9	22.3
China	7.8	0	2.0	11.6	21.3
Egypt	14.0	2.4	0	3.8	20.3
Venezuela	15.7	1.4	0	2.9	20.0
UAE	2.7	10.0	0	5.5	18.2
Indonesia	10.2	0	0	5.8	15.9
Uzbekistan	0.6	9.3	0	2.4	12.2
Iraq	8.9	0	0	2.2	11.3
Algeria	8.5	0	0	2.1	10.6
Mexico	9.3	0	0	0.2	9.5
Thailand	2.1	0.5	0.4	5.4	8.5
Ukraine	0	5.2	0	2.5	7.7
Kuwait	2.8	0.9	0	3.9	7.6
Pakistan	0.1	4.9	0	2.2	7.3
Argentina	0.8	2.5	0	3.2	6.5
Malaysia	3.9	1.0	0	0.8	5.7
Bangladesh	0.3	1.9	0	2.8	5.0
Turkmenistan	0.9	3.6	0	0.6	5.0
Kazakhstan	2.0	0.2	0.4	1.7	4.3
Libya	3.2	0.3	0	0.8	4.2
Qatar	1.2	1.4	0	1.6	4.2
Ecuador	3.7	0	0	0	3.8
Vietnam	0	0.2	0	2.7	2.9
Nigeria	2.4	0	0	0.5	2.9
South Africa	0	0	0	2.1	2.1
Angola	0.9	0	0	0.2	1.1
Philippines	1.1	0	0	0	1.1
Azerbaijan	0.1	0.4	0	0.3	0.8
Taiwan	0.2	0	0	0.3	0.6
Sri Lanka	0.3	0	0	0.2	0.5
Colombia	0.5	0	0	0	0.5
South Korea	0.0	0	0.2	0	0.2
TOTAL	191.9	91.0	3.1	121.6	407.6
o/w OPEC	121.4	39.8	0.0	47.0	208.2
o/w other major oil exporters*	15.8	18.8	0.4	28.0	63.0

Source: IEA, EIA; * countries with net crude exports of >100kbd in 2009

However, in countries where a certain amount of a given fuel is domestically produced and the residual amount imported, the subsidies will be a combination of explicit and implicit subventions.

As can be seen, out of total fossil-fuel subsidies in 2010 of \$408bn, oil accounted for \$192bn of this (47%), twice as much as gas (\$91bn) and coal (\$3.1bn) combined. Indeed, after oil, the most heavily subsidized commodity was electricity, accounting for \$121bn (30% of the global total).

We would note, however, that the number for electricity actually represents subsidies on fossil fuels to generators. Most of this will have been to coal and gas-fired generators, but to the extent that a number of OPEC countries rely on oil-fired production for a meaningful proportion of their electricity (c.60% in the case of Saudi Arabia), we estimate that c.\$20bn of the subsidies on electricity will have been on oil.

This means that total 2010 subsidies on oil – directly on oil for end use and indirectly on oil-fired electricity – were in the order of \$210bn, which is to say just over half of the \$408bn in total global subsidies for fossil fuels.

In terms of the breakdown of total direct subsidies on oil between net exporters and net importers, it can be seen that OPEC countries accounted for \$121bn of the total \$192bn (63%), and other major oil-exporting countries (i.e. those with net crude exports in excess of 100kbd) for a further \$16bn.

This means that the major oil-exporting countries of the world accounted for \$137bn of all direct subsidies on oil in 2010, or 71% of the total \$192bn.

If we then add to this the \$20bn of subsidies we estimate to have been for oil-fired power generators – all of which we assume to be in OPEC countries (mostly Saudi Arabia, Iran, the UAE, and Kuwait) -- we conclude that the major oil exporters accounted for c.\$157bn of the \$210bn in direct and indirect global oil subsidies in 2010, or 75% of the total.

By definition, this means that the overwhelming majority of direct and indirect oil subsidies are implicit rather than explicit.

Indeed, given that some of the subsidies on oil even in net-importing countries like China and India will be on domestic production, we estimate that the share of implicit subsidies in the \$210bn total is 80% or higher.

As far as Nigeria is concerned, however, Figure 3 clearly shows that it ranks towards the bottom of the table in terms of its absolute subsidies, with \$2.4bn on oil, and \$0.5bn on power.

Indeed, Nigeria accounted for just 1.3% of all direct subsidies on oil, and only 0.7% of all subsidies on fossil fuels in 2010, with only Angola amongst other OPEC countries subsidizing less in absolute terms.

Figure 6 then shows the relative levels of subsidy on fossil fuels, breaking this down into three categories. First, there is the average subsidization rate (ASR), which measures the level of subsidy on fossil-fuel consumption expressed as a proportion of the full cost of supply in a competitive market.

Figure 6: Economic weighting of FF* subsidies, 2010

	ASR**	Subsidies per capita	As a % of GDP
Kuwait	85.5%	\$2 799	5.8%
Iran	84.6%	\$1 093	22.6%
Saudi Arabia	75.8%	\$1 587	9.8%
Qatar	75.3%	\$2 446	3.2%
Venezuela	75.3%	\$689	6.9%
Libya	71.0%	\$665	5.7%
UAE	67.8%	\$2 490	6.0%
Turkmenistan	65.1%	\$995	19.3%
Algeria	59.8%	\$298	6.6%
Uzbekistan	57.1%	\$434	30.5%
Iraq	56.7%	\$357	13.8%
Egypt	55.6%	\$250	9.3%
Ecuador	48.7%	\$259	6.4%
Bangladesh	46.1%	\$34	4.8%
Angola	31.5%	\$59	1.3%
Kazakhstan	29.3%	\$269	3.1%
Pakistan	28.9%	\$42	4.2%
Nigeria	28.3%	\$18	1.3%
Ukraine	25.7%	\$169	5.6%
Indonesia	23.2%	\$67	2.3%
Russia	22.6%	\$274	2.7%
Argentina	22.0%	\$161	1.8%
Azerbaijan	21.1%	\$90	1.5%
Thailand	20.7%	\$123	2.7%
Malaysia	20.0%	\$200	2.4%
Sri Lanka	16.1%	\$24	1.0%
Vietnam	14.4%	\$33	2.8%
India	13.5%	\$18	1.4%
Mexico	12.5%	\$84	0.9%
Philippines	7.3%	\$12	0.6%
South Africa	7.2%	\$42	0.6%
Colombia	4.3%	\$11	0.2%
China	3.8%	\$16	0.4%
Taiwan	1.8%	\$25	0.1%
South Korea	0.4%	\$4	0.0%

Source: IEA; *FF = fossil fuels; **ASR = Average subsidization rate, defined as the subsidy on fossil-fuel consumption expressed as a proportion of the full cost of supply in a competitive market.

This means that the higher the ASR, the greater the degree of the subsidy, with the reciprocal of the ASR showing the percentage of the true economic price that consumers are paying (e.g. in the case of Kuwait, which has the highest ASR of 85.5%, consumers are on average paying only 14.5% of the price that would prevail in a competitive market). Second, there are the subsidies on fossil fuels as measured on a per-capita basis, and third the subsidies on fossil fuels as a share of GDP.

Figure 6 again highlights OPEC countries in blue and other major oil exporters (i.e. those with >100kbd in 2009 net crude exports) in orange, and ranks countries in order of the ASR on all fossil fuels.

Looking at these numbers, it is clear that OPEC countries generally have by far the most generous subsidies on fossil fuels on a relative basis, with seven of OPEC's 12 member countries having an ASR above 65%, and five of them an ASR above 75% (Kuwait, Iran, Saudi Arabia, Qatar, and Venezuela).

This explains why subsidies in most OPEC countries exceed 5% of GDP (Iran's 23% reading on this gauge is by far the highest of any OPEC member), although the highest subsidies relative to GDP are actually in Uzbekistan (31%), which is not a member of OPEC.

As far as Nigeria is concerned, however, it ranks last amongst all OPEC countries in terms of its relative subsidies, with an ASR of 28% (the lowest of any OPEC country), per-capita subsidies of \$18 (again the lowest of any OPEC country), and a share of subsidies relative to GDP of only 1.3% (joint lowest with Angola). Nigeria's low subsidies relative to other OPEC members mainly reflects its much lower subsidies in absolute terms than most other OPEC countries and the fact that it has by far the largest population within OPEC.

Beyond Nigeria's absolute and relative standing within OPEC on the question of subsidies, though, the broader significance of subsidies in OPEC countries becomes very clear when we look at the trend in global oil demand over the last decade, and OPEC's surging domestic consumption over this period.

As a result, it is to a closer consideration of this issue that we now turn.

#3 The trend in global oil demand by region since 2000

Figure 7 shows total global oil demand over 2000-10 as per BP's 2011 Statistical Review of World Energy, with oil here defined in its broadest sense as total petroleum liquids, comprising crude and condensates (C+C), NGLs, bio-fuels, and other liquids.

(Important note: The data in Figure 5 and in all subsequent figures until Figure 36 in Section 8 below is presented according to the convention of the sources we are using in this report when looking at total petroleum liquids (BP and the US Energy Information Agency), which is to say on a purely volumetric basis, without adjusting for the energy content per barrel of the different petroleum liquids.

However, and as we explain in Section #7 below, because crude oil has a higher energy density than other petroleum liquids and therefore contains more energy per barrel than other liquids, the headline data as presented by BP and the EIA – and by “headline” here we mean data presented without adjusting for the energy density of the different petroleum liquids -- underestimates the relative importance of crude oil versus other liquids in the evolution of consumption and production over the last decade.

In our view this is a very important point as it is fundamental to understanding why crude-oil prices have risen sharply in real terms since 2005, and that is why we analyze it in greater detail in Section #7 below.)

Looking at the headline consumption data in Figure 7, it can be seen that headline consumption of petroleum liquids increased by 10.8mbd, to 87.3mbd from 76.6mbd, but breaking down the change in demand over the period between the OECD and non-OECD countries is very revealing.

In the OECD countries, annual demand actually fell by 1.7mbd over the course of the decade (46.4mbd in 2010 versus 48.1mbd in 2000), but in the non-OECD countries it grew by 12.5mbd (40.9mbd versus 28.4mbd).

As a region the Middle East – home to six of OPEC's members – recorded the highest rate of growth in demand anywhere in the world, posting an increase of 56% compared with 35% in Africa, 29% in Asia-Pacific, 26% in South and Central America, and declines in North America and Europe (Figure 8).

Figures 9 and 10 then show the year-on-year change in consumption over 2001-05 and 2006-10 respectively, for the world overall and for the OECD and non-OECD components of demand.

As can be seen, while the OECD countries generally increased their consumption over 2001-05, their incremental demand was lower than that of the non-OECD countries in every year over the first half of the decade (Figure 9).

Over 2006-10, meanwhile, the OECD countries' demand declined every year apart from 2010, whereas that of the non-OECD countries increased in every single year over this period (Figure 10).

Figure 11 then shows the 12 countries registering the highest absolute growth in oil consumption over the last decade. Seven of these 10 countries are either in the Asia Pacific or the Middle East, with China's demand growing the most in both absolute and relative terms (+4.3mbd or +90% by 2010 versus 2000), but the second-highest absolute and third-highest relative increase being recorded by Saudi Arabia (+1.23mbd or +78%).

Only one other country – India – recorded an absolute increase over the decade in excess of 1mbd.

In other words, a very large proportion (about two-thirds) of the increase in demand for oil over the last decade came from two groups of countries: (i) fast-growing emerging economies in Asia like China and India; and (ii) the Middle East.

It is true, of course, that in absolute terms China's growth in consumption over the period of 4.3mbd was by far the highest of any single country, and hence that the absolute increase in demand recorded by the Asia-Pacific region was also therefore by far the highest (6.1mbd versus the 2.8mbd of the Middle East, the region with the next highest absolute increase).

It is also true that the Asia-Pacific region's growth in oil consumption would have been even greater had it not been for the decline in Japanese oil demand over the last decade (Japan's consumption fell by 1.1mbd over the period, to 4.4mbd in 2010 from 5.5mbd in 2000).

Nonetheless, we think it fair to say that while the demand growth registered by Asia in general, and China in particular, has been exceptional over the last 10 years, the demand story in the Middle East over the last decade has been no less remarkable in its own way.

Figure 7: Total global oil* consumption (all petroleum liquids), 2000-10 (kbd)

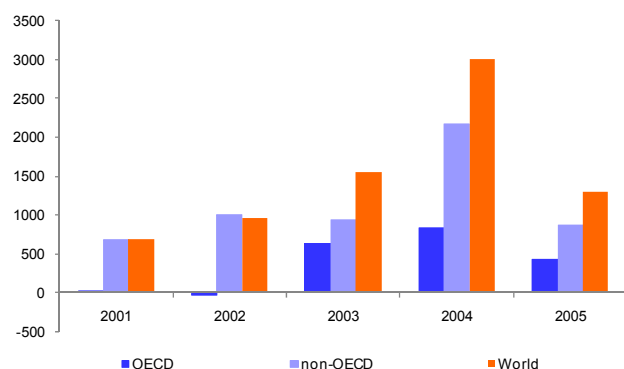
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
Total World Consumption*	76,605	77,304	78,268	79,823	82,827	84,126	84,958	86,428	85,999	84,714	87,382	14.1%
o/w OECD	48,128	48,139	48,106	48,734	49,566	49,996	49,794	49,611	48,053	45,963	46,438	-3.5%
o/w Non-OECD	28,477	29,165	30,162	31,090	33,262	34,130	35,164	36,817	37,946	38,751	40,944	43.8%

Source: BP; *All petroleum liquids, unadjusted for their respective energy densities

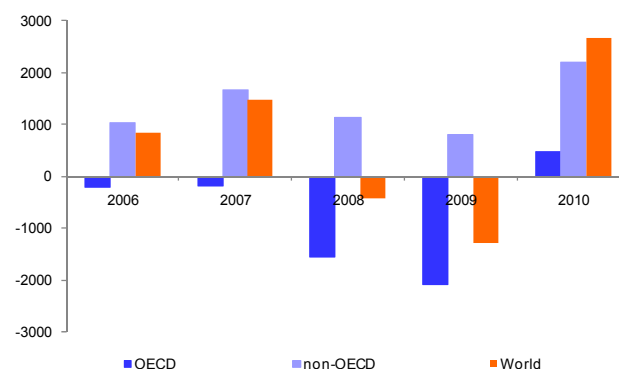
Figure 8: Evolution of global oil* consumption by region ranked by relative increases over 2000-10 (kbd)

	2000	2010	2010/2000	2010/2000
Middle East	5,021	7,821	2,800	55.8%
Africa	2,439	3,291	853	35.0%
Asia Pacific	21,135	27,237	6,103	28.9%
South & Central America	4,855	6,104	1,249	25.7%
Europe and Eurasia	19,582	19,510	-72	-0.4%
North America	23,574	23,418	-155	-0.7%

Source: BP; *All petroleum liquids, unadjusted for their respective energy densities

Figure 9: YoY change in oil* consumption, 2001-05 (kbd)

Source: Deutsche Bank after BP; *All petroleum liquids, unadjusted for their respective energy densities

Figure 10: YoY change in oil* consumption, 2006-10 (kbd)

Source: Deutsche Bank after BP; *All petroleum liquids, unadjusted for their respective energy densities

Figure 11: Evolution of global oil* consumption showing top 10 absolute increases over 2000-10 (kbd)

	2000	2010	2010/2000 (kbd)	2010/2000 (%)
World	76,605	87,382	10,777	14.1%
China	4,766	9,057	4,291	90.0%
Saudi Arabia	1,578	2,812	1,234	78.2%
India	2,261	3,319	1,058	46.8%
Brazil	2,018	2,604	585	29.0%
Singapore	645	1,185	540	83.6%
Russian Federation	2,698	3,199	502	18.6%
Iran	1,304	1,799	495	38.0%
Canada	1,922	2,276	354	18.4%
Thailand	835	1,128	293	35.1%
UAE	396	682	286	72.1%

Source: BP; *All petroleum liquids, unadjusted for their respective energy densities

Figure 12: Breakdown of global oil* consumption increases over 2000-10 between world and OPEC (kbd)

	2000	2010	2010/2000 (kbd)	2010/2000 (%)
World	76,605	87,382	10,777	14.1%
OPEC (nine countries only)**	4,464	7,244	2,780	62.3%

Source: BP; *All petroleum liquids, unadjusted for their respective energy densities; **OPEC members excluding Iraq, Angola, and Nigeria

And the point is that the Middle East is the home of six OPEC countries, (Saudi Arabia, Iran, the UAE, Kuwait, Iraq, and Qatar). As a result, it is not surprising to find that the growth in domestic demand within these six OPEC countries has been exceptionally strong since 2000.

Moreover, internal-demand growth within OPEC countries outside the Middle East has also been strong over the last decade.

Figure 12 shows the growth in oil demand in OPEC countries against the growth in total global demand since 2000 (the OPEC figures do not include Iraq, Nigeria, or Angola, as BP does not provide figures for these three countries separately).

As can be seen, the growth in demand in these nine OPEC countries between 2010 and 2000 was 62%, which is more than four times greater than the 14% rate of growth in global demand over the same period.

And a closer look at the surging internal consumption in OPEC countries over the last decade reveals that it is the largest exporters in OPEC that have experienced the greatest growth in domestic demand.

Accordingly, it is to a more detailed examination of the trend in OPEC's consumption over the last decade that we now turn.

#4 The trend in OPEC's domestic oil demand since 2000

Figure 13 shows the rise in OPEC member countries' demand for oil over 2000-10, ranking them in order of their absolute increase in consumption and using data from the EIA, which unlike BP's data also gives numbers for Iraq, Nigeria, and Angola on a separated basis.

The EIA numbers are slightly different from those of BP but in all essential details they convey exactly the same trends, and the scope of coverage is essentially the same as that of BP (all petroleum liquids, defined by the EIA as crude and condensates, NGLs, other liquids [essentially bio-fuels], and refinery gains).

As with the BP numbers in Figure 12 above, the EIA data here show OPEC demand increasing more than four times as quickly as world growth as a whole (56% versus 13%).

We would also highlight the fact that at 13.6%, Nigeria – which as already shown above has amongst the lowest absolute and certainly the lowest relative subsidies on oil amongst all the OPEC countries – posted by far the lowest rate of growth in domestic demand over the last decade of its OPEC peers, and was almost exactly in line with the rate of growth in total world demand (13.4%).

Figure 13: OPEC domestic oil* consumption, 2000-10 (kbd)

	2000	2005	2010	2010/00	2010/00 (%)
Saudi Arabia	1,537	1,964	2,643	+1,106	71.9
Iran	1,248	1,556	1,845	+597	47.8
Venezuela	500	583	746	+246	49.3
Iraq	462	541	694	+232	50.1
UAE	330	374	545	+215	64.9
Qatar	48	86	166	+118	244.6
Algeria	206	255	312	+106	51.3
Kuwait	264	330	354	+90	33.9
Libya	210	265	289	+79	37.4
Ecuador	131	159	201	+70	54.0
Angola	29	50	74	+45	142.9
Nigeria	246	312	279	+33	13.6
TOTAL OPEC	5,212	6,475	8,148	+2,936	56.3
TOTAL WORLD	76,781	84,064	87,043	+10,262	13.4

Source: EIA; *All petroleum liquids, unadjusted for their respective energy densities

The question, then is, why has OPEC demand increased by so much more than that of the world (and indeed by significantly more than any other region or country except China) over the last decade?

One obvious explanation might be population growth, and as shown in Figure 14, it is true that the combined population of OPEC countries has grown at almost exactly double the rate of the world population as a whole over the last decade (25.8% and 12.6% respectively).

Figure 14: Increase in population of OPEC countries and World, 2000-10

	Total population 2000 (k)	Total population 2010 (k)	Absolute change (k)	Relative change
Qatar	591	1,759	1,168	197.6%
UAE	3,033	7,512	4,479	147.7%
Angola	13,296	19,082	5,786	43.5%
Kuwait	1,941	2,737	796	41.0%
Saudi Arabia	20,045	27,448	7,403	36.9%
Iraq	23,857	31,672	7,815	32.8%
Nigeria	123,689	158,423	34,734	28.1%
Libya	5,231	6,355	1,124	21.5%
Venezuela	24,348	28,980	4,632	19.0%
Algeria	12,345	14,465	2,120	17.2%
Ecuador	30,534	35,468	4,934	16.2%
Iran	65,342	73,974	8,632	13.2%
TOTAL OPEC	324,252	407,874	83,622	25.8%
TOTAL WORLD	6,122,770	6,895,889	773,119	12.6%

Source: United Nations, Deutsche Bank

That said, OPEC's share of total world population has increased less quickly over the last decade than has its share of total global oil consumption.

As shown in Figure 15, OPEC accounted for 5.9% of the world's population in 2010 compared with 5.3% in 2000, but its share of global oil consumption over the same period increased at a more rapid rate, to 9.4% from 6.8%

Figure 15: OPEC share of world population and of total oil* consumption, 2000-10

	OPEC	World	OPEC/World
Population 2000 (k)	324,252	6,122,770	5.3%
Population 2010 (k)	407,874	6,895,889	5.9%
Oil consumption 2000 (kbd)	5,212	76,781	6.8%
Oil consumption 2010 (kbd)	8,148	87,043	9.4%

Source: United Nations, EIA, Deutsche Bank; *All petroleum liquids, unadjusted for their respective energy densities

As a result, even after adjusting for the much faster growth in OPEC's population over 2001-10 than that of the world as a whole, we can see that OPEC still recorded a much stronger rate of growth in per-capita oil consumption than did the world over this period.

Figure 16 ranks OPEC countries according to their rate of growth in per-capita consumption over 2000-10 versus the growth rate for the world as a whole.

Figure 16: Increase in per-capita consumption of oil*, 2000-10 (barrels per capita per year)

	Consumption in 2000	Consumption in 2010	Absolute change	Relative change
Angola	0.8	1.4	0.6	76,2%
Ecuador	3.9	5.1	1.2	31,4%
Iran	7.0	9.1	2.1	30,6%
Algeria	2.5	3.2	0.7	30,3%
Saudi Arabia	28.0	35.1	7.2	25,6%
Venezuela	7.5	9.4	1.9	25,4%
Qatar	29.8	34.4	4.7	15,8%
Libya	14.7	16.6	1.9	13,1%
Iraq	7.1	8.0	0.9	13,1%
Kuwait	49.7	47.2	-2.5	-5,0%
Nigeria	0.7	0.6	-0.1	-11,3%
UAE	39.8	26.5	-13.3	-33,4%
TOTAL OPEC	5.9	7.3	1.4	24,3%
TOTAL WORLD	4.58	4.61	0.03	0,7%

Source: United Nations, EIA, Deutsche Bank; *All petroleum liquids, unadjusted for their respective energy densities

As can be seen, the average consumption in OPEC countries rose by 1.4 barrels per capita per year over the period, reaching 7.3 barrels per capita per year in 2010 from 5.9 in 2000. By contrast, average consumption in the world as a whole essentially stagnated, rising by only 0.03 barrels per capita per year, to 4.61 in 2010 versus 4.58 in 2000.

As a result, while OPEC's very strong absolute increase in oil consumption over 2001-10 is in part explained by its rapid population growth over this period, we would argue that the OPEC countries' high average subsidization rates on oil have also been a major driver of its surging demand for crude.

Indeed, we would argue that there is a very strong *prima facie* case for saying that the subsidies on domestic oil consumption in OPEC countries are the main reason why per-capita consumption within OPEC has increased so much more quickly than per-capita consumption for the world as a whole over the last decade.

All of which raises an absolutely fundamental question: given OPEC's very rapid increase in oil consumption over 2000-10 and its traditional role as the supplier of over half of global exports of crude oil, what has been the trend in its production over the same period in relation to the trend in global production?

It is to a consideration of this question that we now turn.

#5 The trend in global and OPEC production since 2000

Figure 17 below shows the evolution in the consumption and production of all petroleum liquids over 2000-10, and the share of crude oil (crude and condensates) in the total output of all liquids, again using EIA data.

As can be seen, crude accounted for 88% of the total volumetric output of petroleum liquids in 2000, but while the total annual volume had risen by 8% by 2010 to reach 74.1mbd versus 68.6mbd in 2000, its share of the volumetric total declined by three percentage points over the decade to 85.3% in 2010.

Moreover, it is very striking to note that while the output of crude rose very sharply over 2000-05 – by 5.3mbd, to 73.8mbd – over the second half of the decade crude production essentially stagnated at between 73mbd and 74mbd.

Figure 18 then shows the trend in OPEC production of all petroleum liquids against the world total over 2000-10. As can be seen, OPEC output has been remarkably constant against the world total over the last decade, accounting on average for a very steady 40%.

Figure 19 then shows the evolution of OPEC's total consumption of petroleum liquids over 2000-10, and the breakdown of its output by liquid source.

The production numbers show that crude oil has represented a slightly higher proportion of production for OPEC than it has for the world as a whole, and although crude's share in OPEC's total production has fallen slightly over the decade it still represented just over 90% in 2010.

The other noticeable thing about OPEC's crude production is that – as with the trend in global crude production – after rising sharply over 2001-05 it has been essentially flat over 2006-10.

Most significantly of all, however, if we compare OPEC's total production with its total consumption over the last decade, we can see a clear story of two halves.

Taking the figures shown in Figure 19, it can be seen that over 2001-05, OPEC increased its production of all petroleum liquids by significantly more than its consumption: in 2005 its output was 3.7mbd higher than in 2000, but its demand was only 1.3mbd higher.

Figure 20 shows the year-on-year changes in OPEC's output and demand over this period that led to this result.

Over 2006-10, by contrast, the increase in OPEC's production of petroleum liquids (only 100kdb higher in 2010 than in 2005) was far outpaced by the increase in its consumption (+1.7mbd in 2010 versus 2005).

Figure 21 again illustrates the year-on-year changes in output and demand that produced this end result.

Putting these different sets of numbers together gives us Figure 22, which shows OPEC's crude production as a proportion of global production over the last decade.

It follows from the information presented in Figures 17-19 that:

- (i) OPEC's share of global crude output must have been slightly higher than its share of global petroleum liquids production as a whole over the course of the decade; and
- (ii) that its share of global crude output in 2010 must have been lower than it was in 2005.

And this is indeed what the numbers in Figure 22 show. As can be seen, OPEC's share of total crude production was about 2% higher in every year than its share of total global liquids production (averaging 42% over the decade), and although its share of global crude output was slightly higher in 2010 than in 2000, it was down from the highest levels reached in 2005 and 2008.

(Figures 23 and 24 below complement Figure 22 by illustrating the year-on-year changes in global crude-oil production over 2001-05 and 2006-10 respectively)

**Figure 17: Total global consumption and production of oil*, 2000-10, (kbd)**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
TOTAL CONSUMPTION	76,781	77,508	78,161	79,708	82,530	84,064	85,133	85,805	85,301	84,326	87,043	13.4%
TOTAL PRODUCTION	77,774	77,689	76,998	79,603	83,109	84,603	84,680	84,594	85,577	84,449	86,838	11.7%
o/w Crude and conds.	68,584	68,186	67,242	69,518	72,564	73,802	73,518	73,052	73,717	72,355	74,062	8.0%
o/w NGLs	6,370	6,672	6,786	7,046	7,289	7,572	7,816	7,981	7,976	8,098	8,454	32.7%
o/w Other liquids	975	993	1,062	1,052	1,117	1,128	1,231	1,412	1,729	1,855	2,093	14.7%
o/w Refinery gains	1,844	1,839	1,909	1,986	2,139	2,101	2,115	2,149	2,155	2,140	2,230	20.9%
C+C/total production	88.2%	87.8%	87.3%	87.3%	87.3%	87.2%	86.8%	86.4%	86.1%	85.7%	85.3%	

Source: EIA; *All petroleum liquids, unadjusted for their respective energy densities

Figure 18: OPEC production of oil* as share of global output of oil*, 2000-10 (kbd)

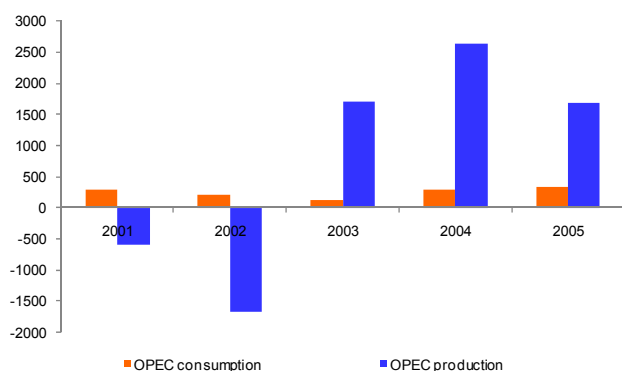
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
Total World Production	77,774	77,689	76,998	79,603	83,09	84,603	84,680	84,594	85,577	84,449	86,838	11.7%
Total OPEC production	31,195	30,592	28,925	30,632	33,265	34,955	34,723	34,374	35,708	33,832	35,055	12.4%
OPEC share of total	40.1%	39.4%	37.6%	38.5%	40.0%	41.3%	41.0%	40.6%	41.7%	40.1%	40.4%	

Source: EIA; *All petroleum liquids, unadjusted for their respective energy densities

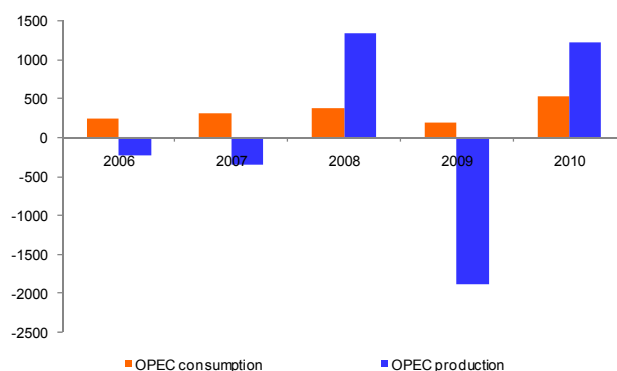
Figure 19: Total OPEC consumption and production of oil*, 2000-10, (kbd)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
TOTAL CONSUMPTION	5,212	5,511	5,725	5,856	6,138	6,475	6,722	7,040	7,423	7,616	8,148	56.3%
TOTAL PRODUCTION	31,195	30,592	28,925	30,632	33,265	34,955	34,723	34,374	35,708	33,832	35,055	12.4%
o/w Crude and conds.	28,980	28,159	26,392	27,980	30,408	31,871	31,591	31,210	32,483	30,599	31,626	9.1%
o/w NGLs	2,014	2,225	2,326	2,473	2,634	2,874	2,955	3,031	3,088	3,097	3,293	63.5%
o/w Other liquids	170	176	181	146	181	155	141	94	98	97	97	-42.9%
o/w Refinery gains	32	32	27	32	42	55	35	39	39	39	39	24.3%
C+C share of total	92.9%	92.0%	91.2%	91.3%	91.4%	91.2%	91.0%	90.8%	91.0%	90.4%	90.2%	

Source: EIA; *All petroleum liquids, unadjusted for their respective energy densities

Figure 20: YoY change in OPEC consumption and production of oil*, 2001-05 (kbd)

Source: Deutsche Bank after EIA; *All petroleum liquids, unadjusted for their respective energy densities

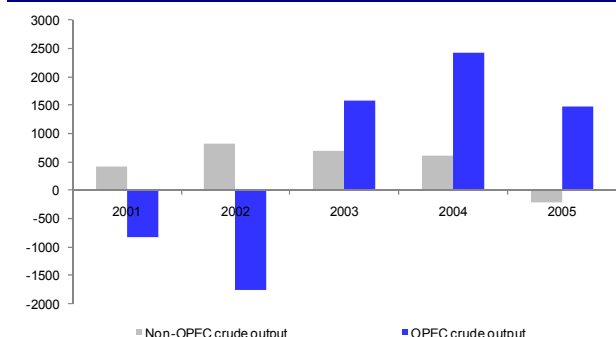
Figure 21: YoY change in OPEC consumption and production of oil*, 2006-10 (kbd)

Source: Deutsche Bank after EIA; *All petroleum liquids, unadjusted for their respective energy densities

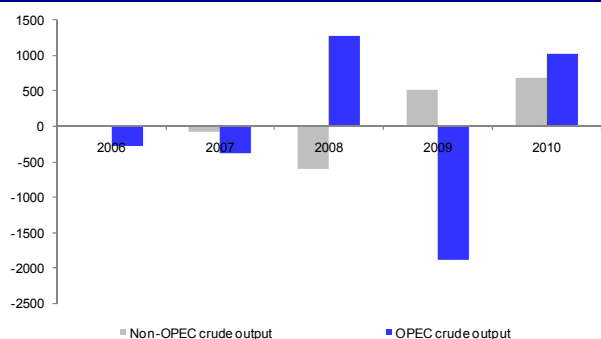
Figure 22: OPEC crude-oil production as a share of world crude-oil production, 2000-10 (kbd)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
World crude production	68,584	68,186	67,242	69,518	72,564	73,802	73,518	73,052	73,717	72,355	74,062	8.0%
o/w OPEC	28,980	28,159	26,392	27,980	30,408	31,871	31,591	31,210	32,483	30,599	31,626	9.1%
o/w non-OPEC	39,605	40,027	40,849	41,538	42,156	41,931	41,927	41,842	41,234	41,757	42,436	7.1%
OPEC share of total	42.3%	41.3%	39.2%	40.2%	41.9%	43.2%	43.0%	42.7%	44.1%	42.3%	42.7%	

Source: EIA

Figure 23: YoY change in global crude-oil production, broken down by OPEC and non-OPEC, 2001-05 (kbd)

Source: Deutsche Bank after EIA.

Figure 24: YoY change in global crude-oil production, broken down by OPEC and non-OPEC, 2006-10 (kbd)

Source: Deutsche Bank after EIA.

In short, what all of our analysis reveals so far is that:

- (i) global subsidies on oil consumption are overwhelmingly concentrated in oil-exporting countries, and in OPEC countries in particular;
- (ii) that on a per-capita basis the rate of increase in OPEC's oil consumption over the last decade has been much greater than that of the world as a whole, a fact that we take to be *prima facie* evidence that subsidies in OPEC countries have been instrumental in driving demand growth in these countries;
- (iii) that the increase in OPEC's production of all petroleum liquids over 2001-05 was much greater than its increase in consumption, but that over 2006-10 this pattern reversed, with OPEC's consumption surging while its production remained flat;
- (iv) that global crude production has essentially stagnated at 73-74mbd since 2005;

- (v) that OPEC's production of crude declined slightly over the second half of the decade (2010 production was 200kbd lower than in 2005), with its share of global crude output falling back slightly from its mid-decade levels.

And from all of this two things necessarily follow.

First, with OPEC's annual consumption of all petroleum liquids increasing by 1.7mbd by 2010 versus 2005, the fact that its production of all liquids increased by only 100kbd while its output of crude actually fell by 200kbd over the same period means that its exports of crude oil must have trended down since 2005.

Second, the fact that headline global consumption of all petroleum liquids also continued to increase over 2006-10 (2010 demand was 2.9mbd higher than the 2005 level) while global production of crude oil remained essentially flat over the second half of the decade means that not only OPEC exports but total *global* exports of crude oil must have trended down since 2005 as well.

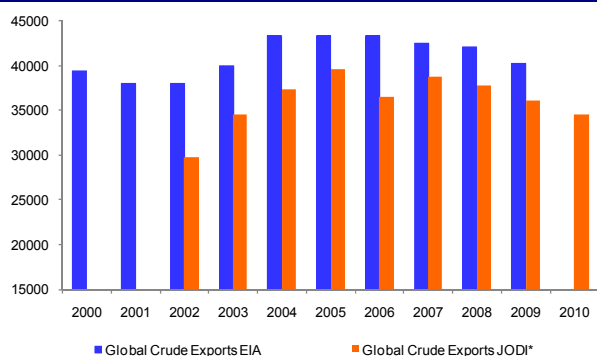
Let us now look at the trend in exports of crude oil over the last decade in more detail.

#6 Global and OPEC exports of crude oil since 2000

Given that the EIA discontinued providing data on oil exports after 2009, we do not have EIA figures for 2010 exports in the way that we have EIA production and consumption numbers for 2010. As a result, while our analysis of global crude exports here still relies mainly on the EIA data (and to this extent, therefore, goes only as far as 2009), we also look at the global crude-exports numbers in the Joint Organization Database Initiative (JODI) dataset (although the JODI numbers have their own limitations, starting as they do only in 2002, and being incomplete in some years for some countries).

Turning then to the numbers themselves, Figure 25 shows the evolution of global crude-oil exports over 2000-09 according to the EIA data, and over 2002-10 according to JODI (based on the data shown in Figure 26 below).

Figure 25: Gross global crude exports, 2000-10 (kbd)



Source: Deutsche Bank after EIA and JODI; *Since the JODI data only includes Iraq from 2007 onwards, we here exclude the Iraq data to provide an internally consistent and comparable JODI dataset

(Note that the JODI numbers shown here exclude Iraq, because JODI gives data for Iraq data only from 2007 onwards and what we are interested in here is a historically consistent dataset so that the trend shown is on the same scope over time. The exclusion of the Iraqi data is the main reason why the JODI numbers in Figure 23 are lower in absolute terms than the EIA numbers, but for those interested Figure 26 below shows the raw JODI numbers over 2002-10 both with and without Iraq.)

As can be seen, despite the difference in the absolute numbers between the EIA and JODI datasets, the trend shown by both is exactly the same: after rising sharply over 2002-05, global exports of crude oil peaked in 2005 and have been trending lower ever since.

Figure 27 then shows the EIA data for gross global and gross OPEC exports of crude oil over 2000-09, and Figure 28 for net global and net OPEC crude exports over 2000-09.

As can be seen from Figures 27 and 28, OPEC's share of gross and net global exports of crude oil has been quite consistent over time, averaging 55% and 61% respectively over 2000-09.

Similarly to the global pattern, OPEC's crude exports rose aggressively over 2002-05, but hit their peak (in the last decade at least) in 2006, and have been on a downward trend since. This pattern in OPEC's exports reflects the reasons already explained above, namely continuing rapid domestic demand growth after 2005 on the one hand, and stagnating production on the other.

Comparing Figure 28 with Figure 27 we can see that OPEC's net exports are virtually exactly the same as its gross exports whereas net global exports are some 4mbd lower on average than gross global exports. This reflects the fact that OPEC countries import virtually no crude oil at all (the EIA shows very small imports for only one OPEC country, Algeria), whereas many of the other countries that are net exporters of crude also import a reasonable amount, while a small number of countries that export crude on a gross basis nonetheless import more and are therefore net oil importers.

Figure 29 then shows gross global and gross OPEC crude exports over 2000-09 graphically, and Figure 30 does the same for net global crude exports and net OPEC crude exports. In both cases, the peak in global exports is clearly shown in 2005.

In short, however one chooses to slice the numbers, 2005 was the year in which – to date at least – global exports of crude oil peaked, and they have been trending lower ever since.

And yet as we saw earlier in this report (Figures 7-12 above and accompanying analysis), total headline consumption of all petroleum liquids has continued to increase since 2005, and this continuing upward trend in demand has been driven to a large extent by China and India, both of which are very large importers of petroleum.

So, if global exports of crude oil have been declining since 2005 but large net importers of petroleum liquids such as China and India have been continuing to grow their overall consumption over this period, we are faced with an interesting question: what exactly have the net-importing countries as a bloc been consuming since 2005 to enable global headline consumption of petroleum liquids to continue increasing in the face of declining global exports of crude oil over this period?

Let us now try to answer this question.

Figure 26: Gross global exports of crude oil, 2000-10 (kbd)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EIA Global Crude Exports	39,380	38,060	38,041	39,964	43,274	43,361	43,322	42,533	42,137	40,218	<i>n/a</i>
<i>o/w Iraq</i>	<i>2,072</i>	<i>1,850</i>	<i>1,495</i>	<i>912</i>	<i>1,600</i>	<i>1,381</i>	<i>1,480</i>	<i>1,618</i>	<i>1,767</i>	<i>1,878</i>	<i>n/a</i>
JODI Global Crude Exports*	n/a	n/a	29,727	34,499	37,315	39,592	36,455	40,437	39,672	38,060	36,401
<i>o/w Iraq</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>1,643</i>	<i>1,850</i>	<i>1,904</i>	<i>1,909</i>
JODI Global Crude Exports** (excl. Iraq)	n/a	n/a	29,727	34,499	37,315	39,592	36,455	38,794	37,822	36,156	34,491

Source: EIA, JODI. *Including Iraq from 2007; **Since the JODI data only includes Iraq from 2007 onwards, we here exclude the Iraq data for to provide an internally consistent and comparable JODI dataset

Figure 27: Gross OPEC crude-oil exports as a share of gross world crude-oil exports, 2000-09 (kbd)

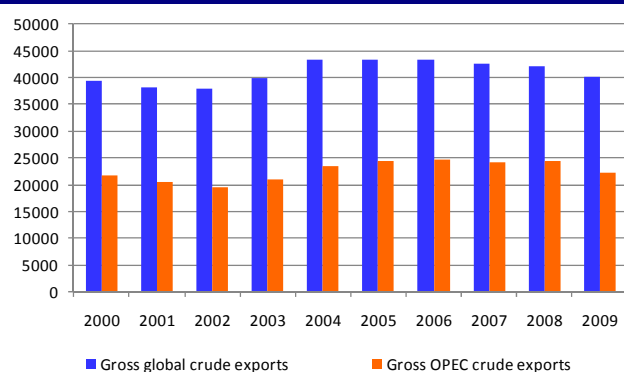
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2009/2000
Global crude exports	39,380	38,060	38,041	39,964	43,274	43,361	43,322	42,533	42,137	40,218	2.1%
o/w OPEC	21,710	20,401	19,419	21,037	23,469	24,326	24,721	24,302	24,475	22,131	1.9%
o/w non-OPEC	17,671	17,658	18,622	18,927	19,805	19,035	18,602	18,231	17,661	18,087	2.4%
OPEC share of total	55.1%	53.6%	51.0%	52.6%	54.2%	56.1%	57.1%	57.1%	58.1%	55.0%	

Source: EIA

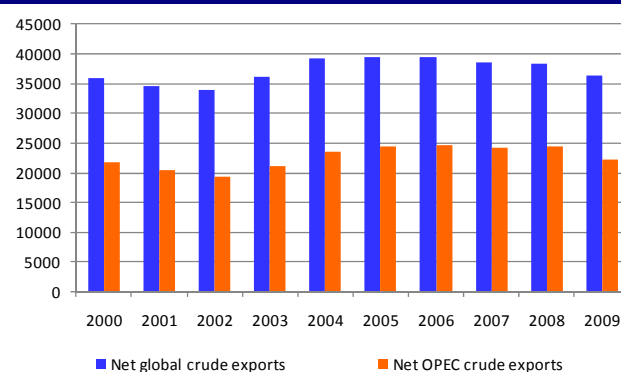
Figure 28: Net global and net OPEC crude-oil exports, 2000-09 (kbd)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2009/2000
Net global crude exports	35,903	34,481	34,015	36,071	39,324	39,409	39,498	38,567	38,379	36,443	1.5%
Net OPEC crude exports	21,704	20,397	19,412	21,029	23,462	24,319	24,714	24,294	24,466	22,123	1.9%
<i>o/w Saudi Arabia</i>	<i>6,444</i>	<i>6,257</i>	<i>5,985</i>	<i>6,873</i>	<i>7,143</i>	<i>7,216</i>	<i>7,036</i>	<i>6,969</i>	<i>7,299</i>	<i>6,274</i>	-2.6%
<i>o/w Iran</i>	<i>2,309</i>	<i>2,229</i>	<i>2,094</i>	<i>2,296</i>	<i>2,556</i>	<i>2,497</i>	<i>2,540</i>	<i>2,618</i>	<i>2,475</i>	<i>2,295</i>	-0.6%
<i>o/w Nigeria</i>	<i>2,069</i>	<i>2,034</i>	<i>1,893</i>	<i>2,164</i>	<i>2,176</i>	<i>2,260</i>	<i>2,190</i>	<i>2,120</i>	<i>1,932</i>	<i>2,051</i>	-0.9%
<i>o/w UAE</i>	<i>1,870</i>	<i>1,743</i>	<i>1,674</i>	<i>1,848</i>	<i>2,172</i>	<i>2,107</i>	<i>2,324</i>	<i>2,289</i>	<i>2,339</i>	<i>2,036</i>	8.9%
<i>o/w Iraq</i>	<i>2,072</i>	<i>1,850</i>	<i>1,495</i>	<i>912</i>	<i>1,600</i>	<i>1,381</i>	<i>1,480</i>	<i>1,618</i>	<i>1,767</i>	<i>1,878</i>	-9.3%
<i>o/w Angola</i>	<i>695</i>	<i>698</i>	<i>854</i>	<i>860</i>	<i>1,011</i>	<i>1,220</i>	<i>1,393</i>	<i>1,659</i>	<i>1,849</i>	<i>1,757</i>	153.0%
<i>o/w Venezuela</i>	<i>2,094</i>	<i>1,947</i>	<i>1,622</i>	<i>1,535</i>	<i>1,587</i>	<i>2,418</i>	<i>2,349</i>	<i>2,225</i>	<i>1,861</i>	<i>1,691</i>	-19.2%
<i>o/w Kuwait</i>	<i>1,317</i>	<i>1,221</i>	<i>1,138</i>	<i>1,249</i>	<i>1,479</i>	<i>1,690</i>	<i>1,760</i>	<i>1,645</i>	<i>1,785</i>	<i>1,365</i>	3.7%
<i>o/w Libya</i>	<i>1,110</i>	<i>1,050</i>	<i>984</i>	<i>1,127</i>	<i>1,219</i>	<i>1,322</i>	<i>1,389</i>	<i>1,315</i>	<i>1,336</i>	<i>1,039</i>	-0.9%
<i>o/w Algeria</i>	<i>803</i>	<i>438</i>	<i>868</i>	<i>1,147</i>	<i>1,272</i>	<i>897</i>	<i>876</i>	<i>856</i>	<i>775</i>	<i>803</i>	-14.2%
<i>o/w Qatar</i>	<i>680</i>	<i>680</i>	<i>571</i>	<i>754</i>	<i>868</i>	<i>933</i>	<i>982</i>	<i>624</i>	<i>684</i>	<i>704</i>	3.6%
<i>o/w Ecuador</i>	<i>241</i>	<i>251</i>	<i>235</i>	<i>265</i>	<i>379</i>	<i>378</i>	<i>394</i>	<i>356</i>	<i>365</i>	<i>342</i>	41.9%
OPEC's share of global total	60.5%	59.2%	57.1%	58.3%	59.7%	61.7%	62.6%	63.0%	63.8%	60.7%	

Source: EIA

Figure 29: Gross global exports of crude oil versus gross OPEC exports of crude oil, 2000-09 (kbd)

Source: Deutsche Bank after EIA

Figure 30: Net global exports of crude oil versus Net OPEC exports of crude oil, 2000-09 (kbd)

Source: Deutsche Bank after EIA

#7 Frustrated crude demand met by lower energy-density alternatives

As explained in Section #3 above, global demand for petroleum liquids has continued to rise since 2005, especially in China and India (both of which are large net importers).

As a result, as global crude-oil production has stagnated and global crude exports have actually declined since 2005, an increasing share of demand in net-importing countries has been satisfied with non-crude liquids. In this respect, a look at the breakdown of consumption by liquid-fuel source reveals that – as was the case with OPEC’s production and consumption examined in Section #5 above – the last decade was a story of two halves.

As can clearly be seen from Figure 17 above, over 2001-05 the increase in the headline consumption of all petroleum liquids was +7.3mbd (84.1mbd in 2005 versus 76.8mbd in 2000) and this was closely matched by the +5.2mbd increase in the output of crude oil over the same period (73.8mbd in 2005 versus 68.6mbd in 2000).

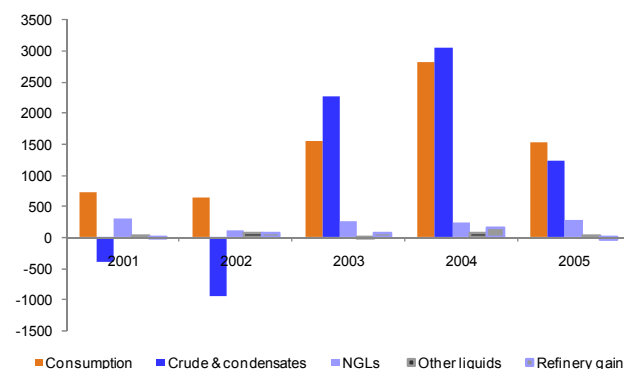
Over 2006-10, by contrast, the supply of crude oil stagnated at or around the 2005 level of 73.5mbd, such that the continuing increase in headline global demand for liquid petroleum fuels over 2006-10 – at +3mbd as per Figure 17 above (87mbd in 2005 versus 84mbd in 2000) a lower increase than over 2001-05 – had to be made up by higher production of NGLs and bio-fuels. The contribution of refinery gains to the increase in total liquids supply over this period was also higher than it had been over 2001-05.

These trends are shown graphically in Figures 31 and 32, and what all of this means is that whereas c.80% of the headline increase in the supply of petroleum liquids over 2001-05 was accounted for by higher crude output, over 2006-10 only 12% of the headline increase in total liquids production was composed of higher crude volumes.

This is a very important point because the presentation of oil-supply data in purely volumetric terms is misleading unless it is adjusted for the energy density of the liquid in question (i.e. the energy it contains per unit volume).

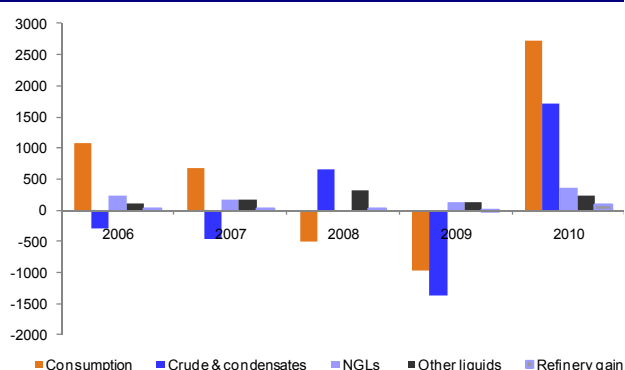
To do this we need to know the amount of Gigajoules (GJ) contained in the same volume of liquid for each of these different petroleum liquids. In other words, we need to convert barrel (bbl) measures of volume into barrels-of-oil equivalent (boe) measures of energy contained in that volume.

Figure 31: YoY change in oil* consumption and production, 2001-05 (kbd)



Source: Deutsche Bank after BP; *All petroleum liquids, unadjusted for their respective energy densities

Figure 32: YoY change in oil* consumption and production, 2006-10 (kbd)



Source: Deutsche Bank after BP; *All petroleum liquids, unadjusted for their respective energy densities

Crude oil on average contains about 6.3GJ/bbl, whereas NGLs on average only about 4.4GJ/bbl (i.e. c.70% of the energy value of crude oil), and bio-fuels between 4GJ/bbl (ethanol) and 5.5GJ/bbl (vegetable oil). This means that ten barrels of NGL equate to only seven barrels of crude oil in energy terms, i.e. 10bbl of NGL = 7boe.

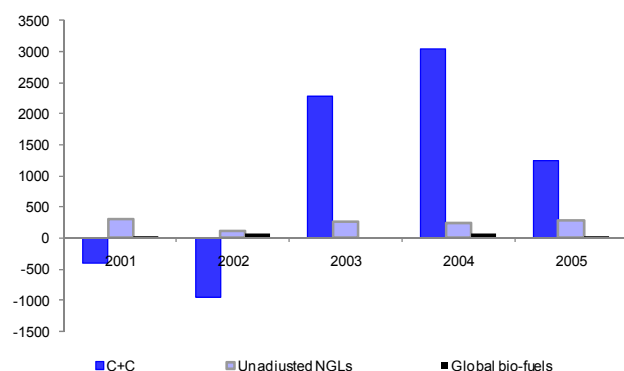
Only if the EIA’s volumetric supply data is adjusted to take account of these varying energy densities will the true contribution of NGLs and bio-fuels to global oil supply be reflected.

Moreover, there is an extra qualification to be made about including bio-fuels and refinery gains in oil-supply data, and this concerns the *net* energy they contribute to society compared with crude oil and heat-adjusted NGLs. As far as bio-fuels are concerned, the issue in this respect is that they are generally very energy intensive to produce as they entail the transformation of an organic energy source into a liquid one. This is one of the reasons that most bio-fuels production still needs to be subsidized (although as explained in Section #8 below, Brazilian bio-fuels are an exception in this respect).

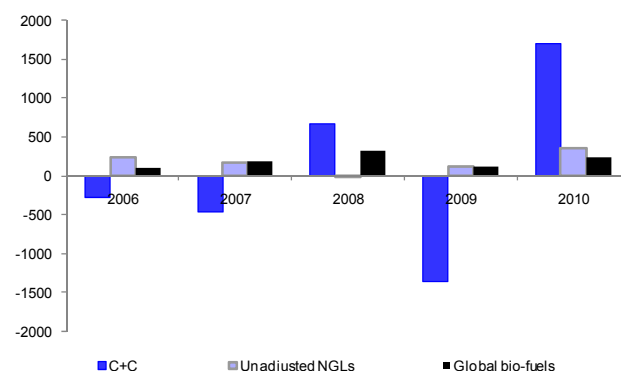
Figure 33: Total global production of crude + condensates and unadjusted value of NGLs and global bio-fuels, 2000-10 (kbd in bbls)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
Crude and condensates	68,584	68,186	67,242	69,518	72,564	73,802	73,518	73,052	73,717	72,355	74,062	8.0%
Unadjusted NGLs	6,370	6,672	6,786	7,046	7,289	7,572	7,816	7,981	7,976	8,098	8,454	32.7%
Global bio-fuels	975	993	1,062	1,052	1,117	1,128	1,231	1,412	1,729	1,855	2,093	114.7%
TOTAL	75,930	75,851	75,090	77,616	80,970	82,502	82,565	82,445	83,423	82,308	84,609	11.4%

Source: EIA

Figure 34: Annual change in C+C plus unadjusted NGLs plus global bio-fuels production, 2001-05 (kbd in bbl)

Source: Deutsche Bank after EIA

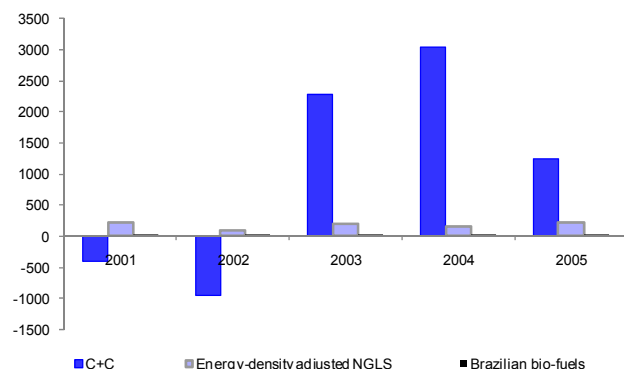
Figure 35: Annual change in C+C plus unadjusted production, 2006-10 (kbd in bbl)

Source: Deutsche Bank after EIA

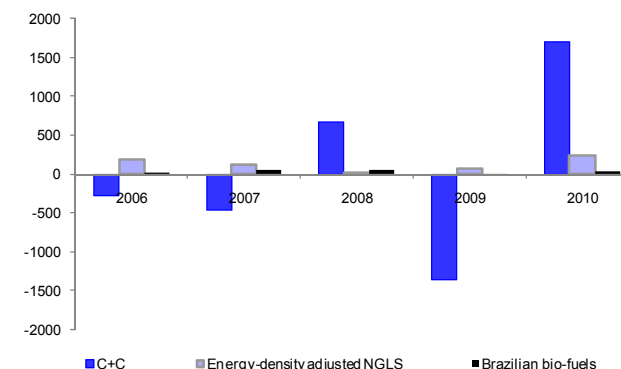
Figure 36: Total global production of crude + condensates and energy-adjusted value of NGLs and Brazilian bio-fuels, 2000-10 (kbd in boe)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2000
Crude and condensates	68,584	68,186	67,242	69,518	72,564	73,802	73,518	73,052	73,717	72,355	74,062	8.0%
NGLs	4,333	4,557	4,642	4,842	5,007	5,228	5,413	5,528	5,529	5,605	5,844	34.9%
Brazilian bio-fuels	119	128	129	136	152	176	201	254	307	295	326	173.3%
TOTAL	73,036	72,871	72,012	74,496	77,723	79,206	79,132	78,834	79,554	78,255	80,232	9.9%

Source: EIA, OECD, Deutsche Bank

Figure 37: Annual change in production of C+C plus energy-density adjusted NGLs plus Brazilian bio-fuels, 2001-05 (kbd in boe)

Source: Deutsche Bank after EIA and OECD

Figure 38: Annual change in production of C+C plus energy-density adjusted NGLs plus Brazilian bio-fuels, 2006-10 (kbd in boe)

Source: Deutsche Bank after EIA and OECD

This means that the net energy they provide to society is much lower than that of crude oil. As far as refinery gains are concerned, these essentially reflect the volumetric increase in liquid from breaking down large hydro-carbon molecules into smaller ones, and as such do not add any extra energy to that contained in the oil before it is processed in the refinery.

In short, as far as meeting the global demand for energy from petroleum is concerned what really matters in the end is the supply of crude oil and energy-density adjusted NGLs and bio-fuels (i.e. NGLs and bio-fuels on a boe basis). Indeed, we would go further and say that as far as bio-fuels are concerned what really matters is the energy-adjusted contribution from commercially viable sources, as these by definition are the least energy-intensive to produce and so have the highest net-energy yield.

And the point is that this number – like that of crude oil itself – has essentially stagnated since 2005. This can be seen from Figures 33-38 above, which allow for a comparison between the unadjusted NGL and bio-fuel output on the one hand, and the energy-density adjusted (and also commercially viable) numbers on the other.

Even on an unadjusted basis (Figures 33-35), it can be seen that the headline increase in crude, NGLs and global bio-fuels combined over 2006-10 (+2.1mbd, i.e. 84.6mbd in 2010 versus 82.5mbd in 2005) was much lower than it was over 2001-05 (+6.6mbd, or 82.5mboe versus 75.9mboe).

However, and as shown in Figure 36, looking at the data after adjusting for the energy density of NGLs and Brazilian bio-fuels (the only ones commercially viable to date) it can be seen that the increase in crude and NGLs over 2006-10 was much lower: only +1mboe, (i.e. 80.2mboe in 2010 versus 79.2mboe in 2005), compared with +6.2mboe over 2000-05 (i.e. 79.2mboe in 2005 versus 73mboe in 2000). As can be seen from Figures 37 and 38, over the second half of the decade the increase in the production of NGLs and commercial bio-fuels on an energy-adjusted basis was nowhere near big enough to compensate for stagnating crude output.

In short, from 2005 onwards the increase in the global output of crude oil and energy-adjusted NGLs and commercially viable bio-fuels has been materially lower than the increase in headline global consumption of petroleum liquids.

And with ever more of the crude that has been produced since 2005 being consumed within OPEC and other major exporting countries, exports of crude have been on a downward trajectory since 2005.

Of course, it follows from what we have just said about the production of petroleum liquids that the EIA's headline numbers for the *consumption* of petroleum liquids over the last decade would also need to be adjusted to reflect the amount of energy actually consumed. That is to say the EIA's headline consumption numbers in Figure 17 above (and BP's consumption numbers in Figure 7 above) would both need to be shown on a boe rather than a bbl basis for them to give an accurate picture of the trend in the amount of energy actually being consumed over time.

For our purposes here, though, it suffices to note that:

- (i) over 2006-10 the output of crude oil essentially stagnated at 2005 levels, such that its share of the EIA's total headline *increase* in the production of petroleum liquids declined to 12% over 2006-10 from c.80% over 2001-05 (or in absolute terms, to 200kbd out of 2.24mbd over 2006-10, from 5.2mbd out of 7.3mbd over 2001-05);
- (ii) after adjusting the volumetric output of NGLs and commercially viable bio-fuels to derive their boe energy content, it is clear that the *increase* in the total energy made available to consumers from the combined output of crude oil, NGLs, and commercially viable bio-fuels over 2006-10 was much lower than it was over 2001-05;
- (iii) from this it follows that the increase in the amount of energy consumed from all petroleum liquids over 2006-10 was also significantly lower than it was over 2001-05; **but also**
- (iv) that to the extent the world's key exporters of crude oil consumed more of their crude output domestically over 2006-10 than they did over 2001-05, global exports of crude declined from 2005 onwards and importing nations increased their consumption of other petroleum liquids with lower energy density while all the time continuing to bid for a declining pool of global crude exports.

In short, we think that since 2005 there has been frustrated demand for crude oil in importing nations.

At the same time, however, taxes and subsidized bio-fuel mandates in importing countries have for a long time led to lower demand for crude than would have been the case without such distortions, and this, in turn, has had an impact on crude producer's incentives to invest over time. As a result, we now consider the extent to which "frustrated supply" on the part of producers might also have made a contribution to the trends in crude-oil production and exports since 2005.

#8 What about the impact of market distortions in oil-importing countries?

We have discussed above the impact of subsidies in oil-exporting countries on their internal demand, but what about the impact of policy measures in oil-importing countries?

There are many ways that governments in oil-importing countries can affect the demand for crude oil, but they essentially boil down to one of two categories or a combination of both: (i) measures focused on price (i.e. taxes), and (ii) measures focused on volume (i.e. subsidies on alternative fuels such as bio-fuels).

In both cases, the effect is the same: to reduce demand in the importing countries below what it would have been in the absence of these policies.

In other words, just as subsidies in oil-exporting countries are a market distortion, so too are taxes or volume mandates on alternative fuels in oil-importing countries: both distort the natural level of demand that would prevail in a free market.

And to the extent that taxes and alternative-fuel mandates reduce demand against BAU conditions in the oil-importing countries, they thereby reduce the incentive in oil-exporting countries to invest, with the result that production in and exports from exporting countries are lower than they would be in the absence of these policies in importing countries.

In short, to the extent that market distortions in oil-importing countries have held back global demand against BAU levels, might it not therefore be argued that they are also part of the explanation as to why global crude production has stagnated and global crude exports have declined since 2005?

In other words, might it not be the case that market distortions in importing countries, by reducing demand, have actually created frustrated *supply* on the part of exporters?

Looking at the policies on taxes and alternative-fuel volume mandates in the OECD countries (30 of the 34 OECD countries are net oil importers), there can be no doubt that they have had a material impact on demand.

As far as taxes are concerned, these vary greatly between different importing countries. For example, the level of taxes in the EU is by far the highest in the industrialized world, while the US and Canada are clearly at the lower end of the scale and Japan is in the middle.

Figure 39 shows that taking average 2010 prices, the four largest EU economies – Germany, the UK, France, and Italy – all had taxes on oil accounting for over 60% of end-user prices for a litre. In Japan, taxes accounted for 50%

of end-user prices, and in Canada and the US, 33% and 16% respectively.

Figure 39: Taxes as a proportion of the end-user price for a litre of oil in 2010 (\$ per litre)

Country	Production and refining margin	Tax	Tax as % of end-user price
USA	\$0.63	\$0.12	16.0%
Canada	\$0.60	\$0.30	33.3%
Japan	\$0.58	\$0.57	49.6%
France	\$0.54	\$0.95	63.7%
Italy	\$0.48	\$0.94	66.3%
Germany	\$0.52	\$1.02	66.3%
UK	\$0.62	\$1.15	65.1%

Source: OPEC

Other things being equal these higher levels of per-capita taxation in the EU and Japan would be expected to lead to lower per-capita consumption there compared with the US and Canada, and this is indeed what the numbers show (Figure 40).

Figure 40: 2010 per-capita oil consumption* in the EU and US (barrels per person per year)

European Union	10.1
Japan	12.5
United States	22.5
Canada	24.4

Source: BP, United Nations, Deutsche Bank; *All petroleum liquids unadjusted for their respective energy densities.

As can be seen, taking BP's headline consumption data for all petroleum liquids, the EU and Japan consumed 10.1 and 12.5 barrels of oil per head respectively in 2010, compared with 22.5 and 24.4 for the US and Canada respectively.

Although other factors are obviously also in play here – for example, Canada's much lower population density and much colder average temperatures would also be an important part of the explanation for its very high per-capita consumption – this shows the correlation between tax levels and per-capita consumption is a very strong one.

In short, these figures are *prima facie* evidence that the impact of taxes on oil demand in OECD countries is a very big one: if the EU's per-capita consumption had been as high as that of the US in 2010, headline global demand would have been 17mbd higher than it actually was.

It is also interesting to compare the level of taxes on oil consumption in the importing countries with the revenues from and subsidies on oil in the exporting countries.

Figure 41 shows OPEC estimates of the average tax take on oil in OECD countries against the total revenues from

oil in OPEC countries over the period 2006-10, together with the IEA estimate of direct subsidies on oil in OPEC countries for 2010 as already shown in Figure 5 above.

Figure 41: Average OECD tax take and OPEC revenues p.a. from oil, 2006-10, and 2010 OPEC oil subsidies

Est. avg. annual OECD oil taxes	\$878 billion
<i>o/w est. avg. annual oil taxes, G7 of OECD</i>	<i>\$600 billion</i>
<i>o/w est. avg. annual oil taxes, other OECD</i>	<i>\$278 billion</i>
Est. avg. annual OPEC oil revenue	\$734 billion
OPEC subsidies on oil in 2010	\$121 billion

Source: OPEC, IEA

As can be seen, not only was the average OECD annual tax take from oil 20% higher than average annual OPEC revenues from oil over this period (\$878bn versus \$734bn), the average annual OECD tax take over this period was more than seven times greater than the IEA's estimate of the amount of direct subsidies on oil in OPEC countries in 2010 (\$878bn versus \$121bn).

In short, and purely in terms of the absolute dollars spent on taxing and subsidizing oil, it is clear that the market distortions created by taxes in oil-importing countries are significantly greater than those created by subsidies in oil-exporting countries (i.e. the absolute dollar incentive *not to consume* in importing countries is much greater than is the absolute dollar incentive to consume in oil-exporting countries).

If we then consider the impact of alternative-fuel mandates in importing countries, the IEA states that there are currently over 50 countries with bio-fuel blending targets or mandates already in place, with others on top of this having announced that they will adopt such quotas going forward (see the IEA's 2011 publication *Technology Roadmap: Biofuels for Transport*).

For the moment, global production remains dominated by the US (41% of the world total in 2010) and Brazil (24%), which together accounted for two-thirds of all bio-fuels supplied in 2010 (US production is overwhelmingly corn-based ethanol, Brazil's sugar-cane ethanol).

Figure 42 shows the breakdown of total global bio-fuels production between ethanol and bio-diesel.

In terms of the increase in production of bio-fuels over 2006-10, Figure 43 then compares the numbers for the supply of 'other liquids' as per the EIA with the OECD data shown in Figure 42 on a barrels-per-day basis.

As can be seen, with the exception of the 2005 numbers, the match between the EIA and OECD data is a very good one, and averaging the two sets of data gives an increase in global production over 2006-10 of 1.05mbd.

Figure 42: Global bio-fuels production*, 2005-10 (m bbls)

	Ethanol	Bio-diesel	TOTAL
2005	304.4	30.5	334.9
2006	365.3	49.2	414.5
2007	453.2	68.9	522.1
2008	526.0	99.5	625.5
2009	578.0	108.0	686.0
2010	625.3	124.7	750.0

Source: OECD, Deutsche Bank; *Volumetric production, unadjusted for energy density; Note that the OECD's numbers are given in litres, which we have converted into barrels.

Figure 43: Global production of other liquids/bio-fuels*, 2005-10 (mbd)

	EIA	OECD
2005	1,128	918
2006	1,231	1,136
2007	1,412	1,430
2008	1,729	1,715
2009	1,855	1,879
2010	2,093	2,055
Increase over 2006-10	+965	+1,137

Source: EIA, OECD, Deutsche Bank; *Volumetric production, unadjusted for energy density

However, with the exception of Brazil's sugar-cane ethanol, global bio-fuels production remains heavily subsidized, and this is likely to remain the case for years to come.

This means that bio-fuel mandates effectively 'crowd out' crude-oil supply in that they require a given amount of bio-fuels to be consumed even if an equivalent amount of crude oil is available more cheaply (in the US today, for example, this means that nearly 1mbd of ethanol has to be taken by refiners instead of crude oil).

Taking Brazil's production out of the equation, this would imply that about 75% of all bio-fuels consumed in 2010 were at the expense of cheaper crude oil, and hence that global crude demand was c.1.5mbd lower than it would have been without subsidized mandates on bio-fuels.

And in terms of the increase in production over 2006-10, given that Brazil's output rose by c.270kbd over this period, this would imply that the extra amount of crude-oil demand displaced by subsidized bio-fuels by 2010 versus 2005 was c.800kbd (as discussed below, though, we would then need to adjust for the lower energy density of bio-fuels).

On the face of it, then, it would seem that there is indeed a case for arguing that the stagnation in global crude-oil production since 2005 and declining trend in global crude exports since then reflects not only frustrated demand but to some extent also frustrated supply.

However, while the market distortions created by taxes and bio-fuel mandates are undeniably significant, the extent to which they can be said to have contributed to reducing exporting countries' incentive to invest in new capacity since 2005 is in our view limited.

We say this for three main reasons.

First, taxes on oil consumption in the main OECD countries have been around for decades, and are generally fixed at a given percentage of the underlying fuel cost such that consumers see the absolute amount of taxes they pay rise and fall in line with wholesale prices.

As a result, we do not think it is plausible to adduce taxes in OECD countries as a reason for stagnating crude production and declining crude exports since 2005, as both producers and consumers have been living with the market distortions such taxes create for decades and nothing has really changed in this regard since 2005.

Second, whilst on our calculations above the impact of subsidized bio-fuels mandates over the second half of the last decade was to increase the amount of crude oil crowded out by an extra 800kbd by 2010 versus 2005, this is not a large number when set against the 74mbd of crude-oil production.

Moreover, this is the headline volumetric number before adjusting for the lower energy content of bio-fuels relative to crude oil. As a result, on an energy-adjusted basis, the extra amount of crude-oil supply crowded out by bio-fuels in 2010 versus 2005 would be lower, as the 'missing' Gigajoules in the volumetric production of bio-fuels would still have to be made up by crude oil. On our calculations it would come to about 615kbd, i.e. $800\text{kbd} \times 0.65$ plus the 'missing' energy in Brazil's volumetric output, which would come to c.95kbd (i.e. $270\text{kbd} \times 0.35$).

(This being said, however, it is clearly the case that the greater the increase in subsidized bio-fuels production going forward, the greater the likely negative impact on oil-exporting countries' plans for future investment in new capacity. Figure 44 shows the OECD's projections for future bio-fuels production out to 2020, with output forecast to increase by a further 1.34mbd by 2020 versus 2010 levels, and with c.400kbd of this being non-subsidized Brazilian production. As such, this would imply that a further 750kbd of crude production could be crowded out by subsidized bio-fuels by 2020 versus 2010 levels on an energy-adjusted basis (i.e. $(1,337 - 400) \times 0.65 + (400 \times 0.35)$), and going further out in time the IEA's Technology Roadmap for bio-fuels cited above sees potential for bio-fuels production to double over the 2020-30 period.)

Figure 44: Projected increase in production of bio-fuels*, 2011-20 (mbd)

2010	2,055
2015	2,783
2020	3,392
Projected increase over 2011-20	+1,337

Source: OECD, Deutsche Bank; *Volumetric production, unadjusted for energy density

Moreover, the impact of this crowding-out effect has arguably in part at least been offset by the long-term impact of Brazil's domestic mandate. By this we mean that if it had not been for the subsidies granted to Brazil's bio-fuels industry dating back to the 1970s, the industry would never have developed to the extent it has today, i.e. to being the most efficient producer in the world with no subsidies required since the middle of the last decade. And if this had not happened, Brazil would arguably be producing a lot less than the c.500kbd of bio-fuels it produced in 2010, and hence consuming more crude oil.

As such, to the extent that Brazil's originally subsidized mandates on bio-fuels have led to a situation today where its bio-fuels are competitive with crude oil, it would be fair to say that rather than crowding out crude-oil supply its bio-fuels output today actually frees up more crude oil for other consumers and thus makes a positive contribution to the global crude-oil balance.

Third, and most tellingly, the absolute incremental impact on importing countries' demand for crude oil since 2005 created by their taxes on oil and subsidized bio-fuel mandates has in any case been more than made up for by rising sources of alternative demand – or that, at least, is the clear message that since 2005 the crude-oil price itself has been sending. In other words, given that the price of crude oil has been significantly higher on average in real terms over 2006-11 than it was over the first half of the decade, we do not think it is plausible to argue that there has not been enough demand globally since 2005 to incentivize a supply-side response. Rather, we think the most plausible conclusion to draw is that since 2005 crude prices have risen to all-time real highs *despite* the distortions created by taxes and alternative-fuel mandates in importing countries rather than because of them.

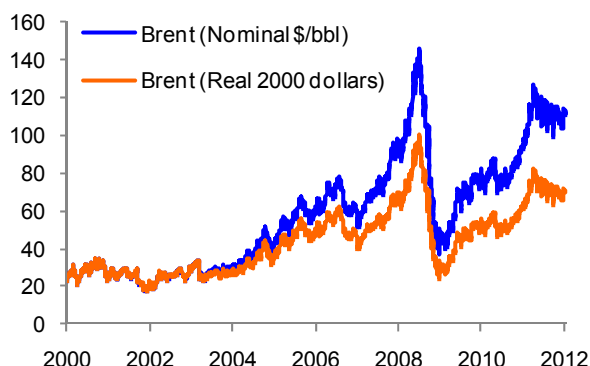
That is to say, prices would have risen to even higher levels in real terms over 2006-11 in the absence of the market distortions we have looked at in importing countries, as under such a scenario demand for crude would likely have been significantly higher (particularly if EU taxes had been closer to US levels).

As a result, we conclude that frustrated demand for crude oil in importing countries has been a much more important factor in driving prices over 2006-11 than has frustrated supply in exporting countries.

#9 The link between production, exports and prices of crude oil

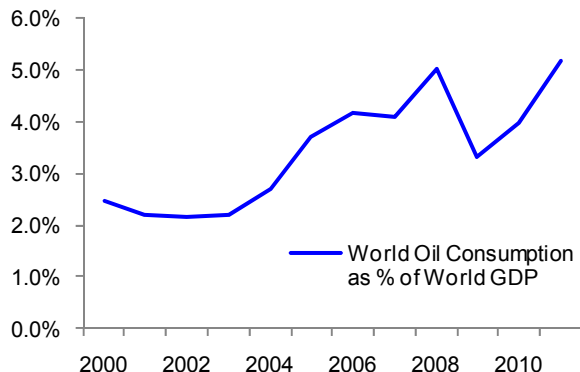
Figure 45 shows the evolution of crude-oil prices in nominal and constant 2000 US-dollar terms since 2000, and Figure 46 the trend in expenditure on crude oil relative to global GDP over the same period.

Figure 45: Average annual Brent crude prices, 2000-10, in nominal and constant 2000 \$



Source: Bloomberg Finance LP, World Bank, Deutsche Bank

Figure 46: World expenditure on crude-oil relative to global GDP, 2000-10



Source: Bloomberg Finance LP, US EIA, World Bank, Deutsche Bank

We find it very striking that the stagnation in crude output and decline in crude exports since 2005 that we have examined above has occurred against the backdrop of crude-oil prices that have on average been much higher not only in nominal terms but also in real terms over 2006-11 than they were in 2005 and over the first half of the decade as a whole.

Although prices crashed in late 2008 and early 2009 in response to the global financial crisis and ensuing OECD recession, they have recovered strongly since the second half of 2009.

Indeed, so strongly have prices recovered since early 2009 that 2011 saw not only the highest ever average nominal price in crude oil (in 2011 Brent averaged over \$100/bbl for the first time ever), but also the highest average *real* price ever (average Brent prices in 2011 were slightly higher even than in 2008 and 1980).

On our reading, this rise in crude-oil prices since 2005 is not hard to explain: as per our analysis throughout this report, the stagnation in crude production has been exacerbated by rising domestic consumption in some of the major exporting countries (driven in large part by very generous subsidies on domestic oil consumption), leading to declining crude exports and hence to a higher real cost of crude oil.

As a result, we take the trends in production, exports and prices of crude oil since 2005 to be strong *prima facie* evidence of:

- (i) involuntary stagnation in output of crude oil by producers (at least over 2006-08); and
- (ii) frustrated demand for crude amongst importers.

To our first point, we say that the stagnation in crude output since 2005 has been largely involuntary because prices were significantly higher on average in real terms over 2006-11 than they were over 2003-05, and yet while crude production surged by +6.6mbd over 2003-05, it has stagnated at 73-74mbd over 2006-11 (Figure 47).

Figure 47: Global crude production and average Brent crude prices in nominal and constant 2000 \$, 2000-11

	Global crude output (kbd)	Average Brent price (nominal)	Average Brent price (constant 2000 \$)
2000	68,584	\$28.53	\$28.53
2001	68,186	\$24.86	\$25.42
2002	67,242	\$25.03	\$25.11
2003	69,518	\$28.48	\$26.05
2004	72,564	\$38.04	\$32.15
2005	73,802	\$55.25	\$44.72
2006	73,518	\$66.11	\$51.35
2007	73,052	\$72.66	\$51.98
2008	73,717	\$98.52	\$65.17
2009	72,355	\$62.67	\$42.81
2010	74,062	\$80.34	\$52.71
2011	n/a*	\$110.91	\$69.71

Source: EIA, Bloomberg Finance LP, World Bank, Deutsche Bank; Note that the FY figure for 2011 is not yet available from the EIA, but that the number for average daily production for the nine months to the end of September 2011 is only 0.1% higher than the number for the equivalent period in 2010 (73.96mbd versus 73.89mbd respectively), which confirms the trend of essentially stagnating output since 2005.

The laws of supply and demand would dictate that so long as there is sufficient spare capacity to meet increased demand surging prices should lead to surging production.

Yet while this happened over 2003-05, it has not happened since, and the failure of production to respond to much higher prices over 2006-08 to anything like the extent that it did over 2003-05 is particularly telling in this respect.

To our second point, we say that there was frustrated demand for crude oil amongst importers precisely because production has failed to respond to higher prices since 2005 to anything like the same extent as it did over 2003-05, with the result that importers have increased their consumption of other liquids while all the time bidding in an increasingly competitive auction for the declining pool of global crude exports.

In short, we can divide the broad dynamics observable in the global oil market since 2000 into two distinct periods:

- (i) the period 2001-05, over which the demand for petroleum liquids increased strongly but so did production and exports of crude oil (with the result that the increase in crude-oil prices over the period was orderly and manageable);
- (ii) The period since 2005, over which time the demand for petroleum liquids has continued to rise, but crude-oil production has stagnated at 2005 levels and exports fallen from their 2005 peak, with the result that crude-oil prices have risen sharply in both nominal and real terms.

Figure 48 underlines the point about the real-terms increase in the average price for Brent crude since 2005, showing that in 2011 it was 56% higher than in 2005.

Figure 48: Average Brent crude-oil prices in constant 2000\$ ad indexed against 2005, 2005-11

	Average Brent price (constant 2000 dollars)	Real price relative to 2005 base of 100
2005	\$44.72	100
2006	\$51.35	115
2007	\$51.98	116
2008	\$65.17	146
2009	\$42.81	96
2010	\$52.71	118
2011	\$69.71	156

Source: EIA, Bloomberg Finance LP, Deutsche Bank

On average over the entire 2006-11 period, Brent prices have been c.25% higher in real terms than they were in 2005.

Moreover, the only year over 2006-11 in which prices were lower in real terms than in 2005 was 2009, and even in that year – i.e. during the worst recession in the industrialized world for decades – oil prices traded at an average price only \$2 below the 2005 level in real terms.

So much for the last decade – what about the future?

#10 Conclusion: Real crude-oil prices set to rise further over the long term

As we have shown above, global demand for petroleum liquids remains on an upward trajectory, but since the middle of the last decade crude-oil production has been struggling to keep up with the rate of increase in consumption.

On the demand side, population growth, industrialization, and urbanization are driving ever higher levels of consumption. On the supply side, the ongoing depletion of existing crude-oil fields is forcing producers ever higher up the supply curve, which is set to lead to ever-increasing absolute and relative contributions to total crude supply from heavier and sourer grades (not to mention, as we have shown in this report, ever higher absolute and relative contributions to total petroleum-liquids supply from NGLs and bio-fuels).

These dynamics have clear implications for crude-oil prices over the long term, and in its *2010 World Energy Outlook* the IEA stated that they would lead to continuing increases in the real cost of crude oil over time, with prices set to reach \$113/bbl by 2035 in constant 2009 dollars, compared with \$60/bbl in 2009 itself.

However, the price of Brent crude already surpassed \$113/bbl earlier this year in constant 2009 dollars, and is trading very close to this level at the moment.

This suggests to us that in order to ensure that the investment required to prevent the frustrated demand for crude growing further over time materializes, the increase in real crude-oil prices will need to be steeper out to 2035 than the IEA's 2010 WEO forecast.

The question is, how much steeper?

This will depend on the inter-play of a number of factors, the most important of which we would highlight as follows:

- (i) the fact that the supply of crude oil from existing fields declines naturally every year (by c.4mbd on a global basis), and the ensuing need to find the same amount from new sources of production each year simply to keep global production constant;
- (ii) the fact that global reserves of crude oil remain very significant, and that the real-price increases and technology improvements since 2005 are making new sources of production economically viable (in this respect US onshore tight-oil production from the Bakken and Eagle Ford shale deposits is particularly noteworthy);
- (iii) the fact that there is scope for the world's major exporters to reform their subsidies on domestic consumption and thereby reduce their growth in domestic demand and so free up more of their production for exports;
- (iv) the special case of Iraq, and its potential for boosting crude output and exports very dramatically over the next decade;
- (v) the fact that importing countries have an ever greater incentive to become more energy efficient and thereby reduce their dependence on imported crude oil.

Let us now look briefly at each one of these factors in turn;

The impact of the natural decline in production: In its *2008 World Energy Outlook* (WEO), the IEA explained the phenomenon of naturally declining rates of output in existing oilfields thus: (p.222):

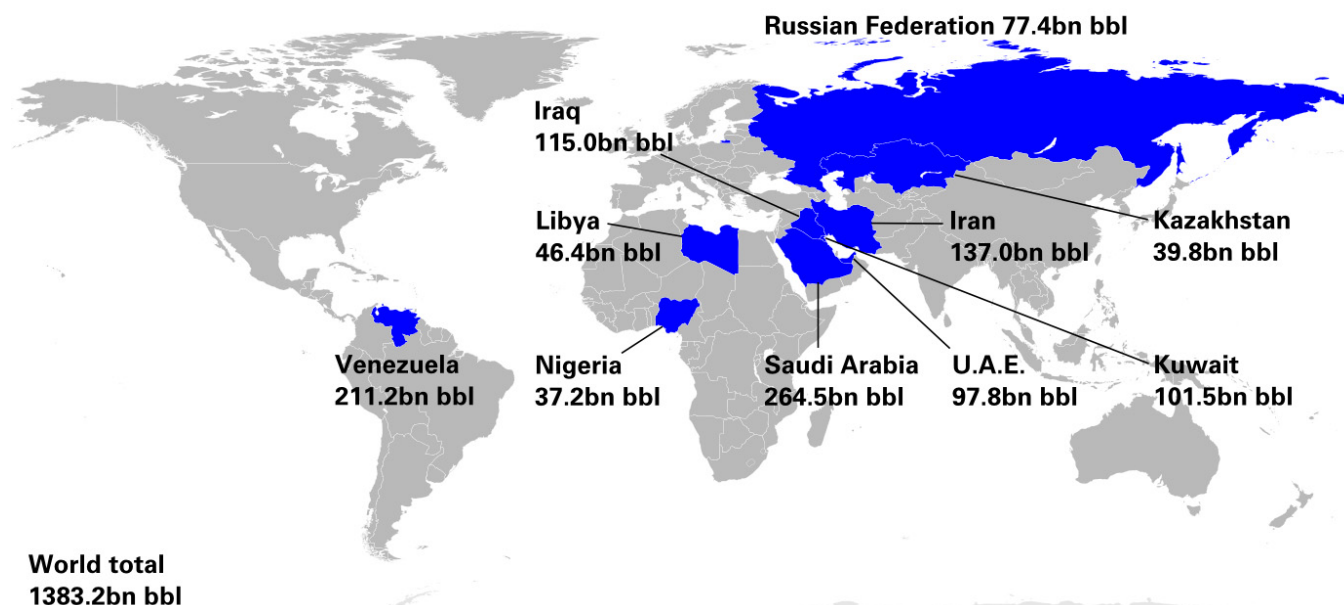
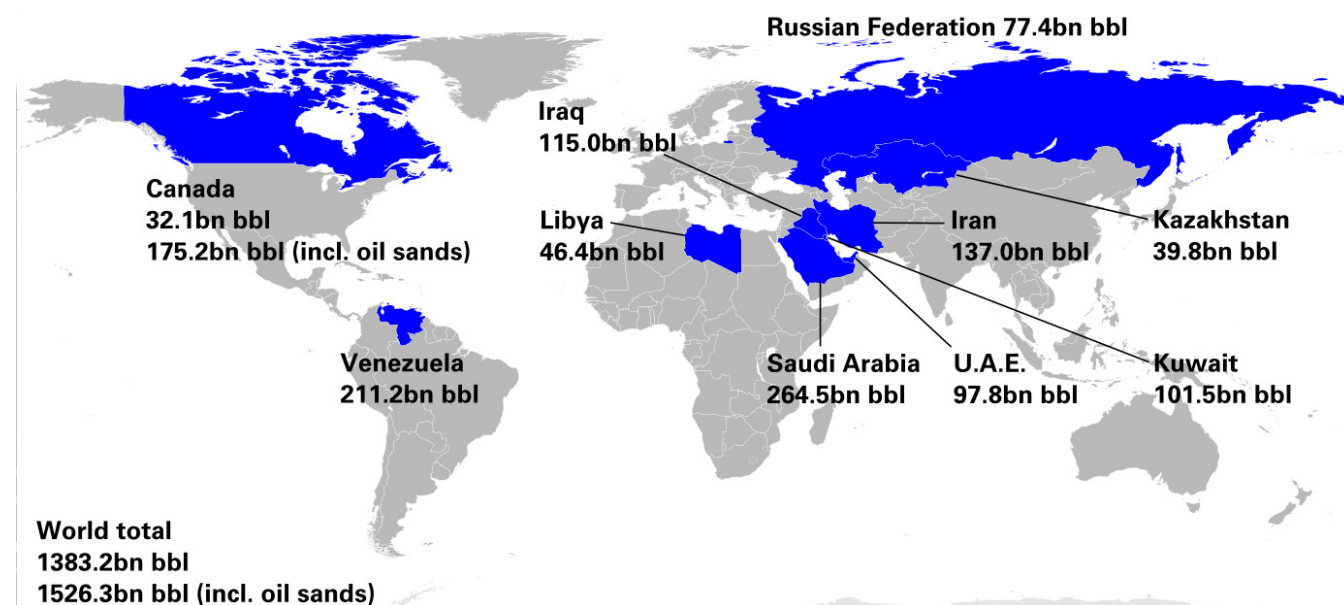
"A major finding of past Outlooks is that the future rate of production decline from producing fields aggregated across all regions is the single most important determinant of the amount of new capacity that needs to be added and the need to invest in developing new fields. In other words future supply is far more sensitive to decline rates than to the rate of growth in oil demand"

This phenomenon occurs across all oilfields worldwide on an aggregated basis because over time all oilfields experience a similar trend across their operating lifetime (Ibid: 229):

"Typically, an oilfield goes through a build-up phase, during which production rises as newly drilled wells are brought into production, a period of plateau production, during which output typically is broadly flat as new wells are brought on stream offsetting declines at the oldest producing wells, and a decline phase, during which production gradually falls with reservoir pressure."

In short, because at any given time a material share of the world's producing oilfields will be in the decline phase, and because the need to replace the lost production from these fields is the single most important driver of the amount of future new capacity required, understanding decline rates is fundamental to forecasting oil-market dynamics.

It is for this reason that the IEA undertook a comprehensive survey of the production profile of 580 of the world's largest fields that had already passed their peak-production phase, and published the findings of this survey in the 2008 WEO.

Figure 49: Economically recoverable crude-oil reserves*, top ten countries (excluding Canadian oil sands)**Figure 50: Economically recoverable crude-oil reserves*, top ten countries (including Canadian oil sands)****Figure 51: Selected countries with higher crude-oil production in 2010 than in 2005 (kbd)**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010/2005
Brazil	1,269	1,295	1,455	1,496	1,477	1,634	1,723	1,748	1,812	1,950	2,055	25.8%
Canada	1,977	2,029	2,171	2,306	2,398	2,369	2,525	2,628	2,579	2,579	2,734	15.4%
United States	5,822	5,801	5,746	5,681	5,419	5,178	5,102	5,064	4,950	5,361	5,474	5.7%
TOTAL	9,067	9,126	9,371	9,483	9,295	9,181	9,350	9,440	9,342	9,890	10,263	11.8%
Change versus 2005	n/a	n/a	n/a	n/a	n/a	n/a	169	260	161	710	1,082	11.8%

Source: EIA

Extrapolating the results of its survey of these large post-peak fields to the totality of the world's producing oil fields (see Chapter 10 of the 2008 WEO, pp. 221-248), the IEA estimated the observed decline rate globally for post-peak fields at 6.7% and the natural or underlying decline rate globally for post-peak fields at 9%.

The IEA defines the observed decline rate as *"the cumulative average annual rate of change in observed production between two given years"*, and the natural decline rate as *"the notional rate of decline in production between two given years had there been no investment beyond that associated with the initial development of the field"*, and in the 2008 WEO it states that it generally used the full production history of each field to calculate the observed decline rate (p.235).

On the basis of the comprehensive analysis of decline rates contained in the 2008 WEO, we infer that the world needs c.4mbd of new production per year just to stand still, and yet as we have seen above, demand for petroleum continues to rise rather than stand still.

However, there are very significant reserves of crude oil left, and the sharp increase in real crude-oil prices since 2005 has made new sources of production commercially viable.

Remaining crude reserves still very significant: On paper, publicly declared global reserves of crude oil remain sufficiently plentiful for both global production and exports to be boosted over the next couple of decades.

As shown in Figures 49 and 50, declared reserves of crude oil came to 1,383bn or 1,526bn barrels depending on whether the 143bn barrels of Canadian oil sands are included in the definition. This would equate to either c.50 years of production at 2010 consumption levels excluding Canadian oil sands, or c.55 years including them. This means that as far as being able to boost the level of crude exports going forward is concerned, the availability of sufficient crude oil reserves *per se* would not appear to be an issue, provided sufficient investment is forthcoming.

Indeed, in this respect a striking feature of the more recent past (2008 onwards) is also the extent to which certain countries' output has started to surprise on the upside owing to the impact of rising prices and advances in technology.

Figure 51 shows the crude-oil production of Brazil, Canada, and the US over the last decade, and it can be seen that after trending down until 2006 Brazil's output has risen every year from 2007, and that of the US and Canada has been rising since 2009. The EIA's numbers also show that for the US and Brazil this rising trend has continued over the first nine months of 2011 (+3% and +1.8% respectively), while Canadian output is slightly down over the first nine months of 2011 (-1.2%).

The combined output of all three since 2005 had increased by 1mbd by 2010 versus 2005 levels, and with US and Canadian consumption actually having declined over 2006-10 while Brazil's rate of consumption has slightly lagged that of its production (20% and 26% respectively over this period), the trends in production and consumption in these three countries combined have had a positive mitigating impact on the balance of global crude exports since 2005.

The explanation for this rising trend in North American and Brazilian output since 2008 is that with higher crude prices and improving technology it has become commercially viable to develop Canadian oil sands in Alberta, US tight-oil deposits on shore (e.g. the Bakken and Eagle Ford plays in North Dakota/Montana and Texas respectively), and ultra-deep water plays in off-shore Brazil. Moreover, this trend can be expected to continue over the next decade, with rising output expected in all three areas.

However, while this phenomenon of rising production from the US, Canada and Brazil is evidence of the real impact that prices and technology can make on output, it is important at the same time to maintain a sense of perspective, and this for two main reasons:

- (i) the combined increase in production of these three countries by 2010 versus 2005 is still only 1mbd, which represents only 1.35% of total global daily output of crude;
- (ii) this figure represents only about 25% of the total amount of new production required every year for global output just to remain constant.

Moreover, the costs of developing remaining reserves will be much higher in real terms than in the past, as historically it is overwhelmingly the most accessible reserves that have been the ones exploited first.

In other words, there is a reason why many more barrels of crude oil have so far been extracted from the deserts of the Arabian peninsula than from the harsh terrain of Alberta.

The remaining recoverable crude is on average of heavier and sourer grades than the crude already produced (most notably the oil sands in Canada and the very heavy grades in the Orinoco basin in Venezuela), and an increasing share of the crude reserves to be developed in future will also come from off-shore fields, in ultra-deepwater.

This means that the physical, technical, and financial challenges to the future exploitation of remaining reserves – with the financial challenges here including not only the raising of capital for financing exploration-and-production (E&P) activities, but also obtaining insurance for potential environmental liabilities as E&P activities move into ever more challenging terrain – will increase over time.

All of which, other things being equal, implies a higher long-run marginal cost (LRMC) for crude oil.

That said, a greater proportion of low-cost production could be made available to global export markets if domestic pricing structures in the major exporting countries were rationalized.

Reform/removal of subsidies in exporting countries:

The IEA estimates that if the subsidies on domestic oil consumption in all countries were eliminated by 2020 (and as we saw in Section #2 above the IEA data shows that over 70% of these subsidies are concentrated in oil-exporting countries), the impact would be to reduce global oil demand by 4.4mbd by 2035 (see the *WEO 2011*).

However, and as the recent events in Nigeria make clear, this is much easier said than done.

Moreover, we think the challenges to reducing and/or removing subsidies in some of the other OPEC countries will be just as great as if not greater than has been the case in Nigeria.

This is because (i) the events of the Arab Spring will keep the desire for political stability at a premium in some of the larger OPEC exporters, and (ii) as we saw in Section #2 above, subsidies in almost every other OPEC country are much higher in both absolute and relative terms than they are in Nigeria.

As a result, whilst we think it reasonable to assume that there will be periodic attempts to reform domestic pricing structures in exporting countries, we would expect the rate of growth in domestic oil demand within OPEC and other major exporters to continue increasing at a much more rapid rate than that of the world as a whole for the foreseeable future.

In short, we see only limited scope for the potential of this factor to be translated into reality in such a way as to arrest the decline in global exports of crude oil materially.

This leaves our last two factors, both of which we would describe as wild cards in that they have the potential to change global crude-oil balances significantly over the next decade: on the supply side Iraq, and on the demand side energy efficiency.

The special case of Iraq: As can be seen from Figures 49 and 50, depending on whether Canada's oil sands are included in the calculation or not, Iraq is either the fourth or fifth largest holder of crude-oil reserves in the world. However, owing to the political turmoil Iraq has experienced over the last decade, its output has been running well below commercially viable levels for the last 10 years or more.

This state of affairs is changing, though.

In their in-depth reports on Iraq (see, in particular, *Iraq and a Hard Place*, 3 January 2012, and *Iraq, the Mother of All Oil Stories*, 10 April 2010), Paul Sankey and his colleagues in DB's global oil equity-research team explain that they expect Iraq to add more new net capacity than any other OPEC member over the 2010-15 period (1.8mbd out of total net new OPEC capacity over this period of 2.7mbd).

As a result, their base-case is for Iraqi output to reach 4.5mbd by 2015 (within a range of 3.5-5.5mbd), and 5.5mbd by 2017 (with a range of 4.2-6.5mbd).

This compares with the 2.7mbd average annualized run rate Iraq had reached in 2011 as of November, and the 2.4mbd it posted in 2010 (both numbers here are taken from the JODI database), such that our colleagues are forecasting growth in Iraqi output versus 2010 levels of 2.1mbd by 2015 and 3.1mbd by 2017.

The Iraqi government itself is much more ambitious than this, and has stated as recently as this month that it expects to achieve daily output of 12.5mbd by 2017, allowing it to export 11.3mbd of crude by that time, up from 1.9mbd in 2010 and the 2.2mbd average annualized run rate for 2011 as of August (again, these numbers are from JODI).

Clearly, if Iraq could reach the level of output and exports it is targeting by 2017, then this would make a tremendous difference to the global crude market over the next decade. Indeed, if it were really able to add 9mbd of crude exports by 2017 versus its 2011 levels, this would – other things being equal – single-handedly reverse the declining trend in global exports and potentially raise global exports of crude to levels above the high-point of the last decade in 2005.

However, for the reasons that Paul Sankey and his team have explained, there are good grounds for being cautious on the extent to which Iraq can achieve the government's declared targets, and we would therefore categorize Iraq as a special case.

In other words, while it certainly has the potential to make a very dramatic change to the outlook for global crude exports in coming years, we will have to wait and see whether Iraq can deliver against the backdrop of continuing political turmoil, particularly following the pull-out of US peace-keeping forces at the end of 2011 (again, see our colleagues' report *Iraq and a Hard Place* for more details on this).

Improving energy efficiency: In the final analysis, the most effective way to neutralize the trend of stagnating crude production and declining crude exports is for both importing and exporting countries to become more efficient in their use of it.

This is a natural ongoing process in any case, as technology improvements over time make it possible to produce and consume all fuels more efficiently, while the price mechanism gives consumers an ever greater incentive to economize as real prices increase.

However, policy incentives can accentuate the impact of both supply- and demand-side measures, and we would expect an intensification of policy incentives in oil-importing countries over coming years. This should certainly help to neutralize the impact of declining crude exports, especially in OECD countries with clear policy frameworks for improving efficiency.

Conclusion: real prices set to rise long term

The extent to which real prices will have to rise over the longer term in order to prevent the frustrated demand for crude oil observable since 2005 from being exacerbated further over time will by definition depend on how steep the ascent up the global supply curve is.

As such, the rise in prices over any given period into the future will in our view depend above all on how much of the world's remaining low-cost supplies are brought to market over the period in question, (hence the importance of Iraq over the next decade, for example), and on the extent to which energy-efficiency gains can be achieved and retained.

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Appendix 1

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Risks to Fixed Income Positions

Macroeconomic fluctuations often account for most of the risks associated with exposures to instruments that promise to pay fixed or variable interest rates. For an investor that is long fixed rate instruments (thus receiving these cash flows), increases in interest rates naturally lift the discount factors applied to the expected cash flows and thus cause a loss. The longer the maturity of a certain cash flow and the higher the move in the discount factor, the higher will be the loss. Upside surprises in inflation, fiscal funding needs, and FX depreciation rates are among the most common adverse macroeconomic shocks to receivers. But counterparty exposure, issuer creditworthiness, client segmentation, regulation (including changes in assets holding limits for different types of investors), changes in tax policies, currency convertibility (which may constrain currency conversion, repatriation of profits and/or the liquidation of positions), and settlement issues related to local clearing houses are also important risk factors to be considered. The sensitivity of fixed income instruments to macroeconomic shocks may be mitigated by indexing the contracted cash flows to inflation, to FX depreciation, or to specified interest rates – these are common in emerging markets. It is important to note that the index fixings may – by construction – lag or mis-measure the actual move in the underlying variables they are intended to track. The choice of the proper fixing (or metric) is particularly important in swaps markets, where floating coupon rates (i.e., coupons indexed to a typically short-dated interest rate reference index) are exchanged for fixed coupons. It is also important to acknowledge that funding in a currency that differs from the currency in which the coupons to be received are denominated carries FX risk. Naturally, options on swaps (swaptions) also bear the risks typical to options in addition to the risks related to rates movements.

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