BP Statistical Review of World Energy June 2013

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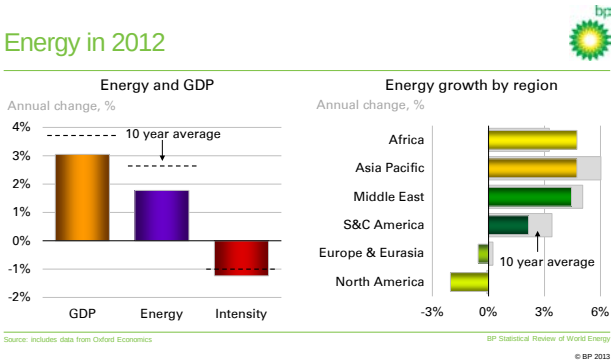
Energy in 2012 – Adapting to a changing world

Christof Rühl, 12 June 2013

Christof Rühl, London, June 2013

1. Introduction



Welcome to the 62nd edition of the Statistical Review.

When the dust has settled, 2012 will have produced a number of headlines. It witnessed the world's biggest increase in oil and gas supplies in the US – and for oil, the biggest increase in the country's history. 2012 witnessed the biggest increase in hydropower in one country as well as the biggest decline in nuclear energy ever. Three of the world's four largest economies (Germany, Japan, China), together representing a quarter of global GDP, are now running their economies with a higher share of renewables than of nuclear. LNG trade, on the other hand, declined for first time since we have records. And record amounts of coal, exiled from the US by the shale gas revolution, were shipped to Europe.

What holds these disparate facts together? As always, it is the aim of this presentation to provide rigorous analysis and a consistent frame of reference.

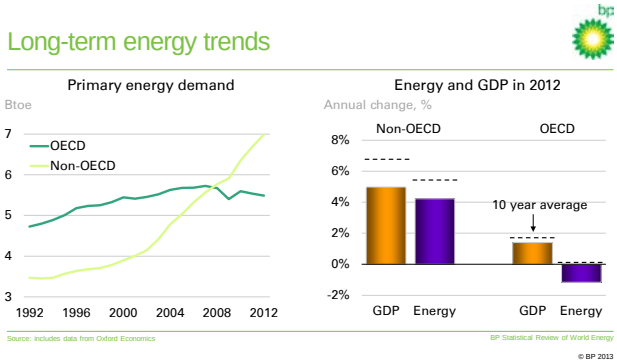
On the face of it, energy developments in 2012 look unsurprising. Consumption growth slowed to 1.8%, below its ten year average, and that holds true for all fuels bar renewables and hydropower, and in all regions except Africa – quite in line with a lacklustre economic performance overall.

And yet, beneath the surface, so many moving parts.

I believe the best frame of reference to discuss these diverse developments is to think of the year 2012 as a year of adaptation – to a changing landscape, in addition to the random disruptions we so often have to report. The energy system moves slowly, everyone agrees, but it does move. It is actually good in adjusting to a changing world; sometimes, it will even drive change elsewhere. This long term context is the best starting point for assessing the data trail of a year in which energy markets appeared calm on the surface, but with lots of adjustments below.

We will start with long-term energy trends.

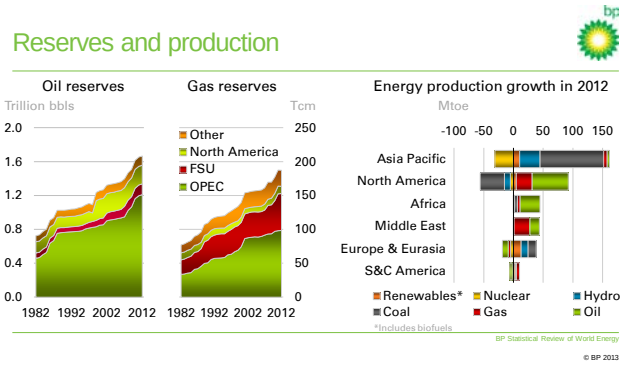
2. 2012 in long-term context



First among these trends is the relentless shift of the world's economic centre of gravity toward the so-called developing world, for our purposes summarised as the countries outside the OECD. Over the last twenty years, global energy consumption has increased by 52%. Over the last ten years, global energy consumption increased by 30%, almost all of which outside the OECD. Then, over the last

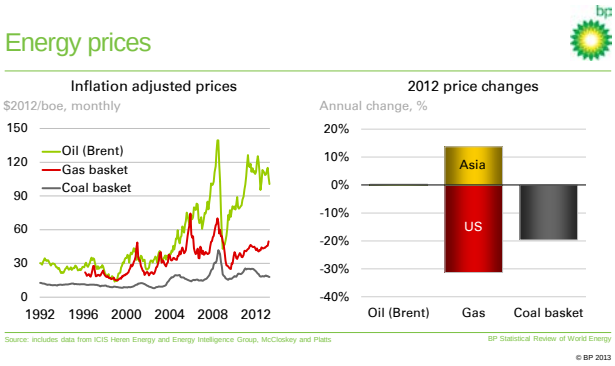
five years, OECD consumption fell – four out of these last five years, to be precise, and in three of these four despite positive GDP growth.

2012 fits right in: OECD energy consumption declined by 1.2%, despite positive GDP growth (1.4%), and hard on the heels of a similar result for 2011. In primary energy consumption, the OECD is now back to where it was in 2002 – despite cumulative GDP growth of 26% over that same period. We have long held that OECD oil consumption is in structural decline, and therefore unlikely to return to its peak of 2005. Surely it is too early to make a similar call for primary energy; but just as certain, this is a development worth watching.



There is a rarely noted corollary to this shift in the centre of gravity. As the non-OECD economies industrialise, they also unlock more resources. We all must have heard the occasional utterance about emerging market growth leading to energy shortages for the privileged few. The data tell us clearly that the industrialising part of the world not only outpaces the OECD in terms of consumption growth, it also contributes a fair share to energy production: over the last ten years, the non-OECD accounted for 98% of global production growth. In 2012, this share dropped to 92% in the wake of the soaring US output from shale formations and decelerating coal production growth in China (3.5%).

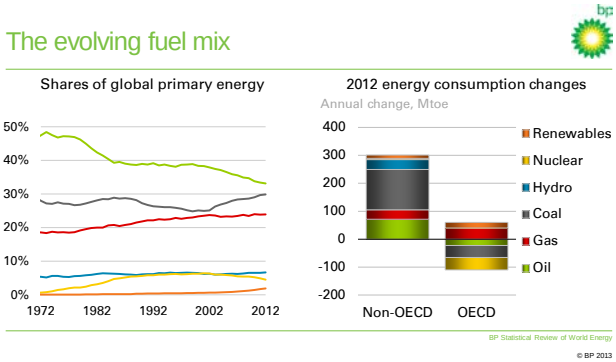
Over all this time, oil and gas reserves kept rising. 2012 saw another addition to oil reserves (15 billion barrels). Gas reserves, however, recorded their first decline ever in our database (-0.5 Tcm). Of all the countries in the world, it was driven by lower prices and reduced drilling activity in the US. Keep in mind that proved reserves, different from technically recoverable reserves, will change not only with technology and discovery, but with prices as well. This is what happened in the US. Overall, proved oil reserves were 26% higher than a decade ago, and 60% higher than in 1992 – despite the production of nearly 600 billion barrels of oil over the past two decades. Proved gas reserves are up 21% over the past decade and 59% compared to 1992.



The last decade has seen an unprecedented rise in energy prices – so much so that some of us may have gotten used to the idea of further growth. In inflation adjusted terms, average annual oil prices (Brent) for the last five years were 230% higher than for the same period ten years ago; for coal, the increase was 140%; and for natural gas, 90%. Over the last five years, the spread across fossil fuel prices has widened as well.

2012 saw a moderation of sorts: oil remained relatively stable, but at record levels, gas prices bifurcated across regions, dropping massively in the US (-32%) but rising in all other regions of the world; and coal declined everywhere (the basket by 20%). Only coal prices have remained in tune with the broader commodity price cycle. We will look at the reasons as we go along.

Meanwhile, higher prices take their toll. They impact demand, in particular in countries where economic growth is less energy intensive and consumers are not sheltered by subsidies. Changing price differentials will shape the global fuel mix; and high prices will eventually trigger supply responses.

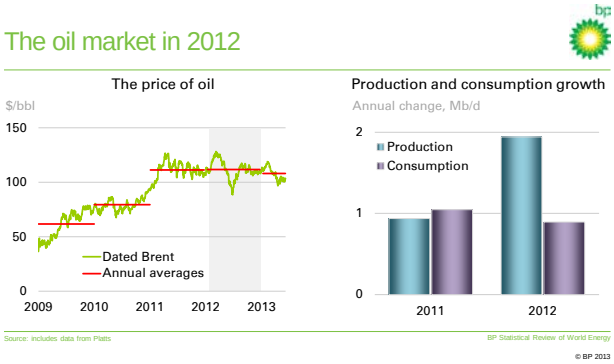


2012 provides examples for all these effects. Oil, in energy terms the highest valued of all fuels, continued its slide in global market share that started with the first oil price shock in 1973. In 2012, oil was the only fossil fuel that lost market share in the OECD and the non-OECD alike. Second, price spreads between gas and coal triggered competition between them, often across borders. As to supply reactions, I have already quoted you some headline figures on last year's unconventional oil and gas supplies. We will chronicle each of these developments in some detail in what follows.

There are more long term trends, and more examples of 2012 events accentuating or contradicting them. We best trace them fuel by fuel – starting with what is still the central market in global energy, the market for oil.

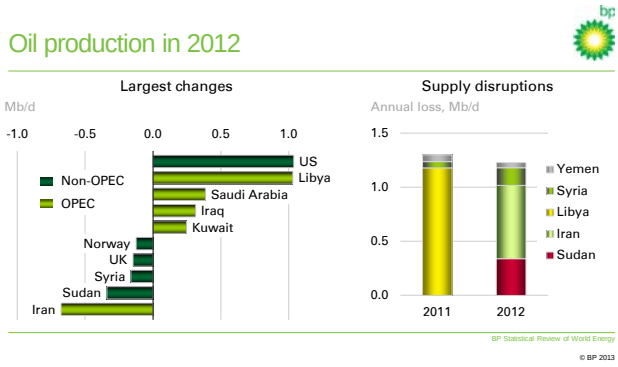
3. Fuel by fuel

Oil



While oil remains the world's dominant fuel, it has lost market share for a remarkable 13 years in a row, and its share of global primary energy consumption (33.1%) is the lowest in our data set. Against the backdrop of a weaker global economy, and weaker oil demand growth, world oil prices remained essentially flat, with Dated Brent rising on average by just 41 cents to $111.67 per barrel – another record high nominal price but the smallest absolute price change since 1978. This apparent stability, however, masks significant changes that happened in 2012 and so far this year.

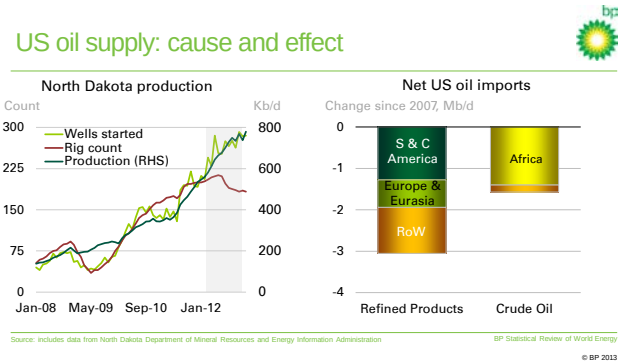
On the surface, 2012's oil market data suggests a disconnect between supply and demand not reflected in the relative stability of prices. Global oil consumption rose by a below-average 890 Kb/d (0.9%). But global oil production rose twice as rapidly, by an above-average 1.9 Mb/d, nearly double the growth seen in 2011.



Before we address that apparent disconnect, we need to take a closer look at the underlying data, starting on the supply side. For the second consecutive year, a major OPEC producer experienced a significant decline in output. Iranian production fell by 680 Kb/d due to international sanctions; adding in outages in several other MENA countries resulted in aggregate losses of well over 1 Mb/d again in 2012 – with many of these disruptions continuing into 2013.

And yet global output still rose strongly, with OPEC accounting for nearly three-quarters of the growth in global production. The near-complete recovery in Libyan output was combined with large increases in Saudi Arabia, Iraq and Kuwait.

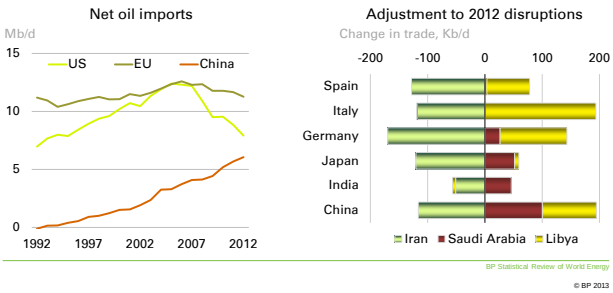
Production outside of OPEC also increased, by 490 Kb/d. The United States recorded the largest increase in the world in 2012 – and last year's increase was also the largest annual gain in oil production in US history. Unsurprisingly, tight oil continued to be the driver of supply growth: last year, output in North Dakota and Texas – the states with the most productive tight oil formations – increased by nearly 800 Kb/d. So far this year, supplies have continued to accelerate, with year-to-date US production (as of May 31st) rising by more than 1.3 Mb/d. Elsewhere, increases in Canada and Russia failed to offset disruptions in Sudan, Syria, and Yemen, as well as ongoing declines in mature provinces such as the North Sea.



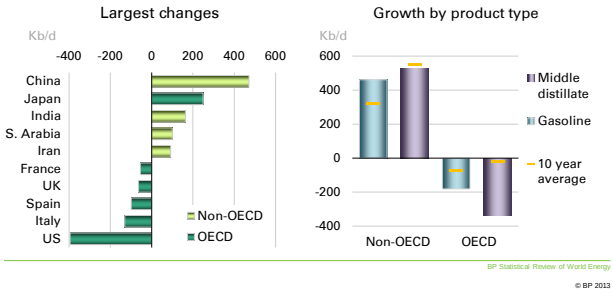
The story of shale gas and tight oil development in the US has been well-documented by now with its massive resource base and innovations in horizontal drilling and hydraulic fracturing. Meanwhile, efficiency gains have emerged as a third critical factor behind the rapid growth of production in these plays. In North Dakota, for example, the number of new wells started over the last year grew by more than 50% and so did the state's oil production – even though the number of rigs grew by only 10%.

Driven by tight oil growth, US production has expanded by 2 Mb/d over the last five years, the largest increase in the world and twice that of Iraq (1 Mb/d), which accounted for the second largest increment. This rise in US output is having significant impacts on the country's trading patterns. Five years ago net refined product imports were over 2 Mb/d; in 2012 the country's net exports were 1 Mb/d. Given the similar light sweet characteristics of domestic tight oil and West African crude, imports from African producers have declined as well, by nearly 1.5 Mb/d over this period.

Emerging oil trade patterns



Oil consumption in 2012



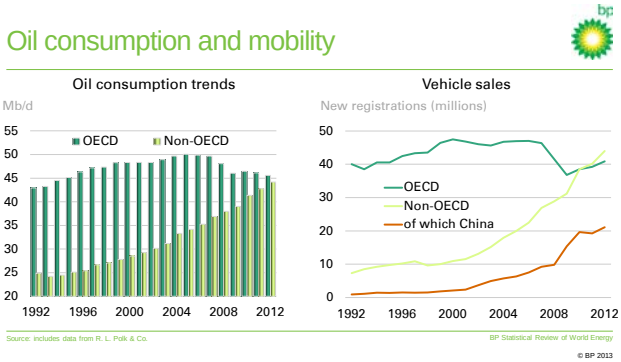
The strong growth in US output, combined with (as we shall see) weaker consumption, has dramatically reduced overall US oil import requirements. Since peaking in 2005, US net imports have fallen by 4.5 Mb/d, or 36% – a reduction nearly as large as the entire 2012 consumption of the world's third-largest consumer, Japan. Over that same period, Chinese net oil imports rose by 2.8 Mb/d or 84%. In 2005, the US and EU imported similar amounts; in 2012, US net imports were nearly one-third below those of the European Union.

Other events in 2012 also influenced trading patterns, including sanctions affecting Iranian exports and the return of Libyan production. As Iranian deliveries to Europe fell sharply, the region expanded its imports from North Africa by more than 500 Kb/d on the back of recovering Libyan supplies. Asia also curtailed Iranian purchases, with higher Saudi production largely offsetting these lost volumes – except in China, where refinery throughputs grew fast enough to create room for increased imports from both Libya and Saudi Arabia.

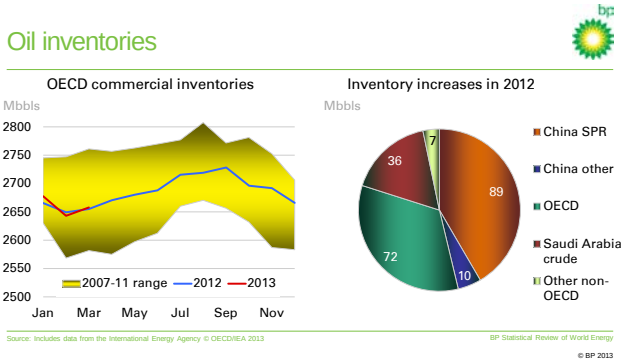
Turning to consumption, we once again saw falling demand in the OECD – by 530 Kb/d or 1.3%, the sixth decline in the past seven years. Europe and the US drove the decline as, in addition to the economic slowdown in Europe, both regions saw strong consumer reactions to the sustained level of high prices, especially in the transport sector. The US, for example, saw the largest improvement in fuel economy for new light vehicles sales since 1980. Bucking the declining trend was Japan, where consumption of oil (along with natural gas and coal) rose to offset the decline in nuclear power. This was a one-off effect for 2012, however, and Japanese consumption has returned to its structural decline this year.

Once again, declining OECD consumption was more than offset by continued growth in the non-OECD economies, where consumption grew by a below-average 3.3% or 1.4 Mb/d. Even though oil consumption growth was below average in China due to weak economic growth, the country still registered the largest increment to oil consumption in the world for the 12th time in the last 13 years, with consumption now surpassing 10 Mb/d. Among refined product categories, light distillates were the fastest-growing portion of oil consumption, driven by growth of gasoline in the emerging economies, while below-trend growth of

middle distillates reflected the economic slowdown.



all other refined product categories rose by just 3.3% p.a.



Oil is no exception to the long term energy demand growth in the non-OECD. Taking a longer term view, non-OECD oil consumption has risen by 19 Mb/d, or 70%, over the past 20 years and now accounts for nearly half of world consumption. OECD consumption, by contrast, grew by just 4% and with the recent declines discussed above, now stands at the lowest level since 1995.

In addition to rapid economic growth, a key supporting factor of non-OECD oil consumption growth in recent years has been rising vehicle ownership, particularly in China. Since 2011 non-OECD annual vehicle sales have exceeded the OECD, driven by rapidly rising incomes. The numbers are staggering: in 1992, emerging economies purchased 16% of the world's new vehicles; by 2012, the new vehicles sales worldwide had grown by 79% and the non-OECD share had risen to 52%. China's share of the global total over that period jumped from 2% to 25%. And even with high oil prices and significant efficiency improvements, this rapid growth in the vehicle fleet has resulted in robust growth in gasoline consumption. In the past five years, non-OECD gasoline consumption increased by 5.1% p.a., while consumption of

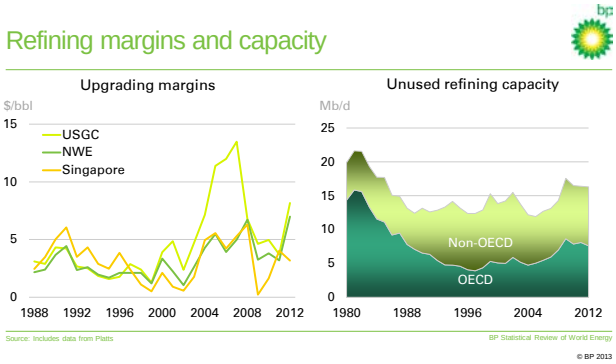
So the question remains: with such a large mismatch between production and consumption growth in 2012, how did oil prices remain flat? The answer lies in inventories. At first glance, the behaviour of inventories in the OECD – an industry standard for assessing stock changes – does not appear helpful: for the year as a whole, they grew by roughly 70 million barrels, not enough to explain the gap between supply and demand growth. But if the experience of the past decade tells us anything, it's that the OECD is no longer the main driver of oil markets and that emerging market inventories, which will continue to expand to cover increasing consumption, are becoming a critical factor in global oil balances.

And indeed, estimates of inventory movements outside the OECD, while incomplete, nonetheless help to "fill in the gaps" of the oil market story in 2012. Estimated inventory increases outside the OECD account for nearly two-thirds of the reported global changes last year, as producers and consumers voluntarily added to stocks in an environment of heightened concern regarding supply risks. For example, additions to China's strategic stockpile – officially still a state secret – are estimated to

have been higher than all of the growth in OECD inventories.

So far in 2013, prices were supported early in the year by an unusually cold winter in the Northern Hemisphere boosting consumption growth. But more recently, global oil production has again outpaced consumption, with OPEC supply remaining high and non-OPEC production growth momentum returning as the impact of previous disruptions has ebbed. In response, OECD inventories have rebounded and prices have edged lower.

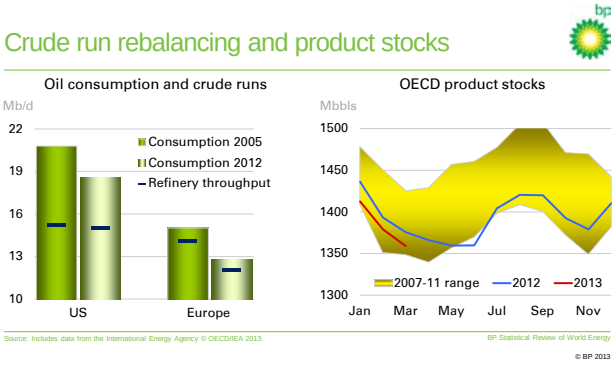
Refining



Global average refining margins improved markedly in 2012 and so far into 2013, although there was hardly any improvement in global capacity utilisation. Large regional differences reflect the underlying strain of markets adjusting to new refining capacity in some geographies, while there were closures elsewhere.

Gasoline cracks responded to the strong non-OECD demand growth described earlier. In the Atlantic Basin, high margins were supported by a slew of refinery closures. Average US Gulf Coast sour coking margins exceeded $8/bbl, whilst NW European sweet cracking margins averaged $7/bbl, the highest since at least 1988. Margins in the US were even better for those sites capable of processing substantial quantities of domestic crudes as the discount of WTI to Brent widened (from $16.2/bbl in 2011 to $17.5/bbl in 2012) because pipeline infrastructure improvements continued to lag North American crude production growth. In contrast, Asian sour hydrocracking margins averaged only $3/bbl, almost $1/bbl below 2011 levels, reflecting the substantial amount of new refining capacity that was added in this region.

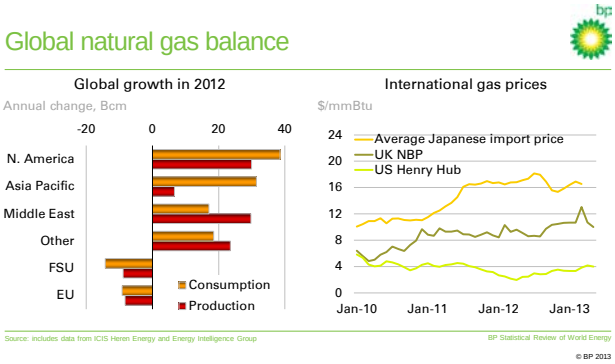
Net global refining capacity additions last year totalled 360 Kb/d, but this total hides much larger increases in some regions and corresponding reductions in others. China (710 Kb/d) and India (300 Kb/d) have expanded the most, but their additions were closely matched by reductions in Europe (700 Kb/d) and the Caribbean (570 Kb/d). In this way, the migration of refining capacity away from established markets continued in 2012, despite modest global net additions. Non-OECD economies have accounted for more than half of global distillation capacity and crude runs since 2010. However, last year their share of global unused capacity increased to the highest proportion since 2007 – a reflection mainly of the contrasting capacity developments in both groups.



China accounted for almost two thirds of last year's 480 Kb/d growth in global crude runs and nearly all of the net growth in the non-OECD (310 Kb/d). In the OECD, crude runs grew by 160 Kb/d with reductions in Europe, Australasia and Japan more than offset by growth in North America. European crude runs fell for the 7th year in a row, by around 150 Kb/d. Since 2005, liquids demand has fallen by around 2 Mb/d in each of the US and Europe – but US crude runs are down by 210 Kb/d over the same period and European crude runs have fallen by more than 2 Mb/d. US refiners benefit from more complex configurations, lower natural gas prices and in some cases, access to discounted North American crudes. These advantages have helped to turn the US into a major product exporter, a position it is likely to consolidate for at least as long as crude oil exports are legally constrained.

2012 also saw its share of disruptions to refining operations, including hurricanes, the Petroplus insolvency and the explosion at Venezuela's Paraguana refining complex. These amplified the effects of capacity reductions, added to the time lags involved in rebalancing crude and product trade and in this way helped to keep OECD product stocks low for most of the year, and into 2013.

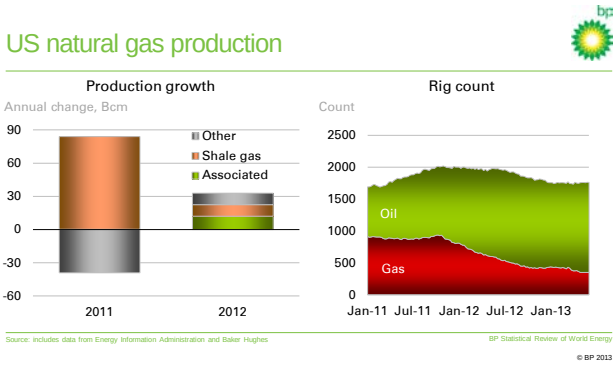
Natural gas

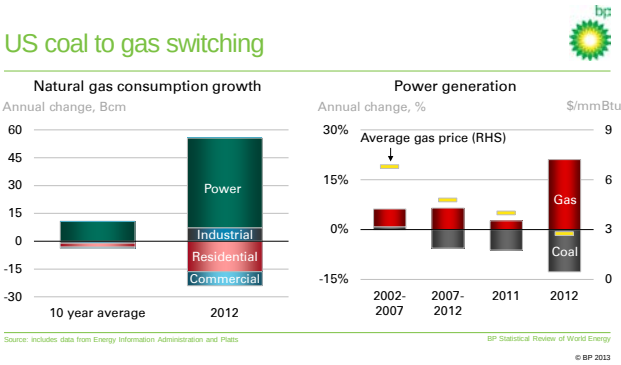


Two trends dominated the evolution of natural gas markets over the past few years: the rapid growth of shale gas in the US, and the expansion of global LNG. US production continued to grow in 2012, if at a slower pace; but LNG trade declined, for the first time in our data series. These developments, together with the continuing impact of Japan's post-Fukushima adjustment, shaped gas markets in 2012 and created an important example of inter-fuel competition.

Global gas consumption rose by 2.2% (82 Bcm) in 2012, faster than 2011 but below the ten year average (2.7%). The US saw the world's largest volume gain in consumption (31.6 Bcm, 4.1%) – an increase by itself bigger than that of any global region. Production grew by 1.9% (72 Bcm) globally, below average as well and with growth in the US slowing. The European Union (5.5%, 8.3 Bcm) and the FSU (1.4%, 8.9 Bcm) registered the largest regional declines, while LNG imports to Asia continued to rise.

Regional gas prices moved in lockstep with this pattern. Spreads widened, with US prices recording their lowest annual average since 1999, Japanese import prices reaching a new average annual record and UK spot prices edging up as the global competition for LNG tightened the market in Europe.





US production continued to rise in 2012, by 4.7% (32.9 Bcm), but growth was significantly below the record expansion of 2011 (7%, 44.9 Bcm). The slowdown was driven by the reorientation of US drilling away from gas and toward higher-priced oil; the impact on gas output would have been much sharper without the rapid growth of associated and liquids-rich gas triggered by rising oil output.

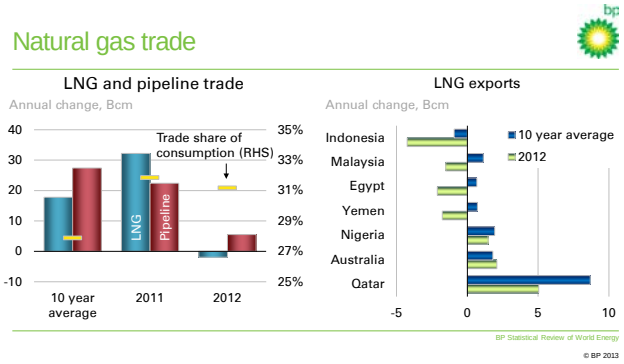
Henry Hub prices were on a declining path from late 2011 until reaching a low point of $1.83/mmBtu in April 2012. As a result, many dry shale gas plays became uneconomic and producers reduced related activity. The overall gas rig count declined by 46%. Switching from dry to wet and associated gas production, encouraged by high oil prices, helped to contain the impact: non-associated shale gas production grew by 84 Bcm in 2011, but by a mere 10 Bcm a year later, while associated gas output rose by 12 Bcm, accounting for 36.6 % of total US production growth. Declining supply growth has continued into 2013 so far.

2012 started with unusually warm winter weather, curtailing heating demand, while US gas production continued to expand strongly – a combination which left markets over-supplied and inventories at unusually high levels. Some relief was provided by lower pipeline imports from Canada (4.4 Bcm) and higher exports to Mexico (3.4 Bcm); falling net LNG imports helped as well (4.1 Bcm).

But the main balancing factor and the only sector flexible enough to absorb the surplus was the power sector – which required gas prices to fall far enough to be able to compete with coal for baseload power generation. All told, an additional 44 Bcm of gas went into the power sector last year, boosting gas fired power generation by 21% (217 TWh) – the largest increment of any fuel in US power generation for at least 40 years, and leading to an all-time high for gas fired power generation (1295 TWh). Coal fired power generation (-12%) fell to its lowest level since 1987, and US coal consumption declined by almost 12% in 2012, in volume terms the largest decline worldwide.

This switch accentuates a trend that saw gas fired generation expand by an average of 6.5% p.a. and coal fired generation decline by 5.6% p.a. since 2007. I can't help but note the similarity of these numbers to a development exactly 30 years ago, when coal displaced oil

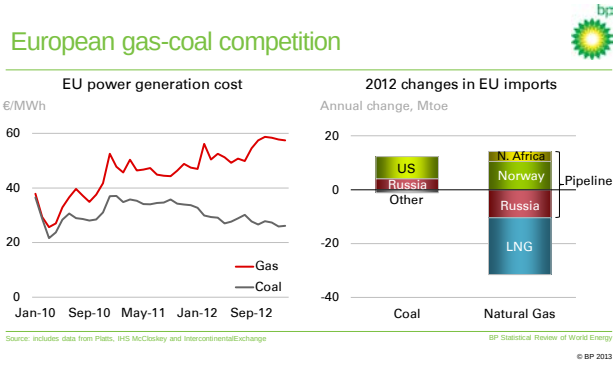
in power generation. That switch, of course, never reversed. It remains to be seen how much of the power market gas can hold on to. So far in 2013 we have seen some loss of gas share in power as gas prices recover from their lows.



While US gas production growth last year slowed but remained relatively strong, fortunes changed for the remarkable history of LNG. For at least two decades, international gas trade had been growing – on average 2.5 times, and LNG trade more than 3 times, as fast as consumption every year. Until last year, that is, when LNG trade declined by 0.9% (1.9 Bcm). How did this happen?

The prime suspects would be the lumpy nature of capacity growth in LNG and under-utilisation of existing capacity. Indeed, in contrast to the large additions (most notably from Qatar) that characterised the last decade, only one new project was actually operating by the end of 2012 - the lowest annual capacity increase since 2002. Utilisation rates also fell, either because rising domestic demand or falling production crowded out gas, or in the wake of unplanned outages and outright infrastructure damage. Examples include Indonesia (-15%, -4.2 Bcm), Algeria (-15%, -2.6 Bcm), Egypt (-24%, -2.1 Bcm) and Yemen (-20%, -1.8 Bcm).

The net effect was a decline in supply availability. With Asian demand for LNG remaining strong, and Japan facing a growing need to replace nuclear power post-Fukushima, the LNG market tightened. Japan increased LNG imports to a record high of 119 Bcm and paid a record premium (up to $9.47/mmBtu) over European spot prices to attract supplies. China and other Asian importers accounted for a collective increase of 9.2 Bcm (9%) amidst solid economic growth and a severe drought in Latin America required higher LNG imports (43%, 4.6 Bcm). With no need to compete for LNG at the Asian price level, European LNG imports declined by 24.2% (21.8 Bcm).



The lack of LNG should have been good news for traditional suppliers to the European gas market, such as Russia and Norway. Instead, they faced competition from an unexpected quarter – cheap coal. Much of it came from the US, exiled by the shale gas revolution. But coal imports from Russia also grew strongly (14%).

While international coal prices were falling because of oversupply, European gas prices continued to rise. Russia maintained its oil-indexed pricing, at the expense of losing share to other suppliers, notably to Norway which had switched much of its supply to spot-related prices. Russian exports to Europe declined by 10%, while Norwegian supplies

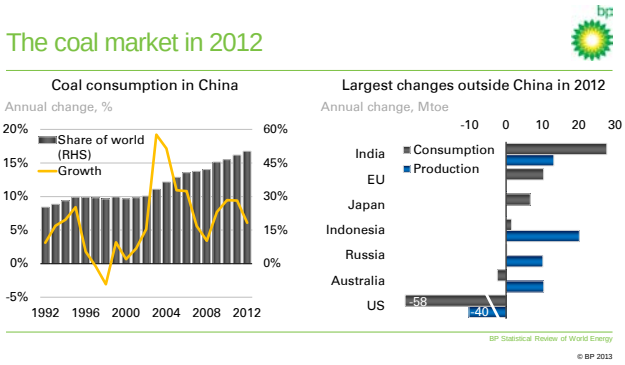
increased by 12%. But the net effect of Russia's willingness to sacrifice volume for prices was to keep European gas prices relatively high, opening up a large gap between the cost of generating power from gas and from coal, with coal-fired power on average 45% cheaper than gas-fired power. Carbon prices (to be discussed later) were far too low to redress the balance in favour of gas.

The result was a large switch from gas to coal in power generation – a mirror image of the US experience, although on a smaller scale. Taking the largest five European power markets in aggregate, gas-fired power fell by 19% in 2012 while coal-fired power was up 12%; in volume terms gas lost around 17 Bcm of demand in the power sector, compared to the 44 Bcm gain in US power sector demand. Overall, European gas consumption declined by 2.3% in 2012 while European coal consumption rose by 3.4%.

Standing back from all the detail, 2012 demonstrated once again the interconnections among regional gas markets. The gas market is not yet globally integrated like the market for oil, but developments in one region increasingly impact other regions, either through the pricing of LNG or indirectly through the coal market.

Coal

Global coal growth moderated last year, with consumption as well as production growth below average. Consumption growth decelerated to 2.5% (101.3 Mtoe), almost half the rate of 2011; and production growth slowed from 6.1% to 2% (86.2 Mtoe).



All the intricacies of cross-Atlantic coal trade aside, in global terms coal remains a China story. The engine of China's industrialisation, domestic coal production, rose by 135% over the last ten years. For this period, one fuel in one country accounted for more than one third of global energy consumption growth, and last year China consumed more than half the coal in the world for the first time.

Such volume comparisons will remain important. But the Chinese data also hint at a more intricate question. The Chinese authorities aim to rebalance the economy, from extensive growth toward a higher share of services and domestic consumption. If successful, this would lower China's coal intensity. The 2012 data appears to indicate that coal consumption may have re-entered a path of slowing consumption growth which had started in 2003, when coal growth reached almost 20%. In 2009-10, this path was interrupted by energy intensive stimulus programs, administered to combat the global economic crisis. It is too early to tell, but this is yet another development worth watching.

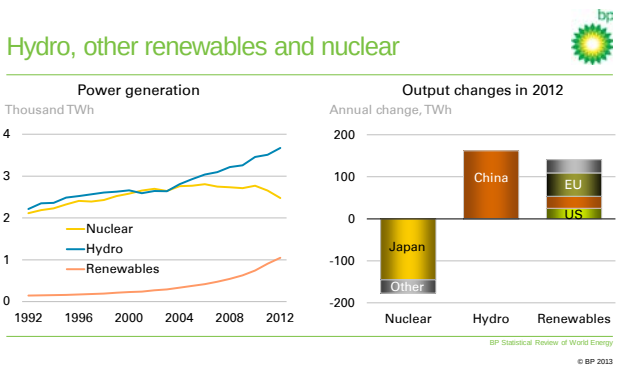
Outside of China, the slow-down of consumption growth was widespread. By region, we saw notably faster growth only in Africa and the European Union. By country, the main exceptions were Japan, where coal

(5.4%, 6.6 Mtoe) helped to mitigate the consequences of nuclear outages; and India where coal demand rose substantially (9.9%, 27.7 Mtoe) to replace gas in power generation – a story of falling availability of natural gas because of regulated prices.

Production growth outside China was dominated by coal exporters. Coal continues to internationalise, with steam coal trade outpacing global consumption for the 10th consecutive year. Falling prices in all regions increased the significance of shipping costs, and the recovery of previously damaged infrastructure, especially in Australia and South Africa, boosted competition further. As a result, exports tended to concentrate regionally – with Indian Ocean suppliers redirecting trade to Asia, the US targeting Europe, and Russia reaping the benefits of its location and increasing exports to both, Asia and Europe.

The main currents laid out here have continued into 2013 so far. In the first four months, coal prices fell in Europe and Asia, but increased in the US due to higher gas prices. Coal suppliers have begun to cut back production, with China's output down by 2% year-on-year.

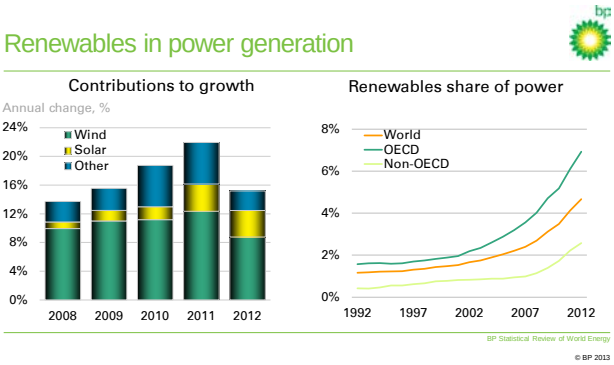
Non-fossil fuels



The growth paths of global hydro and nuclear power generation diverged, largely due to developments in China and Japan.

Despite near average precipitation, global hydroelectric output grew by an above-average 4.3% (161 TWh) in 2012. All the net increase, however, occurred in China. On the back of a massive program of capacity expansion, China accounts for more than half the global increment over the last ten years; in 2012, it booked the largest annual increment on our records (23%; 162 TWh). Rainfall, as well as capacity growth, is uneven. Brazil, for example, where hydro accounts for 75% of all power generation, suffered a drought which reduced hydro (by 2.8%, 11TWh) and led to additional LNG imports.

Global nuclear generation suffered a second year of record decline (-6.9%, 177 TWh) and as a result its share of nuclear output in primary energy consumption fell to 4.5%, the lowest since 1984. The near-complete shutdown in Japan accounted for 82% of lost nuclear production last year, with the rest attributable to unplanned outages and safety checks around the world. Outside the OECD, nuclear generation continued to grow, albeit at a slower pace (3.7% vs. 5.9% in 2011). Globally, China (12.5%, 11 TWh) and Russia (2.7%, 5 TWh) recorded the biggest increments.



Renewable power generation grew by 15.2% in 2012, just above the ten year trend (14.5% p.a.), but also experiencing its first serious slowdown. With relatively slow growth in total power generation, renewables continued to gain market share, rising to 4.7% of power generation globally. In the EU, they supplied 12.9% of all electricity in 2012; in the US 5.3%, and outside the OECD 2.6%.

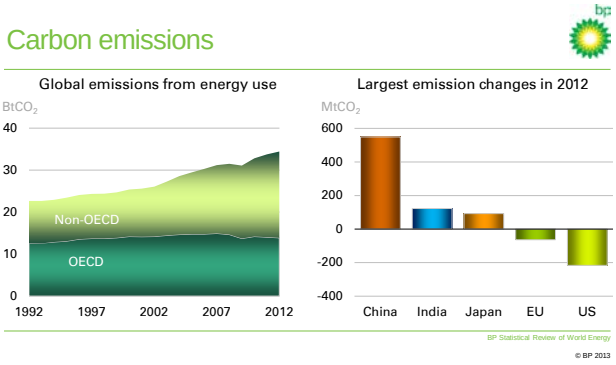
Growth was led by three countries China (6.5 Mtoe, 25.1%), the US (5.7 Mtoe, 12.3%) and Italy (2.5 Mtoe, 29.5%) together accounting for almost half (46%) of global generation growth last year. China overtook Germany as the second largest renewable power producer, behind the US. In both China and Germany (as well as in Japan), renewables now provide more power than nuclear.

Renewables, however, remain dependent on policy support. If they scale up too fast, the cost of that support can become unmanageable. In a number of countries, particularly in Europe – where penetration rates are highest but budgets are strained – financial support has been reduced. This dependence can create its own turbulence: the prospect of reduced policy support, for example, drove the strong additions to wind capacity in the US hit a new record at 13 GW. The anticipated withdrawal of financial support in 2013 encouraged developers to accelerate activity into 2012 while the support was still available. As a result, prospects for 2013 are for strong growth in US wind production, but a much lower level of wind capacity additions.

While renewable power growth slowed, biofuel production fell by 0.4%, led by the first fall in US ethanol production since 1996. With the worst drought since the 1950s and falling gasoline consumption, US ethanol was squeezed between high corn prices and the "blend wall", forcing several ethanol plants to close.

Despite declining biofuels and slackening growth in renewable power, renewables in aggregate continued to increase their share of primary energy consumption, from 2.2% in 2011 to 2.4% in 2012.

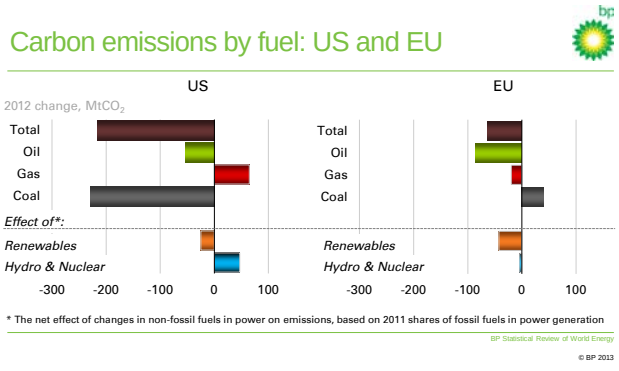
Carbon emissions



Global carbon emissions from energy consumption are estimated to have risen by 1.9% (723 MtCO2) in 2012, slightly faster than primary energy consumption. Over the past decade emissions grew 2.8 % per annum, also faster than primary energy consumption (2.6%), with a small decline in the OECD (-0.2% p.a.) offset by growth in the non-OECD (5.8% p.a.).

Unsurprisingly, the largest growth in 2012 came from China (548 Mt, 6%) and India (122 MT, 6.9%); Japan also recorded a significant increase (92 Mt, 6.7%) as it adjusted to the loss of nuclear energy. The US recorded the largest reduction in emissions world-wide, dropping faster than the EU: in 2011 they were evenly matched, but in 2012, the US decline accelerated and the EU decline halved.

This may appear surprising, given the aggressive policy stance on emissions reduction taken by the EU. And if we look just at the emissions avoided through the growth of renewable power or, for that matter, at reduced emissions from oil consumption, the EU does better than the US. But all that is overwhelmed by the fuel switch in power generation discussed earlier – from gas to coal in the EU, and from coal to gas in the US.



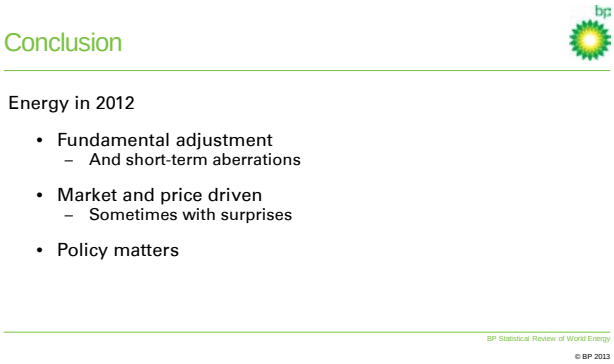
For each unit of power generated, a coal plant emits roughly twice as much CO2 as a modern gas plant. The net effect of higher gas consumption and lower coal consumption in the US (across all sectors) was an emission reduction of 164 Mt; the opposite effect in the EU was an emission increase of 21 Mt. Only looking at the power sector would make the impact of varying shares of coal and gas even more stark.

Replacing coal with gas in power is one of the cheapest ways to reduce carbon emissions – far cheaper per tonne of carbon than renewable power or more stringent vehicle emission standards. Moreover, the EU is known for deliberate climate policy, the US is not. So once again the question, what went wrong? It is a price effect. Weak coal prices, in part due to coal displaced in the US by cheaper shale gas, combined with relatively strong gas prices favoured coal-fired power in Europe.

In theory, the EU ETS carbon price was designed to offset such a cost advantage. It would have taken a carbon price in the range of €40-45/tonne to keep gas competitive in baseload power; whereas the actual carbon price averaged just €7.90/tonne in 2012 (down from €14.78 in 2011).

The EU ETS carbon price has fallen to record lows (averaging €4.30 in 2013 to date), due to the build-up of a large surplus of allowances. To a large extent this surplus reflects the impact of the recession in Europe. Changes in economic fortune were not anticipated when the supply of allowances was fixed. But it also reflects the unintended consequences of related but poorly integrated policy interventions –mandated renewable and energy efficiency targets were also not anticipated when the ETS was designed. The support of these with various subsidy mechanisms outside the EU ETS contributes directly to reducing the demand for and hence the price of carbon permits. In this way, one part of climate policy (the carbon price) has fallen victim to the success of another (the renewable and efficiency targets).

4. Concluding remarks



Where does this leave us?

Starting with many moving parts, and taking the long term perspective, we saw many examples of adjustment – some of them well attuned to long established trends; and in the course of pushing these trends forward, creating new perspectives: the case of shale, for example, or the demand patterns between OECD and non-OECD. Some of them, and this is not up to us to judge today, are changes which may turn out to be temporary: the case of US gas reserves, perhaps, or the decline in LNG trade.

We saw policy examples and how holistic thinking matters more and more as international markets integrate.

The conclusions are not new, but that does not make them unimportant.

Energy concerns all of us. We hope that you find the data in this year's review useful, and we hope they lead to a good discussion.

Disclaimer The data series for proved oil and gas reserves in *BP Statistical Review of World Energy June 2013* and referenced in this speech does not necessarily meet the definitions, guidelines and practices used for determining proved reserves at company level, for instance, under UK accounting rules contained in the Statement of Recommended Practice, 'Accounting for Oil and Gas Exploration, Development, Production and Decommissioning Activities' (UK SORP) or as published by the US Securities and Exchange Commission, nor does it necessarily represent BP's view of any proved reserves. Rather, the data series has been compiled using a combination of primary official sources and third-party data.