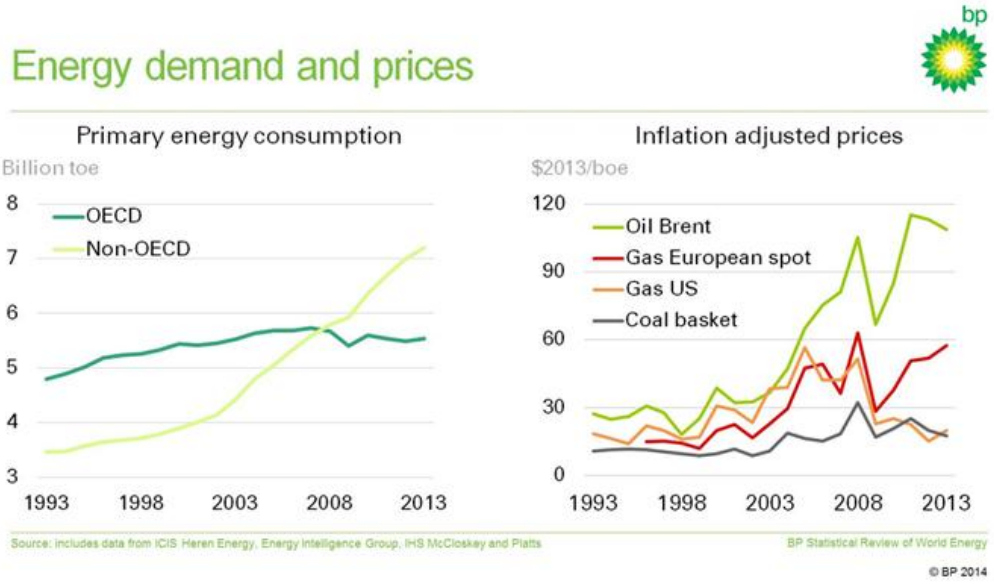
Energy in 2013:
Taking stock

Christof Rühl
Group Chief Economist

World Petroleum Congress, Moscow
16 June 2014

Introduction: the last ten years

The purpose of this review has always been to provide objective data on global energy developments; and to chronicle changes in global energy markets year by year, in as rigorous a fashion as possible. Here is last year's chapter.

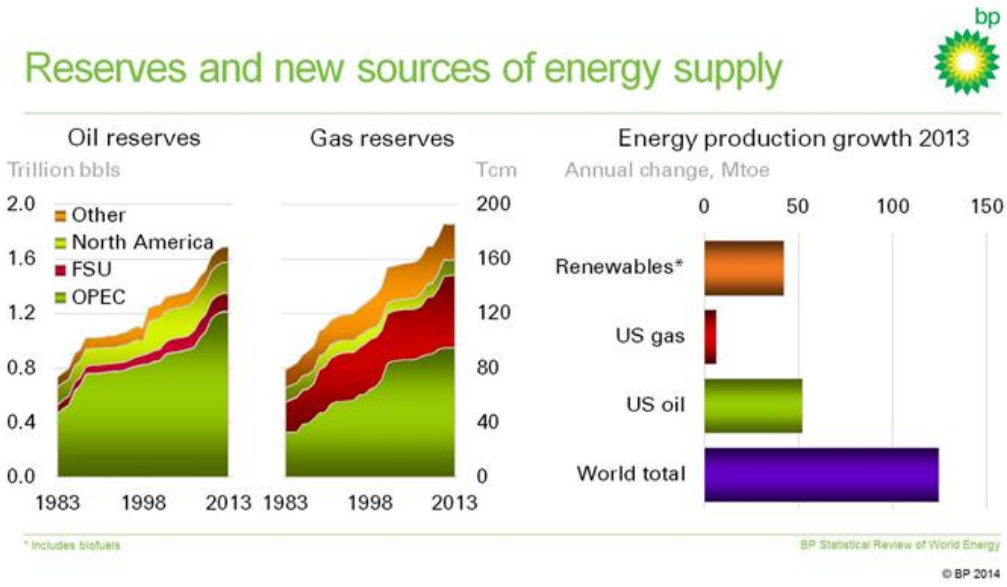


To begin with, let's step back a little.

Ten years ago, the energy world looked rather different. Much of what we took for granted has changed. It is always a good first step to look back at where you came from before assessing today. What have been some of the major changes over the past decade?

Ten years ago, the developing world, classified here as non-OECD economies, had started to embark on a period of rapid economic growth (the term BRICs was coined in 2001). From 2001 onward, this showed up as an "energy gap" – global energy demand growth became dominated by the non-OECD from the turn of the millennium; in 2008, they overtook the OECD. China, rightly or wrongly, came to symbolize this ascent, overtaking the EU in 2007, the US in 2010 and the whole of North America last year. Many would have found this hard to believe ten years ago.

Energy markets are huge and the supply response can be sluggish. So prices started to rise – and to diverge. Oil prices rose the fastest, of course, but many of the implications are easily forgotten: Today, we think of oil prices above $100 as normal, and many an analyst remains gainfully employed by investigating gas price spreads – an activity which would not have attracted much attention ten years ago.



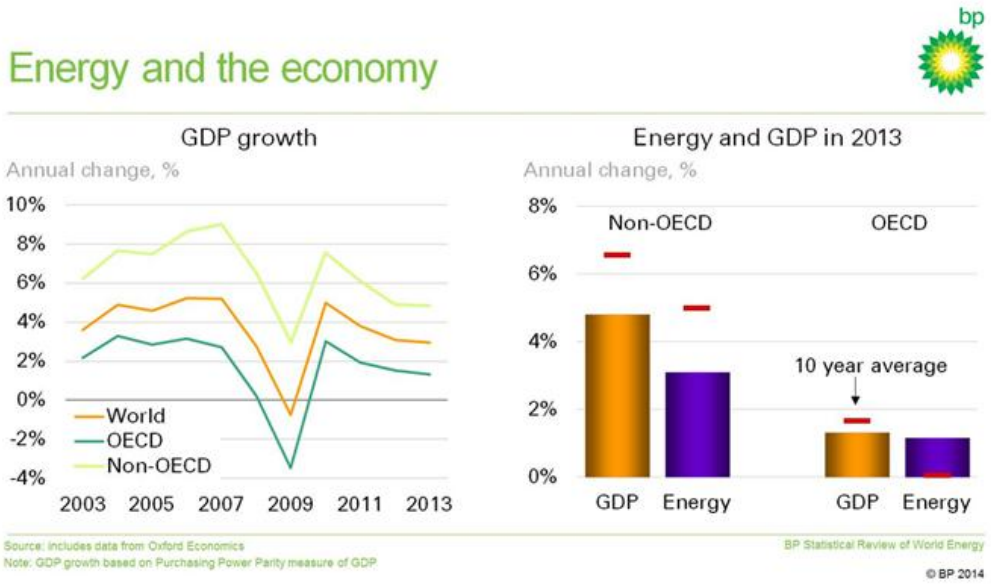
One trend that has not changed is reserves growth. It was always one of our more popular statistics, but saying that proved reserves had increased, after yet another year of rapid oil, gas and coal consumption growth, created a lot more disbelief then than now. But increase they did: Proved oil and gas reserves are up 27% and 19%, respectively, over the last ten years alone – despite production growth of 11% and 29%.

Perceptions change, not only about reserves. A supply response always existed but it became widely recognized only after it triggered the emergence of “new” sources of supply. The biggest item on this list has to be the emergence of unconventional oil and gas resources. That this would happen in the competitive energy world of North America makes perfect economic sense, in retrospect. But who would have thought?

If we loosely group together fuels that may classify as “new”, simply by virtue of having not been around a decade ago, including renewables motivated by newly found climate change policies (and high fossil fuel prices), they account for 81% of global primary energy production growth last year.

Time to look at this in more detail.

Energy and the economy



Global economic growth has been softening since 2010, the year of big economic stimuli. Last year it was 3%, a little weaker than 2012, and considerably below its ten year average [3.7%], which now includes the years of boom and bust before and after the economic crisis. Economic performance softened in the OECD and non-OECD alike, but the economic "growth gap" between them has narrowed since the crisis.

Energy consumption followed economic growth, but with a twist.

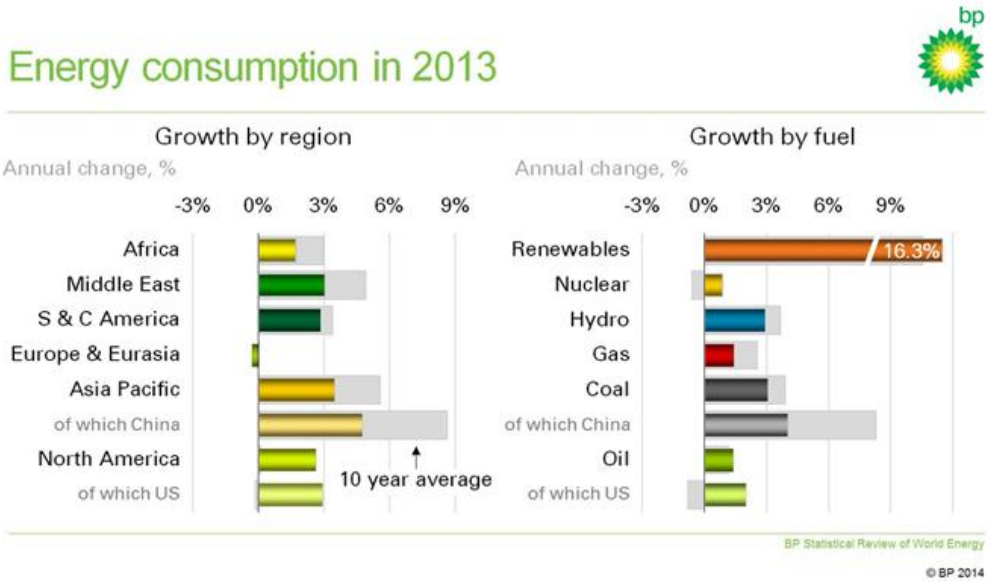
Energy consumption growth in the OECD has been flat over the last ten years, despite economic growth of 18%. And, if we take a particularly fitting sub-set, energy consumption in today's 28 member states of the European Union last year was back at the level of 1988, despite cumulative economic growth of 54% – raising the intriguing question whether, or under which circumstances, it may be possible to combine economic growth with stagnant or falling energy consumption.

Meanwhile in the non-OECD, stronger economic growth and industrialization necessitated continued consumption growth before, during and after the crisis. The relationship between economic and energy growth was quite similar in the OECD and non-OECD the ten years before the crisis. After the crisis, and presumably related to large, energy intensive stimuli, energy intensity improved faster in the OECD.

2013 broke this pattern. Global primary energy consumption accelerated from 1.8% to 2.3%, just a tick below the ten year average [2.5%] and despite slackening economic growth. For the two subgroups, fortunes diverged.

OECD energy demand rose by 1.2%, offsetting an equal decline the previous year, despite slowing and lacklustre economic performance – almost on a par with GDP growth

[1.3%]. Non-OECD energy consumption, in contrast, grew by only 3.1%, the slowest rate for 13 years, except for the crisis year 2009 – and substantially below GDP growth [4.8%].



North America, the only region globally to show above-average growth, drove the OECD acceleration, with energy demand growing even faster than GDP. The non-OECD slowdown was concentrated in Asia, with energy consumption growth below 4% for only the second time in 12 years, while economic growth held steady [5.2%].

The contrasting experiences of North America and Asia Pacific reflect the differing fortunes of the world's largest energy consumers, China and the US. Together, they account for more than 70% [72.52%] of world energy consumption growth.

In 2013 Chinese energy growth slipped from 7.0% to 4.7%, and thus well below its ten year trend [8.6% p.a.] – although the People's Republic reported unchanged economic growth of 7.7%. The Chinese slowdown was concentrated in coal but is visible in oil as well. Meanwhile, US primary energy consumption grew by 2.9%, rebounding from a 2.8% decline in 2012. Much of this is due to weather effects; but beyond the weather, there are signs of underlying strength in US industrial sector energy use, in particular of oil products.

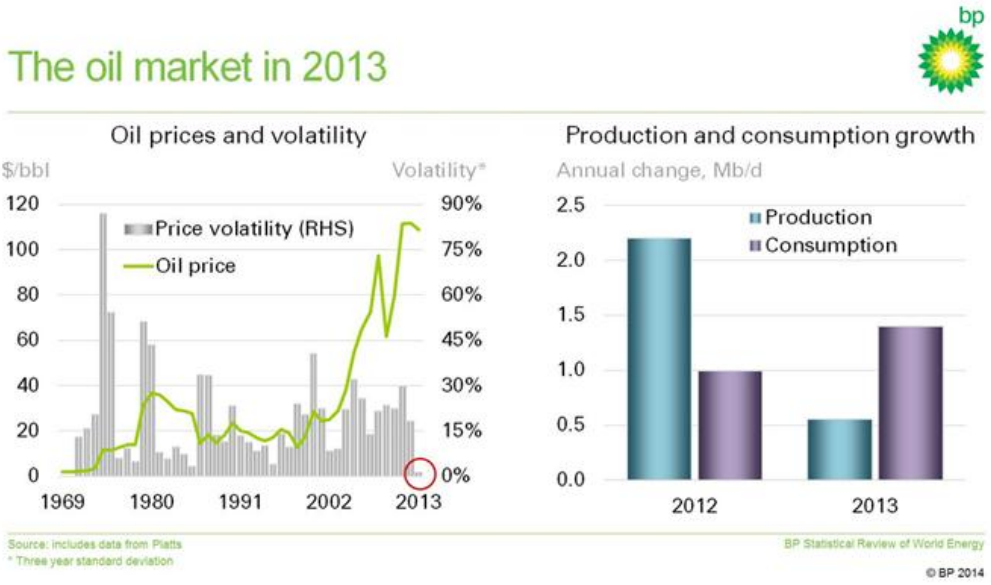
The effects are visible, even if we only look at global fuel aggregates. China is responsible for the relative weakness of coal growth, and the US for the relative strength of oil growth. We will discuss the details in a minute.

All told, the diverging performance of China and the US caused “energy gap” between non-OECD and OECD energy consumption growth to narrow sharply. It became the smallest since 2000.

What can energy data tell us? Are these data points a harbinger of things to come or just an aberration? Too early to tell is the appropriate answer. In our textbooks, energy demand is the consequence of economic growth. In reality, where data measurement is less than perfect, energy data often allows for conclusions about real economic activity. In the present context, it is easy to see how abundant domestic resources in the US would eventually give a boost to the economy, not just to energy demand. It is much harder to see how the fundamental restructuring underway in China could leave an imprint only on energy demand without, eventually, affecting economic performance as well.

Let’s look at these developments fuel by fuel.

Fuel by fuel – Oil

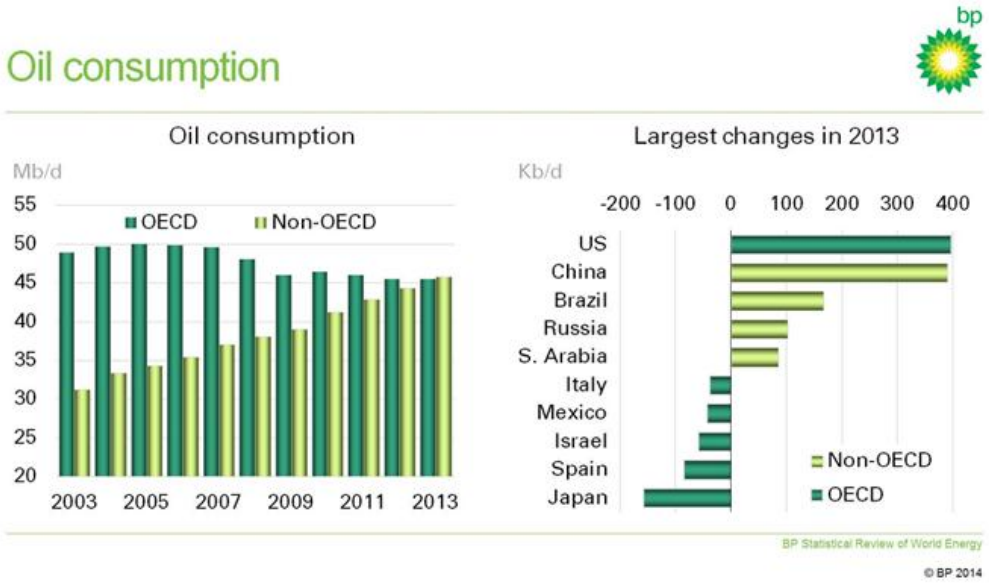


Oil prices over the last three years have been high but remarkably stable. In 2013, they dipped slightly, with Dated Brent averaging almost $109 [$108.66], $3 below the average of 2011 and 2012. This has been the third consecutive year of prices above $100, a first in both real and nominal terms; and it has been the three year period with the lowest price volatility since 1970.

The stability in oil prices betrays significant changes in the underlying balance between consumption and production. In 2013, global consumption growth exceeded production growth by a wide margin—the exact opposite of the dynamics in 2012. As a result, inventories fell.

And 2013 was yet another year of turbulence in oil production. We are familiar with the ongoing story of rapid growth in the US; but it was also yet another year of significant supply disruptions, most notably in North Africa and the Middle East.

So why did prices remain so stable? We will investigate in detail, starting with global oil consumption.

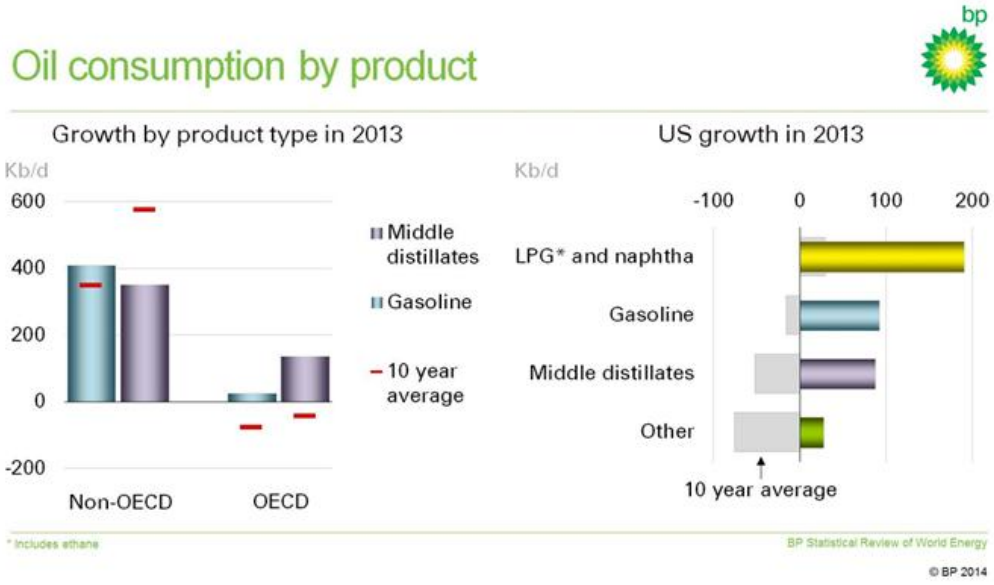


Global oil consumption last year rose by 1.4 Mb/d in 2013, or 1.4%, higher than both 2012 and the ten year average. As has become the norm, growth was driven by the emerging economies of the non-OECD, which for the first time accounted for the majority of global consumption. OECD demand remained stagnant.

In the OECD, the US stood out as its consumption grew by 400 Kb/d, the fastest growth of any country last year – and (in volume terms) outpacing China for the first time since 1999. In contrast, consumption in the rest of the OECD fell by a larger than average 380 Kb/d, led by a 160 Kb/d decline in Japan, where oil was backed out of power generation by renewables, coal and improved efficiency. European consumption dropped by 130 Kb/d, with the largest declines seen in the countries most affected by the recession, such as Spain, Italy and Greece.

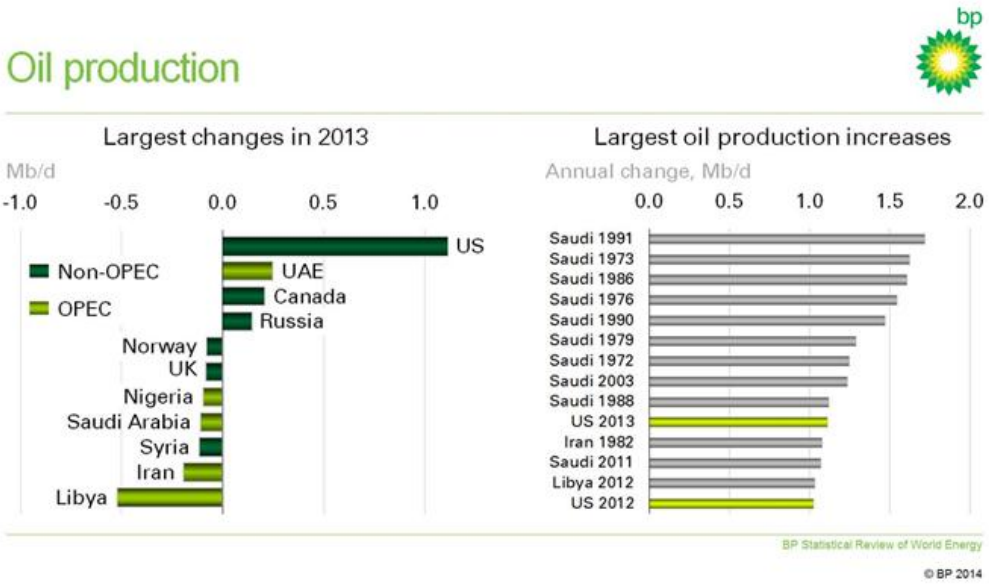
Non-OECD consumption rose by 1.4 Mb/d or 3.1%, well below the ten year average [3.9%]. This weakness was especially pronounced in China, where demand grew by only 390 Kb/d – the lowest since the recession in 2009. Growth in India [40 Kb/d] fell to its lowest level since 2001 as subsidies were reduced while in the Middle East, growth was limited by civil unrest and rising use of natural gas in Saudi Arabia's power sector.

So far in 2014, global oil demand growth has been slower due to more modest demand growth in the US and a further slowdown in China.



A review of oil consumption by product can help to identify underlying economic forces. Light distillates, such as gasoline, more dependent on prices, were the fastest growing product category for the second consecutive year [620 Kb/d], whereas middle distillates, more dependent on economic activity, grew only slowly [490 Kb/d]. The main driver of light distillate growth was strong gasoline demand in the non-OECD; OECD gasoline consumption registered a rare, small increase. The slowdown in middle distillate demand growth was again entirely driven by the developing world where growth almost halved [to 350 Kb/d from 660 Kb/d in 2012]. And within this group it was again China which accounted for by far the largest part of the slowdown.

Distinguishing by product category also helps to disentangle the question why the US saw such a dramatic increase in oil consumption last year – up 400 Kb/d, against an average annual decline of 110 Kb/d over the last ten years. This cannot be explained by economic growth which slowed from 2.8% to 1.9% last year. The rise was focused in the industrial sector, including refining and petrochemicals, which contributed almost 80% of net growth [310 Kb/d]. Much of this growth was for light products (in particular LPG), facilitated by the robust growth of domestic natural gas liquids, which has driven down prices significantly over the last few years.



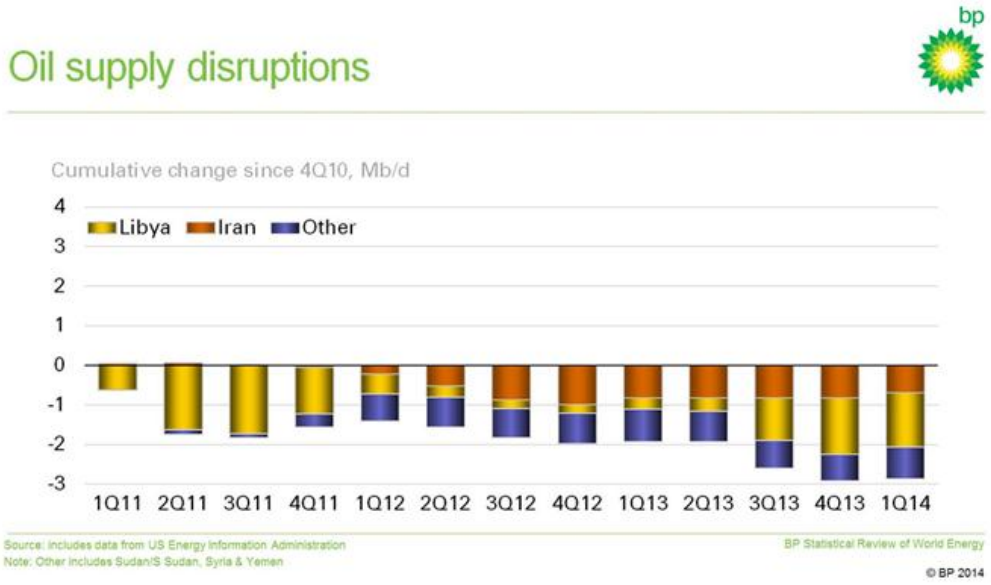
Turning to production, 2013 can once again be characterized as a tale of major supply disruptions and historic US growth. We will address these in turn after reviewing the data.

Global output rose slightly in 2013 [560 Kb/d], due to the largest increase in non-OPEC countries (1.2 Mb/d) since 2002. The main contributor to this growth was the US, but supplies also grew in Canada and Russia. Russia (150 Kb/d) posted a record high for the post-Soviet era. Canadian production (210 Kb/d) reached an all-time high due to continued oil sands growth. These increases more than offset continued declines in mature areas such as the North Sea [UK and Norway, 80 Kb/d each].

Meanwhile, OPEC production contracted by 600 Kb/d. In addition to unplanned disruptions which we will discuss in a minute, Saudi Arabia cut output by 110 Kb/d after producing at record levels in 2012. The declines were only partly offset by an increase in the UAE [250 Kb/d], which set a new record for itself. Average OPEC crude production was near the group's 30 Mb/d production ceiling, which has been in place since December 2011.

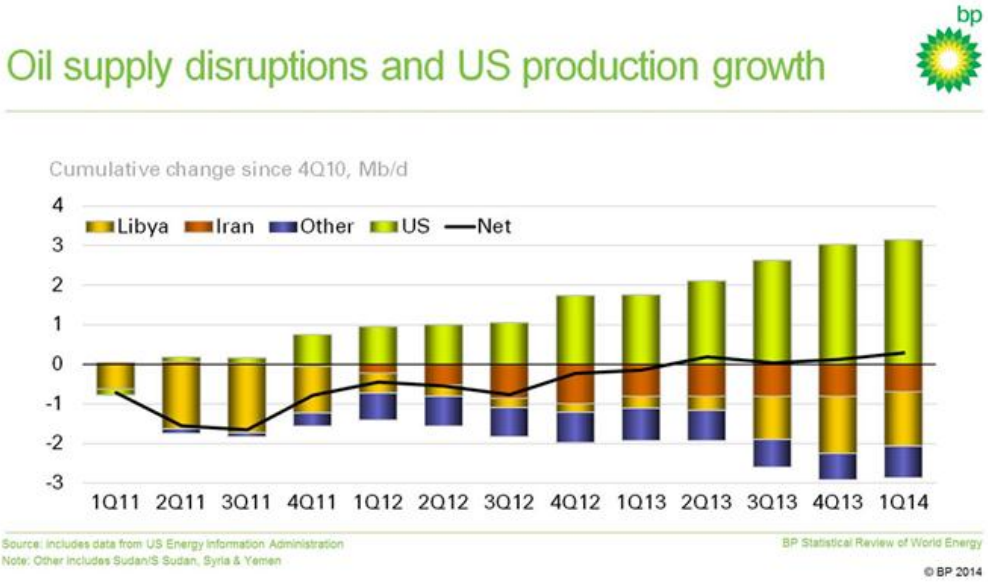
US oil production exceeded 10 Mb/d in 2013, reaching the highest level since 1986. Driven by tight oil plays, US production rose by over 1.1 Mb/d in 2013 -- the second consecutive year of above 1 Mb/d of supply growth, and the second consecutive "biggest increase in US history". Indeed, only Saudi Arabia has ever had a bigger increase than the US in 2013 – nine times in total, to be precise; but in six of those nine times the increment resulted from the ability to tap existing spare production capacity. In terms of "organic" growth, based on capacity expansion, last year's US increase therefore was the fourth biggest in history.

So far this year, US production growth has been even stronger [nearly 1.3 Mb/d, year-on-year]. OPEC crude output has fallen further, averaging well below 30 Mb/d and largely due to the ongoing sharp decline in Libyan output.



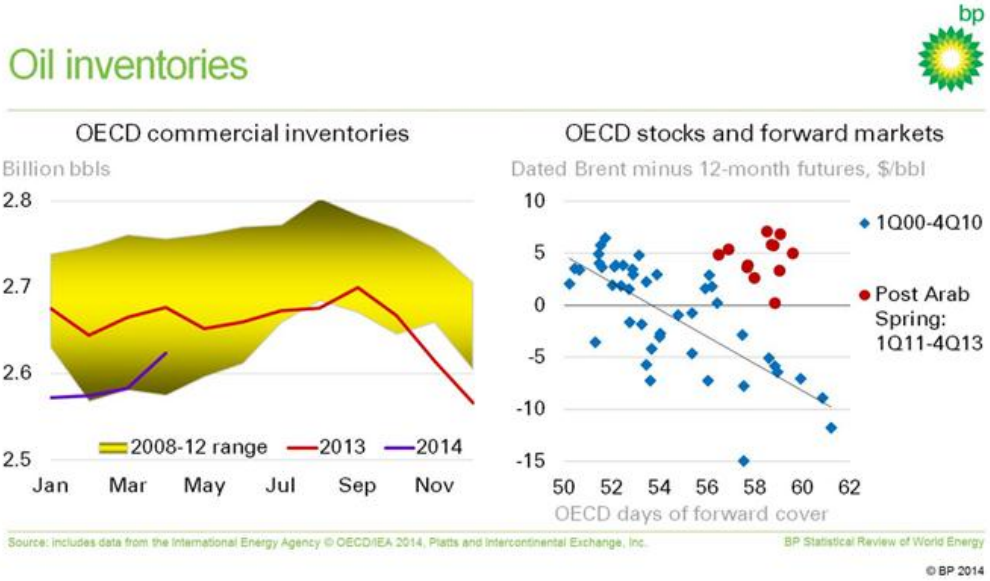
As in recent years, supply disruptions were large and concentrated in North Africa and the Middle East. Libya has been a focal point: following initial outages of 1.2 Mb/d in 2011 due to civil war, production staged a nearly-full recovery in 2012 [1 Mb/d]. But renewed unrest in the second half of 2013 led to an average annual decline of 520 Kb/d last year. Iranian production declined by 190 Kb/d as a result of continued international sanctions. Significant losses were also seen in Syria, the Sudans and Yemen. Cumulative supply disruptions since the advent of the “Arab Spring” from these countries have reached an extraordinary 3 Mb/d.

We are now in a better position to return to the question of why oil prices were so stable the last three years, despite the violent shifts we observed in production.



For the biggest part the answer has to be that the supply disruptions in Africa and the Middle East were matched almost exactly by the shale-related production increases in the US. It is a fair conclusion that oil markets would look very different today, had we only witnessed supply disruptions on the scale they actually happened. And vice versa, oil markets would look very different today had we only witnessed the shale "revolution" in the US. Importantly, the match is sheer coincidence. Higher prices may induce more shale production. But virtually nothing else of logic or substance connects the two developments. And so markets will remain on edge – or eerily calm -- until one side gains the upper hand.

Inventories

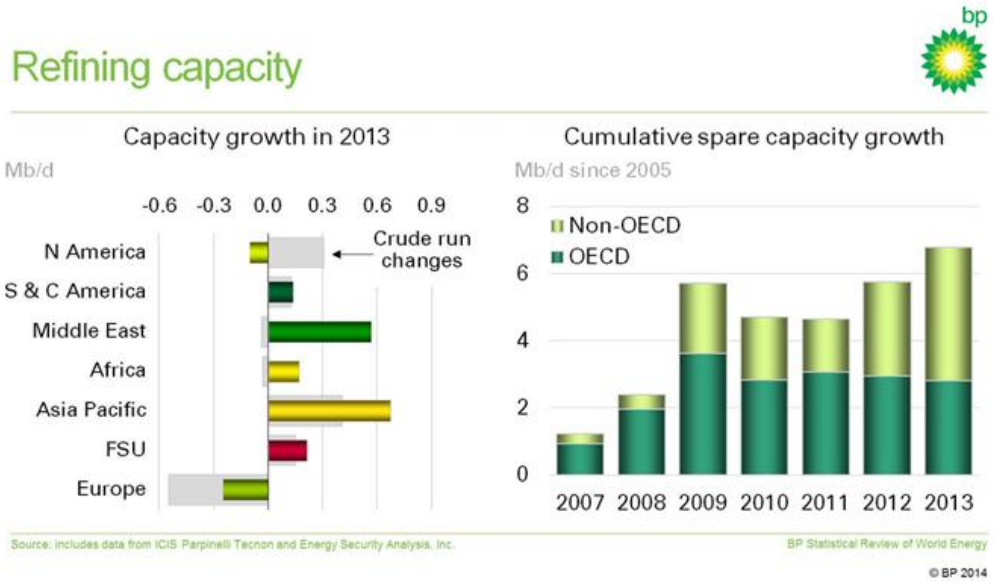


In an interesting way, this current stand-off finds itself reflected in the relationship between prices and inventories. Commercial inventories contracted in 2013, ending the year down almost 100 Mbbls on 2012, at the lowest year-end level since 2004. At the start of the year, inventories were ample following strong production growth in 2012, but stronger demand growth soon corrected this, and when Libyan supply collapsed in September, OECD inventories started to fall rapidly. Stocks have remained low so far this year, particularly for refined products.

But there is a more subtle dimension.

The relationship between the level of OECD commercial inventories and prices has shifted since the advent of significant supply disruptions in early 2011. The shape of the forward curve since then indicates that market participants are willing to pay a higher premium relative to future prices to hold physical inventories than was the case a few years ago – a clear indication of an increased desire for precautionary inventory holdings. Even as inventories fell in late 2013 (and so far this year) this higher premium has remained in place. Current inventory levels under the old, pre-disruption regime would have corresponded to lower spot and/ or higher future prices.

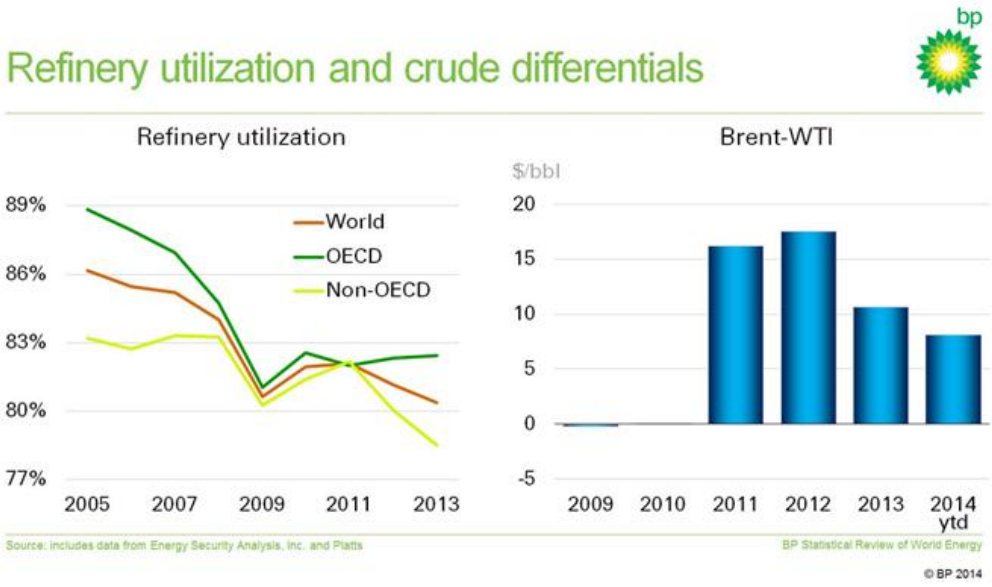
Refining



Global refining has been struggling for years, squeezed between excess capacity and slower throughput growth. Regional disparities are adding to the woes of the sector, with more capacity being added East of Suez and US throughputs rising as a result of rising

tight oil production: Since crude exports from the US are legally constrained, US refineries are processing the discounted domestic crude at home and exporting products instead. 2014 so far saw a continuation of these trends.

Global refining capacity grew by 1.4 million b/d last year, the highest net capacity addition since 2009. Capacity growth was led by China (660 Kb/d) with the Middle East not far behind. Global crude runs, in contrast, grew by only 0.4 million b/d and as a result, global spare capacity is now almost 7 Mb/d more than it was in 2005, the low point in our data series. Despite this dismal background, global refining margins were strong during the first half of 2013 due to a combination of cold northern hemisphere weather and refinery outages.



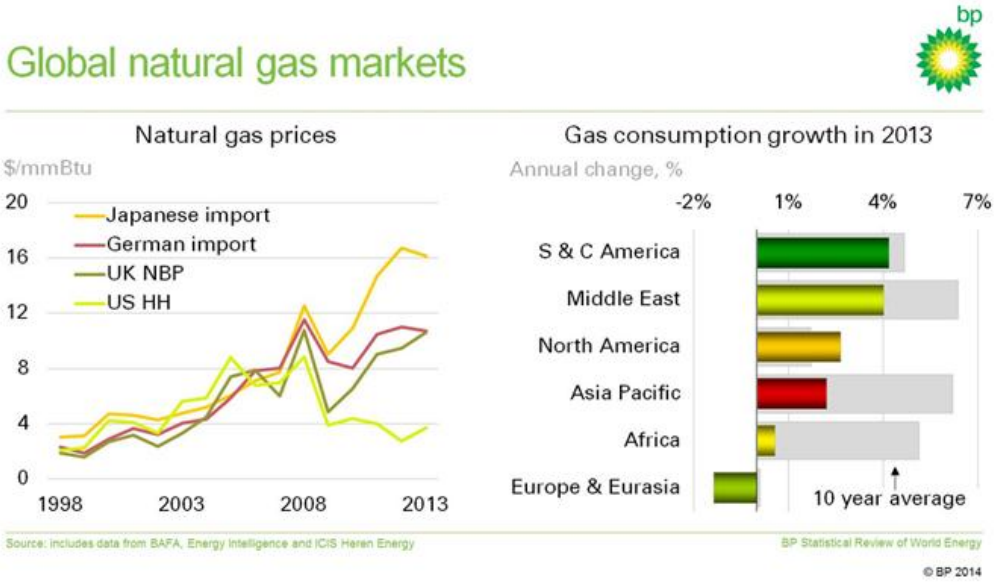
Last year's capacity and throughput developments meant that global average refinery utilization slipped to 80.4%, the lowest rate since 1987. Utilisation in the non-OECD fell to 78.5% because of the fast pace of capacity additions, but OECD refinery utilization improved marginally, with US crude runs benefiting from continued price discounts for domestic crudes, and because of refinery shut downs elsewhere. The US added new crude oil pipeline capacity that helped to alleviate the transportation bottlenecks which drive relative WTI prices, but with tight oil output rising at a rapid clip, logistics additions are inevitably less uniform than the ramp-up in crude supply. As a result, the differential continues to be volatile.

The new pipeline infrastructure has made it possible to move more crude to the Gulf Coast, but export constraints mean that the price discounts have spread to a wider range of crudes. As a consequence, US refiners exported record volumes of distillate last year

rather than replenish domestic stocks. Its reduced dependence on long-haul crude imports may well have facilitated a longer term drop in working product inventory.

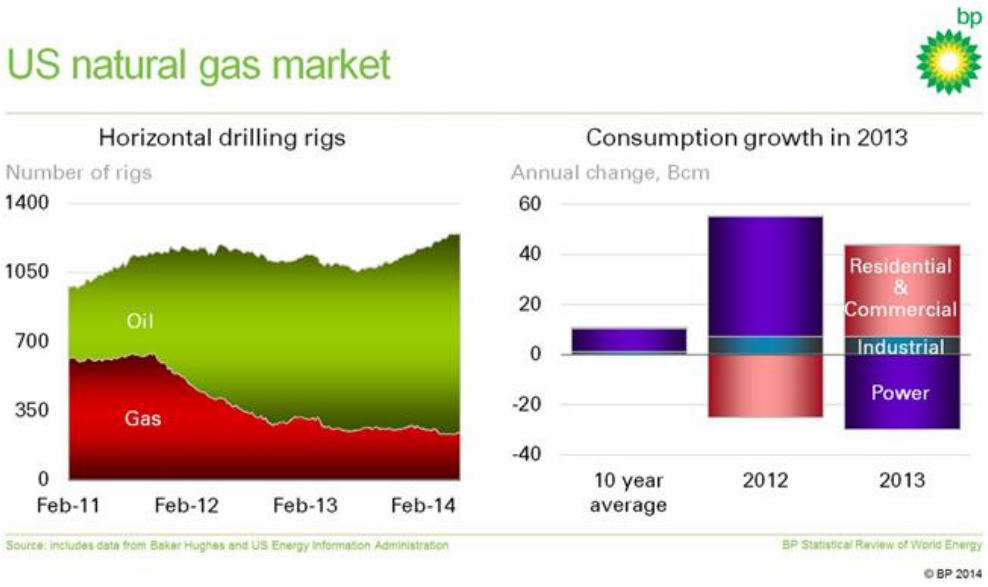
Conversely, European crude runs in 2013 fell [-550 Kb/d], to their lowest annual level since 1985. European demand is contracting and – different from Asia – today's problems can only be fixed by reducing capacity.

Natural gas



Natural gas markets are slowly transforming themselves, on the back of two developments: the shale gas "revolution" in the US and the increasing integration of hitherto segmented regional markets, supported by the rapid expansion of liquefied natural gas (LNG). In 2013, these forces took a breather - US shale gas production growth slowed, and LNG expansion remained very modest.

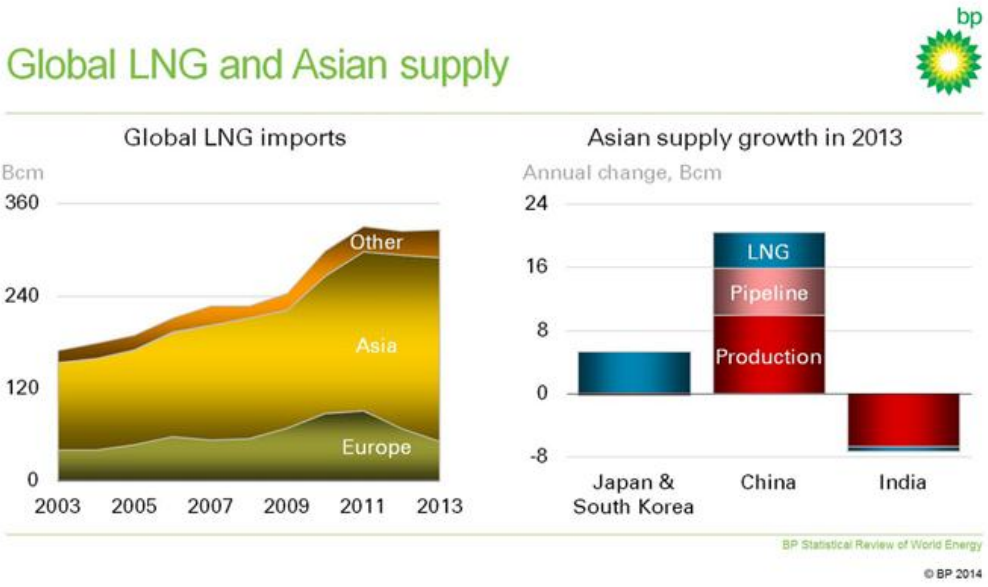
Globally, growth of consumption [1.4%], production [1.1%] and trade [1.8%] all slowed. Regional price differentials narrowed. As in all other fossil fuels, the demand slowdown was more pronounced in the developing world: Natural gas was the only fuel where OECD consumption growth outpaced non-OECD growth. Like oil, tracing OECD growth leads to the US; unlike oil, China was not the reason for weak growth in the non-OECD.



To disentangle what happened, let's start with the latest chapter of the evolving US shale story. This chapter starts with slowing production growth; from 7.3% in 2011, to 5% in 2012 and 1.3% in 2013. It has nothing to do with "running out of shale" – as some pundits have claimed – and everything to do with the fungibility of drilling rigs and the power of price signals.

US gas prices hit a 13 year low in 2012, and started rebounding in the wake of a cold winter early in 2013. For the year they were up 34.5% on average, almost offsetting the 2012 decline. However, because of the persistently high oil-gas price differential, this was not enough to accelerate production growth. It remained more attractive to "chase liquids", i.e. to continue to divert drilling rigs from shale gas to tight oil production. Almost all the growth in gas production last year came from associated and wet shale gas; dry shale gas was down.

Higher prices, low storage and the demand for heating signaled by a 17% increase in residential and commercial demand, however, did induce a dramatic pull out of natural gas from power generation – the point where it faces heads-on competition with other fuels. Total US consumption grew by 2.4% but gas-fired power generation declined by 8.9%, substituted by coal; coal-fired generation grew by 5%. For the first time since 2008, gas lost market share in US power generation, falling back almost 3 percentage points [30.3% to 27.4%] - the biggest such loss since 1973.



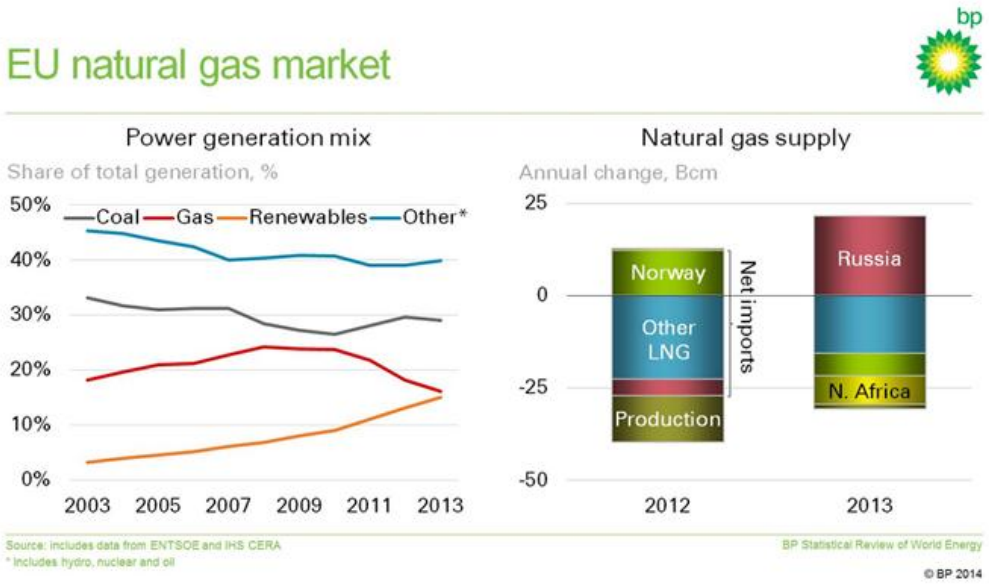
LNG projects are large and investments can be lumpy. Currently, supply growth is in the middle of a multi-year lull, with very limited capacity expansion. In 2013, supplies expanded by merely 0.6%. This is keeping markets tight, allocating flexible cargoes to those willing and able to pay high prices. Small wonder, then, that we are witnessing massive adjustments. Asia, where fully 81% of all natural gas imports are met by LNG, remained the prime destination, with almost 75% of all cargoes headed that way.

Japan remained the world's largest LNG importer, with post-Fukushima demand for LNG persisting at record levels -- but its gas fired power plants are now operating at full capacity, and so Japanese imports have stopped growing. Instead, South Korea assumed the mantle of recording the world's largest import growth, and again triggered by nuclear outages.

Meanwhile in China, big strides were made toward the stated political goal of increasing the share of natural gas in the energy mix [currently 5.1%]. At 10.8%, China logged the biggest increase in gas consumption in the world last year [15.3 Bcm]. And although production listed the second largest global increment [9.5%, 9.9 Bcm], this still left a large gap for import growth. The gap was filled by rising LNG (up 22.9%) as well as pipeline imports [28.0%]; the latter mostly from Central Asia where tentative steps toward domestic price reform in Turkmenistan -- coincidence or not -- lowered consumption by roughly the amount of pipeline exports.

The flip-side of higher demand growth and limited LNG availability is that it puts the spot-light on problems with domestic production. India is the prime example: caps on producer prices have stalled investment and last year led to the world's largest decline in gas

production [6.7 Bcm or 16.3%]. Lack of cheaper priced domestic gas and the huge price advantage of coal over LNG imports has caused large scale substitution of gas with coal, assigning to India also the world's largest decline in gas consumption [7.3 Bcm or 12.2%]. Ironically, almost a third of the coal was imported.

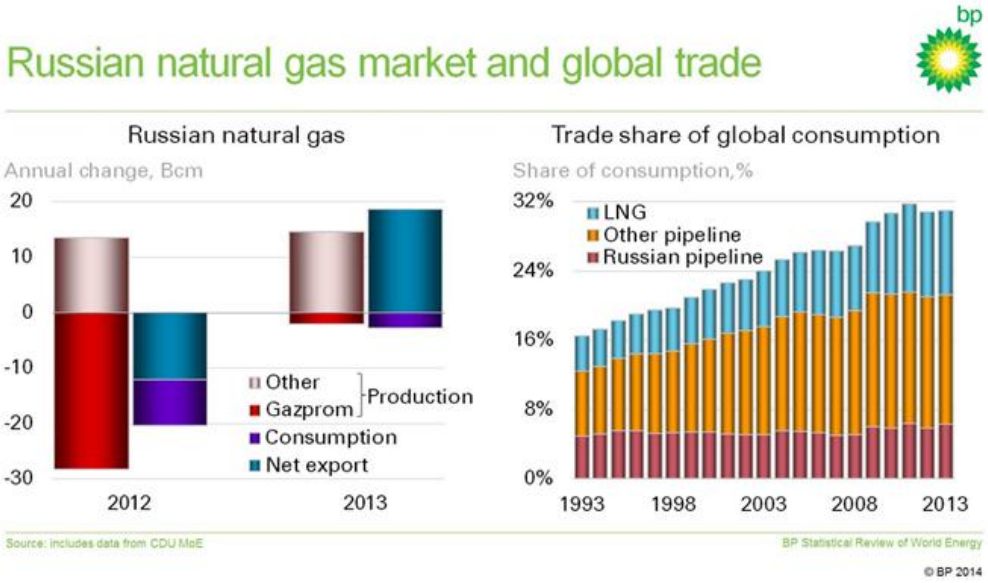


Europe took a rain check on the competition for LNG, helped out by Russia. EU production appears in terminal decline and consumption reached the lowest level since 1999. In 2013 consumption fell by 1.1% and production by 0.5%, and imports declined slightly.

As in the US, the year had started with a cold winter and low storage levels. Demand for heating drove up spot prices by 12.3% for the year, whereas oil-indexed contract prices fell gently and in line with the price of oil [-2.6%]. Gas lost the competition in power generation against cheaper coal and non-fossil fuels: In power, its market share declined by more than that of coal; while non-fossils gained. Overall though, EU gas consumption still fell less than coal, because of increased heating demand.

As was the case for global oil markets, EU imports were affected by the social unrest plaguing Africa. Falling exports from North Africa [-18.7%], Nigeria [-43.9%], and also Norway [-5.2%] meant a need for alternative deliveries. In the event, Russia stepped into the void, eliminating the need to compete for expensive LNG. The net result was a big shift in the composition of imports, with imports from Russian rising by 19.5% -- a marked reversal of 2012, when Russia had lost 12% of the EU gas market to Norway because Gazprom maintained oil price indexation while Norway adjusted its pricing closer to spot prices. In 2013 the rapid increase of European spot prices eroded much of the previous

differential, but Gazprom, by its own accounts, also offered discounts and rebates to sell gas on more competitive terms.



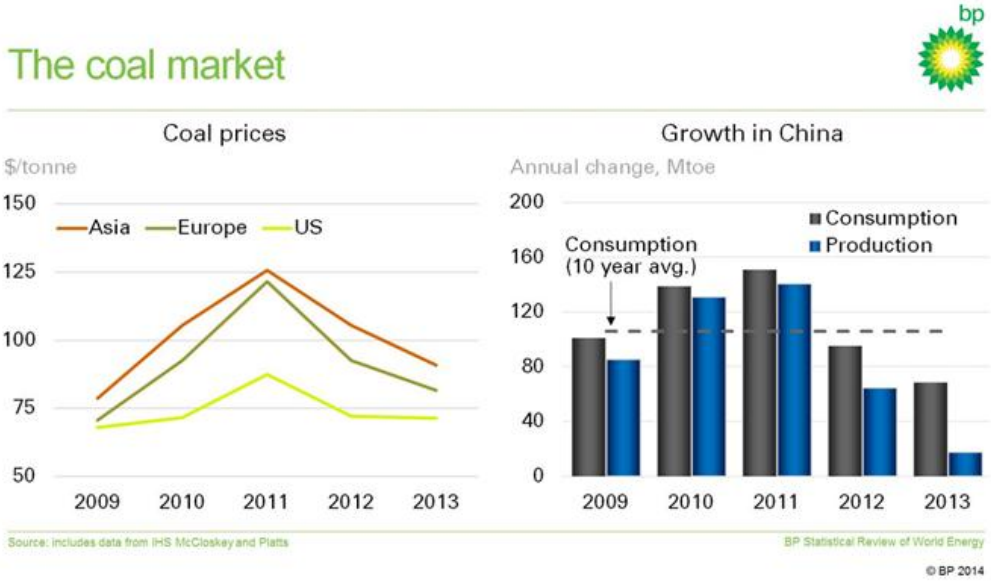
Russia bucked the global trend: Gas production increased by 2.4% or 12.4 Bcm - the largest production increase in the world, on the back of higher capacity utilization and increasing output from independent gas producers – that is all producers except Gazprom, which holds the export monopoly. Last year they accounted for 28% of Russia's production and, because they offer cheaper gas, supplied 39% of Russia's domestic gas consumption. The erosion of its market share at home allowed Gazprom to direct more resources abroad.

A drop in domestic gas consumption also helped [0.4%, 2.8 Bcm], in part because Russia's Far East suffered from severe flooding early in 2013; the one silver lining to this cloud was the second biggest growth in Russian hydropower on record. Together with falling electricity demand, it reduced the call on all other fuels for power generation, including natural gas to make room for more exports. All told, exports grew by 18.6% or 10.7 Bcm.

How do these differing regional stories affect the evolution of global gas trade? Trade has grown at more than twice the rate of global consumption for at least two decades, with LNG expanding even faster. Since 2011, this relationship has started to de-couple, with trade growth slower than consumption and LNG losing market share. In 2013, gas trade expanded by only 1.8%, slightly above consumption growth but considerably below the long term average of 5.2%, with pipeline trade again expanding faster [2.3%] than LNG [0.6%].

The temporary lull in LNG supply growth can not obscure the general direction of travel – towards a more inter-connected gas world. One episode from 2013 nicely illustrates the degree of integration international gas markets have already achieved: gas displaced by strong hydro in Russia was exported to Europe while LNG destined for Europe was re-exported to drought-stricken South American markets. In effect, hydroelectricity from Russia with too much rainfall was shipped half way around the globe to areas with too little – in the form of natural gas.

Coal



Coal rounds out the fossil fuel picture. In developing economies, this fuel of industrialization often is a reasonable indicator of economic health; in the OECD, coal markets are characterized more by competition with other fuels in power generation, driven by politics as much as by prices. 2013 was no exception.

Overall, coal markets slowed. Consumption growth of 3.0% remained below its long term average; production growth was the weakest since 2002 [0.8%]; prices fell in all regions on de-stocking and low demand while regional price differentials narrowed with intensifying competition between suppliers.

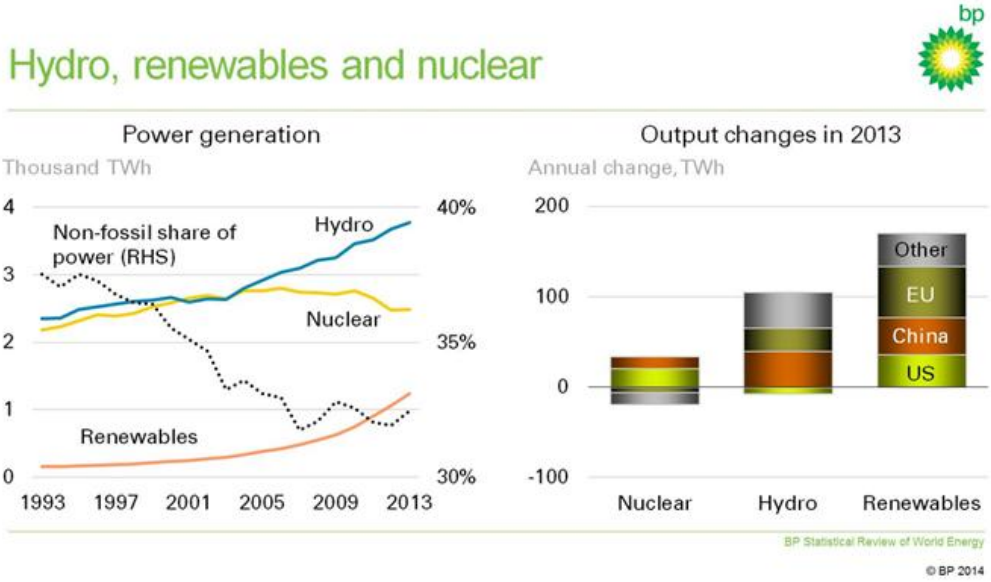
The big story in coal markets is China, where coal accounts for 67% of the national energy mix. Coal consumption rose by 4% in 2013, less than half the ten year average [8.3%]. New policies to conquer local pollution by shutting down coal-intensive production and encouraging coal substitution may have played a part, but the scale of such measures is limited by the restricted availability of natural gas. In China, the share of the service sector in GDP exceeded that of the industrial sector for the first time last year and

so moderating industrial production growth was one contributing factor. Still, it remains hard to reconcile the coal slowdown with steady GDP growth.

Elsewhere we find the data corresponding to the fuel switching described in the gas section: In India, rapidly declining domestic gas production and the price advantage of coal over LNG imports caused coal consumption to rise by 7.6%, the second largest volumetric increase on record. In the OECD, US consumption rebounded [4.6%] on higher natural gas prices whereas in the EU's shrinking energy market, coal contracted faster than gas [-2.5%], losing market share also to renewables.

Coal production and trade mirrored these patterns. Chinese coal production slowed to 1.2%, the lowest increment since 2000. For the first time in 15 years, China did not record the world's largest increase in coal production; Indonesia did. China became the world's largest net coal importer in 2012 and cheaper foreign coal made further inroads into Chinese markets last year. Seaborne trade slowed [to 4.3% from 14.5% in 2012 for steam coal] but, in an environment of falling prices and rising transport costs, producers were quick to adjust. Production increased the most among suppliers with easy access to Pacific markets, such as Indonesia [9.4%] and Australia [7.3%] while production in the US [-3.1%] and Columbia [-3.7%] declined in line with in falling demand in Europe and global price differentials.

Non fossil fuels



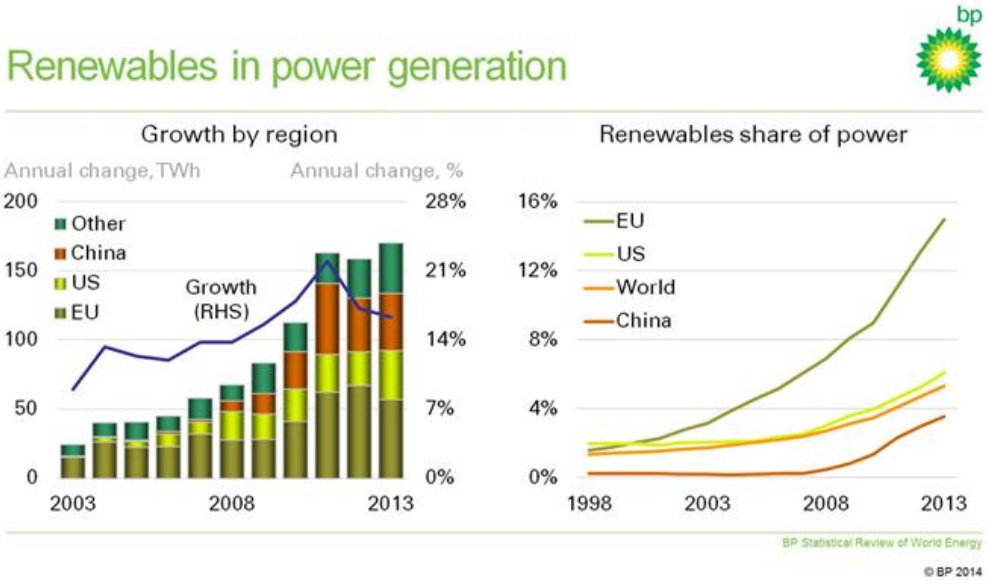
Many will not be aware that the share of non-fossil fuels in total power generation was on a declining trend through the 1990s and the early 2000s, as renewables were too small to make a difference and the growth of hydro and nuclear failed to keep up with total power

generation. Over the past decade, faster hydro growth, and the scaling up of renewables halted the decline.

2013 was a big year for non-fossil fuels: growth was above average, they increased their share of global power generation to almost one third [32.5%], crowding out fossil generation in the EU and the US along the way.

Nuclear made the smallest contribution [0.9%, 15 TWh], simply by ending two years of decline. Post-Fukushima safety reviews were scaled down and fewer reactors were out of operation. In Japan, generation continued to fall (-3.4 TWh, 18.6%), but from already extremely low levels. At the time of writing, all of Japan's nuclear reactors are offline. Elsewhere, declines in Korea, Ukraine, Spain and Russia were offset by growth in the US (21 TWh or 2.8%) and in China (13 TWh, 13.9%).

Global hydro growth slipped to 2.9%, down from 4.5% in 2012, largely because of slowing capacity additions in China and – how could it be otherwise – global precipitation patterns: Brazil experienced severe drought conditions for the second consecutive year [-7.0%] while Europe and Eurasia saw a second year of generation increase [5.5%]. Slow growth it may have been, but it was enough to lift the share of hydropower in global primary energy to a new record of 6.7%.



This leaves us with renewables, the largest contributors to non-fossil growth in 2013. Power generation from renewables grew by 16.3%. This was the lowest growth rate since 2009 while growth in volume terms [170 TWh] recorded an all-time high. Renewables made a larger contribution to primary energy growth than natural gas. As a share of

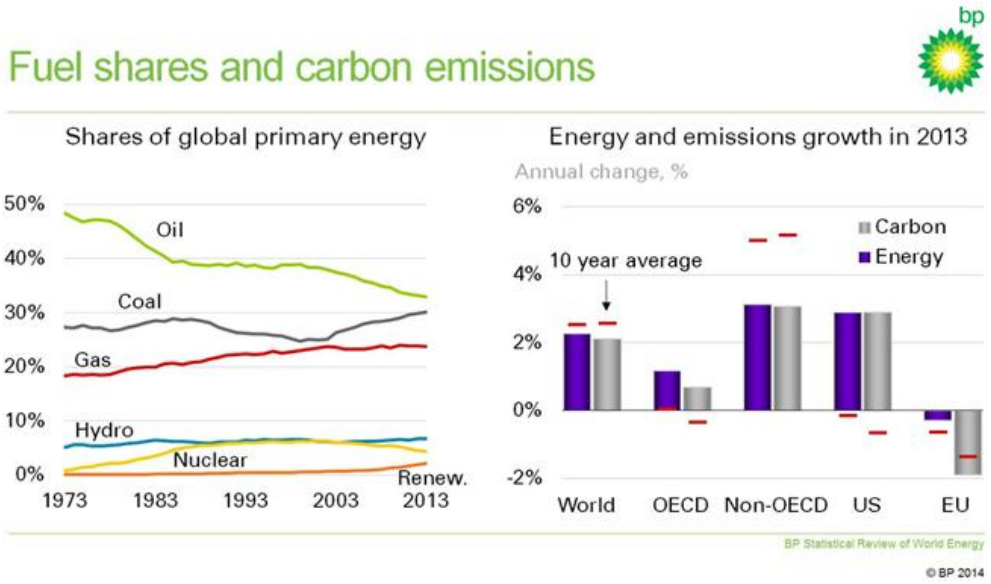
global electricity generation renewable power reached 5.3% in 2013, up from 2.7% five years earlier.

As a share in global primary energy, renewables stood at 2.2% last year; adding in biofuels brings the renewable total to 2.7%.

Renewables grew in all regions, and in almost all countries. The EU as a bloc is still ahead of the US and China, in annual increment and in the share of renewables in power generation. The EU now receives 15.0% of its power from renewable sources. At the same time, however, the EU growth rate has slowed, from 20.6% in 2011, to 18.0% in 2012 and 13.5%, leaving even the 2013 volume increment smaller than the 2011 and 2012 increments. It is no accident that this slowdown affects most the very region where penetration rates, and therefore subsidies, are highest.

The coincidence of slower growth rates with high volumetric contribution points at the underlying dilemma. Renewables are still subsidized. Sizeable annual increments reflect the scale renewables have already reached, while the slowdown of their growth indicates the weakening of financial support as they scale up and the burden of rising subsidies on society increases.

Fuel mix



An easy way of weaving the annual fuel by fuel changes into a coherent pattern is to look at how they affect the global fuel mix. With the exception of gas, which saw its market share dip to 23.7%, the shares of each fuel pushed into unfamiliar territory in 2013. Oil's share declined to 32.9%, a new low in our data set and extending a 40 year falling streak that goes back to the first oil price shock in 1973. Coal's share took another step on the

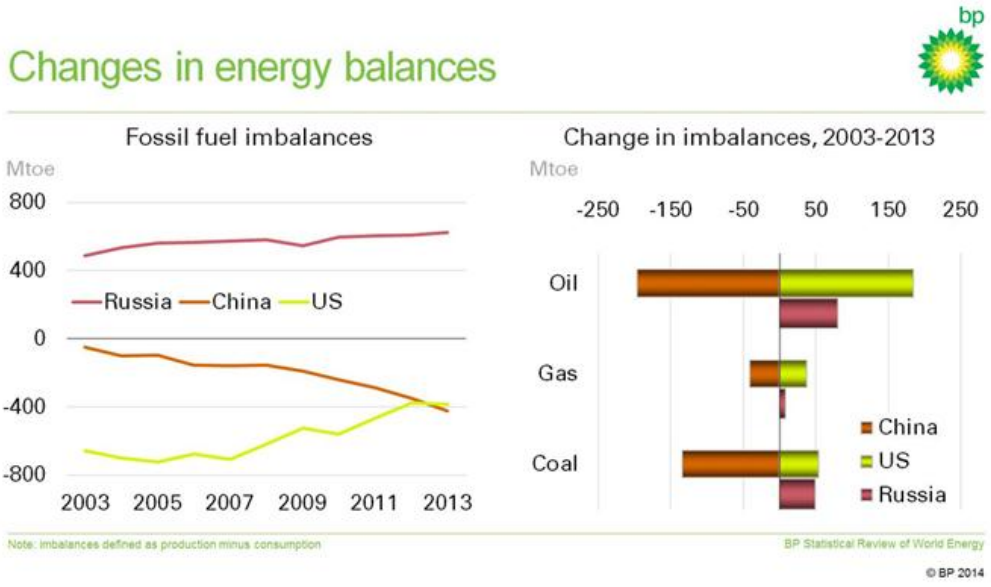
steady upward march that had started in 2002, when non-OECD industrialisation started in earnest; its share increased to 30.1%, the highest since 1970.

Carbon emissions per energy unit vary widely among fuels, and so the evolution of the fuel mix has implications for carbon emissions. In 2013 non-fossil fuels in power enjoyed relatively strong growth, increasing their aggregate share of primary energy [from 13.1% to 13.3%]. Despite this, global carbon emissions grew almost as rapidly as total primary energy [2.1% versus 2.3%] because of the rising share of coal. This has been a very important trend over the years -- carbon emissions have grown less rapidly than GDP courtesy of improved energy efficiency, but they did keep pace with energy consumption. In other words, there has been no change in the carbon intensity of the global fuel mix over the last decade. In the OECD, carbon emissions per unit of energy declined in 2013 due to the increased share of non-fossil fuels. In the non-OECD, the rising share of non-fossil fuels was offset by the rising share of coal and the declining share of natural gas – and emissions grew at the same rate as primary energy [3.1%].

The net result is that carbon emissions continue to rise too fast for comfort – restrained by improving energy efficiency, but not affected by changes in the global fuel mix. In the US, for example, much of the large decline in emissions recorded in 2012 was reversed last year as the power sector switched back to coal and away from gas. From the dimensions of the system, it is easy to see how even small switches from coal to gas could dramatically impact global emissions growth.

The one region reaping benefits from changes in the fuel mix was the EU where strong growth of renewables and hydro contributed to declines in both coal and gas use in power. EU emissions in 2013 were more than 13% below their 1990 level – and, like oil, almost back to where they were in 1969. For the world as a whole, however, emissions are 55% above the 1990 level.

Energy imbalances

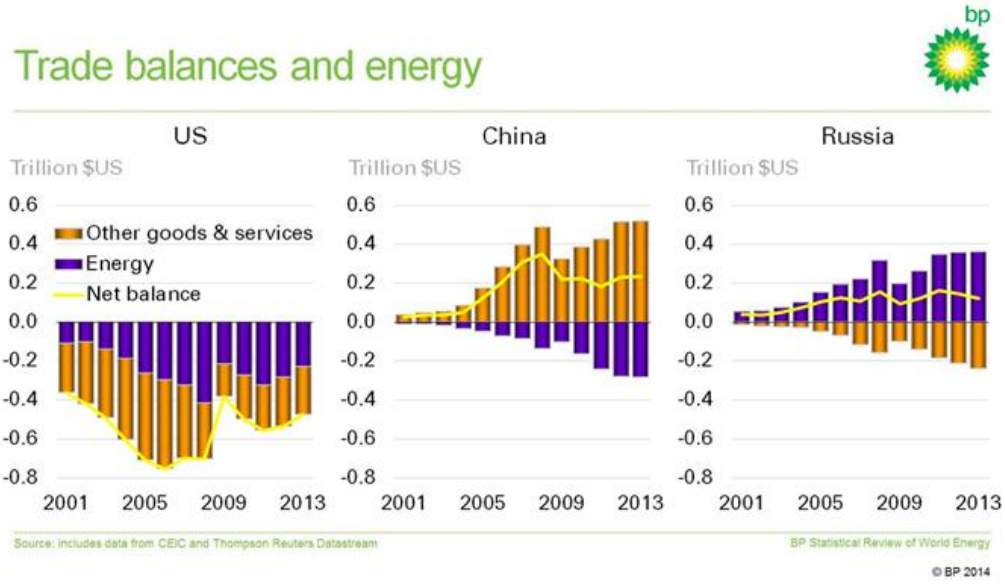


Let us conclude by returning to one of the issues raised at the beginning – the linkages between energy and the economy; and to an example of how the remarkable shift in physical energy balances which has occurred over the last decade will affect the global economy.

China, the US and Russia are the world's top three consumers and producers of energy today – in this order, and for both consumption and production. Russia is the world's largest exporter of fossil fuels, while the US and China are the second and third biggest importers (after Japan).

Over the last ten years, physical energy balances for these countries – simply the difference between domestic production and consumption – have shifted. Globally, the US had the biggest increase in oil and gas production – and the largest decline in oil and coal consumption. China had the biggest increase in coal production and in the consumption of every single fossil fuel. Russia had the second biggest increment in oil production.

Working out the net results of changes in physical production and consumption shows China's deficit for oil and gas worsening by almost exactly the same magnitude by which the US deficit improved. As a result, the Chinese primary energy deficit overtook that of the US for the first time last year. Russia's surplus improved for every fossil fuel over this period, so far allowing it to maintain its position as the world's largest holder of an energy surplus.



These shifts in physical energy balances do have macroeconomic implications. One of them is a global balance of payment effect. Global energy trade amounts to roughly 15% of the global trade in goods and services and changes in national energy balances typically have a sizeable effect on any countries balance of payments.

In the US, energy imports still make up about half of the trade deficit. However, on the back of diminishing oil and gas imports, this deficit is shrinking fast. China, on the other hand, sees increasing import dependence eating into its trade surplus; despite rapid economic growth, energy imports as a share of GDP almost tripled from 2003 to 2013.

Russia has a sizeable trade surplus [5.7% of GDP] due to its energy exports. However, if expressed as a share of GDP, the non-energy related deficit doubled over the last ten years while energy exports grew in line with GDP. If expressed as a share of GDP, Russia's overall trade surplus is falling fast.

If one would have asked any economist over the last ten years for potential sources of trouble to the global economy, global trade imbalances would have loomed large in the response. From today's point of view it seems as if global energy balances, by eating into the US deficit as well as into the Chinese surplus, are becoming a part of the solution.

Conclusion

Energy in 2013

- Energy and the economy - a two way relationship
- When things happen - ask the data
- Markets work - if you let them

Where does this leave us? I have done this for 9 years now, so please allow for a short personal conclusion.

Energy goes directly or indirectly into any type of economic activity. It clearly matters, and the link to the economy is not a one way street. But few economists devote time to it. By taking energy matters out of this wider context, the discussion suffers and often does not reflect the attention this topic deserves.

Second, every year we encounter weird twists and turns in the data. And every year, in the journey to find out what happened and why, it is rigorous interrogation of the data which delivers answers. This is another aspect, where more work could benefit us as an industry, and an understanding of the work we do.

And finally, there is an old adage, which always comes up in the end – markets matter. It comes with an addendum, however: If you let them. In global energy and energy politics, perhaps much more than elsewhere in policy making, we see both sides of this coin. This is not what the Statistical Review is about, but it is what falls out of the objective data we collect – every year.