Energy in 2013 – Taking Stock: Highlights from the 2014 BP Statistical Review of World Energy

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Introduction

Today, the energy world looks rather different than it did ten years ago; much of what we took for granted has changed. The dominant role of the developing world in energy growth, oil prices above $100 and a wide gap between regional gas prices, the emergence at scale of renewables and uncoverntional oil and gas – many would have found all of this hard to believe ten years ago.

Yet, nowdays we think of these trends as normal. If we loosely group together fuels that classify as "new", simply by virtue of having not been of any materiality a decade ago, including renewables, then these accounted for 81% of global primary energy production growth last year.

The global energy system is huge and moves only slowly, but it does move. It is the purpose of this paper to review the latest global energy developments and to document changes in global energy markets based on the 2014 edition of BP Statistical Review of World Energy. The best place to start is by investigating the relationship between energy and the economy.

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% p.a.), 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.

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 fiscal stimuli in the developing world, 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% p.a.) and despite slackening economic growth. For the two subgroups, however, 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%) and well above the 10-year average. 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%).

The contrasting experiences of the OECD and non-OECD reflect the differing fortunes of the world's largest energy consumers, China and the U.S. Together, they accounted for more than 70% 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 China reported unchanged economic growth of 7.7%. The slowdown in Chinese growth was concentrated in coal but is visible in oil as well. Meanwhile, U.S. 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 U.S. industrial sector energy use, in particular of oil products.

The diverging performance of China and the U.S. caused the "gap" between non-OECD and OECD energy consumption growth to narrow sharply. It became the smallest since 2000.

We tend to think of energy demand as 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 U.S. 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.

To trace these developments in more detail it is best to look at them 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),

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See footnote at end of text.

$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[1].

The stability in oil prices betrays significant changes in the underlying balance between consumption and production and yet another year of record supply disruptions. To understand why prices remained so stable one needs to delve into the detail.

Global oil consumption last year rose by 1.4 Mb/d, 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. The U.S. stood out as its consumption grew by 400 Kb/d, against an average annual decline of 110 Kb/d over the last ten years. This was the fastest growth of any country last year – and (in volume terms) outpacing China for the first time since 1999. The rise was focused in the industrial sector, including refining and petrochemicals, which contributed almost 80% of net growth. 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.

Non-OECD consumption rose by 1.4 Mb/d or 3.1%, well below the ten year average (3.9% p.a.). This weakness was especially pronounced in China, where demand grew by only 390 Kb/d – the lowest since the recession in 2009 and in India, where growth fell to its lowest level since 2001 (40 Kb/d) as subsidies were reduced.

Turning to production, 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 – together more than offsetting continued declines in mature areas such as Mexico and the North Sea.

U.S. oil production exceeded 10 Mb/d in 2013, reaching the highest level since 1986. Driven by tight oil plays, U.S. 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 U.S. history". Indeed, only Saudi Arabia has ever had a bigger increase than the U.S. 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 U.S. increase, therefore, was the fourth biggest in history.

Meanwhile, OPEC production contracted by 600 Kb/d. In addition to unplanned disruptions (which we discuss below), 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.

As in recent years, supply disruptions were large and concentrated in North Africa and the Middle East. Cumulative disruptions since the advent of the "Arab Spring" in Libya, Iran, Syria, Yemen and the two Sudans 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-based production increases in the U,S. It is a fair conclusion that oil markets would look very different today, had we only witnessed supply disruptions on the scale that actually happened. And vice versa, oil markets would look very different today had we only witnessed the shale "revolution" in the U,S. Importantly, the match is sheer coincidence. Higher prices may induce more shale production eventually. But virtually nothing else of logic or substance connects the two developments. And so markets remain on edge – or eerily calm – until one side will gain the upper hand.

This current stand-off was also reflected in the relationship between prices and the level of OECD commercial inventories. Since the advent of significant supply disruptions in early 2011, the shape of the forward curve indicates that market participants are willing to pay a risk premium relative to future prices for holding physical inventories – a clear indication of an increased desire for precautionary inventory holdings.

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 U,S, throughputs rising as a result of rising tight oil production: since crude exports

from the US are legally constrained, U.S. refineries are processing the discounted domestic crude at home and exporting products instead.

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.

The U.S. added new crude pipeline capacity, which 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, U.S. refiners exported record volumes of distillate last year (1.1 Mb/d) 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 U.S. and the increasing integration of hitherto segmented regional markets, brought about by the rapid expansion of liquefied natural gas (LNG). In 2013, these forces took a breather - U.S. 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 slowdown in demand growth 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 U.S.; but unlike oil, China was not the reason for weak growth in the non-OECD.

To disentangle what happened, we start with the latest chapter of the evolving U.S. shale story. U.S. 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 Henry Hub prices 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 (1.3% in 2013). 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.

U.S. total natural gas consumption grew by 2.4% driven by residential heating demand. However, higher prices meant that for the first time since 2008, gas lost market share in U.S. power generation to coal, falling back almost 3 percentage points (30.3% to 27.4%) – the biggest such loss since 1973.

Turning to LNG, currently global supply growth is in the middle of a multi-year lull, with very limited capacity expansion. LNG projects are large and investments can be lumpy. 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. Asia, where 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 domestic production listed the second largest global increment (9.5%, 9.9 Bcm), this still left a large gap for import growth.

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%; imports declined slightly as well.

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 Russia rising by 19.5% – a marked reversal of 2012, when Russia had lost 12% of the EU gas market to Norway after Norway had adjusted its prices close to spot price levels while Gazprom maintained oil price indexation. 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.

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 growing 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% p.a., with pipeline trade again expanding faster (2.3%) than LNG (0.6%). However, the temporary lull in LNG supply growth can not obscure the long term direction of travel – towards a more inter-connected gas world.

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 (0.8%) was the weakest since 2002; 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% p.a.). New policies to conquer local pollution by shutting down coal-intensive production and encouraging coal substitution may have played a part, but they started only late in the year and their scale 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 the official, 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, U.S. consumption rebounded (4.6%) on higher natural gas prices whereas in the EU's shrinking energy market, coal contracted (-2.5%) faster than gas, losing market share also to renewables.

Non fossil fuels

2013 was a big year for non-fossil fuels: growth was above average and they increased their share of global power generation to almost one third (32.5%), crowding out fossil generation in the EU and the U.S. along the way. 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. Only over the past decade have faster hydro growth and the scaling up of renewables halted the decline.

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. 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%).

Renewable power was the largest contributor to non-fossil growth in 2013 and made a larger contribution to primary energy growth than natural gas. However, at 16.3% this was the slowest growth rate since 2009 while growth in volume terms (170 TWh) recorded an all-time high.

Renewables grew in all regions, and in almost all countries. The EU as a bloc is still ahead of the U.S. 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 growth rate in the EU

has slowed more than in other regions, from 20.6% in 2011, to 18.0% in 2012 and 13.5% last year, 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.

The fuel mix and carbon emissions

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 declining trend 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, because of the rising share of coal, global carbon emissions grew almost as rapidly as total primary energy (2.1% versus 2.3%). 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. 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.

Concluding remarks

In conclusion we return to 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 U.S. 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 U.S. and China are the second and third biggest importers (after Japan).

Over the last ten years, physical energy imbalances for these countries – simply the difference between domestic production and consumption – have shifted. Globally, the U.S. 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 U.S. deficit improved. As a result, the Chinese primary energy deficit overtook that of the U.S. 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 U.S., 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. Meanwhile, in Russia the non-energy deficit is rising fast, reducing its overall trade surplus as it is not being compensated for by rising energy export revenues.

Where does this all leave us? Energy goes directly or indirectly into any type of economic activity and the link between the economy and energy is not a one-way street. Every year, when preparing the Statistical Review, we encounter strange twists and turns in the data and every year, it is rigorous interrogation of the data which delivers answers to the question of what happened and why.

Footnote

[1] Volatility is defined as three year standard deviation.