

Energy in 2017: two steps forward, one step back

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London 13 June 2018





1. Introduction

Our aim when producing the Statistical Review is that it should be the onestop shop of choice for all your statistical needs.

Customers can come back year-after-year safe in the knowledge that their regular staples will be available: updated and fresh, impeccably sourced, cleaned and ready for consumption, neatly ordered in familiar rows. Some may even have an Ikea-moment and end up using data they didn't even know they wanted.

But even though we have been in the marketplace for 67 years, we can't rest on our laurels. The energy world is changing, and we need to keep up with evolving tastes and needs. This year, we are offering new data on the fuel mix within the power sector and on key materials, such as cobalt and lithium, which are playing an increasing role in the energy transition.

I am afraid to say that – unlike BP's retail outlets – we don't offer customer loyalty cards. But we do have the advantage that everything in our one-stop shop is free!

Before taking you through some of the highlights of this year's produce, let me thank everyone who has been hard at work collecting, cleaning and stacking the data shelves over the past couple of months ready for your convenience.



That work was led by the rest of the Economics team, supported as always by the tireless efforts of the team from Heriot-Watt University. A huge thanks to all of them, this is very much a team effort.

At first blush, some of last year's data might seem a little disappointing. Growth in overall energy demand is up; gains in energy intensity are down. Coal consumption grew for the first time in four years. And, perhaps most striking of all, carbon emissions are up after three consecutive years of little or no growth.

What does this tell us about the energy transition? Is it progressing less rapidly than we thought? Has it gone into reverse?

I would caution against being too alarmed by the recent data. We always knew that some of the exceptional outcomes seen in recent years reflected the impact of short-run cyclical factors, as well as longer-term structural forces shaping the energy transition. Global GDP was growing at below average rates, weighed down by weakness in the energy-intensive industrial sector. Output from some of China's most energy-intensive sectors was falling in outright terms. Those factors were unlikely to persist. Indeed, last year's Stats Review presentation had the very snappy title of "short-run adjustments and long-run transition".

And sure enough, some of those short-run adjustments came to an end last year. But many of the structural forces shaping the energy transition continued, particularly robust growth in renewables and natural gas.



Last year's energy data is perhaps best seen as a case of "two steps forward, one step back".

2. Key features of 2017

Let's start by looking at some of the headline numbers.

Global energy demand grew by 2.2% in 2017, up from 1.2% last year and above its 10-year average of 1.7%. This above-trend growth was driven by the OECD, particularly the EU. Much of this strength can be directly related to the pickup in economic growth. But it also reflected a slight slowing in the pace of improvement in energy intensity (or energy productivity): the amount of energy needed to produce a unit of output.



Growth in GDP and energy

Despite the unusually strong growth in the OECD, the vast majority of the increase in global energy consumption came from the developing world, accounting for nearly 80% of the expansion.



China alone contributed over a third of that growth, with energy consumption growing by over 3% in 2017, almost three times the rate seen over the past couple of years. This sharp pickup was driven by a rebound in the output of some of China's most energy-intensive sectors, particularly iron, crude steel and non-ferrous metals. Despite this increase, the growth of China's energy demand in 2017 was still significantly slower than its 10-year average, and its rate of decline in energy intensity was more than twice the global average.

Two steps forward, one step back.

These contrasting dance moves can also be seen in the fuel mix.

The forward progression can be seen in that around 60% of the increase in primary energy was provided by natural gas and renewable energy. Natural gas (3.0%, 83 Mtoe) provided the single largest contribution to the growth of primary energy, buoyed by exceptional growth in China. This was closely followed by renewable energy (including biofuels) (14.8%, 72 Mtoe), which again grew rapidly – punching far above its weight – driven by robust growth in both wind and solar power.

The step back was coal (1.0%, 25 Mtoe), which grew for the first time since 2013. This was largely driven by India, but it's also notable that Chinese coal consumption increased after three years of successive falls.





That's a very quick summary of the big picture for 2017.

The plan now is to look at some of the developments and issues in last year's energy markets in a little more detail, starting first with global oil markets.

3. Oil and refining

One of my favourite TV shows when I was growing up was a show called Dallas. It had a cast of many different characters: some who had been in the show for a long time but still had the power to surprise; battling against Young Turks, new on the scene, who we had to get to know and learn about their behaviour. The show would lurch from crisis-to-crisis; with building tension and intrigue, often ending at nail-biting moments.

Sound familiar?

Spencer Dale, London, 13 June 2018



The good thing about Dallas was that you only needed to wait a week for the next episode. We have had to wait a year until the next instalment of the Stats Review to see how the drama of real-life oil markets has developed.

To remind you where we left off at the time of last year's Statistical Review: flows of oil production and consumption had come back broadly into balance, but inventories remained at record-high levels; OPEC, together with 10 non-OPEC countries led by Russia – sometimes known as the Vienna group – had begun to implement their promised cuts in oil production in order to accelerate the adjustment in inventories; but US tight oil had started to pick up, threatening to offset the impact of the production cuts.

Like all good cliff-hangers, this begged a number of questions:

- would the production cuts by OPEC and other members of the Vienna group work;
- how much and how quickly would US tight oil respond; and
- what would all this mean for oil prices?

So what happened next?

Soap operas need an element of continuity against which the more unpredictable elements of the show can unfold. Dallas – for those of you old enough to remember – had JR Ewing's constant nastiness and Sue



Ellen's constant drinking. The constant in oil market in recent years has been the strength of demand growth.

And that continued in 2017, with oil demand growing by 1.7 Mb/d, similar to that seen in 2016, and significantly greater than the 10-year average of around 1.1 Mb/d. To put the recent strength of oil demand in context, average growth over the past five years is at its highest level since the height of the commodity super-cycle in 2006/7. This despite all the talk of peak oil demand, increasing car efficiency and growth of electrical vehicles. All of those factors are real and are happening, but persistently low oil prices can have a very powerful offsetting effect.

Not surprisingly, oil demand in 2017 continued to be driven by oil importers benefitting from the windfall of low prices, with both Europe (0.3 Mb/d) and the US (0.2 Mb/d) posting notable increases, compared with average declines over the previous 10 years. Growth in China (0.5 Mb/d) was closer to its 10-year average.

But there were some signs in the product mix that the boost from low oil prices may be beginning to wane. Growth in consumer-led fuels most exposed to oil price movements – especially gasoline – slowed in 2017. In contrast, diesel demand bounced back, buoyed by the acceleration in industrial activity.





That's the constant bit of the storyline, what about the unpredictable events; particularly on the supply side and the interaction between the OPEC production cuts and the response of US tight oil?

The impact of the production cuts can be seen in growth of supply last year. At an aggregate level, output growth in 2017 (0.6 Mb/d) was similar to that in 2016. But the pattern of that growth flip-flopped quite sharply. After growing by 1.6 Mb/d in 2016, output by OPEC and other members of the Vienna group fell 0.9 Mb/d last year as the cuts in production took effect. In contrast, after falling in 2016, oil production by countries outside of the Vienna group grew by 1.5 Mb/d, led by the US and a bounce back in Libya (which was not part of the Vienna agreement).





The Vienna group had a target for production cuts of almost 1.8 Mb/d, relative to the base month of October 2016.¹ In practice, the production cuts have far exceeded that, with cuts totalling nearly 2.5 Mb/d in April 2018. This overshoot has been concentrated in Venezuela – where the economic and political crisis has caused production to fall by almost 700 Kb/d, far in excess of the target reduction of 100 Kb/d – and to a lesser extent in Saudi Arabia and Angola.

The production cuts were instrumental in increasing the pace at which oil stocks fell back to more normal levels last year. In particular, the dampening in aggregate supply growth associated with the production cuts, combined with the robust increase in demand, meant daily consumption exceeded production for much of 2017. As a result, OECD commercial inventories fell by about 150 million barrels in 2017, and in March of this year were broadly

¹ The base month for the Vienna group was October 2016, except for Angola (September 2016) and Kazakhstan (November 2016).



in line with the five-year moving average measure originally highlighted by the Vienna group.

There is no perfect measure of the 'normal' or equilibrium level of oil stocks. The 5-year moving average measure is distorted by including the most recent couple of years in which stocks were excessively high. But if we exclude the most recent period, and consider a measure based on the average level of stocks prior to 2015, this has the drawback that it doesn't take account of the likely increase in desired inventories as consumption has increased in recent years. Trying to avoid both problems, the Inventories* measure is based on the average level of stocks prior to 2015 adjusted for the increase in consumption since then.² This measure suggests that the current level of inventories may be just a little above 'normal' levels.





² This measure also includes an estimate of the additional oil required to fill the new pipelines built since 2015.



That said; the impact of the production cuts would have been even bigger had it not been for the response of US tight oil and NGLs, which have grown by almost 2 Mb/d since October 2016. Indeed, the pace of this second wave of growth in US tight oil seen over the past 18 months or so is comparable to the rapid growth seen in 2012-2014 – even though prices in the earlier period were materially higher. Indeed, the scale of the increase in US tight oil meant the impact of the production cuts was increasingly offset as we moved through 2017.

Although more recently, increasing bottlenecks within the supply chain, together with signs that investors are becoming less willing to finance continued high levels of investment, suggest there may be some limits to the speed with which tight oil can grow going forward.



The speed and scale of OPEC's actions mean that it continues to have the ability to smooth temporary disturbances to the oil market. But the relatively rapid response of US tight oil reinforces the limits on OPEC's power. If OPEC tries to resist more permanent or structural changes in the market,



there is an increasing risk that these actions will quickly be cancelled out by the responsiveness of US tight oil.

Focussing on tight oil for a moment: a central part of its success over the past 5 or 6 years has been the strong and continuous gains in productivity, as technology and know-how have improved.

However, the most recent data for the Permian which has accounted for around two-thirds of the increase in US tight oil since 2017, paint a sharply different picture. In particular, using conventional measures based on 'initial output per rig', measured productivity fell sharply in the second half of 2016 and the first half of 2017, before recovering somewhat in the second half of last year.

But much of the fall in this conventional measure of productivity was driven by a sharp decline in the rate at which drilled wells were subsequently fracked and completed – as the supply chain within the Permian tightened and drilling processes became more complex – rather than by a fall in the underlying productivity of the wells drilled.

If we control for these changes in the completion rate by considering a measure of productivity based on 'initial output per completed well', this points to a gradual flattening off in productivity last year, rather than a sharp decline. This measure can be further refined to control for the increasing length of drilled wells, by considering a measure of 'initial output per lateral foot of each completed well'. This third measure points to a slight decline



in productivity during 2017, but far less pronounced than implied by the conventional measure.



It is perhaps not surprising that as US tight oil output has increased rapidly, causing production to spread out from the sweetest spots, productivity has begun to flatten out. And, importantly, this measure of productivity doesn't link directly to profitability, if the cost of drilling continues to fall or if acreage is drilled more intensely. But it does perhaps suggest that the very rapid increases in tight oil productivity that characterised much of the initial phase of the shale revolution may be beginning to fade.

Wrapping up last year's episode and bringing these developments in demand and supply together in terms of their implications for prices. Prices drifted lower during the first half of 2017 as stocks remained stubbornly high. But as the production cuts started to bite and inventories began to fall, prices increased with Dated Brent reaching a high of \$66/bbl by the end of last year. For the year as a whole, Brent averaged \$54/bbl, up from \$44/bbl in 2016 – the first annual increase since 2012.



Oil prices have obviously increased significantly further since then, raising the question of what happens next.

This will depend, amongst other things:

- on the behaviour of OPEC and the other members of the Vienna group – how will they respond to the overshoot of the production cuts, and when and how will they begin to exit from the cuts; and
- on the behaviour of US tight oil will productivity keep declining; and are the recent issues with credit availability and supply-chain bottlenecks simply short-term growing pains or could they act as more persistent constraints on growth?

To find out the answer to these and other key developments tune in to the next exciting instalment of the Stats Review.

<u>Refining</u>

The strong growth in oil demand fed through into refining, with refining runs increasing by 1.6 Mb/d in 2017, more than twice their 10-year average. The increase in throughput, together with continuing declines in availability in Latin America, allowed space for refinery runs in US and Europe to expand after being squeezed in 2016. The increase in refinery runs, together with another year of weak capacity growth, pushed refining utilization to its highest levels for almost 10 years. Refining margins also rose, supported by the impact of hurricane Harvey, high utilization rates and product stocks falling back to more normal levels.





The Brent-WTI differential widened sharply in the second half of 2017, averaging \$5/bbl in the second half of 2017. This widening largely stemmed from the speed and scale of the ramp-up in Permian production, which led to increasing bottlenecks (and hence costs) in transporting crude to the Gulf coast. These bottlenecks persist today.

4. Natural gas

2017 was a bumper year for natural gas, with consumption (3.0%, 96 bcm) and production (4.0%, 131 bcm) both increasing at their fastest rates since the immediate aftermath of the financial crises.

The growth in consumption was led by Asia, with particularly strong growth in China (15.1%, 31 bcm), supported by increases in the Middle East (Iran 6.8%, 13 bcm) and Europe.





The growth is consumption was more than matched by increasing production, particularly in Russia (8.2%, 46 bcm), supported by Iran (10.5%, 21 bcm), Australia (18%, 17 bcm) and China (8.5%, 11 bcm).

Surge in China's gas demand

The single biggest factor driving global gas consumption last year was the surge in Chinese gas demand, where consumption increased by over 15%, accounting for around a third of the global increase.

Much of this rapid expansion can be traced back to the Environmental Action Plan announced in 2013, which set targets for improvements in air quality over the subsequent five years. With that five-year deadline looming, the Chinese authorities in the spring of last year announced an enhanced set of measures for Beijing, Tiajing and 26 other cities in the North-East provinces of China, designed to meet the environmental objectives.



These measures, which were further reinforced in the autumn of last year, were focussed on the use of coal outside of the power sector. In particular, a combination of very sizeable carrots and sticks were used to encourage industrial and residential users to switch away from coal to either gas or electricity, with the vast majority opting for gas. Although most attention has focused on the 3 million households affected by this policy, the biggest factor driving the expansion in gas demand was switching within the industrial sector. The resulting increase in gas demand was greatly compounded by the switch into gas reaching a peak just as winter heating demand was ramping up.

The surge in Chinese gas demand led to severe strains within China. Retail and wholesale gas prices increased sharply. Imports of LNG were ramped up beyond notional capacity levels. And there was widespread rationing of gas, especially for industrial users, as priority was given to residential users.



Some of these tensions and strains simply reflect the speed with which gas demand increased: there is a limit to how quickly LNG imports can be increased; imports of pipeline gas, especially from Turkmenistan, didn't grow by as much as perhaps expected. But the strains also highlight the



underlying weakness of gas infrastructure in China. The network of pipelines across China is incomplete, leading to significant distributional issues. More importantly, gas storage capacity in China is inadequate to match the seasonal fluctuations in demand – effective storage capacity in China is around 3% of consumption, compared with close to 20% in the US and Europe. These types of structural issues can't be fixed overnight and are likely to constrain the extent to which Chinese gas demand outside of the power sector can grow in the near term.

These constraints are reflected in more recent policy announcements which have identified a wider range of options to improve local air quality, including the use of 'scrubbed' coal in utility-scale boilers and combined heat-and-power plants. Chinese gas demand looks set to continue to increase strongly this year, not least because the surge in gas demand continued into the first part of this year and some of the rationing that held back demand in the final part of last year is likely to ease. But it seems unlikely that the extent of the surge in gas demand seen in China last year will be repeated in 2019 and beyond.

Growth in LNG trade

The other central factor supporting the strength of global gas markets last year was the continued expansion of liquified natural gas (LNG), which increased by over 10% in 2017, its strongest growth since 2010, aided by the start-up of new LNG trains in Australia and the US.





China's increased need for LNG accounted for almost half of the global expansion, with China overtaking Korea to be the world's second largest importer of LNG after Japan.

The tidal wave of LNG projects that were sanctioned between 2009 and 2014 led many commentators to predict the emergence of surplus LNG as it took time for demand to catch up with the rapid growth in supplies.

To illustrate this, the green supply line gives a sense of the implied profile for LNG supplies, as at the end of 2014, given the starting dates of the LNG projects that had been sanctioned at that point.³ This implied profile was materially higher than the range of LNG demand forecasts published by the major external consultants at that time, suggesting a persistent surplus of LNG; or LNG glut.

³ For LNG facilities involving multiple trains, only the first train is assumed to start on the announced completion date, with subsequent trains assumed to begin at 6 monthly intervals.





But many observers have so far been surprised by the apparent absence of such a glut. There is certainly little evidence of LNG facilities standing idle due to a lack of demand.

This absence partly reflects that, due to a variety of technical issues, actual LNG supplies - shown by the yellow line - have come on stream less quickly than originally planned, moving supply more into line with the original demand profiles.

However, the apparent absence of a glut also reflects the fact that the surplus LNG supplies which did emerge resulted in bouts of unsustainably low prices rather than a build-up of idle capacity.



This is illustrated by Asian spot LNG prices - shown by the Japan Korea Marker (JKM) – over the past couple of years fluctuating in a range between US LNG exporters' full-cycle costs and their short-run operating costs. Exporters of US LNG have been willing to supply LNG as long as they covered their operating costs, even if that was less than their full-cycle costs.



So there has in fact been an LNG glut of sorts in recent years, but this has resulted in periods of unsustainably low prices rather than idle LNG capacity.

One final point on LNG.

The greater mobility of LNG exports, in terms of their ability to alter their destination in response to price signals in a way that pipeline exports cannot, is likely to lead gas markets around the world to become increasingly integrated, with regional gas prices increasingly moving in unison.



Interestingly, this growing integration can already be seen in global gas prices. The correlation between European and Asian spot prices has been really quite high since the previous wave of LNG trains in 2009/11. But more recently, the correlation between these markets and US gas prices has also begun to increase. This correlation is likely to increase further as Henry Hub increasingly plays the role as the anchor price for global gas prices.

This increasing integration is also apparent in a convergence of the volatility of gas prices in different markets. As markets open up, shocks in one region are increasingly shared across the world, leading to more similar patterns of variability across markets.



5. Coal

After several years of free-fall, the coal market experienced a mini-revival last year, with both global consumption and production increasing.





Global coal consumption rose by 1%, (25 mtoe), with India (4.8%, 18 Mtoe) recording the fastest growth, as demand both inside and outside of the power sector increased. Interestingly, after three years of successive declines, China's coal consumption (0.5%, 4 Mtoe) also ticked-up. This is despite the substantial coal-to-gas switching in the industrial and residential sectors, as increases in power demand in China sucked in additional coal as the balancing fuel.

World production of coal increased more strongly (3.2%, 105 mtoe), driven by notable increases in both Chinese (3.6%, 56 Mtoe) and US (6.9%, 23 Mtoe) output. Interestingly, the increase in US production came despite a further fall in domestic consumption, with US coal producers instead increasing exports to Asia.

Somewhat counter-intuitively, the increase in Chinese coal production was a result of the on-going measures to reduce excess capacity within the Chinese coal sector. A central part of this reform process has been managing the need for a Goldilocks-type price for coal. Too hot and it would



reduce the pressure for inefficient mines to close or merge, as well as raising general energy costs. Too cold and it would threaten the underlying viability of a sector that still provides around 60% of China's energy.

To help achieve this balancing act, the Chinese authorities at the beginning of 2017 introduced a target band for steam coal prices of 500-570 RMB/metric ton. The Blue area either side of the target band signals increasing attention by the authorities; and the red lines denote just that: the authorities' 'red lines' for domestic coal prices triggering intervention.

The fact that Chinese spot coal prices were above the red line through much of last year spurred a series of policy measures to increase coal supplies and so ease price pressures. The increase in Chinese coal production of over 3.5% last year, its strongest growth for six years, was a direct result of these actions.



Spencer Dale, London, 13 June 2018



6. Power sector

The power sector really matters. It's by far the single biggest market for energy: absorbing over 40% of primary energy last year. And it is at the leading edge of the energy transition, as renewables grow and energy efficiency improves. As I mentioned, this year's Stats Review for the first time includes comprehensive data on the fuel mix within the power sector, aiding our understanding of this key sector.

Global power generation increased by 2.8% in 2017 close to its 10-year average. Almost all that growth came from the developing world. OECD demand edged up slightly, but essentially the decoupling of economic growth and power demand in the OECD seen over the past 10 years continued, with OECD power broadly flat over the past decade. It's worth remembering that, when commentators proclaim that the world is electrifying, power demand in the developed world hasn't grown for the past 10 years.





Oil

2013

Renewables

2017

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The increase in global power generation was driven by strong expansion in renewable energy, led by wind (17%, 163 TWh) and solar (35%, 114 TWh), which accounted for almost half of the total growth in power generation, despite accounting for only 8% of total generation – as I said, punching far above their weight. Although wind continued in its role of the bigger, more established, elder cousin, it was solar energy that made all the waves.

In particular, solar capacity increased by nearly 100 GW last year, with China on its own building by over 50 GW – that is roughly equivalent to the generation potential of more than two-and-a-half Hinkley Points. Global solar generation increased by more than a third last year. Much of this growth continues to be underpinned by policy support. But it has been aided by continuing falls in solar costs, with auction bids of less than 5 cents/KWh – which would have been unthinkable for most projects even just a few years ago – now almost common place. Yes: I know that there is lots of fine print that needs to be read when understanding the true price of these auctions. And I realise that these costs do not cover the systemwide stability issues associated with renewables. But even so, the cost reductions in solar over the past few years are significant.











Standing back from the detail of what happened last year, the most striking – and worrying – chart in the whole of this Stats Review is the trends in the power sector fuel mix over the past 20 years.



Striking: because despite the extraordinary growth in renewables in recent years, and the huge policy efforts to encourage a shift away from coal into cleaner, lower carbon fuels, there has been almost no improvement in the power sector fuel mix over the past 20 years.

The share of coal in the power sector in 1998 was 38% – exactly the same as in 2017 – with the slight edging down in recent years simply reversing the drift up in the early 2000s associated with China's rapid expansion. The share of non-fossil in 2017 is actually a little lower than it was 20 years ago, as the growth of renewables hasn't offset the declining share of nuclear.

I hadn't realised that so little progress had been made until I looked at these data.

Spencer Dale, London, 13 June 2018



Worrying: because the power sector is the single most important source of carbon emissions from energy consumption, accounting for over a third of those emissions in 2017. To have any chance of getting on a path consistent with meeting the Paris climate goals there will need to be significant improvements in the power sector. As I bored many of you during the Energy Outlook, the answer to almost any policy question on how best to reduce carbon emissions from the energy sector over the coming decades is: start with the power sector; then focus on the power sector; and then, if you have any spare policy capacity, push harder in the power sector.

But this is one area where at the global level we haven't even taken one step forward, we have stood still: perfectly still for the past 20 years. This chart should serve as a wake-up call for all of us.

7. Carbon emissions from energy consumption

The backward step in last year's data is most stark in carbon emissions from energy consumption, which are estimated to have increased by 1.6% in 2017. That follows three consecutive years of little or no growth in carbon emissions. So, on the face of it, a pretty big backward step.

The factors driving the pick-up in carbon emissions are of course the same factors that we have just been discussing. Global GDP growth picked up to above trend rates. Much of that growth was driven by industrial activity,



which is more energy hungry, causing gains in energy intensity to slow. And the turnaround in coal consumption, from the substantial falls seen in the previous three years to a small rise last year, meant the improvement in carbon intensity was more muted.



How worried should we be?

Last year when we discussed the exceptional performance seen over the previous three years, I suggested that some of that improvement was likely to be structural and would persist, but that the degree of improvement was probably exaggerated by several cyclical factors, particularly in China. Given that, as those short-run factors unwind – like they have done this year – its' not surprising that carbon emissions increased to some extent.

But the extent of that pickup has probably also been exaggerated by some short-run factors working in the opposite direction. The unusually strong



economic and industrial growth in the OECD, and the extent of the bounce back in power demand in China, which sucked in coal as the balancing fuel.

My guess is that some of the deterioration in 2017 relative to the previous three years will persist, but not all of it.

So a bit worried, but not overly so. Personally, I am more worried by the lack of progress in the power sector over the past 20 years, than by the pickup in carbon emissions last year.

8. Cobalt and lithium

Finally, as I mentioned at the outset, a key challenge for the Stats Review is that it needs to adapt to the changing needs of you, our customers.

One of the questions I am most often asked is whether the available supplies of raw materials used to produce batteries for electric cars could act as a constraint on the speed with which they grow. That question was one of the reasons why we included a new section in this year's Stats Review on 'Key Materials for the Changing Energy System', including data on cobalt and lithium which are used in the production of batteries for electric cars.

In terms of the basic facts.



Lithium production is concentrated in Chile and Australia, with Chile holding the majority of proved reserves. Lithium production increased by almost 50% between 2015 and 2017 as prices more than doubled.

For cobalt, the Democratic Republic of Congo accounts for the vast majority of both production (66%) and proved reserves (49%). Cobalt prices picked up sharply last year as demand increased, but this has not yet fed through into a significant increase in production. The pace of this response may be affected by the fact that cobalt is produced as a by-product of copper and nickel mining and so production depends on price trends in these metals as well.



Lithium and cobalt: production and reserves

The question of whether the availability of either of these metals could act as a constraint on the growth of electric cars deserves a whole presentation on its own.

The short answer is that if either metal is likely to pose a bottleneck, it appears most likely to be cobalt. The announced expansion plans for Lithium production look sufficient to ensure ample supplies for the next 10



or 15 years. In contrast, the geographical concentration of reserves, together with the nature of its production process, means this is less clear for cobalt. But the new wave of battery technologies now being developed requires less cobalt. So rather than act as a constraint on the growth of electric vehicles, the availability of cobalt could simply provide further momentum to this technological change. Watch this space.

9. Conclusion

Global energy markets in 2017 took a backward step in terms of the transition to a lower carbon energy system: growth in energy demand, coal consumption and carbon emissions all increased. But that should be seen in the context of the exceptional outcomes recorded in the previous three years. Some backsliding was almost inevitable.

The road to meeting the Paris climate goals is likely to be long and challenging, with many twists and turns, forward lurches and backward stumbles. To navigate our progress will require timely, comprehensive and relevant data.

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