TRUSTED SOURCES
Emerging Markets Research & Consulting

New Energy
Energy demand

Analysts

Kingsmill Bond
New Energy Analyst
+44 20 3653 0634
kxb@trustedsources.co.uk

Stephen O'Sullivan
Managing Director, China Energy Research
+44 20 7183 5280
sos@trustedsources.co.uk

For more information please contact Sales:

sales@trustedsources.co.uk
+44 20 7183 5280

19 Apr 2016

Consensus energy forecasts: Why they are wrong

The forecast growth of renewables is massively understated

Consensus forecasts of global energy supply and demand have a weak track record, show an obvious bias and make assumptions about future energy demand and renewables supply that are not credible. They imply that fossil fuel demand will keep on rising for another generation or more. In reality, at current growth rates, fossil fuel demand will peak by 2020.

Key judgments

- **Consensus solar and wind growth forecasts are too low.** Consensus uses costs that are backward-looking and hence underestimates solar and wind supply growth, forecasting just 7-9 per cent a year. In 2014 actual supply growth was 15 per cent, capacity growth in 2015 was 19 per cent, and is likely to be 19 per cent this year.
- **Consensus energy demand growth is too high.** Consensus expects future demand growth of energy of more than 1 per cent per annum, which is high, given that two-thirds of global energy demand comes from the OECD, where consumption is falling, and China, where it is stagnant.
- **Consensus is naive on the politics.** The consensus view sees rising carbon dioxide production and ever greater oil imports by China and India. Given COP21, local desires to reduce pollution and the need to reduce oil import dependency, we expect more policy action to reduce fossil fuel demand.
- **The end is nigh.** Taking all these favourable assumptions into account means that consensus expects fossil fuel demand to carry on rising for a generation. More realistic assumptions imply that it will perhaps start to fall by the end of this decade. The tipping point is, in our view, very close – possibly as soon as 2020.

Important information: Please see last page of this report for all disclaimer/disclosure information

Consensus energy forecasts

Who makes up consensus?

Most forecasters look at individual aspects of the energy markets. So they forecast either oil supply and demand or coal demand or gas supply, for example. There are relatively few who forecast energy demand as a whole. However, because of the fungibility of energy and the ability of renewables to compete in a growing number of areas across the energy complex, we believe it is necessary to look at energy as a whole. We thereby get a holistic understanding of change.

The IEA and BP are the key sources of consensus views on future energy demand

Judging by which organizations are most frequently cited in energy projections, the consensus view on overall energy demand and supply is largely formed by the IEA and BP. BP publishes just one scenario, but the IEA publishes three – 'Current Policies', 'New Policies' and '450' (the scenario needed to keep global warming to 2 degrees Celsius). We focus on the IEA's 'New Policies' scenario, which is its central one, but include the other two as they help to set the context for thinking about energy demand.

We also consider published views on global energy demand from Shell (the continuity scenario, called 'Mountains'), Statoil (the COP21 scenario, called 'Reform'), Exxon, and Greenpeace (the change scenario, called 'Revolution'). These views differ quite widely from the consensus view set out by the IEA and BP and we do not believe that they are widely used by financial markets. We draw attention to them here to show the range of opinion on the future of energy demand.

What are consensus views?

We summarise disparate views as far as possible

We divide supply into three subcomponents: solar and wind supply; supply of slow-growing non-fossil fuels (nuclear, hydro, biomass); and supply of fossil fuels. In 2015 solar and wind supplied 2 per cent of global energy, fossil fuels 86 per cent and the rest 12 per cent. Solar and wind have been growing at around 20 per cent per annum, slow-growth non-fossil fuels at 2 per cent and fossil fuels at whatever is left (0.5 per cent in 2014).

We take the most recent publications of the relevant organizations, simplify them as much as we can (which requires some assumptions on our part), and summarize the results below. Each organization uses a slightly different methodology, different start and end dates for its forecasts, different units and so on. Nevertheless, a very clear pattern emerges, which we seek to draw out. Some organizations have multiple scenarios; but in order to reduce complexity, we select the one that appears to be central.

Our core contention is that consensus overstates likely energy demand growth and understates the growth of solar and wind energy. As a result, the expected demand for fossil fuels is significantly overstated. We also believe that even the IEA's '450' scenario is too conservative with regard to the growth of renewables.

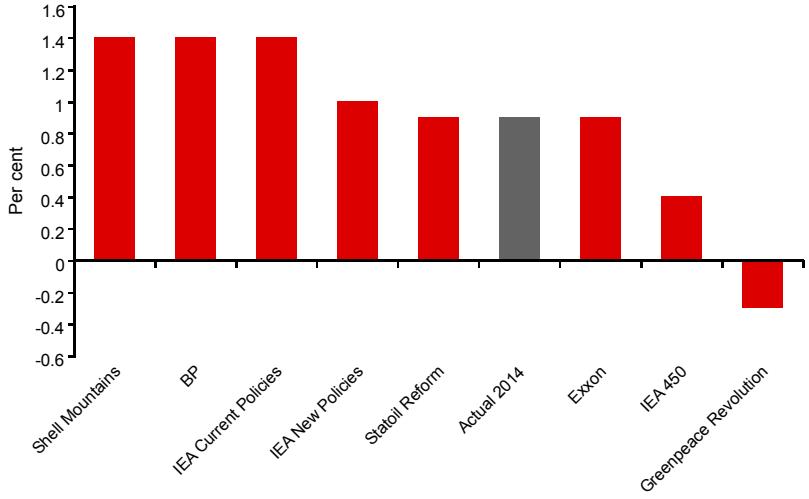
Total energy demand

Consensus demand growth is 1-1.4 per cent CAGR

The IEA and BP expect total energy demand to grow annually by 1 per cent and 1.4 per cent, respectively, for the next 20-25 years.

There is a fairly wide range of forecasts around these projections – from Shell's 'Mountains scenario', which forecasts 1.4 per cent annual energy demand growth to Greenpeace's 'Revolution' scenario, which forecasts a 0.3 per cent annual decline in global energy demand.

Chart 1: CAGR of total energy demand, 2014-40



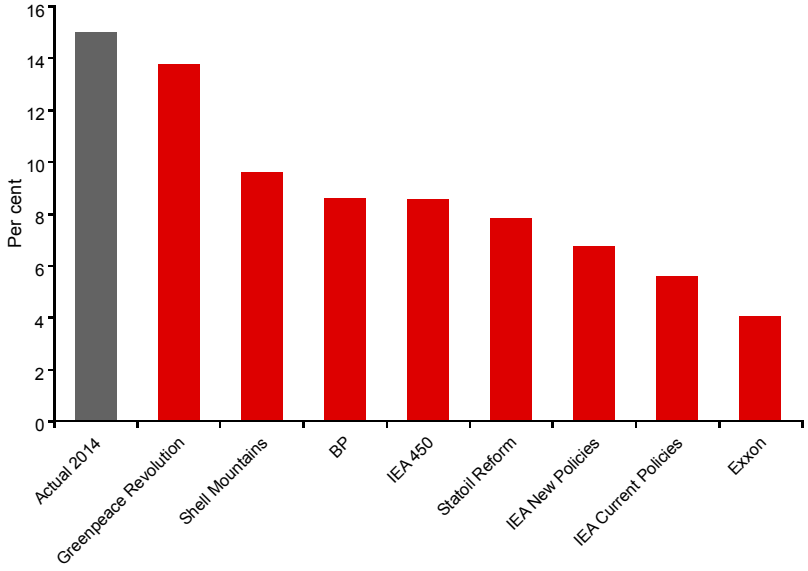
Sources: BP, Shell, IEA, Exxon, Statoil, Greenpeace.

Solar and wind supply

Consensus solar and wind supply growth is 7-9 per cent CAGR

The IEA and BP forecast solar and wind supply growth of 7-9 per cent a year over the next 20-25 years. Other forecasters make higher projections, led by the Greenpeace 'Revolution' and Shell 'Oceans' scenario, which expect 14 per cent growth. Actual growth of solar and wind generation in 2014 was 15 per cent. Capacity growth was 19 per cent in 2015, and is likely to be around 19 per cent this year.

Chart 2: CAGR of solar and wind supply, 2014-40



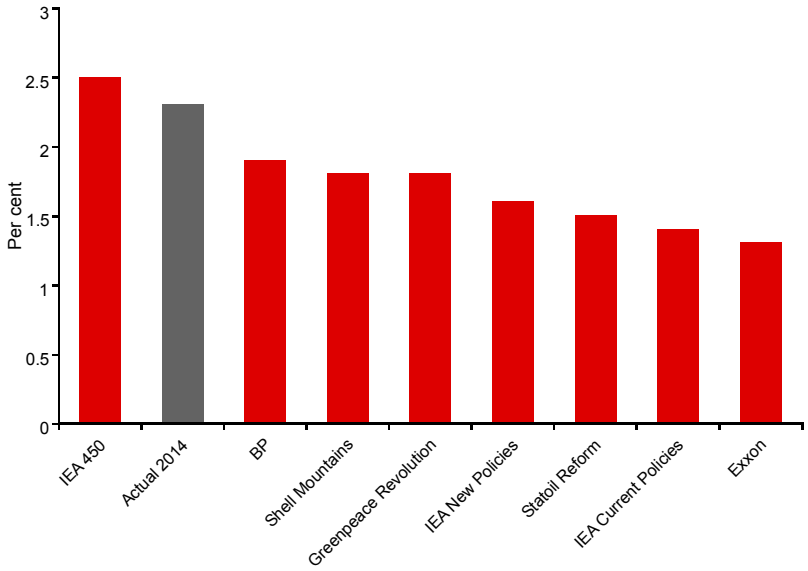
Sources: BP, Shell, IEA, Exxon, Statoil, Greenpeace.

Other non-fossil supply

Consensus growth estimates for non-fossil supply is just under 2 per cent

There is a reasonable degree of agreement on the growth of other non-fossil sources of supply – nuclear, hydro and biomass. IEA sees them growing at 1.6 per cent a year and BP at 1.9 per cent. What characterizes all these technologies is that they are relatively developed and slow-growing.

Chart 3: CAGR of Nuclear, hydro and biomass supply, 2014-40



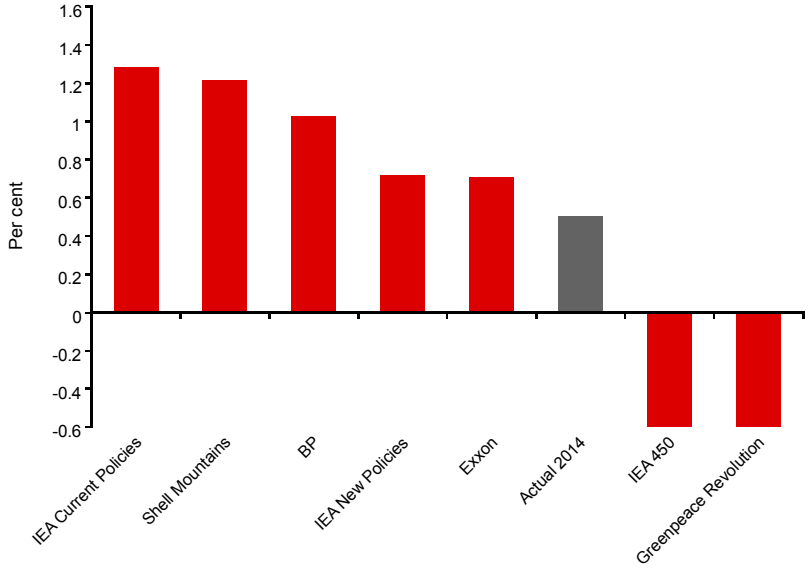
Sources: BP, Shell, IEA, Exxon, Statoil, Greenpeace.

Fossil fuel supply

Fossil fuel supply is the residual: forecast CAGR is around 1 per cent

As noted above, we see fossil fuel supply as the residual between global demand growth and the supply of energy from other sources. In light of the relatively bullish energy demand growth numbers and bearish renewables supply growth numbers, it is not surprising that the consensus sees plenty of room for fossil fuel supply growth. The IEA forecasts 0.7 per cent growth and BP 1 per cent growth in the period to 2040. In 2014 actual fossil fuel supply growth was just 0.5 per cent.

Chart 4: CAGR of fossil fuel supply, 2014-40



Sources: BP, Shell, IEA, Exxon, Statoil, Greenpeace.

The tipping point

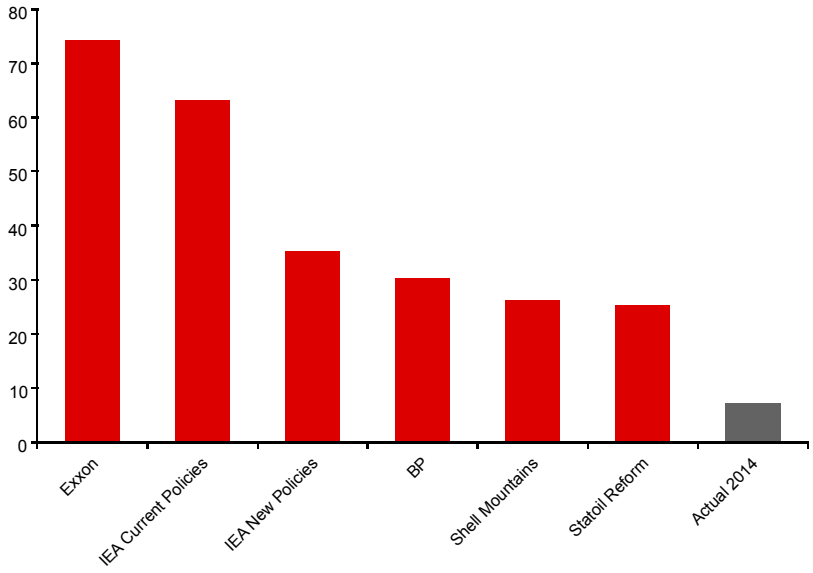
The consensus view is that the tipping point is at least a generation away

Two key assumptions – on total energy demand growth and on the growth of solar and wind – enable us to calculate when we will see the point at which renewables make up all of the increase in global energy supply and fossil fuel supply starts to fall. We call this the tipping point.

Under the assumptions of most of the forecasts, we are at least a generation away from this tipping point. However, if current growth numbers are maintained, we will reach the tipping point by around 2020.

We take the core assumptions on energy demand growth and the growth of renewables from the relevant organizations for the next 25 years in order to calculate the implied number of years until this tipping point. This date may, of course, differ from the unpublished forecasts of the relevant players. Nonetheless, this methodology gives a good sense of how far away the consensus thinks the tipping point is.

Chart 5: Implied number of years until tipping point



Sources:TS estimates, Shell, Statoil, BP, IEA, Exxon.

Why does this matter?

The wrong assumption about rising fossil fuel demand has major consequences for markets

The reason why we focus on total fossil fuel demand is because equity markets implicitly assume that fossil fuel demand will rise. The oil market forward curve is upward sloping, while talk is of the bounce-back in oil prices associated with the cut in capex and so on.

All of this is justified in a world where fossil fuel demand will continue to rise for another generation. However, we believe that this assumption is incorrect. As we lay out in detail in a separate note, titled 'Fossil fuels: The beginning of the end', we believe that fossil fuel demand will peak by around 2020.

Over long periods, there is a certain amount of fungibility for fossil fuels. Coal can substitute gas in the production of electricity, gas can substitute oil in some areas of transport and petrochemicals and so on. The wider diffusion of the electric car would, of course, open up the transport sector to competition from other fossil fuels and renewables.

We believe that by the end of the decade, the various fossil fuels will be locked in a Darwinian struggle for demand. This will put constant downward pressure on price and shape a very different world for the fossil fuel companies. No longer will they be able to rely on a return to scarcity pricing and marginal costs. They themselves will be engaged in constant rounds of cost cutting and falling margins.

Problems with consensus estimates

We split our critique of the consensus view into three parts: generic problems with the methodology, specific areas of concern, and general inconsistencies. Generic problems include the natural bias of the forecasters, the general difficulty of forecasting energy demand and the weak track record of forecasters, especially in renewables.

The natural bias of consensus views

Consensus on energy is formed by the fossil fuel sector, which has obvious consequences.

Asking oil companies for a view on future oil demand is a little like asking gold miners for a view on future gold prices. You know in advance that the view is going to be bullish.

It is, of course, axiomatic in academic literature that the last people to see change coming are the incumbent operators. So it was that IBM failed to spot the rise of the personal computer, the electricity companies dismissed renewable energy out of hand a decade ago and car companies sought to squash the electric vehicle. Because incumbents have such detailed knowledge of their technology and are so deeply aware of the limitations of challenger technologies, they fail to recognize the ability of new technologies to drive down prices so fast that they become accepted.

If it is relatively easy to dismiss the views of oil companies as inherently biased, then what about those of the IEA – the organization most frequently cited in forecasts of energy demand? The IEA was set up in 1973 in order to protect the interests of oil-consuming countries and to stop them from being at the mercy of OPEC. A key mandate, therefore, is to ensure that the world does not get into a major oil supply deficit, implying an obvious bias towards forecasts of higher demand for energy.

Moreover, the fact that the IEA makes forecasts on the growth of renewables does not mean that this is its core area of expertise. It would be natural for the inherent assumptions of the fossil fuel sector to have an influence on IEA thinking.

Why it is inherently hard to forecast energy demand

Forecasting long-term energy demand is not easy, in any event. We see three inherent weaknesses in these long-range energy-demand forecasts:

- It is almost impossible to forecast innovation effectively. The industry tends to extrapolate current trends, while the history of energy suggests that energy systems are always changing.
- Energy prices have been extremely hard to forecast. Few forecasters foresaw the massive increase in oil prices after 2001 or the collapse over the last 18 months.
- Most big-picture energy models are overly complex. Complexity is vital when seekinging to understand detail but counterproductive when forecasting the big picture over the long term. The more complex the model, the more likely it reflects the inherent biases of the many experts putting it together.

The track record of consensus forecasts for energy and oil

Forecasts of energy demand have been weak

As is widely appreciated, consensus forecasts for energy demand have a very poor track record. According to the prolific energy historian and analyst Professor Vaclav Smil, the average forecast during the period 1960-80 for US total energy demand for the year 2000 was 80 per cent higher than actual demand.

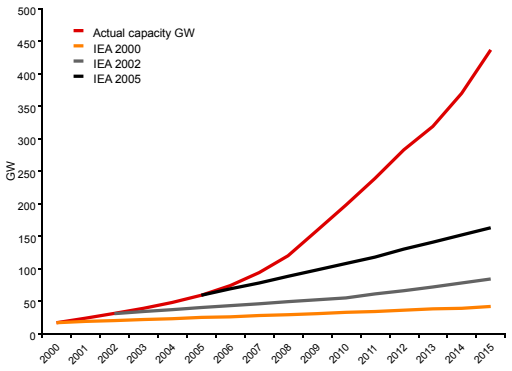
In the 1990s, too, forecasters expected much higher demand for oil than in fact has materialized. In 2000, for example, the IEA forecast in its WEO that oil demand would reach 116 mbpd in 2020. Its latest forecast, made in 2015, is for 98 mbpd of demand in 2020. The gap is not much more than the combined annual output of Russia and Saudi Arabia.

The track record of consensus forecasts for renewables

. . . and those for renewable energy especially weak

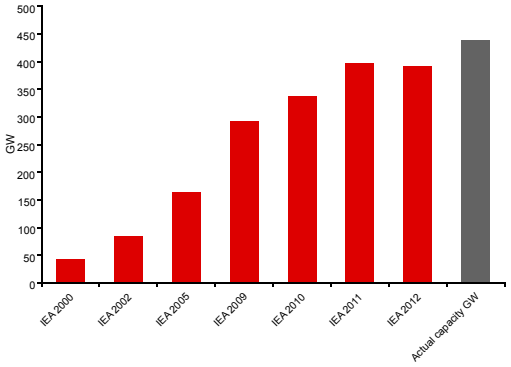
The track record of the IEA (and the oil companies) in their forecasts for the growth of renewables is so poor as to merit its own separate analysis. Charts 5 and 6 below show the IEA forecasts for solar and wind capacity against actual numbers, using data highlighted by Greenpeace.

Chart 6: IEA forecasts for wind capacity versus actual GW



Sources: IEA, Greenpeace.

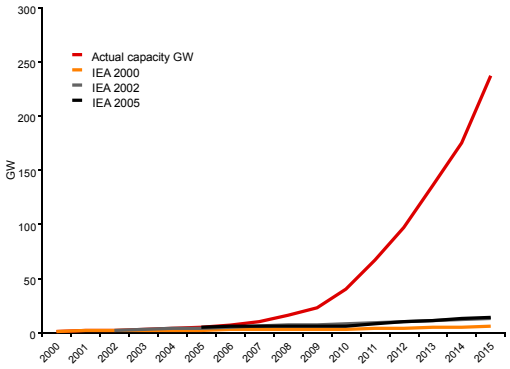
Chart 7: IEA forecasts for wind capacity GW in 2015



Source: IEA.

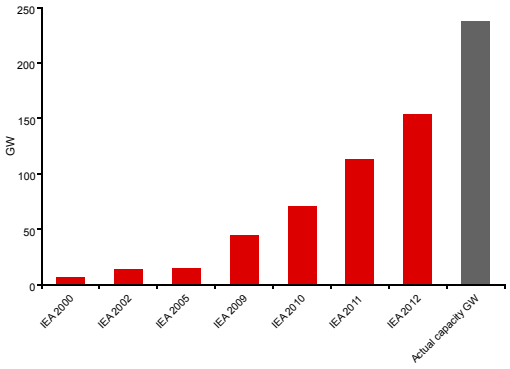
Even in recent years, the IEA has been incorrect in its forecasts of wind and solar supply. If we take the forecast for 2015 capacity, for example, we see that even as recently as 2012 (when many projects were apparent) projections were still significantly too low.

Chart 8: IEA forecasts for solar capacity versus actual GW



Sources: IEA, Greenpeace.

Chart 9: IEA forecasts for solar capacity GW in 2015



Source: IEA.

Specific forecast issues

We approach the issue of energy forecasts with considerable humility. Teams of dozens of energy analysts with decades of experience have created highly complex models that underlie the forecasts that the market uses today. However, it is the function of the financial markets to make up their own minds, regardless of accepted wisdom, the world is changing fast, and old models may no longer be valid. And it is in this spirit that we believe we can make some valid observations.

We believe that the consensus forecasts significantly underestimate the speed of solar and wind growth and are too optimistic about overall energy demand growth. We set out our own assumptions on the key variables in a separate piece, 'Fossil fuels: the beginning of the end.'

The growth of solar and wind

As we have already seen, the consensus is that energy produced from solar and wind sources will grow at 7-9 per cent per annum. As the IEA publishes the most detailed data on this forecast, we single out some of the assumptions that it makes on costs and growth.

Costs

The IEA uses cost data that are too high . . .

In the WEO 2015, the IEA uses cost data which we believe are too high. There are two reasons for this:

- The IEA uses relatively old data on costs. For example, in the WEO 2015 the IEA quotes data from 2014 for newbuild technologies implying that the cost of new solar (both household and utility) is US$250 per MWh and that of wind US$100 per MWh. However, costs are falling rapidly and it is key to stay up to date. As set out in detail by organizations such as Lazard or IRENA, the cost of new solar and wind is now far lower than the IEA figures suggest. For example, in its November 2015 levelized cost of energy (LCOE) study, Lazard estimates the cost of utility solar in the US at US$58 to US$70 per MWh and of wind at US$32 to US$77 per MWh. (We will address this issue in detail in a separate piece.)

- The IEA assumes that costs fall with the speed of deployment but then underestimates the speed of deployment. Consequently, it ends up with a relatively low reduction in costs. For example, the data in the WEO imply a CAGR of cost declines over the period to 2040 of 1 per cent a year in wind and 4 per cent a year in solar. Standardized data from Lazard over the period 2009-15 show that the actual annual fall in wind costs in the US has been 14 per cent and that of solar has been 25 per cent.

As a result, the IEA argues that the renewables industry will still need subsidy in 2040. It forecasts new solar subsidy of US$50 per MWh in 2040 and new wind subsidy of around US$20 in 2040. Given that costs of solar and wind continue to fall rapidly, it seems highly unlikely that they will still be getting subsidy for new build in 25 years' time. On the contrary, we expect solar and wind costs to drive down the prices of fossil fuels in the future.

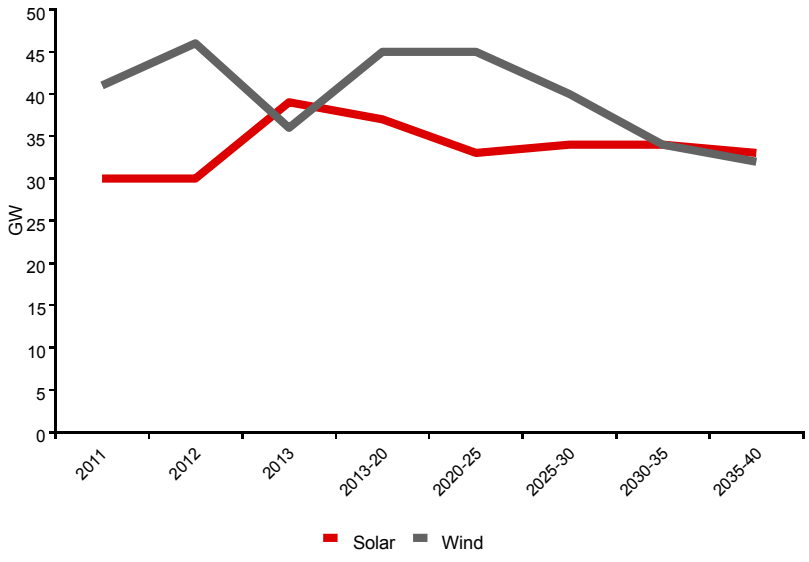
Growth

. . . and has forecasts for growth in renewables that are clearly too low

The IEA forecasts for the growth in renewable supply are clearly out of date and out of line with what is happening in the market.

In the 2015 WEO, the IEA forecasts an average annual capacity addition of 37 GW for solar and 45 GW for wind during the period 2013-20. And it expects this capacity addition to fall over time.

Chart 10: Annual capacity additions



Source: IEA.

We believe that this prediction is overly conservative:

- Capacity additions of solar and wind in 2015 (according to the latest data from IRENA) were 47 GW and 64 GW, respectively, which is already considerably higher than the expected average for the next five years.
- The solar and wind industries already anticipate rising supply for the next few years and are tooling up to provide it. Hardly a month goes by without one of the Chinese solar panel manufacturers announcing expansion plans.
- Global solar and wind capacity has been recording high growth rates for years.

- COP21 provides an extra impetus to governments to move their power generation sectors towards renewables.
- Costs continue to fall. All things being equal, a 5 per cent fall in costs would lead to a 5 per cent increase in deployment.

Historical context for the growth of new energy sources

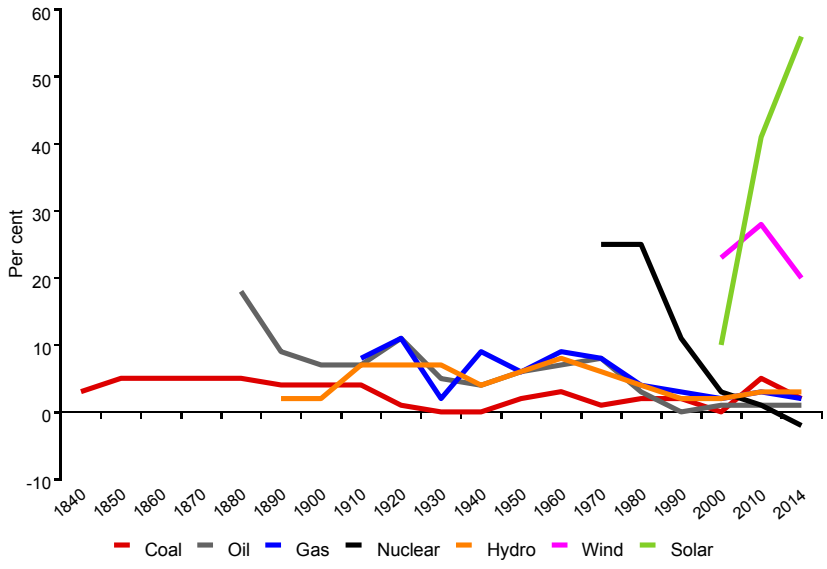
Consensus misreads energy history: renewables are not the same as fossil fuels

In the recent BP long-term energy presentation, it was stated by Spencer Dale, BP's chief economist, that the company had forecast very high levels of growth for solar and wind in the context of energy history. The implication was that it was already being generous and no larger growth forecast was needed.

Although we plan to address this issue in more detail in a note on energy history, it seems relevant to review here why we believe that this framework for thinking is incorrect. The growth of solar and wind is not the same as the growth of fossil fuels for the following reasons:

- Fossil fuels can be extracted in only a small number of locations. Renewables technologies can be deployed in almost all countries.
- The world has moved on a bit since the 1920s. Innovations that work in one location can rapidly be copied.
- Renewables are a technology, not a commodity. Their price can therefore continue to fall, driving penetration still higher.
- The issue of size is not relevant in this context as the global economy and population are much larger than a century ago.
- The growth in the supply of solar and wind energy is already much faster than that enjoyed by fossil fuels in their period of rapid growth. Chart 11 below shows the compound annual growth rate over each decade since historical records began as well as the four years 2010 to 2014 to illustrate this.

Chart 11: CAGR of energy production by technology



Sources: Rembrandt, Smil, BP.

Total energy demand growth

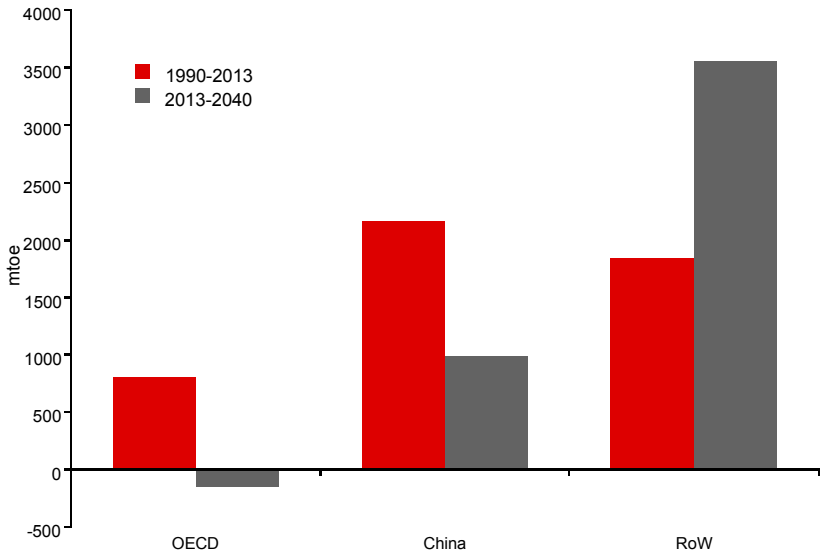
Consensus forecasts for total energy demand growth are relatively high

There are many assumptions that go into global energy demand growth forecasts. In its excellent piece on this issue titled 'Lost in transition', published in 2015, Carbon Tracker notes that for most of these forecasts, the view of the IEA and BP is a relatively positive one so far as energy demand is concerned. Population growth estimates are relatively high (0.9 per cent per annum), real GDP per capita growth estimates are high (2.5 per cent per annum) and efficiency gains are relatively low (2 per cent to 2.4 per cent per annum) in light of COP21 commitments. Global energy demand growth would be lower in the event that global GDP growth is less than 3.4 per cent or efficiency gains are higher than 2.4 per cent.

Moreover, it is difficult to get to a total energy demand growth forecast of more than 1 per cent in a world where OECD demand is falling and Chinese demand is stagnant. In 2013, for example, the OECD made up 39 per cent of global energy demand and China 22 per cent. China accounted for 45 per cent of the growth in total energy demand from 1990 to 2013, but energy demand growth has since slowed there to around 1 per cent.

We illustrate this with data from the IEA 'New Policies' view on the sources of growth for global energy demand, contrasting the period 1990-2013 with 2013-40. In the IEA forecasts, the burden of growth in energy demand falls upon the rest of the world. This is precisely the region that is poorest and most lacking in energy supply and it is located predominantly in the sunnier parts of the world – in Africa, India and Southeast Asia. And therefore it is the region that will be most inclined to buy renewable energy if it is cheaper than fossil fuels on a fully costed basis.

Chart 12: Increase in global energy demand



Source: IEA WEO 2015.

Other inconsistencies

There are a number of other inconsistencies that are not necessarily apparent at the level of granular forecasting but are clearer from a wider perspective.

The forecasts assume that the world produces more carbon dioxide than is consistent with two degrees of global warming; that China and India will be subject to high dependency on foreign imports of oil; and that China and India are prepared to tolerate more pollution in their already polluted cities.

What this means in practice is that the current linear forecasts are likely to run up against increasingly prescriptive government regulation to seek to reduce the use of fossil fuels. Official forecasters may be unable to incorporate this type of change into their models, but financials markets will.

Carbon dioxide production

Forecast fossil fuel demand growth is incompatible with measures to cut production of carbon dioxide

There is a clear inconsistency between energy demand forecasts and carbon targets.

Under the IEA New Policies scenario, carbon dioxide production in 2040 would be 37 Gt, versus 32 Gt today. Under the BP scenario it would be 38 Gt.

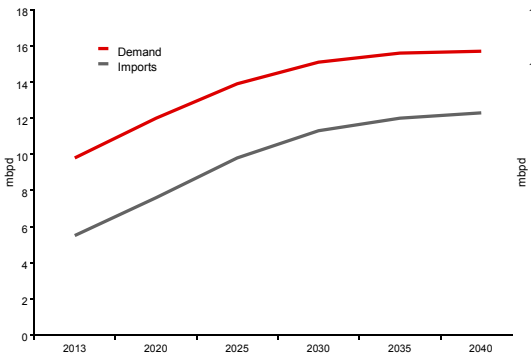
However, for the world to be able to keep warming at under 2 degrees by 2040, the IEA 450 scenario implies that by 2040 carbon dioxide production needs to be 19 Gt. This implies a reduction in demand for fossil fuels of over 40 per cent.

Geopolitics

Forecasts assume that India and China will become ever more dependent on oil imports . . .

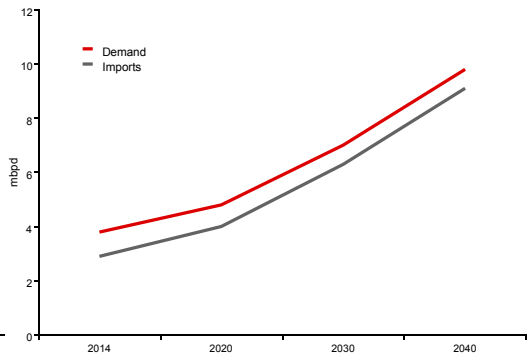
The IEA view on oil imports into China and India assumes that by 2040 China will be importing 78 per cent of its oil and India 93 per cent, as demand and imports grow rapidly.

Chart 13: China oil demand and imports



Source: IEA.

Chart 14: India oil demand and imports



Source: IEA.

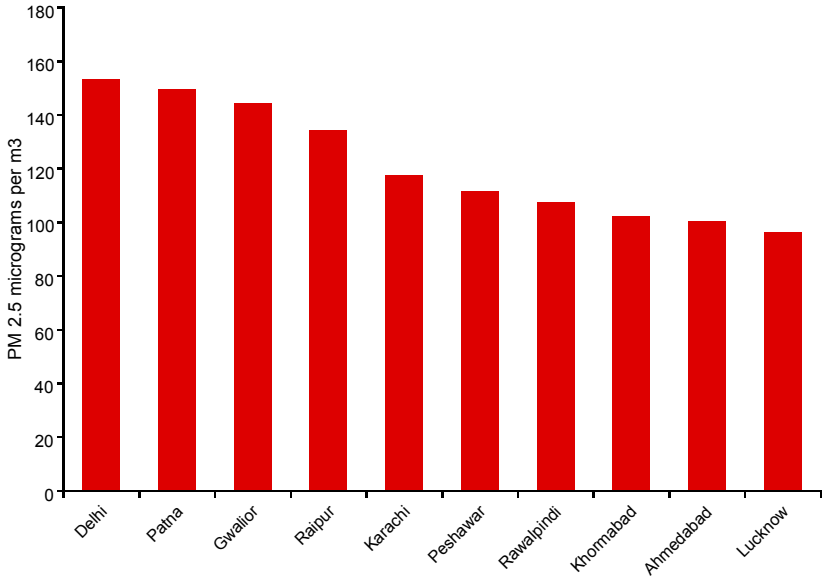
However, such a degree of exposure to oil imports, mainly using sea routes controlled ultimately by the US Navy, is incommensurate with a desire to enjoy foreign policy autonomy.

Pollution

. . . and their cities will become even more polluted

India and China already have some of the most polluted cities in the world. The WEF published data on the world's most polluted cities in 2015. Six of them are in India.

Chart 15: The world's most polluted cities

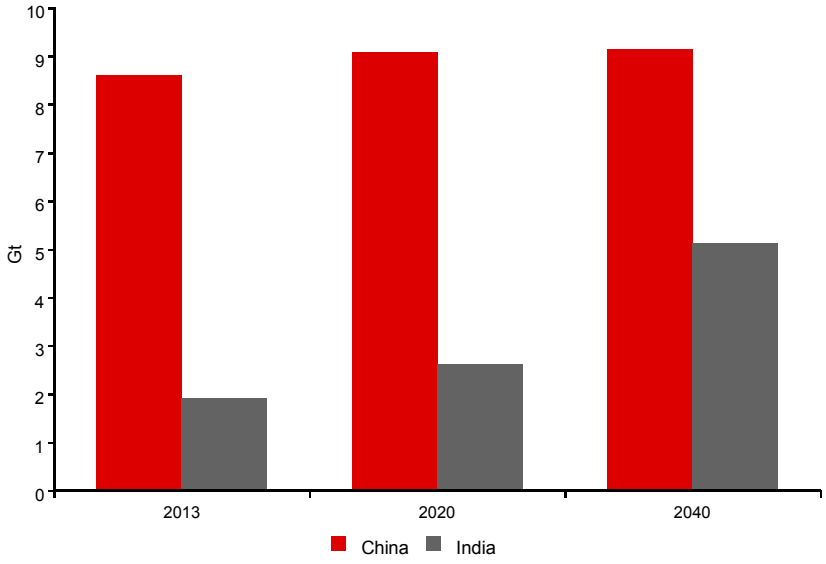


Source: WEF 2015.

Meanwhile, the desire for clean air is an increasingly important policy issue for China.

Under the 'New Policies' scenario, the IEA assumes that Chinese carbon dioxide production will continues to rise and that production in India will almost triple. We believe that these forecasts will increasingly run up against policy action.

Chart 16: China and India C02 emissions



Source: IEA.

Recent TS Research

Brazil

8 Apr 2016	Brazil: A government up for sale
1 Apr 2016	Brazil: Dilma tries to buy more time
24 Mar 2016	Brazil: No sign of relief for the embattled Dilma administration

Russia

13 Apr 2016	Oil price outlook: Russian perspectives on the 'OPEC-plus' meeting in Doha
4 Apr 2016	UPDATE/ European gas market: Oil-price recovery threat to Gazprom's price war
31 Mar 2016	Russia privatization: Fiscal fear is a powerful motivator

India

23 Mar 2016	India: On the road in Delhi and Mumbai - A political - economic divide emerges
17 Mar 2016	India Monitor: Competitive federalism paves way for investment reform
1 Mar 2016	India:Budget solid on macroeconomic stability but only incremental on reform

China

11 Apr 2016	China: How so many got the RMB wrong
8 Apr 2016	The 'Thucydides Trap' looms in East Asia
4 Apr 2016	On the road in Wuhan: Central China is booming, for now

S.E. Asia

15 Apr 2016	On the road in Indonesia
29 Mar 2016	On the road in Thailand

EM Macro Strategy

14 Apr 2016	FX Scorecard
7 Apr 2016	Brazil: A protracted exit for Dilma favours local debt
1 Apr 2016	EM Strategy Monthly - April 2016

Reform Watch

17 Feb 2016	China Reform Agenda Mark Two: Don't run before you can walk
14 Dec 2015	Reform Watch: Reform Barometer: Politics trump reform in emerging markets
30 Nov 2015	India Reform Watch: Goods and Service Tax still hostage to politics

Trusted Sources Disclosure Statement

Please read this important disclosure statement which includes our disclaimer and copyright status

The analysis and information presented in this report (**Report**) by Trusted Sources UK Limited (**TS**) may include summary profiles of key companies in the relevant sector and the information is offered for subscriber interest only. This Report is not to be used or considered as a recommendation to buy, hold or sell any securities or other financial instruments and does not constitute an investment recommendation or investment advice.

The information contained in this Report has been compiled by TS from various public and industry sources that we believe to be reliable; no representation or warranty, expressed or implied is made by TS, its affiliates or any other person as to the accuracy or completeness of the information. TS is not responsible for any errors in or omissions to such information, or for any consequences that may result from the use of such information. Such information is provided with the expectation that it will be read as part of a wider investment analysis and this Report should not be relied upon on a stand-alone basis. Past performance should not be taken as an indication or guarantee of future performance; we make no representation or warranty regarding future performance. The opinions expressed in this Report reflect the judgment of TS as of the date hereof and are subject to change without notice.

This Report is not an offer to sell or a solicitation of an offer to buy any securities. The offer and sale of securities are regulated generally in various jurisdictions, particularly the manner in which securities may be offered and sold to residents of a particular country or jurisdiction. Securities referenced in this Report may not be eligible for sale in some jurisdictions. To the fullest extent provided by law, neither TS nor any of its affiliates, nor any other person accepts any liability whatsoever for any direct or consequential loss, including without limitation, lost profits arising from any use of this Report or the information contained herein.

No director, officer or employee of TS is on the board of directors of any company referenced herein and no one at any such referenced company is on the board of directors of TS. TS does not invest in any securities although it is possible that one or more of TS's directors, officers, employees or consultants may at times be invested in the securities of a referenced company.

TS is not authorised or regulated in the United Kingdom by the Financial Services Authority or by any other regulator in any jurisdiction for the provision of investment advice. Specific professional financial and investment advice should be sought from your stockbroker, bank manager, solicitor, accountant or other independent professional adviser authorised pursuant to the Financial Services and Markets Act 2000 if you are resident in the United Kingdom or, if not, another appropriately qualified independent financial adviser who specialises in advising on the acquisition of shares and other securities before any investment is undertaken.

Contact us

Trusted Sources UK Limited

London +44 20 7183 5280
Hong Kong +852 2534 7426 (IND-X Advisors)
info@trustedsources.co.uk **www.trustedsources.co.uk**