

BP Energy Outlook 2030

By Christof Rühl and Joseph Giljum*

Introduction

The outlook for global energy is not just a matter for energy companies: it is an issue for all of us. As consumers, investors, producers and policy-makers we all face difficult choices regarding the future of energy. Our Energy Outlook¹ seeks to contribute to this debate by assessing future energy trends “to the best of our knowledge” - not as an exercise in trend extrapolation, and not based on anyone’s political agenda. The resulting outlook examines three major areas: (1) energy trends that are likely to shape the world for the next 20 years (2) oil, gas, coal, and power markets and (3) variables of uncertainty that could alter the outlook.

Global energy trends

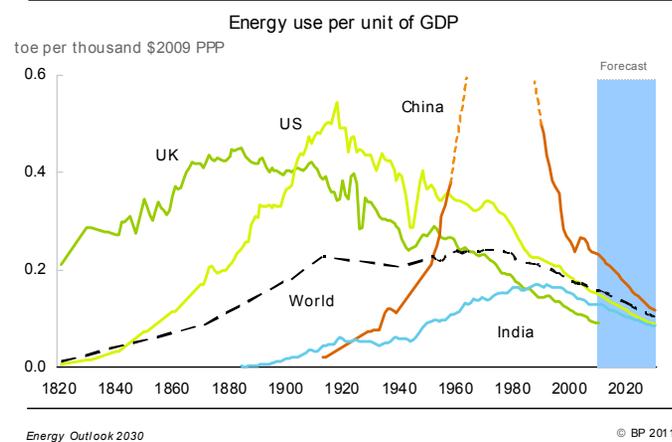
Overall, population and income growth are the two most powerful driving forces behind the demand for energy. The world we live in today is a one where about 80% of the population generates around 35% of global GDP and uses for that 54% of global energy. That share and absolute use of energy is set to increase, prompting the fundamental question – can the world fuel itself? One side argues that human ingenuity and markets will provide the supply necessary to fuel economic growth, while another believes that resource constraints will limit emerging market industrialization. To help address this fundamental question it will be helpful to look at the past to better understand the evolution of energy markets in the future.

Historical trends of energy intensity and industrial development show a common pattern: as countries industrialise, energy intensity tends to rise and then fall, with the peak in intensity usually coinciding with a peak in the share of the industrial sector in GDP. Furthermore, the level of the peak can be explained: first, the peak tends to be lower the later countries industrialise – as better technology makes possible the production of similar GDP levels with lower energy input. Second, resource abundance tends to create higher peaks (for example, the U.S. peaked at a higher level than the UK, although it industrialised later) because abundance leads to lower prices and provides fewer incentives to improve efficiency. Finally, the economic system matters: countries which industrialised under central planning (e.g., China or Russia) tend to exhibit very high energy intensity, as market signals were excluded from resource allocation. The improvement, once markets are allowed to function, is dramatic.

How do these trends assist in answering the fundamental question of whether there will be enough fuel for continued industrialisation and economic development? What the data show is an accelerating process of convergence across countries toward lower and lower levels of energy intensity. At a global level, energy intensity peaked in 1970 and efficiency has risen ever since. However, since the dissolution of central planning in the 1990s, which ushered in the unprecedented pace of industrialisation in the “developing” world, that convergence to lower levels of energy intensity has become more prevalent. This reflects “globalisation”: energy traded across borders, common use of the latest technologies, and an equalisation of consumption baskets across nations. In addition to this convergence, history reveals another long term trend: fuel substitution and with it, a greater diversification of the fuel mix. These are two critical trends that we believe are likely to carry forward – energy efficiency will continue to improve at a global level, together with an increasingly diversified fuel mix. This means that economic growth over the next 20 years is likely to continue to be more energy efficient than in the past, but also that the world will be using a growing variety of energy sources, and continue to diversify away from fossil fuels.

Even though efficiency improves, total energy demand is set to rise as consumption shifts from West to East. As developing nations industrialize, urbanize, build infrastructure, and increase their use of transportation, the rapid growth in

Historical trends and patterns of development



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demand witnessed in the non-OECD over the past 20 years is set to continue. World primary energy consumption grew by 45% over the past 20 years, and is likely to grow by another 39% over the next 20 years. Non-OECD energy consumption will be 68% higher by 2030 and accounts for 93% of global energy growth. OECD energy consumption in 2030 is just 6% higher than today.

The overall fuel mix changes relatively slowly, due to long asset lifetimes, but gas and non-fossil fuels gain at the expense of oil and gas. Over the coming 20

years the market share of the three main fossil fuels appears set to converge at around 27%, while the three non-fossil fuels reach around 7% each, indicating an important shift away from fossil fuels. For the first time ever, non-fossil fuels are likely to make the single biggest contribution to energy consumption growth, as fossil fuels' share of energy growth drops from 83% in 1990-2010 to 64% in 2010-2030.

Nevertheless, the implications for climate change policies are sobering. Overall, we expect CO₂ emissions to rise by 27%, with an average annual growth rate of 1.2% (compared to 1.9% for the past two decades). CO₂ emissions in the OECD fall by about 10%, but a 50% rise in the non-OECD more than compensates. There is a silver lining though: from 2010-2020, non-OECD emissions growth averages 5%, but then slows to almost 1% for 2020-2030. Although implying progress, it clearly is not enough to put

the world on the path the scientific community considers necessary to limit temperature rises.

Oil

Oil is expected to be the slowest-growing fuel over the next 20 years. Global liquids demand (oil, biofuels, and other liquids) is likely to rise by 16.5 Mb/d, exceeding 102 Mb/d by 2030. Growth comes exclusively from rapidly-growing non-OECD economies, with non-OECD Asia accounting for more than three-quarters of the net global increase. OECD demand in our view peaked in 2005, and consumption is expected to decline over the next 20 years. Overall, OECD consumption is predicted to fall back to its 1990 level, while non-OECD consumption is projected to more than double from its 1990 levels, overtaking the OECD by 2015.

By sector, liquids demand growth is driven by non-OECD transport, with a smaller role for non-OECD industry (largely petrochemicals). Expected OECD declines are concentrated outside the transport sector, in sectors where oil can be displaced by gas and renewables, but OECD transport demand is expected to fall post 2015, as technology and policy lead to improved engine efficiency.

75% of supply growth will need to come from OPEC. An increase of 13 Mb/d over the coming 20 years (mostly accounted for by NGLs and conventional crude in Iraq and Saudi Arabia) would put OPEC's share of global oil production back to levels last reached in the early 1970s. Non-OPEC supply will also rise, driven by a large increase in biofuels and smaller increments from Canadian oil sands, deepwater Brazil, and the FSU which should offset declining conventional production in mature provinces.

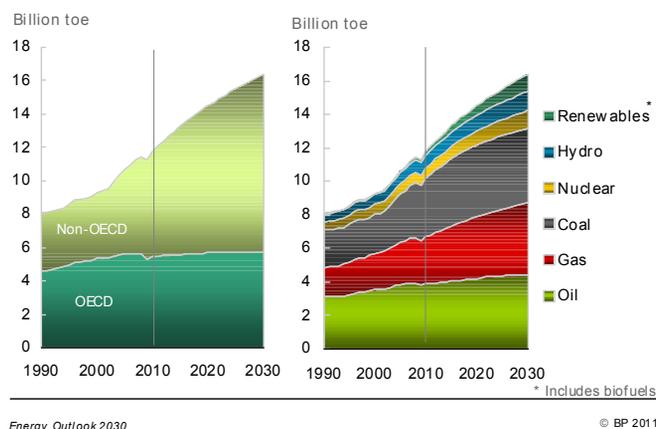
Gas

Natural gas is projected to be the fastest growing fossil fuel to 2030. Non-OECD countries account for 80% of the rise in gas consumption, with growth averaging 3% to 2030. Demand grows fastest in non-OECD Asia (4.6% p.a.) and the Middle East (3.9% p.a.).

By sector, growth is fastest in power and in industry – consistent with historic patterns. And while trebling from today's level, compressed natural gas use in transport is confined to 2% of global transport fuel demand in 2030. In the OECD, with its more modest consumption growth, gas plays an increasingly important role in displacing coal in power generation, led by Europe where the share of gas in power generation rises from 42% today to 65% in 2030. This is driven by policy to curb emissions via carbon prices, mandates, and low carbon technologies. In the non-OECD, the industrial and power sectors drive demand growth, but there is scope for substituting coal in power generation as well.

As for supply, unconventional gas (shale gas and CBM) will play an important role over the coming decades. Unconventionals are likely to account for 57% of North American production in 2030 and

Non-OECD economies drive consumption growth



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could make LNG exports economically viable. Outside North America, the ability to overcome technical and regulatory hurdles will determine their pace of development. We expect significant unconventional production in Europe only after 2020. In China, where natural gas currently accounts for only 4% of the fuel mix but is expected to rise to 9% by 2030, unconventional gas is likely to contribute 41% to this rapid growth of supply.

LNG is projected to grow 4.4% per year to 2030, more than twice as fast as gas production. Its share in gas supply increases from 9% in 2010 to 15% in 2030. The expansion is assured by three waves of new projects - currently from the Middle East, then primarily from Australia starting in 2015, and later from Africa.

Coal

Declining OECD coal consumption (-1.2% p.a.) is more than offset by growth in the non-OECD (2% p.a.). In China and India the phase of rapid consumption growth ends around 2020, but elsewhere in the non-OECD coal continues to grow steadily. Coal has been central to the development of China, which accounted for 80% of the growth of world coal demand from 1990 to 2010 and is still expected to account for 77% of the growth to 2030. However, there is a clear recognition within China that it needs to move away from its heavy dependence on coal. Environmental constraints (local air pollution as much as climate change concerns) and the rising cost of domestic coal resources are expected to curb Chinese coal growth.

Power

Historically there has been a strong correlation between income and electricity demand. We expect that relationship to persist but to be modified by efforts to promote end-use efficiency. The ratio of global electricity growth to GDP growth should fall to 0.7 in 2010-2030 from 0.9 in 1990-2010. This implies that the industrialising non-OECD economies move onto a less electricity-intensive path. Power generation in the non-OECD is set to overtake the OECD by 2012, and will continue to grow at more than three times the OECD rate. Despite this, non-OECD electricity consumption per capita remains well below OECD levels. As a percentage of the OECD level, non-OECD per capita consumption increases from 20% today to 30% in 2030. We assume that policy will support the continued rapid growth of non-fossil power generation – especially renewables, which attain a global share of 10% by 2030.

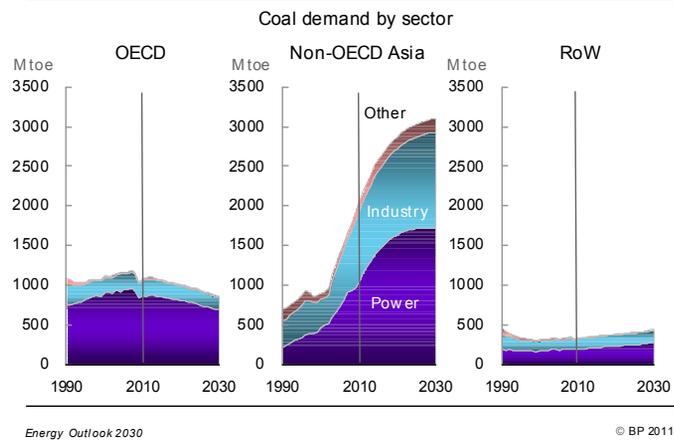
What can bend the trend?

There are, of course, numerous uncertainties that may alter this outlook. Global economic growth remains the key to energy demand growth: a change in the GDP growth rate (up or down) of about 1% would lead to a cumulative impact on energy demand in an order of magnitude of around 13%, depending on the fuel.

Climate policies are another. The carbon emissions implied by our Outlook are a far cry from the trajectory to 450 parts per million by 2100 which, according to scientists, would open the prospect of limiting temperature increases to two degrees. We did calculate an alternative Policy Case by strengthening our assumptions about climate change policies to the extent (we felt) realistically possible; but still global emissions, though declining after about 2020, end up higher in 2030 than in 2010. Clearly this is a wake-up call to us all.

The final uncertainty leads us back to the starting point, namely whether energy supply will be sufficient to support the continued high economic growth which is needed to

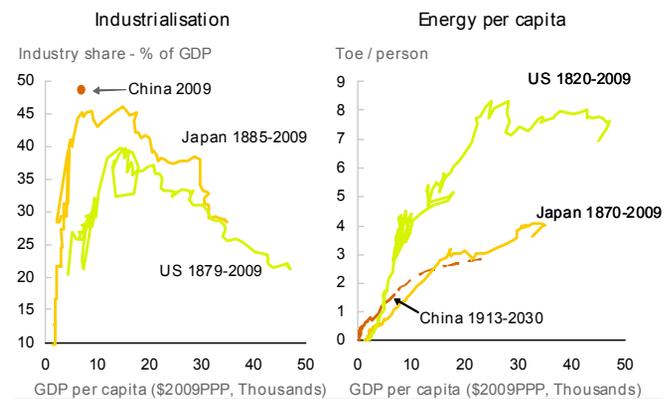
Coal continues to grow despite losing share in power



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China's pathway shows relatively low energy growth



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lift developing countries out of poverty. In our outlook, China's growth will become significantly less energy intensive after 2020, reflecting the path of economic development discussed earlier, as China currently has a very high share of industry in GDP relative to other countries. However, the scale of China's energy requirements is such that any change will have an impact on global energy markets. Energy prices (or supplies) could indeed become a temporary constraint on growth and in this regard, China is merely the most visible representative of a large group of rapidly industrialising economies.

Conclusions

Overall, this Energy Outlook illustrates four key topics. (1) Global energy consumption growth will need to continue, to fuel industrialisation in the developing world and, we conclude, it can do so as efficiency improvements are likely to accelerate. (2) The global fuel mix will continue to diversify and for the first time, non-fossil fuels will be major sources of supply growth. (3) The resulting slow-down in CO₂ emission growth, supported by energy policies and new technologies, nevertheless fails to put the world on a safe carbon trajectory. (4) Energy policies are driven by security as well as by climate change concerns – with diverse outcomes across fuels and regions.

Footnote

¹ http://economics.bpweb.bp.com/en/local_assets/documents/Oil_briefs_and_pres/BP_energy_outlook_2030_jan_2011.pdf

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