

Changes in global energy: will they be led by policies or driven by events?

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As disseminated in the International Energy Agency's *World Energy Outlook 2014*, the global energy system increasingly looks to be in danger of falling short of the high hopes placed upon it. Energy security concerns are on the rise in oil and gas markets as turmoil in the Middle East may jeopardise upstream oil investment needed today and the conflict between Russia and Ukraine has reignited concern about gas supply in Europe. Energy efficiency remains an indispensable tool to bring about a more sustainable energy mix, but energy prices and government policies must provide the right signals to continue to encourage its uptake. Meanwhile, global greenhouse-gas emissions keep rising, setting up a critical round of international climate negotiations in Paris in 2015. Ultimately, it will take deliberate and sustained policy action by governments to overcome the inertia of current trends and to spur the development of a more secure, more affordable and cleaner energy system.

When surveying the state of the global energy system, I see one which increasingly looks to be in danger of falling short of the high hopes placed upon it. Turmoil in parts of the Middle East – the world's only large source of low-cost oil – has rarely been greater since the oil shocks in the 1970s. Conflict between Russia and Ukraine has turned our attention once more to gas security in Europe. Nuclear power, which for some countries plays an important strategic role in their energy security, faces an uncertain future. Electricity access, one of the most basic forms of energy security, remains out of reach for many, including two out of every three inhabitants of sub-Saharan Africa. And the starting point for the very important climate negotiations in Paris next year is far from encouraging: global greenhouse-gas emissions continue to rise and air pollution in many of the world's fast-growing cities is stifling.

I am comforted to see that gains in energy efficiency and reductions in the cost of emerging energy technologies, such as solar photovoltaics, have helped to alleviate some of the stresses on the global energy system. But ultimately, in my view, it will take deliberate and sustained policy action by governments to overcome the inertia of current trends and spur the development of a more secure, more affordable and cleaner energy system. To shed light on the energy pathway that lies ahead, and to better inform decision-makers about their

choices, we at the International Energy Agency have taken up new analyses in the *World Energy Outlook 2014*.

Energy demand centres shift and the fuel mix evolves

In our central scenario – which takes account of existing and planned policies – we project global energy demand to grow by 37 % in the period to 2040. While this is a significant increase, we see a development pathway for an expanding world population and economy that is considerably less energy-intensive than it once was. Growth in global energy demand slows from above 2 % per year during the last two decades to 1 % per year after 2025. This is the result of both price and policy effects, and a structural shift in the world economy towards services and lighter industrial sectors. We notice also that the geographic distribution of energy demand undergoes significant changes: energy use in the mature economies is generally flat, while growth is concentrated in the developing economies. Slowing economic growth and more efficient energy use in China eventually diminish its huge influence on global energy demand growth, giving way to India, Southeast Asia, the Middle East and sub-Saharan Africa as the principal drivers by the early 2030s.

The world's energy mix evolves into four almost-equal parts in 2040: oil, gas, coal and low-carbon sources (mainly renewables and nuclear power) (see Figure 1). The share of fossil fuels in the mix, which has remained broadly constant over the past three decades, remains dominant but falls gradually to just less than three-quarters in 2040. Meanwhile, we expect renewables to grow faster than any other fuel. The trend towards greater use of low-carbon energy sources and away from fossil fuels is most pronounced in mature economies. But in absolute terms, growth in the use of low-carbon energy sources is about twice as large in developing economies, though it is exceeded by growth in the use of fossil fuels, as all possible options are used to satisfy strong growth in demand for energy services.

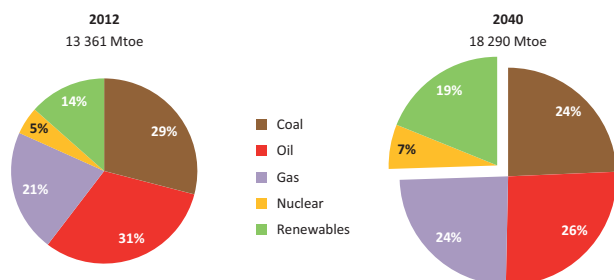


Figure 1 – Global energy demand by energy source

Energy security concerns are on the rise

Oil markets are currently well-supplied, but short-term conditions should not divert our attention from trouble that may lie ahead. We project oil demand to increase by 14 million barrels per day in the period to 2040. But only a few regions show significant growth in supply over the next two decades – the United States, Canada, Brazil and the Middle East – while the rest of the world shows a net decline in output (see Figure 2). The Middle East, and Iraq, in particular, will be relied upon to fill a significant share of the oil supply gap. Given the current turmoil, however, there is a real concern about a shortfall in investment today which is needed to deliver extra barrels from the early 2020s. The result of such a shortfall would be tighter markets and higher prices everywhere,

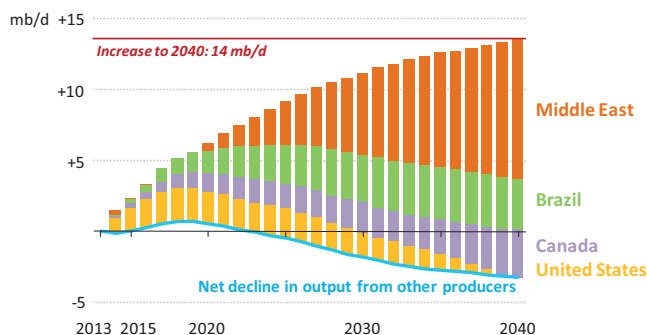


Figure 2 – Growth in global oil demand and incremental oil production by region

though countries which are poised to experience strong oil demand growth – the fast-growing economies in Asia, for example – would be particularly vulnerable.

Concerns about gas supply security have once again become relevant, at least in Europe, but we expect that markets will be better equipped to deal with market disruptions in the future, even as global gas demand rises by more than 50 % in the period to 2040. A key reason is the rise in the trade of liquefied natural gas (LNG), which almost doubles in volume during the projection period. Growth in the LNG trade will diversify supplies to global gas markets, led by Australia and joined in the coming years by the United States, Canada and East Africa. We expect increasing destination flexibility to be another feature of LNG trade, as more and more cargos are able to seek the best price. But while LNG can bolster the security of gas supply, the expense of transporting gas long distances means it cannot transform the long-term competitive position of gas in markets that rely on imports (Europe and Asia-Pacific). Cheaper gas would have to come from domestic production. China, for example, has huge estimated unconventional resources that could potentially alter the long-term economic case for gas in the Asia-Pacific market.

Coal is abundant and its supply is secure, but its use looks set to be increasingly constrained by measures to tackle air pollution and reduce CO2 emissions. Global coal demand grows by 15 % in the period to 2040, but we see almost two-thirds of the increase occurring during the next ten years. After a period of unprecedented growth, Chinese coal demand slows through the 2020s and reaches a plateau. Demand declines in mature economies, including in the United States, where coal use for electricity generation plunges by more than one-third. India becomes the world's second-biggest coal consumer by 2020, and soon after surpasses China as the largest importer. In the absence of rapid and widespread adoption of high-efficiency coal-fired generation technologies and, in the longer term, of carbon capture and storage (CCS) technologies, it has become clear that increased coal use is incompatible with climate goals. We therefore think it a prudent strategy to ensure that new coal-fired plants are both high-efficiency and CCS-ready.

Prices and policies have to be right to get more efficiency into the mix

Energy efficiency is not only an indispensable tool to relieve pressure on energy supply but can effectively cut energy-import bills and mitigate environmental impacts. These benefits partly explain the renewed policy focus we see on efficiency in many countries. In the transport sector, more than three-quarters of global car sales are now subject to fuel-economy standards. As a result, we project oil demand for transport to rise by only one-quarter in the period to 2040 despite the number of cars and trucks on the road globally more than doubling. In our analysis, new efforts on efficiency suppress oil demand growth by an estimated 23 mb/d in 2040 – more than current production of Saudi Arabia and Russia combined – and reduce gas demand growth by 940 billion

cubic metres – more than current output in North America. Efficiency measures can also help to address the concerns in some energy import-dependent regions that higher prices for natural gas and electricity put their energy-intensive industries at a competitive disadvantage. But we think that regional energy price disparities are set to persist and that North America, in particular, will remain a relatively low-cost region in the period to 2040.

wind power accounting for the largest share of growth in renewables-based generation (34 %), followed by hydropower (30 %) and solar technologies (18 %). As the share of wind and solar PV in the world's power mix quadruples, however, their integration both from a technical and market perspective will become more challenging. For example, we project that wind will reach 20 % of total electricity generation in the European Union and solar PV will account for 37 % of summer peak demand in Japan.

The power sector is leading the transformation of global energy

We expect the power sector to contribute more than any other sector to the reduction in the share of fossil fuels in the global energy mix. In total, we anticipate some 7 200 gigawatts (GW) of capacity will need to be built to keep pace with increasing electricity demand while also replacing existing power plants that are due to retire by 2040 (around 40 % of the current fleet) (see Figure 3). We project renewables to grow strongly in many countries, increasing their share of global power generation to one-third in 2040. But at the same time, adequate price signals will be needed to ensure timely investments in new thermal generation capacity, which is necessary, alongside investment in renewables, to maintain the reliability of electricity supply. This will require reforms to current market design or electricity pricing in some regions.

Renewable energy technologies are rapidly gaining ground, helped along by global subsidies amounting to \$120 billion in 2013. With rapid cost reductions and continued support, we project renewables to account for almost half of the increase in total electricity generation in the period to 2040, while the use of biofuels more than triples. Globally, we see

Is Paris the last chance for the 2°C goal?

With the current greenhouse-gas emissions trajectory consistent with a long-term global temperature increase of 3.6 degrees Celsius (°C) compared with pre-industrial levels, international climate negotiations under the UN Framework Convention on Climate Change are moving into a critical phase. Countries have been invited to communicate their intended nationally-determined contributions to a climate agreement early in 2015. Their aim will be to reach a climate agreement at the Conference of the Parties (COP) in Paris in December 2015 and to apply its terms from 2020: the first round of targets would set the course for the all-important decade for CO₂ emissions from 2020 to 2030. Because energy production and use is responsible for around two-thirds of greenhouse-gas emissions, the sector will strongly influence the negotiations and will play a central role in the implementation of any outcome.

The Intergovernmental Panel on Climate Change has concluded that the world has an overall CO₂ emissions budget of 2 300 gigatonnes (Gt). More than half of the carbon

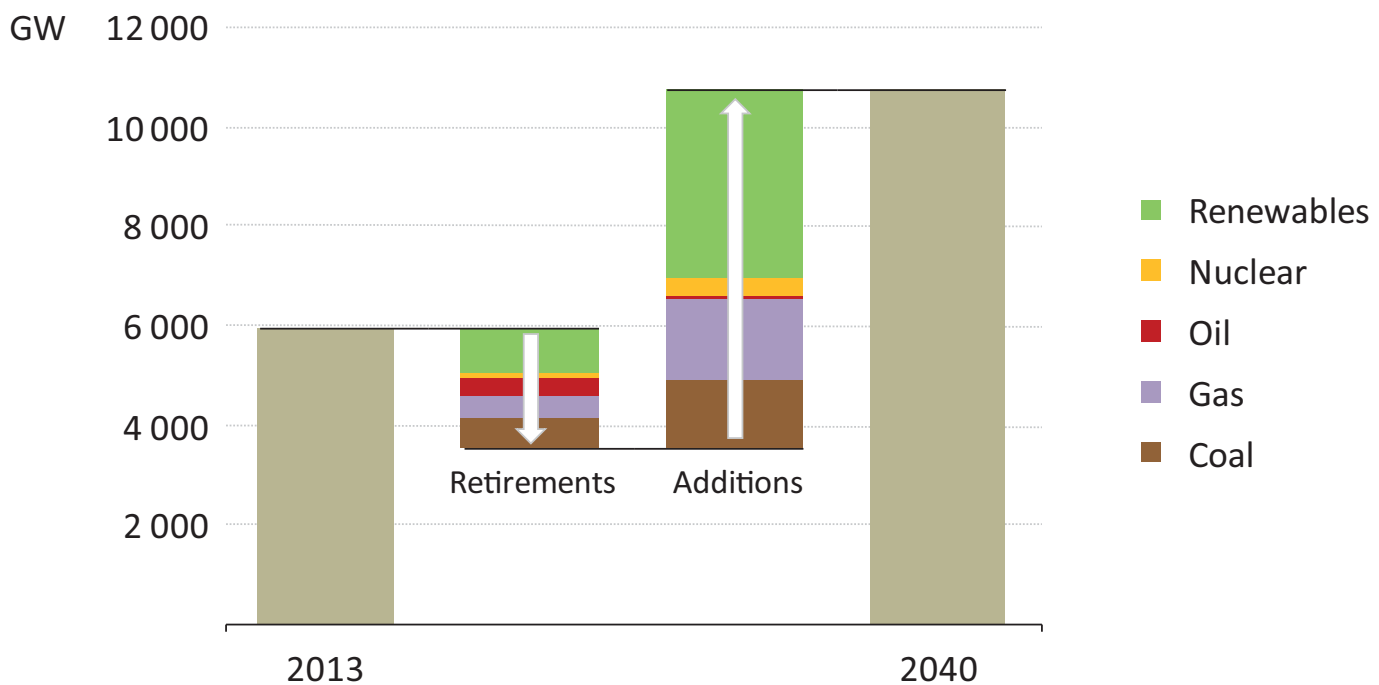


Figure 3 – Changes in power generation capacity by source

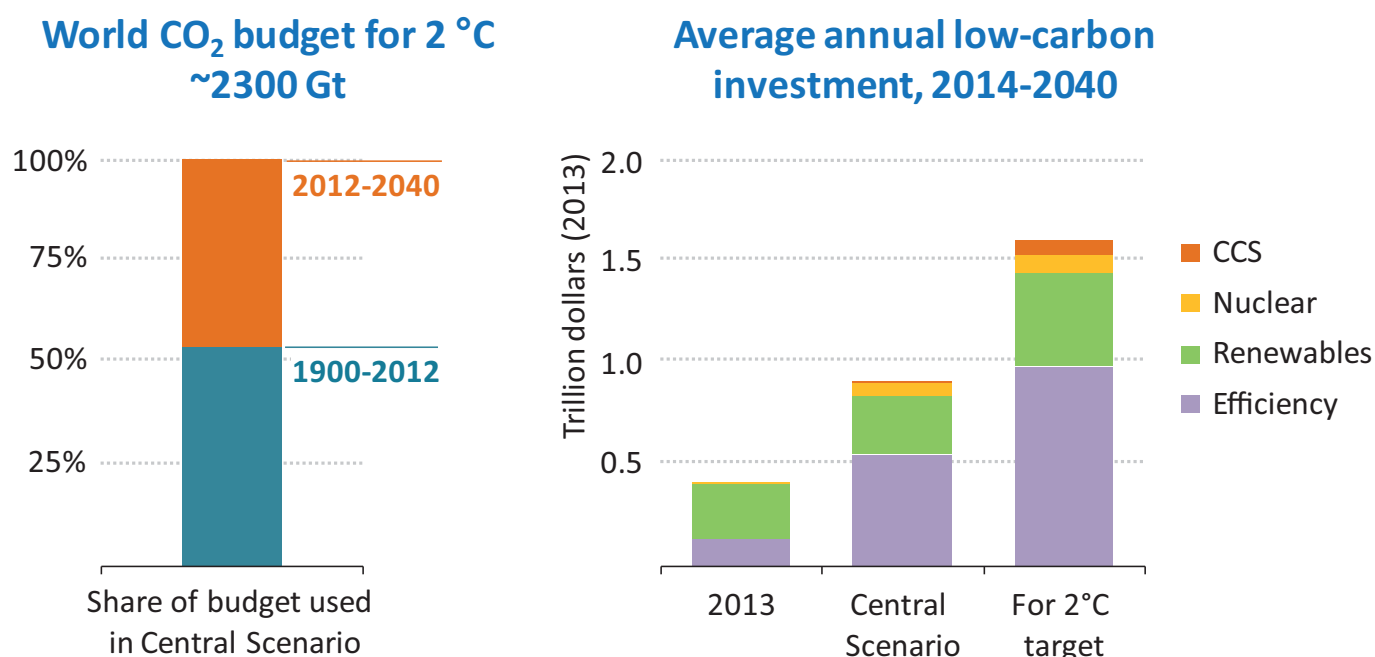


Figure 4 – World CO2 emissions budget and annual low-carbon investment needs

budget has been used to date, which means that the world can emit no more than around 1 000 Gt of CO₂ to preserve a 50 % chance of reaching the internationally agreed goal of 2°C to avert the most severe and widespread impacts of climate change (see Figure 4). If we continue on existing trends, our analysis shows that the entire carbon budget will be used up by around 2040. Even more sobering, this occurs despite recent major policy efforts to cut emissions, such as the Clean Power Plan in the United States, the 2030 framework for climate and energy policies in the European Union, and efforts to curb air pollution from coal use in China. Our analysis implies we could not emit any additional CO₂ after 2040 if the 2°C goal is to be achieved, which is of course unrealistic.

The need to accelerate efforts to mitigate greenhouse-gas emissions is urgent. In 2013, the world invested \$400 billion in low-carbon technologies, mainly in renewables and energy efficiency. Existing and planned policies to encourage renewables, nuclear and carbon capture and storage, as well as energy efficiency, promise to further boost investment in these technologies. Our main scenario projects average annual investment in low-carbon technologies to be more than twice as high in the period to 2040 (\$900 billion per year) as it was in 2013. This level is still far from enough to reach the 2°C goal, which requires average annual investment of almost \$1.6 trillion per year until 2040. To facilitate this investment,

and to shift the energy sector onto a low-carbon track, the upcoming COP in Paris will need to send a strong signal to private and public energy investors that all major countries are committed to long-term decarbonisation. Given the importance of the energy sector in reaching climate target, and the urgency to act, the IEA will launch another World Energy Outlook Special Report in June 2015 that looks closely at the role of the energy sector to address global greenhouse-gas emissions.

A call for action

While I see concerning signs of stress in the global energy system, I also believe strongly that governments hold the power to chart a better course. Our analysis demonstrates evidence of how effective policy action can be, particularly if we take examples from action that has been taken on energy efficiency. I expect the coming year to be a critical one for developments in regions where turmoil and conflict are posing risks to energy security and for the negotiation of commitments that will preserve the long-term health of our climate. With much to be done to make our energy system more secure, more affordable and cleaner, policy-makers should actively steer us onto a more sustainable path rather than allow the energy system to evolve based on events.