
# Shaping the future of energy

by Gerald Stang

More than six months after the Paris climate talks concluded with a historic agreement, the implications for the energy sector are becoming clearer. While energy policymakers continue to have different priorities and pressures, they increasingly have the same broad goals: meet the energy needs of their citizens today while charting a course towards a more sustainable future. But every state will travel a different path towards sustainability, and many factors beyond the imperative for decarbonisation will shape the energy sector in the decades ahead. How will key trends in energy technology, investment and geopolitics influence energy policy decisions across Europe and around the globe?

## The situation today – uncertainty reigns?

Assessing the evolution of energy use (and climate pollution) is made difficult by the volatility and uncertainty in all energy markets. While prices for renewables continue to drop (at different rates for different sources in different locations), the fact that oil and gas prices have been so low since 2014 complicates the situation. Low prices make fossil fuels relatively more affordable, and would be expected to cause a downward pressure on investment in green technologies. But these same low prices also create opportunities for governments to cut fossil fuel subsidies or even increase carbon taxes without upsetting their citizens as much as might be the case if prices were high.

It does not help that energy experts have a poor track record at predicting future energy prices. (If there is anyone with a good track record on this, they are keeping their success, and their future market earnings, to themselves.) Although several leading organisations, including BP, the International Energy Agency (IEA), the World Energy Council, the US Energy Information Administration (EIA), and the Organisation of the Petroleum Exporting Countries (OPEC) itself, produce regular reports on the future of the energy world, in recent years, these projections have appeared outdated even sooner than usual.

Historically, geopolitical disruptions such as the 1990 Gulf War or the 1979 Iranian Revolution could be blamed as unforeseeable black swans that disrupted pricing forecasts. Today, black swans continue to occur (9/11, the 2008 financial crisis etc.), but the increasing complexity of international energy markets means that many contrasting trends can occur at the same time, among a more diverse range of major importers and exporters. Pressures to shift to entirely different energy systems are being felt at different intensities across the globe, so policymakers may struggle to find their footing in

making decisions that can have long-term consequences.

Improved understanding of the role of a few key factors related to energy technology, investment and geopolitics may help clarify the situation.

## Long-term technology trends

Not every form of renewable energy technology will live up to the hype surrounding it. Fortunately, not all of them need to, provided a sufficient number can be scaled up to wide use. As the number of companies, governments (at all levels), and research institutions investing resources into green energy technology continues to expand, more and more different technologies are being developed, tested, and marked for additional improvement or for the scrap heap.

It is already possible to identify a number of technologies that are likely to have limited future growth. Many technologies, such as geothermal energy, will be useable only in certain areas. Hydro power, which for many years has been a dominant non-carbon based energy source, has a limited number of dam sites available to be developed outside parts of Africa and South America. Carbon capture and storage (CCS), requires the right geological formation to store C02; the window for wider development of CCS may already be closing as costs are not falling fast enough relative to competing technologies. Nuclear energy, long seen as the energy of the future, will see limited growth. As understanding of the costs of risk management and decommissioning has improved, the cost of new nuclear programmes has risen, with nuclear making some economic sense only if done on a massive scale, as in China. Biofuels compete with other crops and have thus been limited to large-scale use in places like Brazil where sugar crops grow easily and farmland (former forests) is plentiful. Pending some unexpected breakthrough, no other renewable energy source is likely to expand in a major way.

And a range of oil-related technologies should also be included in the limited growth category. The frontier fields of oil development in the Arctic, or deepwater, or the oil sands are seen as increasingly expensive, and though a future rise in oil prices may once again make these somewhat more attractive, the demand for new oil will soon be on the permanent downswing. This is not to consign all these technologies to irrelevance, but to note that their ceiling for growth may be lower than their protagonists would hope.

Other technologies seem to have a much brighter future. Solar power and wind power, of course, have seen their costs drop rapidly over the past decade, allowing them to become increasingly price competitive in some locations even without government support. This trend is very likely to continue in the years ahead as wind and solar research and investment reach ever greater levels. Though it is inefficient to use solar panels where there is little sun, or wind turbines where the wind does not blow, there are more than enough windy and sunny locations around the earth to ensure that solar and wind power will continue to grow rapidly, forming the twin pillars of global renewable energy production in the years to come.

In the long term, the phasing out of fossil fuels and the phasing in of renewable technologies will not merely involve swapping one power source for another. The geography of energy production will also change, requiring new investment in distributed generation and smart grids to bring the power to where it is needed. The world will become increasingly electrified, as point source fossil fuel burning (cars, generators, and factories) will instead switch to electrical power and batteries. Different ways of storing energy will be another boom sector, from fuel cells to lithium-air batteries, and perhaps even more long-term ideas such as hydrogen or thermal storage.

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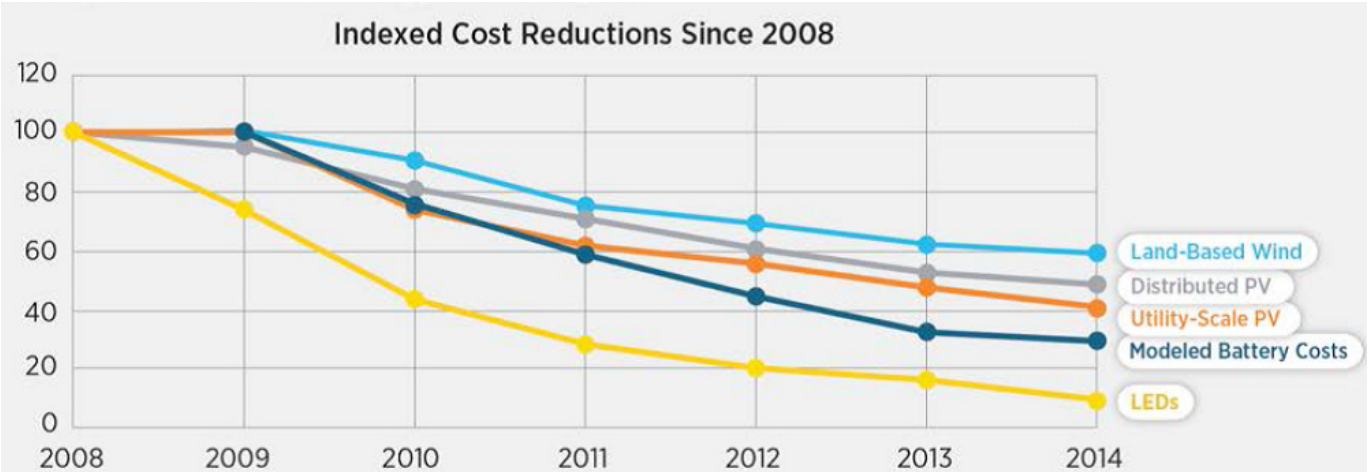
While in the long term, gas usage will be phased out along with other fossil fuels, there is uncertainty over what role it will play in the medium term and whether it can serve as a bridge fuel. European demand is still uncertain, though the same stable or dropping demand as has been a trend over last six years cannot be presumed for the years ahead. Long-term gas demand is highly dependent on climate decisions (taxing carbon), the pace of development of competing energy sources, progress in energy efficiency, and infrastructure path dependence. Gas investments taking place in Europe today are underwritten more by security of supply concerns (governments), or by security of demand concerns (Gazprom), neither of which is the same

**Falling costs for clean energy technologies**




Source: US Department of Energy, 'Revolution...Now - The Future Arrives for Five Clean Energy Technologies – 2015 Update'

as having commercially viable projects driven by private investors. This means that the future of all gas-related technologies, from production to final use, remains unclear.

There may be no silver bullet for achieving energy security, but improved energy efficiency may come close. Even as the energy intensity of economies is reduced, there is still a long way to go to fully cut the link between economic growth and energy use (though not as far from cutting the link between growth and carbon). But through the intelligent development of new materials and technologies, supported by appropriate price pressures, energy demand can be cut back significantly across all sectors. This has long been the case in the automobile sector as mileage rates continue their decades-long improvement. But many other sectors, notably in the building sector, significant efficiencies remain to be developed, making technological advancement in the area of energy efficiency a key factor in reaching 'peak energy'.

## Long-term energy investment

Three key energy investment trends are likely to continue for the foreseeable future. First, the global trade in energy products will eventually peak and drop off significantly. As new geographies of energy production are developed, with distributed generation and smart electrical grids, the massive transport of fuels over long distances by pipeline or truck or boat will gradually be phased out. This will not happen overnight, but will have major implications for the shipping industry and for global trade.

Second, economic growth will decouple from carbon use and even from energy use. For years, the energy world was worried about 'peak oil' after which the rate of oil production would begin to outstrip the finding of new resources. As oil has continued to be found in large quantities, but the world has begun to focus on decarbonisation, the idea of the world reaching 'peak demand' for oil within a couple decades has been floated. Most recently, with the slowing and even dropping of energy demand in parts of the developed world, the idea of reaching global 'peak energy' in the coming years has been mentioned, not with respect to oil but in relation to all energy use. Such a possibility, once unthinkable, can now be considered, as economies are decoupled from energy use, with increasing efficiencies allowing for the replacement of retiring fossil fuel based energy with a lesser amount of non-carbon based energy sources.

The third trend is the increasing primacy of regulation and policy in shaping energy investments. Policymakers trying to discern the future can be tempted to throw up their hands and think small. Yet they are, collectively, more central to shaping our energy future than ever before because the long-term energy goals for all countries are more clear and consistent than ever before (more efficient, more green, less reliant on outsiders, more consumer responsive). This has led to even the most laissez faire countries to spend more on energy R&D, pick technology winners within their economies, and intrude ever deeper into shaping the choices of the companies and institutions which drive energy markets. The cost competitiveness problems of CCS, for example, result not just from its technical challenges, but because governments find it easier to spend on competing technologies rather than to tax carbon. The decisions of energy innovators and investors are going to be driven as much by expectations of what the policy environment will look like as what the pricing environment will be.

## Long-term energy geopolitics

Three trends can also be discerned in the field of energy geopolitics. The first is the reduction of leverage for leading suppliers. With increasing diversity of energy types and suppliers, facilitated by more open and global markets, the power of even the most dominant suppliers (or groups of suppliers) will continue to wane over the long term. They can continue to be profitable, and even dominant within some regional markets, but will have reduced capacity for exercising political leverage over their energy trade partners. This trend has accelerated in recent years, but has been in place since the original energy price shocks of the 1970s pushed importers to improve their energy security, which they have done.

The second trend is the increasing focus on citizen needs that is shaping how states pursue their energy goals. Energy policy remains an important issue for developing national power and defending sovereignty, but even most autocratic states are ensuring that their energy policies can also serve the energy needs of their own citizens. Even among energy suppliers, paying attention to citizen needs is a major issue. Saudi Arabia, for example, has been quite successful in ensuring that its citizens have both energy access and receive some of the benefits of their export earnings. Nigeria provides a counter example, where providing neither electricity nor a share in the energy profits has led to decades of unrest. Among both suppliers (see Mexico) and importers (see China), one component of this trend has been the gradual openness to market pressures in order to provide pricing signals for consumers, investors and producers.

The third trend is increased energy cooperation at the international level. Though efforts of varying success have been made in the past to align the energy decisions of narrow groups of countries (via OPEC or the IEA, for example), bringing disparate groups to the same table is a relatively new phenomenon that is likely to continue. The Paris climate talks represent only the most obvious example of the willingness of countries to chart out common goals and principles for their energy use. The G20 meetings of energy ministers and the Energy Charter Treaty process are other important examples of this trend. Bringing different, often competing, interests together like this has been facilitated by the end of the Cold War and by the first two geopolitical trends mentioned above.

## Challenges for policy makers

For each of these three trend areas, some key lessons may be discerned. In the technology field, it can be difficult to pick and choose winning technologies. It will be important to flexibly support research and development, without overspecifying exactly which technologies can be developed and scaled up. In terms of energy investment, there will be a long-term challenge for governments to provide infrastructure to match future supply and demand patterns. Helping provide clarity can involve clearly laying out long-term goals for the energy sector, and then making efforts to map broad paths to get there so that investment incentives can be put in place. The Deep Decarbonisation Pathways Project is one example of efforts to define a broad path. In addition, the costs of transition will not be low, so in order to ensure the best possible use of resources, it will be useful to take advantage of market functioning – for energy and carbon – to drive movement along the path, as consumers, investors and producers take action based on market signals (shaped by smart regulation).

With regard to geopolitics, it will need to be taken into account that pushing towards a different energy future will result in winners and losers; some locations and some industries will be more easily able to make a green transition – it will be important to keep a close watch on these differences and take action to reduce the difficulties for those that might be left behind, internationally and within Europe. This responsiveness to the impacts of groups and on individual citizens will mean taking action at the right level of governance, building on international frameworks, national and continental plans, and local capacities to put plans into action. Cities and regions can play an increasing role as locations for technical and regulatory experimentation; it is not uncommon for cities to use climate change as a framing issue for green planning and development, largely decoupled from national frameworks. Cities and regions will continue to be more and more networked across borders. This can be seen most clearly in North America where cities and states are cooperating across borders on climate action, stepping into the relative vacuum left by their slow-acting national governments.

The global energy scene is likely to become yet more complicated in the years ahead. Navigating this complexity need not require the creation of detailed plans set in stone, but will require a solid understanding of the key trends at play, and a capacity to shape and adapt to these trends in the pursuit of clearly defined long term goals.

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 | QN-AK-16-024-2A-N | ISBN 978-92-9198-457-2 | ISSN 2315-1110 | doi:10.2815/651821