July 2020

THE OXFORD INSTITUTE FOR ENERGY STUDIES

forum

A QUARTERLY JOURNAL FOR DEBATING ENERGY ISSUES AND POLICIES

COVID-19: GLIMPSES OF THE ENERGY FUTURE?

Malcolm Keay and David Robinson

The question mark in the title of this article is deliberate. The authors have not set out to demonstrate that the impact of Covid-19 on the energy sector is necessarily a harbinger of things to come. Rather, the article presents a question: if COVID-19 does indeed offer a glimpse of the future, as seems possible, what conclusions should energy companies draw about their strategies and business models?

The first section looks at some of the ways in which the impact of COVID-19 could provide insights into a future decarbonized energy sector. It lists a number of features of the energy scene since the start of the lockdown period which seem consistent with forecasts for the longer term in many climate scenarios.

The second section looks in more detail at electricity, which is further down the road to decarbonization than other energy sectors. It examines the changes arising from decarbonization measures, in many cases accelerated by COVID-19. These changes have altered most of the fundamental characteristics of the industry, turning it 'upside down'. Recent experience has accelerated the trends, providing some useful (and perhaps unexpected) lessons for the future.

The third section brings together elements from the first two sections to indicate what sorts of change could be in the cards in relation to oil and gas and what they might imply for industry strategies and business models.

Glimpses of the future

During the COVID-19 epidemic, the world has witnessed changes which are consistent with developments that have been widely forecast for 2030 and beyond. For instance:

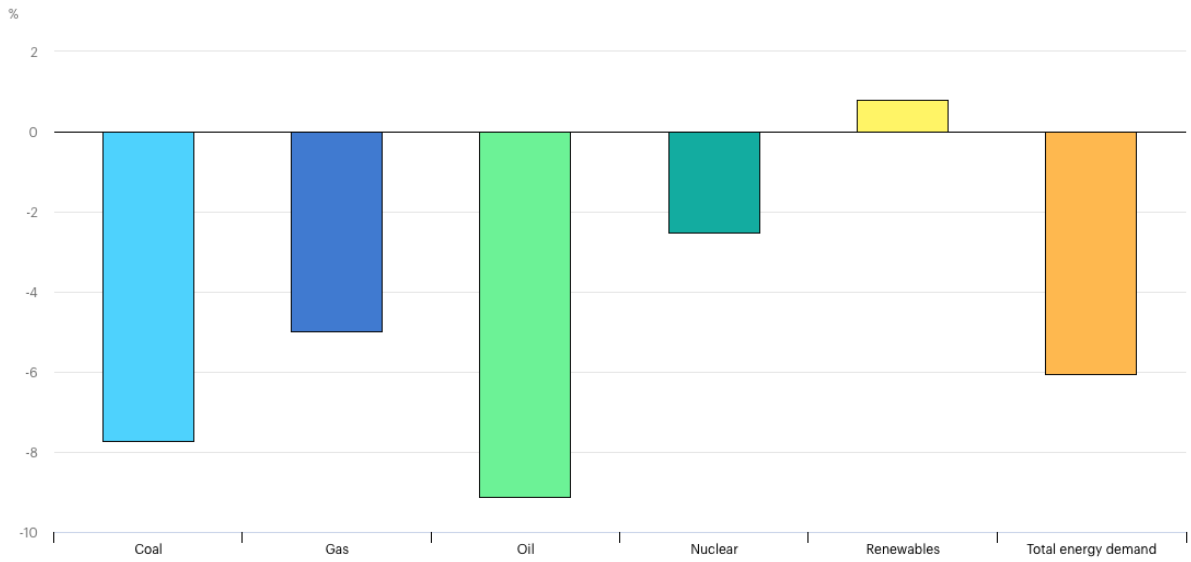
- Global energy demand fell by 3.6 per cent in the first quarter of 2020, and the International Energy Agency forecast a decline of about 6 per cent in 2020, equivalent to the increase of the last five years.
- Global coal demand fell by 8 per cent in the first quarter of 2020, due to falling demand in the power and industrial sectors and substitution by natural gas and renewables in the power sector.
- Global oil demand was down by about 5 per cent in the first quarter of 2020, reflecting travel restrictions and a decline in shipping. The International Energy Agency expects global oil demand to fall by 9.3 million barrels a day this year, equivalent to almost a decade of growth.
- There has been a shift towards electricity, especially in residential use. Electricity demand has fallen by much less than demand for other types of energy, due to increasing residential consumption – matching a shift seen in many decarbonization scenarios.
- Renewables have provided an increasing share of energy generation, while base-load operations have declined.

Renewable energy generation increased by 1.5 per cent, while generation from other sources fell.

- Absorbing renewables has presented major challenges. Rising renewable output and lower demand have caused problems for many systems. In California, for instance, for the first quarter of 2020, renewable curtailments were twice as high as in the first quarter of 2019.
- Falling and negative wholesale electricity prices have coincided with rising final tariffs. Lower demand and rising renewable output is driving wholesale prices down, while negative prices have become more common as generators have to be paid to reduce output in the face of low and inflexible demand. In a small number of cases, consumers have been able to enjoy these negative prices; more commonly, final tariffs are rising or will rise. In Germany, for instance, network charges (per kWh) increased to recover fixed costs from lower throughput, renewable subsidies rose with higher renewable output, and balancing charges increased.
- Confinement at home has significantly increased consumer use of the internet for work from home, online shopping, and communications. The accelerated digitalization of society is consistent with an increase in the potential for more active consumer participation in the power sector, especially with the support of aggregators and energy communities, and, more widely, with the increase in telework and reduction in business and leisure travel.

Experience during COVID-19 has thus introduced and tested new patterns of energy demand and supply in line with those that have been widely predicted for a more distant future. It is reasonable to ask what the implications of these changes are for policymakers and companies in the energy sector.

Projected changes in primary energy demand by fuel in 2020 relative to 2019



Source: International Energy Agency, Global Energy Review 2020.

Electricity

In recent years, the Oxford Institute for Energy Studies (OIES) has researched and analysed the changes under way in the electricity industry. These have been driven by two main forces: the increasing penetration of intermittent renewable sources, in response to climate change measures and declining cost; and developments in information technology, which have transformed the industry's capacity to control, monitor, and coordinate different sources and activities. Together these developments have fundamentally changed the nature and operations of the sector, turning it 'upside down'. The table below summarizes the ways in which the industry of the future is likely to differ.

Projected changes to the electricity industry

	2020	Future
Cost structure	Mainly marginal	Mainly capital
Generation structure	Mainly centralized	Decentralized
Pricing	kWh	?
Planning and operation	Flexible supply to match demand	Flexible demand to match supply
Control and dispatch	From centre	Throughout system (internet)
Role of demand side	Passive	Interactive
Role of grids	Neutral conduit	Smart player

To a significant extent the glimpses discussed above have provided a preview of this future system – for instance, in the UK, in the first quarter of 2020, generation from renewables exceeded that from fossil fuels for the first time. With the still significant nuclear component, that meant that the dominant element in the cost structure of generation was capital rather than marginal cost, and that the flexibility of generation diminished substantially. Meanwhile, generation from decentralized sources has grown – for instance, output of solar power (mainly decentralized) at its peak on 20 April 2020 met around 30 per cent of UK demand, a record. At times intermittent renewables as a whole have reached 60 per cent or more of generation. During the weekend of 23–24 May, renewable generation in the UK amounted to 73 per cent of the total, while, not coincidentally, carbon intensity reached the lowest level recorded, at 46g/kWh – well below the target for 2030 and a reduction of over 90 per cent compared with the 1990 baseline. Changes on the supply side are capable of meeting even very ambitious carbon targets.

But there have also been challenges. Renewables output has been volatile – for instance, during the week commencing 4 May, wind averaged 9.2 per cent of the generation mix for the first six days of the week before jumping to 41 per cent on 10 May. In short – in line with expectations for the future – the system has been much less carbon intensive, but it has also had to adapt much more rapidly and flexibly than in the past and without the tools it used to rely on.

It may prove helpful that the future has arrived more quickly than expected (even if only temporarily). In the process, we may be able to learn some practical lessons which, while consistent with the general trends above, were not necessarily obvious in advance. For instance:

- **Role of nuclear –** Many industry observers have seen decarbonization as paving the way for a nuclear renaissance, arguing that no other source can provide large quantities of secure, carbon-free baseload power. But experience in 2020 suggests that nuclear may not be such a good fit in a decarbonized system – the concept of 'baseload' is becoming less relevant, and large quantities of inflexible generation are proving more of a problem than a solution in a renewables-dominated system. An agreement reached this spring between the UK System Operator and EDF Energy to reduce output from the 1.2GW Sizewell B nuclear power station was one illustration of the problem. If nuclear is to have a role in the low-carbon future, it may have to be by providing flexibility rather than baseload power. Indeed, in France, this seems to be happening already – the French system operator has described itself as acting like 'permanent acrobats'. The design and operation of any new nuclear plants may need to be based on their acrobatic abilities.
- **Role of the demand side –** Although overall energy demand has seen the big shifts described above, electricity demand has in fact changed relatively little (at least in terms of the scale of the changes needed to make a significant contribution to decarbonization), and its role may need to be rethought. Traditionally, the demand side has been seen as passive and the main policy focus has been on energy efficiency. Even in relation to 'demand response', most attention has been on shifting consumption away from times of peak demand. But recent experience has created a new focus on peak supply and the need to find efficient ways of increasing demand to match it (e.g. by filling storage). However, the instruments for doing so remain rudimentary – negative wholesale prices rarely get through to consumers (and sometimes not even to generators sheltered by renewable support schemes). They have been supplemented by ad hoc instruments, like the UK System Operator's Optional Downward Flexibility Management service, to encourage large users and generators to increase demand or reduce generation during low-demand periods, but these remain marginal elements. In the longer term, more fundamental market reforms will likely be

needed to encourage active consumer participation, for example as outlined in a 2017 OIES proposal for a 'two market' model.

- **Platforms –** The old model of electricity supply was straightforward: electricity flowed from a central generating unit, through transmission and distribution systems, to the consumer. Now the picture is much more complicated. Not only are consumers increasingly active participants via flexible demand, they may also be producers themselves (e.g. via rooftop solar panels), and their demand patterns may be more complex (e.g. for electric vehicles), while more real-time information about their consumption is available via smart meters. Meanwhile, a host of other sources (e.g. decentralized generation, storage, and community energy systems) also need to be coordinated. Future business models may depend on the effectiveness of a company's platforms for integrating all the sources in real time (just as Uber, which is essentially a platform, has revolutionized the car hire business). Two recent developments may illustrate this: in March 2020, Octopus Energy announced a partnership with E.ON in the UK to migrate about 6 million customers to its Kraken platform over the next two years; and in May, Origin Energy, one of the three big Australian suppliers, acquired a 20 per cent stake in Octopus Energy, reportedly attracted by its platform. When these rollouts are complete, some 17 million customers will be on the Kraken system.

The changes in electricity brought about by the COVID-19 lockdown are providing not only glimpses of what a decarbonized energy future might look like, but also some useful practical lessons on how businesses and consumers might need to respond. The key message is that while new technologies are needed to lower carbon emissions, they are not the end of the story. Their effect is to change the whole underlying system's operation and dynamics. For companies in the sector, developing new lower-carbon products is not enough. They must reappraise their role in the context of the new system dynamics and may need a fundamental change in their business models.

Oil and gas

This key message also applies to oil and gas companies facing a decarbonized future. The energy transition will require new ways of thinking, and new business models. In transport and heating, as in electricity, the energy transition will not be simply a matter of replacing fossil sources with renewables; companies will need to consider the dynamics of the prospective new system and their role in it.

In transport and heat, as in electricity, technology change will of course be required as a first step, probably to a mixture of electricity and hydrogen. But either approach leads to a completely new set of system requirements. For instance, electric vehicles would be an active part of the complex new electricity system described above – a key source of short-term storage and flexibility. Government policy and corporate strategy for energy and transport companies will have to change to reflect the nature of the new business.

The new platforms described above, which may be a key source of competitive advantage, will also help to link the transport and electricity sectors. In this new world, companies will need to think about the energy system as a whole, not just particular sectors like transport or heat.

While electrification will be one key vector for decarbonizing transport, buildings, and some industrial sectors, it will also need to be integrated with a range of non-electric technologies, including decarbonized gases, thermal water storage, wastewater heating and cooling systems, and more. Downstream, energy system platforms will assist in the optimization of all energy services, not just electricity.

Upstream, energy system thinking is also important – perhaps particularly for hydrogen, because the economics almost certainly require combining multiple end-product markets for hydrogen in multiple countries, which in turn requires coordination of infrastructure both between and within countries. For instance, in June 2020 Repsol announced a project combining green hydrogen from electrolysis with CO_2 to manufacture net-zero emissions transportation fuels. Projects like Repsol's, linking electricity, hydrogen, and transport, may be the norm rather than the exception in future; companies will need the skills and expertise to prosper in this complex new world.

Conclusion

COVID-19 offers an early glimpse of what most long-term forecasts anticipate for the energy sector: declining demand for fossil fuels, increasing shares of electricity in final energy markets, growing residential electricity consumption and consumer participation, and the need for flexibility to cope with high penetration of intermittent renewable energy sources. We cannot know how quickly this future will arrive, but the COVID-19 crisis is foreshadowing some of the new challenges and opportunities and

should be used by companies to reflect on their own strategies.

Electricity companies have already had 10 years to adapt to an industry turned upside down and have had to develop new business models. Very few of them anticipated the enormous scale of the changes, and it remains to be seen how many will succeed in the new business environment. Oil and gas companies have not yet had to face the full force of this kind of systemic change; most companies argue that they will have time to adapt, using revenues from existing businesses to make the needed adjustments. COVID-19 may be a useful wake-up call. If there is one message, especially noticeable from the experience of the power sector, it is that the energy business has changed: it is no longer about selling oil, gas, and electricity and gradually changing to a lower-carbon mix. We are entering a new paradigm where bottom-up (technology and economics) and top-down (political) pressures are moving in the same direction, towards the need for integrated, fully decarbonized energy systems, where consumer decisions are especially important. Corporate strategy for all energy companies needs to reflect this emerging new paradigm.