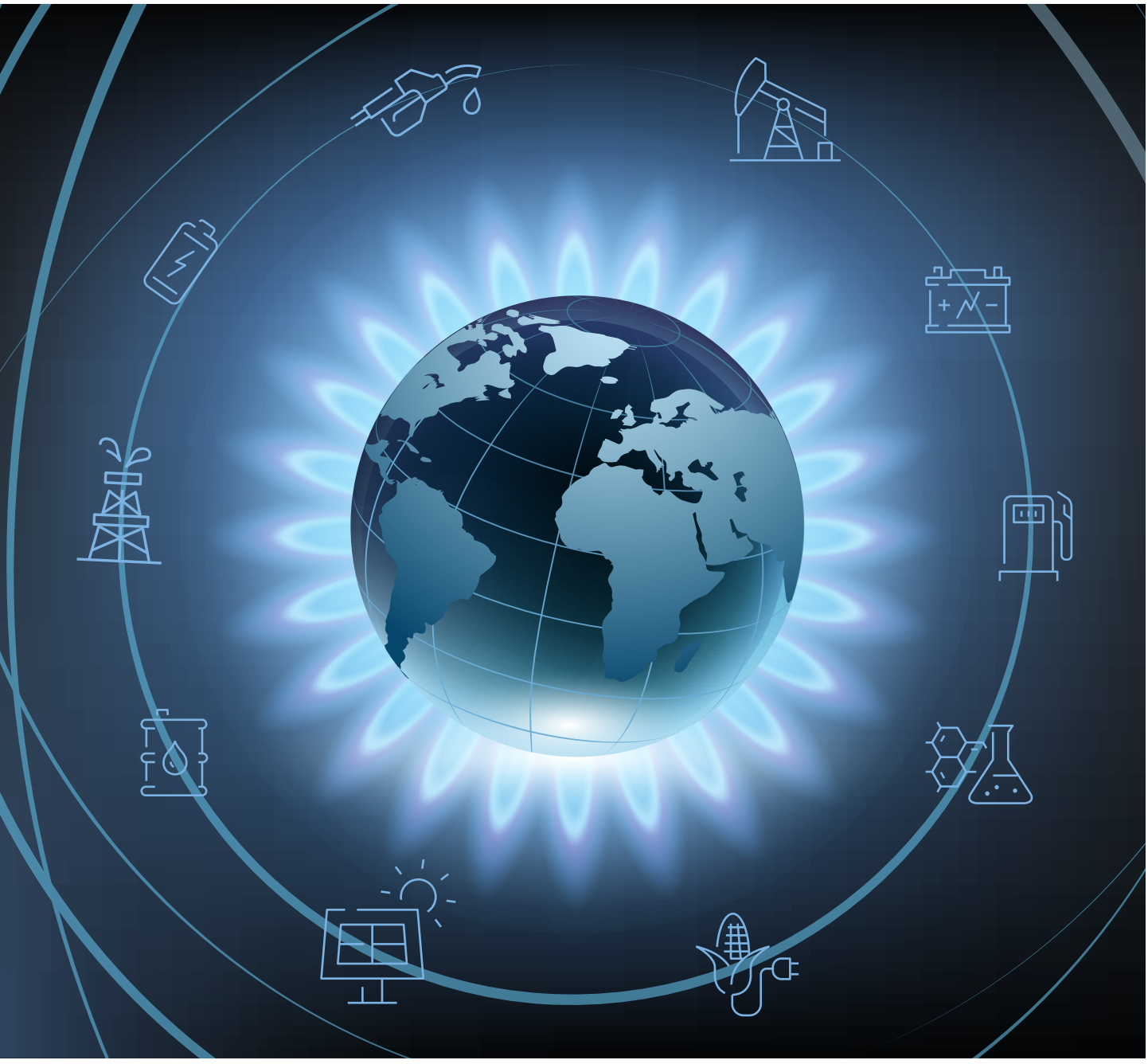
UNECE

How Natural Gas can Displace Competing Fuels



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How Natural Gas Can Displace Competing Fuels

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Executive Summary

If there is to be a significant role for gas as a transition fuel, let alone as a destination fuel, then national governments will have to develop gas-related strategies that encourage the use of gas in the near- and medium-term while providing for a subsequent orderly transition from gas towards a vastly increased use of renewables. This also applies to decision-making institutions such as the European Council of Ministers, as well as the European Commission in its twin role as proposer and implementer of EU policies.

In much of Northern, Western and Southern Europe, any incremental requirement for power generation will almost certainly come from renewables, with gas perhaps taking a little of the slack from coal, but primarily with renewables replacing coal.

Much of Europe is already phasing out its use of coal, which means that the UNECE region has an opportunity to provide concrete examples to the rest of the world, and particularly to Asia, as to how coal can be eliminated in much of the energy spectrum.

There is likely to be considerable geographical diversity in the UNECE region concerning the role of gas over the next 30 years. Modelling carried out by the International Institute for Applied Systems Analysis (IIASA) in Vienna shows that a policy stance based on a Pathway to 2°C results in a radically different energy mix to a 'business as usual' scenario. In particular, it challenges the conventional wisdom that gas is needed as a transition fuel to decarbonise the economy. More powerful arguments for the use of gas are its role in the provision of both energy security and quality of life.

In general, it can be argued that in much of the European Union - notably in such traditional coal consuming countries as Germany, Italy and Spain - it is quite possible that a combination of political will and competitive renewables pricing will drive a major transformation in the very near future.

But while targets for the removal of coal from electricity generation in many EU countries may be met much earlier than their projected date, it looks increasingly as if it will be renewables, rather than natural gas, that plugs the gap. Some countries, notably Spain and the United Kingdom, are already producing power from renewables at a lower cost than power from coal.

In other parts of the UNECE region, notably amongst the gas producers of Russia and Central Asia, the transition will likely be much slower.

It is possible that demand for gas will increase in the short-term. Longer-term prospects are less bright. The International Energy Agency, for example, anticipates that demand for natural gas in the European Union in 2040 may well be down 17% on current totals.

There will, however, still be a significant market for gas supplies from Russia in view of declining production in northwestern Europe. As long as the rest of Europe remains committed to gas, Russia will, in all probability, be able to maintain its share of European gas markets. If necessary, Russia can offer gas at prices that would almost certainly be lower than those of than any rival supplier. So while Russia will face increased competition from LNG, it should still be able to maintain current export levels even in a potentially shrinking gas market.

In both Russia and Central Asia, gas will continue its dominance of the domestic market.

Decarbonisation and energy sustainability remain key objectives in the current energy transition. But they are not identical and it is far from clear how efforts to achieve decarbonisation and to secure energy sustainability will affect each other.

Overall, in the near-term it appears renewables can be expected to provide low-cost electricity in much of the UNECE region. Renewables will be favoured both by investors seeking to profit from the market and by governments and politicians seeking to benefit from the provision of low-cost energy to the public whilst limiting the burden on public finances.

As a consequence, coal is on its way out, limited mainly by social costs. For gas, this means policy makers must now judge how the energy transition will impact their societies and develop flexible and adaptive policies to minimise the risks to their energy security and promote their economies.

1. Introduction

Gas can displace other fossil fuels, coal and oil, to a greater or lesser extent. But much depends on governmental policies, as well as on commercial market developments. Gas also has the potential to displace nuclear, as well as various traditional fuels, such as peat and fuelwood. (The issue of the relationship of gas to renewables, whether it is more complementary than competitive, is addressed in the second paper in this series).

Gas enjoys significant advantages. It is plentiful and its availability as both pipeline gas and liquefied natural gas (LNG) ensures there is already considerable diversity in both sources of supply and routes for supply, two key elements in ensuring energy security. It is already well developed, with extensive distribution systems throughout much of the UNECE region, and the technologies associated with natural gas handling are well understood.

However, it should not be assumed that gas will be the automatic replacement for fossil fuels. Much depends on the balance between two aspirations that have much in common but are not identical. The first is the rapid decarbonisation of energy; the second is the use and development of energy in a sustainable manner. The first is necessary to avert or overcome the climate emergency; the second is necessary to ensure the economic well-being of the global population.

In principle, natural gas is in a remarkably strong position to play a leading role in the phasing out of coal in power generation, thus contributing significantly to reduced CO_2 emissions. At the same time, it can complement to renewables, which are already playing an important role in terms of energy sustainability and which should prove to be the foundation on which long-term energy sustainability is to be based. The relationship between natural gas and renewables is explored more fully in Paper Two: How natural gas can support the uptake of renewable energy.

However, because the two objectives of decarbonisation and energy sustainability are not identical, there is a need for clear policy initiatives, not least since the steady increase in renewables output will impact on the average load factor of thermal generation. At present, it is far from clear how efforts to achieve decarbonisation and to secure energy sustainability will affect each other.

Overall, there is considerable evidence that in some parts of the UNECE region, notably Western and Northern Europe, there may well be little or no augmented role for gas, Renewables and energy efficiency measures will be enough to meet future demand for power. The question is whether this may also prove true in other UNECE sub-regions and member states, notably Poland, Ukraine, and Russia.

The issue of baseload capacity, and the role of gas in this capacity, is addressed in the second paper.

2. Key Points

The primary issue, in terms of both carbon emissions and short-to-medium term energy sustainability, is the ability of gas to replace coal. At the same time, however, it is crucial that natural gas should also intensify its efforts to secure a bigger role in transportation and other products and services currently reliant on oil.

Energy intensive industries generally rely on fossil fuels. Gas can serve much of this market – coking coal required to produce coke for blast furnaces remains an exception – more cleanly, and often more efficiently, than other fossil fuels.

Until recently, switching from coal to gas appeared to be the most cost-efficient way of securing a major reduction in carbon emissions. In 2016, one of Statoil's Senior Vice Presidents, Rune Bjornson, seemed to be very much in the mainstream when he declared: "One of the most important and quick fixes for the European climate is to substitute coal with gas. Very, very important. It is the most cost-efficient, quick fix to meet the climate challenge."[1]

The conventional wisdom may no longer be wise. There is now increasing evidence that the costs of renewables, including those required to create flexible distribution systems to help compensate for current intermittency, are not only challenging this assumption in Western and Northern Europe but in other UNECE sub-regions as well.

Moreover, policies to promote renewable forms of energy have succeeded – not least as a result of both direct and indirect government support – and renewables are increasingly challenging fossil fuels and nuclear in terms of true life-cycle costs.

For example, the UK's most recent auction for electricity generated from renewables on 20 September 2019 included awards to six offshore wind projects, with a combined capacity of 6.7 GW, that are expected to deliver electricity on a completely unsubsidised basis. The first three are due to come on line in 2023/4 and to provide electricity at a fixed price (in real 2012 UK currency) of £39.65 per megawatt hour (MWh), while the second three, to come on line in 2024/5, will deliver at a fixed price of £41.61/MWh. For its part, the UK government anticipates that the overall wholesale electricity price will range between £48.95/MWh in 2023-24 to £52.36/MWh in 2026-27. By comparison, the government's agreement for development of the 3.26 GW capacity Hinkley Point C nuclear power station, which is currently scheduled to come on line in 2023, provides for electricity to be delivered at a fixed price of £92.50/MWh.

There are also political and social issues that could significantly impact on the ability of gas to replace coal. These include the reluctance of countries with economies and communities that are reliant on coal production to move rapidly to eliminate coal production or even to reduce it significantly in the near future. This approach is best exemplified by Poland's desire to secure a "just transition" for its coal industry, most notably expressed when it hosted COP 24 in December 2018 in Katowice, the country's coal-mining capital. Its importance was further underscored by the fact that Poland currently accounts for around 100,000 of the European Union's 185,000 coal miners. While it is necessary to phase out coal on environmental and health grounds (see Paper Two for the impact of coal-related health costs in the UK) and while this can increasingly be expected to reflect an increasing underlying lack of profitability in the coal sector, it is

equally important to recognise that this will require a very substantial – and potentially expensive – programme to tackle the social and economic consequences to coal-mining communities.

Energy transition is a complex business that it cannot be assumed that the rate of change will be the same across the UNECE region. For gas, it does look as if the window of opportunity to displace coal for electricity production is closing rapidly. This means the industry will have to move fast to make crucial investment decisions that may, in large part, be determined by essentially non-commercial requirements. A comment made by IIASA's Holger Rogner at a UNECE meeting in May 2019 that "the market will invest in gas up to 2040 – if it makes sense" looks increasingly likely to be remembered for its last four words, rather than for the first nine.[2]

Part of the problem is that there is no agreement amongst the stakeholders whether the conventional wisdom is changing and at what rate. This is exemplified by the attitude of one major energy company, which is prepared to focus very strongly on science and technology, including such key elements as carbon capture and storage and the development of battery storage, but which still considers that fossil fuel development should remain its core business.

There are also serious projections that demand for gas may well decrease from 2030 onwards - or even earlier. For example, the IEA's 2019 World Energy Outlook anticipates that under its central base Stated Policies scenario, the EU's demand for natural gas, which amounted to 466.8 bcm in 2018, will total just 386 bcm in 2040. So if gas is to penetrate potential new markets and take advantage of the opportunities that new technologies are opening up, the gas industry needs to start making serious investment plans now, even though this might not make immediate commercial sense. This is perhaps the most crucial element of all in terms of actions required in the immediate future.

If there is to be a significant role for gas as a transition fuel, let alone as a destination fuel, then national governments and decision-making institutions such as the European Council of Ministers (as well as the European Commission in its twin role as proposer and implementer of EU policies) will have to develop gas-related strategies that encourage the use of gas in the near- and medium-term while providing for a subsequent orderly transition from gas towards a vastly increased use of renewables. It might not be realistic to assume that all UNECE member States will coordinate their policies in this respect, but it is crucial that they share information concerning both the nature and implementation of their policies.

3. The Specifics of Gas Displacement of Coal

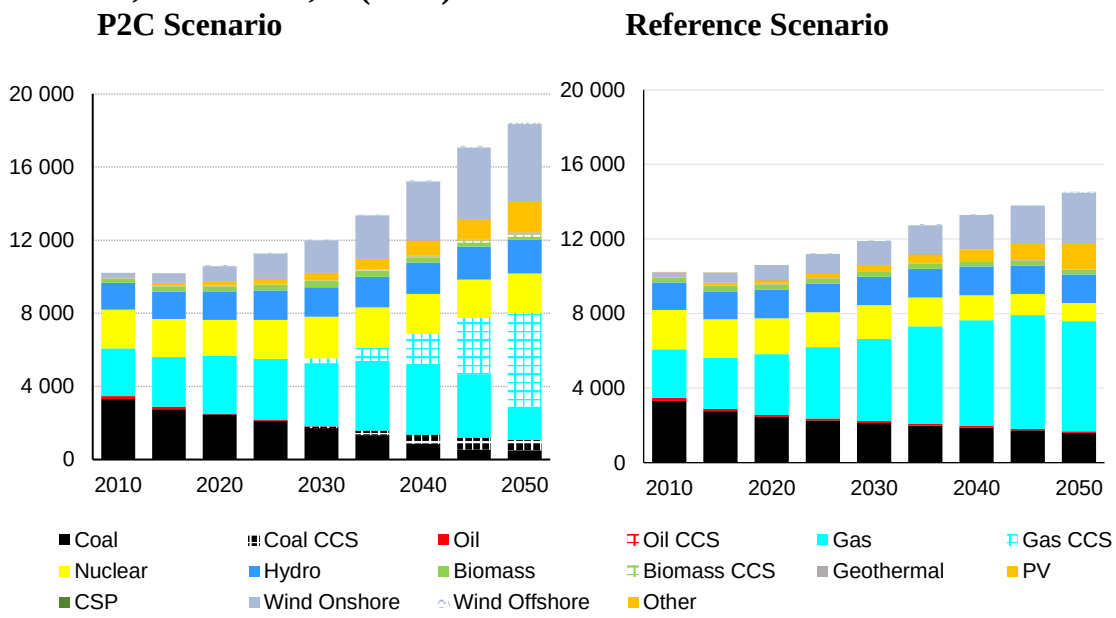
There are opportunities for gas to displace coal, but much depends on such key factors as the pace of reduced costs in producing and installing renewables, advances in technology and the speed with which both governments and companies take advantage of such changes. Such factors can only be understood using integrated energy models.

These models indicate that decarbonisation can favour the use of gas. For example, the most optimistic scenario in the recent IIASA modelling of the UNECE region is the P2C Scenario in which countries strive to stay on a trajectory to limit global warming to 2°C. This scenario sees power generation from coal fall by half over a 10-year period, from

2,760 terawatt hours (TWh) in 2015 to 1,336 TWh in 2025. It then collapses to just 456 TWh in 2030, to a mere 181 TWh in 2035 and to only 2 TWh in 2040. By 2045 it has been eliminated altogether. Natural gas steps in to fill the initial gap, rising from 2,728 TWh in 2015 to 3,764 TWh in 2025 and then to 4,095 TWh in 2030 and to 4,446 TWh in 2035. Then it starts to decline, falling to 3,351TWh in 2040, to 3,412 TWh in 2045 and to just 1,751 TWh in 2050.

The IIASA P2C Scenario, predicated on strong government actions to secure swift decarbonisation, such as carbon pricing and carbon budgets, illustrates the radical nature of the energy revolution that is required if the UNECE region is to meet the Paris targets. A 'business as usual' scenario, the IIASA Reference Scenario, anticipates that coal will still be holding on to a market of some 1,766 TWh in 2050, and that gas, far from entering a decline, will continue on an upwards trajectory, reaching 3,868 TWh in 2025 and then positively soaring to 4,589 TWh in 2030, to 5,657 TWh in 2035, to 6,328 TWh in 2040 and to 6,877 TWh in 2045. Its growth continues after that, to hit 7,135 TWh in 2050, and even then some further growth is anticipated in the 2050s, albeit at a slower pace. In effect, the IIASA model shows that, as a transition fuel whose use has to be curtailed to meet the Paris targets, natural gas would be responsible for generating 1,751 TWh in 2050. In contrast, were its role to be that of a destination fuel, IIASA's Reference Scenario estimates it would quadruple its contribution to electricity generation, reaching 7,135 TWh in 2050 (see Figure 1).

Figure 1.
Electricity Generation Mix in the UNECE Region under the P2C and Reference Scenarios, 2010 – 2050, in (TWh)



The investment implications of these two trajectories are radically different. Indeed, in the IIASA P2C scenario, which assumes policies will be introduced that ensure that Paris 2-degree Centigrade (P2C) limit for global temperature increase will be delivered, much will depend on the costs associated with developing and marketing new technologies. Thus one of the most striking aspects of this scenario is that it presumes that costs will be sufficiently low, and technology sufficiently high, to ensure the introduction of large-scale gas carbon capture and storage (CCS). This has yet to be achieved and early introduction can only be

expected if its deployment is required by regulation or supported by either a carbon price regime to encourage its development or higher prices for oil to boost enhanced oil recovery. The IIASA P2C scenario anticipates such CCS entering service in the late 2020s, yielding 254 TWh in 2030 and then soaring to 806 TWh in 2035, to1653 TWh in 2040, to 2873 TWh in 2045 and to 4,610 TWh in 2050. Such developments will be crucial, given that this IIASA scenario anticipates an increase in total electricity generation across the entire UNECE region from 10,214 TWh in 2015 to 17,362 TWh in 2050.

However, extensive investment will be required if such a scenario is to become reality, with IIASA calculating the total cost at almost seven trillion dollars and with spending on renewables exceeding that on gas.

But the key issue may not be the long-term investment requirement, but the fact that much of the UNECE region is now at an inflection point where renewables are cheaper than coal for power generation. This makes coal doubly vulnerable to demands that it should be replaced as quickly as possible since it not only produces more carbon emissions than any other fossil fuel, but is also increasingly expensive.

According to Carbon Tracker's Matthew Gray, "The economics of coal power is collapsing: by 2030, 95% of coal will cost more to run than new renewables."[3]

When Carbon Tracker prepared its initial data in 2018, just two European countries, Spain and the United Kingdom, were already producing power from renewables at a lower cost than power from coal. Carbon Tracker considered that in 2019 no less than 16 other countries would reach this tipping point. These were: Austria, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Poland, Portugal, Romania, Slovakia and Slovenia. Carbon Tracker anticipated that Czechia and the Netherlands would follow in 2020; that Turkey would find it cheaper to rely on renewables than coal in 2023; and Ukraine in 2024. As for the final termination of coal-fired plant that usually takes a bit longer. Sweden ceased to rely on coal imports in 2017 but residual stocks are still available and its last coal-fired power plant is not scheduled to close until 2022. On a world-wide basis, Carbon Tracker considered that 42%of the operating coal fleet was already uneconomic in 2018 and that by 2040 this would have risen to 72% "independent of additional climate or air pollution policy."[4]

The eclipse of coal by renewables in large parts of the UNECE region furnishes concrete examples of how coal can be eliminated in much of the energy spectrum. But with particular regard to Poland, Ukraine, Russia and Kazakhstan, there is still a need to ensure that the phasing out of coal is conducted in a manner that tackles the serious social consequences that accompany the end of any major industrial enterprise. The need to focus on the idea that the UNECE can set an example in this regard reflects two salient facts. The first is that the region includes member States that are either moving rapidly to eliminate the use of coal in power generation or that are reaching the point at which renewables are actually cheaper than coal as a source for power generation. The second is the UNECE's member States only account for around 10.6% of global coal-fired electricity generation. BP's 2019 Statistical Review of World Energy indicates that the total for the UNECE region is not much more than 1,070 TWh out of a worldwide total of 10,100.5 TWh.[5] By contrast, coal-fired electricity production in the Asian Pacific region accounts for 7,290.8 TWh, almost 72.2 % of the global total.

But if this serves to underline Gray's argument that "the climate challenge will be won or lost with Asian coal power," it also serves to demonstrate that because it is so much easier for much of Europe to wean itself off coal, it becomes essential for those who can achieve this to set the right example if the world is to come anywhere close to reaching the Paris targets. In this regard, it is not just a question of how the richer nations of Northern and Western Europe bring coal-fired production to an end, it is how this to be done in the UNECE countries that are more reliant on coal – not least in social terms – such as Poland, Russia and Kazakhstan.

In most European countries, it is already cheaper to produce power from renewables than from coal. And in almost all the rest, that will be the state of affairs in 2024. Elsewhere in the UNECE region, Carbon Tracker notes that with regard to the United States, "new renewables will be cheaper than running coal in 2019."[6]

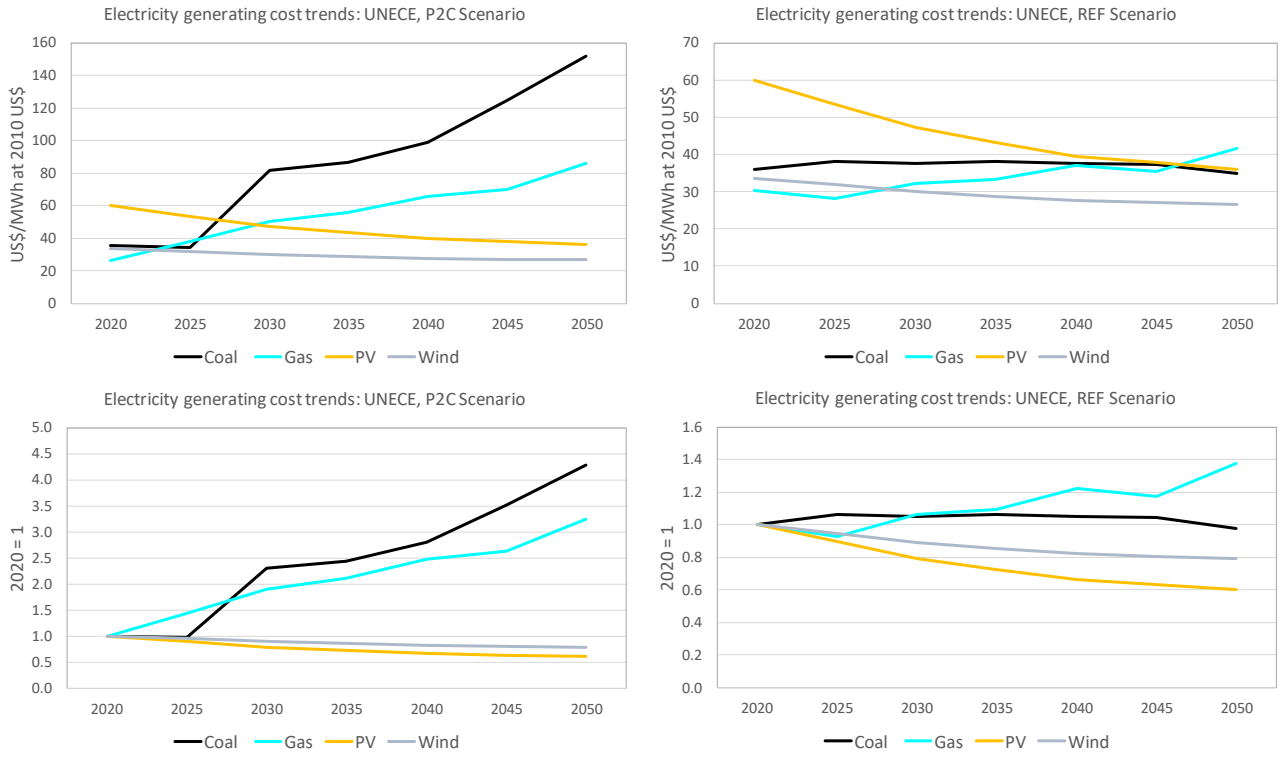
There is, however, one very major exception to this - Russia. According to Carbon Tracker, solar power in Russia is likely to cost much the same as coal in 2040, but its natural complement, onshore wind power, is still likely to be significantly more expensive. It would seem reasonable to posit that a similar situation might well obtain in Kazakhstan, although this is a country for which there is no Carbon Tracker data.

On the other hand, Germany may witness a much faster set of coal plant closures. Officially it has said that it will terminate coal-fired power in 2038, but Michaela Spaeth, Energy & Climate Ambassador for Germany's Foreign Office, has declared: "We will try to be out of coal industry in 2038. As a person, not a diplomat, I hope it would be earlier. We need to get out of carbon industry as soon as possible." [7] Ambassador Spaeth then produced her own answer as to why this might happen: "Renewables and a decarbonised economy is by now so cheap. If you had told me 10 years that you could generate electricity from renewables for two eurocents per kilowatt hour…."[8].

She did not need to complete the thought; the price of renewables is falling so rapidly. In the UK auction system, for example, the price of offshore wind was expected to hit £100 ($1.245) per megawatt hour (MWh). In practice, offshore wind was able to deliver power to the system in 2017 at prices as low as £57.50 ($70.60) and by 2019 this had fallen to just £39.65 ($50.05). Indeed, solar photovoltaic and onshore wind no longer require subsidies to compete in many markets around the world. In the UNECE, it is not clear whether UK offshore wind power can yet afford to offer subsidy-free bids at auction, but these are expected in both Germany and the Netherlands.

What this indicates is that it is increasingly likely that renewables will play a greater role than gas in replacing coal in much of Europe. Much depends on what kind of markets develop. There is also a question as to whether the rapid advance of renewables is itself dependent on sustained government support or whether this is no longer a crucial element for expansion of renewables into the electricity market (see Figure 2).

Figure 2.
Electricity Generating Costs Trends, P2C vs Reference Scenario



The economic challenge of low-cost renewables means that coal producers, not only inside the EU but also in countries outside the EU, possess compelling economic arguments to secure the replacement of coal with renewable sources. Indeed, according to Carbon Tracker, the only exception to this is Russia, which it considers should end most of its coal-fired power by 2030 but acknowledges that some will still be required as late as 2050. It can be argued, however, that this model implicitly assumes that commercial considerations would impel coal plant closures in the next decade or so, which in reality may not necessarily prove to be the case.

So where does this leave gas?

The answer depends on which part of the UNECE region is being considered. In much of Northern, Western and Southern Europe, it almost certainly means that any incremental requirement for power generation will come from renewables, with gas perhaps taking a little of the slack from coal, but primarily with renewables replacing coal.

In Poland, with new gas import infrastructure in place – notably the LNG terminal at Świnoujście and the Baltic line that will enable it to import Norwegian gas via Denmark – it is reasonable to expect that gas will retain a high share in the energy mix for some years. As coal's dominance diminishes – it accounted for 90% of power generation in 2005 but this fell to 75% in 2017 and is expected to shrink to 40% by around 2040, so the role of both gas and renewables has grown. If, as expected, the cost of renewables continues to fall significantly, this will give them a further boost.

This means that considerable attention will be needed to ensure what the Polish authorities consider to be a just transition. The end of coal-fired power means the end of the Polish

coal mines, and that means that major efforts to restructure the economy of the mining areas around Katowice will be required.

While such issues as carbon taxation, carbon credits and fuel subsidies (whether for renewables or fossil fuels) naturally play major roles in determining market conditions for particular fuels, it should be stressed that tackling the social consequences of the end of coal-mining should be an obvious target for EU structural and regional funding.

In general, it can be argued that in much of the EU – notably in such traditional coal consuming countries as Germany, Italy and Spain – it is quite possible that a combination of political will and competitive renewables pricing will drive a major transformation in the very near future, with targets for the removal of coal from electricity generation being met much earlier than their projected date.

4. Specific Regional Zoom-ins

A different picture is likely to emerge in other UNECE areas. Turkey, Ukraine, Russia and Central Asia may well pursue quite different trajectories.

4.1. Turkey

When Turkey first agreed to import gas from the Soviet Union in 1984, it was precisely because of the environmental impact of its reliance on coal, and especially lignite, to generate power for the cities of Ankara and Istanbul. The need to end the smog that routinely attacked these cities and persistently hovered over the Turkish capital in winter, led first to the development of the 15 bcm/y Western Balkans line through Ukraine, Moldova, Romania and Bulgaria to Turkey (and onward to Greece) and then Blue Stream, a 16 bcm line under the Black Sea that connects Russia directly to Turkey. Despite persistent disputes, notably over pricing, these lines have served Turkey well, providing a vibrant example of how gas can improve the environment.

Nonetheless, a generation after Turkey signed its first agreement to import Soviet gas, concern about the costs of fuel imports prompted the country to look once again at the feasibility of boosting development of indigenous coal and lignite, its only significant fossil fuel resources.

This phase now appears to have passed, not least because the likelihood of high gas prices has receded while there is also an increasing awareness of Turkey's very substantial potential to generate electricity from renewables, notably wind and solar (it already has a very large hydropower sector) at a time of rapidly falling renewables costs. Moreover, Turkey currently receives gas from a wide variety of suppliers as well as Russia, notably Azerbaijan, Iran and the United States (Turkey is Europe's biggest customer for US LNG). Such diversity has substantially eased previous energy security concerns. It also has a distribution system that covers roughly three-quarters of the country's 83 million people.

There seems little indication that Turkey wishes to increase its reliance on gas beyond the commitments it has already made for pipeline gas imports and the flexibility offered by its creation of new LNG import terminals. From a supply perspective, the new TurkStream pipeline from Russia will essentially do little more than serve to provide an alternative route

for Russian gas supplies currently delivered via the Western Balkans system, which Russia's Gazprom will no longer use for deliveries to Turkey once TurkStream is completed. Although the final capacity of TurkStream will be roughly double that of the Western Balkans line, almost all the extra capacity will be used to deliver gas to customers in Southern and Central Europe currently served by Russian lines though Ukraine.

This would seem to indicate that in Turkey, as in Western and Northern Europe, the future of natural gas lies not so much in replacing coal as in performing a balancing role in a country that, on both environmental and commercial grounds, should take considerable advantage over the next decade of its potential to develop not wind, solar, geothermal and run-of-the-river hydropower. This, in turn, will boost Turkey's role in gas storage. In July 2019, Turkey broke ground at the Tuz Golü (Lake Tuz) Underground Storage Expansion Facility in central Anatolia, a project which it says is intended to result in the establishment of the world's largest underground gas storage facility. Tuz Golü currently has a 1.2 bcm capacity and the expansion, which is due to be completed in 2023, is intended to take capacity to 5.4 bcm. The facility would then have the ability to inject 80 million cubic metres a day (mcm/d) into the Turkish gas network.

However, lack of clarity concerning the trajectory of renewables development in Turkey makes it uncertain as to how much gas will be required to fill such a role – and for how long. Turkey has targets for the uptake of renewables but no plan for actual implementation. Although renewables advocates say that Turkey has the second-best potential for wind power in Europe (eclipsed only by Scotland), actual development of wind projects is slowing down and is below the government's strategic objective. There is also doubt as to whether solar power will reach its 3,000 MW target this year. These developments appear to reflect the loss of a major major inducement to develop renewables, the feed-in tariff system, which is scheduled to end in 2020. Investment in hydropower, likewise, is slowing down.

However, there has been significant success in geothermal, with capacity rising from 600MW to 1300 MW this year, while biomass is on track to reach a 700 MW target. In May, one of the leading developers of renewable energy in Turkey, Fiba Enerji Chairman Murat Özyeğin, said Turkey's Energy Market Regulatory Authority (EMRA) was an experienced and effective regulator and that the country had the political will to develop renewables. But he also listed various challenges, including the need for clarity on the feed-in tariff issue, a belief that such a tariff should be based on the US Dollar or the Euro to ensure foreign investment, and licensing reform. This last was needed because important projects tended to get delayed as a result of licenses being traded rather than used for actual development.

The nature of the balance between gas and renewables should become clearer in 2020 as major gas contracts come up for renegotiation and as the government's Action Plan starts to be finalised.

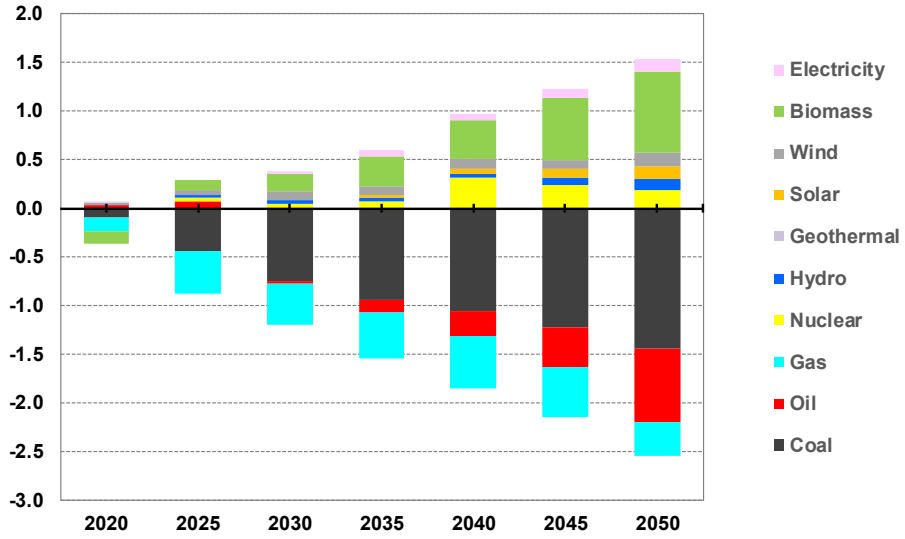
4.2. Ukraine

Nervousness about both the security and cost of gas supplies would seem to favour an accelerated transition to renewables in Ukraine but the path is not clear, not least because of political and security issues. Much of the country's coal industry, which has traditionally

played a major role in Ukrainian energy development, lies in areas controlled by separatist forces. There are uncertainties concerning the future of direct supplies of gas from Russia, an issue tied to the future of the transit of Russian gas across Ukraine to markets further west. At present, although the majority of the country's gas imports actually consists of gas molecules that originate in Russia, they arrive in Ukraine indirectly, notably via Poland and Slovakia.

Nonetheless, judging from the IIASA studies, adoption of the Paris targets would result in a fundamental change in the way in which Ukraine generates its energy. In effect, while the share of gas in the energy mix would diminish in the decades to 2050 under IIASA's P2C scenario, the decline in coal output would be much greater as renewables took on an increasing role in overall energy production (see Figure 3).

Figure 3.
Impact of P2C Scenario on Coal & Gas in Belarus, Moldova and Ukraine subregion 2020-2050



4.3. Russia

In the case of Russia, two very different approaches need to be considered. The first concerns international energy markets, the second Russia's domestic fuel balance.

On the international front, Russia has a very strong incentive to promote its gas exports to the rest of Europe, backing this up with the argument that it is helping to reduce carbon emissions globally by substituting for existing coal use. Thus Ruslan Edelgeriyev, President Putin's Special Envoy for Climate Affairs, has described the NordStream 2 Pipeline project, intended to supply up to 55 bcm/y of gas from Russia to European markets via Germany, as "a project in favour of climate protection."[9]

As long as the rest of Europe remains committed to gas, Russia will have a reasonably secure market. However, there is no particular expectation that most gas markets in Europe are set to grow substantially while, as discussed in an accompanying paper (See Paper 2: Gas and Renewables) the challenge from renewables in these markets is likely to be very strong indeed. In all probability Russia will be able to maintain its share of European gas

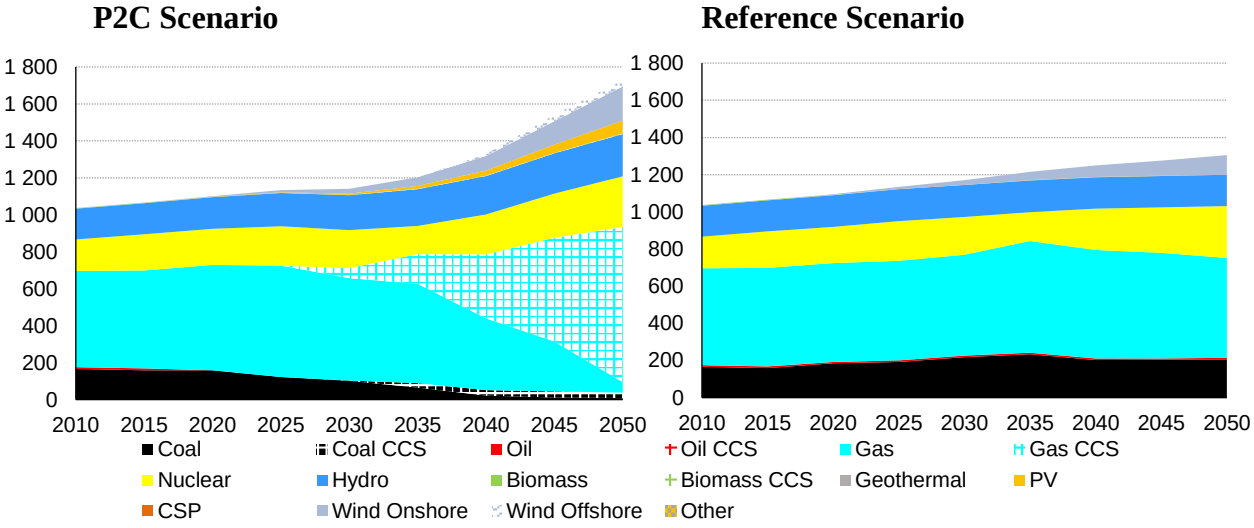
markets because it can, if necessary, almost certainly offer gas at lower prices than any rival supplier so that it may also be able to maintain current export levels even in a potentially shrinking gas market. Some of this gas will obviously replace coal, but that will be primarily a consequence of government policies in coal consuming countries and the falling cost of renewables rather than a response to the availability of Russian gas.

Things would change considerably if Russia and the other major gas producers, notably Kazakhstan, Turkmenistan and Azerbaijan, were to be part of an integrated energy market with their European customers, existing or prospective, stretching from the Atlantic to the Pacific. BP's latest Statistical Review shows that Europe, (defined as all states west of Russia with the exception of Belarus and Moldova, whilst including Turkey) is, collectively, by far the biggest purchaser of Russian gas, accounting for 200.7 bcm (81.0 %) of total Russian exports of 247.9 bcm in 2018. At the same time, Russia is by far the biggest supplier of gas to Europe, with the 200.7 bcm of Russian supplies accounting for (36.5 %) of total European imports of 550.4 bcm in 2018. An integrated energy market that incorporated the EU's existing Energy Union, the Energy Community member States outside the EU, and the gas producers of the Eurasian Economic Union – with the logical inclusion of Turkmenistan and Uzbekistan as well – would not only foster economic interdependence but serve to promote the exchange of energy resources and technology that would enable the UNECE region as a whole to compete ever more strongly on international markets.

On the domestic front, the likelihood that renewables will not able to compete with coal on cost means that if Russia were to join in any global effort to achieve the two-degree target – and Russia has only announced its de facto ratification of the Paris agreement in September 2019 – it would have to close down the majority of its coal-fuelled power stations by 2030 with gas as the main replacement fuel.

This is highly unlikely, but not impossible. In 2018, coal accounted for just under 16% of total Russian electricity generation, while gas accounted for almost 47%, nuclear for 18% and hydro for 17% (see Figure 4).

Figure 4
Electricity Generation Mix in Russian Federation under the P2C and Reference Scenarios, 2010 – 2050, in (TWh)

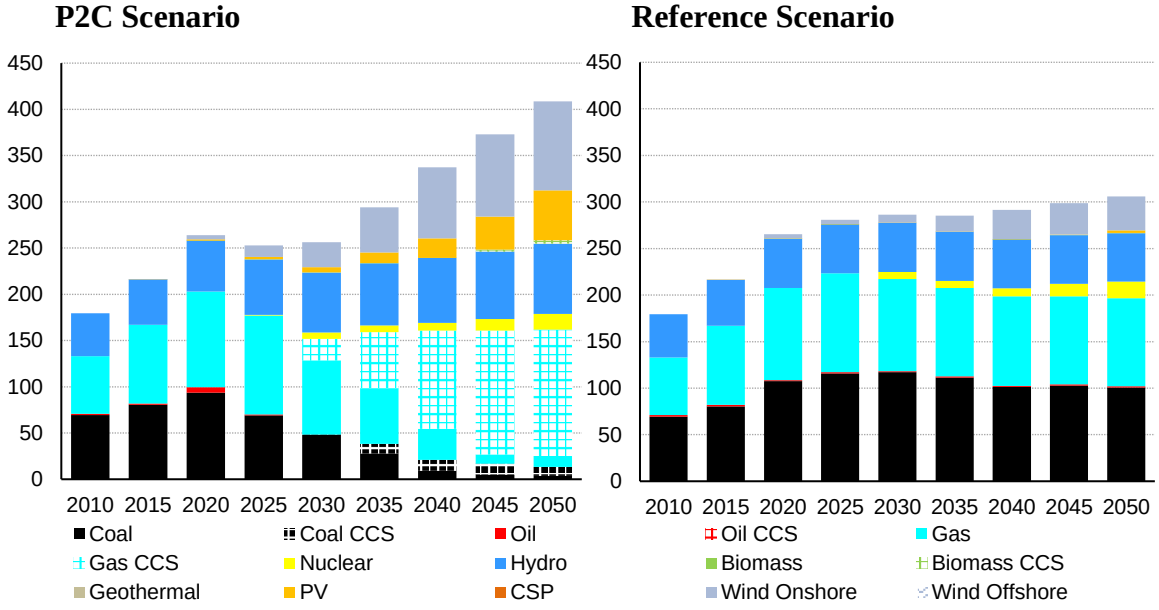


If Russia were to promote commercial prices for domestic energy this would provide encouragement for both Gazprom and other Russian gas producers to seek to increase their share of the market at the expense of coal. It would, of course, also help to promote renewables. This seems unlikely, and it is also far from clear that, in the near future at least, there will be any kind of government-backed drive to replace coal with gas on any significant scale.

4.4. Central Asia

In many ways, the issues confronting Central Asian member states in the UNECE reflect those of Russia. However, almost certainly their solutions will vary considerably from country to country. Overall, the region stands to gain very considerably from policies designed to implement the Paris targets on limiting carbon emissions, not least through the expansion of electrification. The IIASA scenarios indicate that, overall, Central Asia's electricity demand would likely be one-third higher under the P2C scenario than under the Reference scenario (See Figure 5).

Figure 5.
Electricity Generation Mix in Central Asia under the P2C and Reference Scenarios, 2010 – 2050, in (TWh)



Moreover, the increased role of wind and solar power will serve to ensure a greater geographical distribution of electricity supplies in a region that still has many communities that lack connections to national or area grids. The way in which the implementation of policies to deliver the Paris targets serves to boost both gas development in the main producing countries – Kazakhstan, Turkmenistan and Uzbekistan – and the growth of renewables throughout the region, including the hydropower-dependent nations of Kyrgyzstan and Tajikistan, is addressed in Paper 2.

4.4.1.Kazakhstan

There is massive potential for gas to replace coal in Kazakhstan, not least since gas is plentiful, with massive gas caps sitting atop some of the nation's largest oilfields, while the country's internal gas distribution system has recently been significantly expanded, so that areas that once were dependent on coal-fired electricity can now turn to gas. Whether this will actually happen, however, is far from certain.

The main issue is simply that energy demand is soaring. It rose from 67.6 MTOE in 2017 to 76.4 MTOE n 2018. Of this, no less than 36.4 MTOE came from coal in 2017 and 40.8 MTOE in 2018. Since gas only accounted for 13.7 MTOE in 2017 and 16.7 MTOE in 2018, there would appear to be plenty of scope for gas.

Most of Kazakhstan's gas would require significant investment to develop, while its abundant coal reserves enable it not only to utilise coal to generate 70% of its electricity but help serve to free up other fossils fuels, notably gas but also oil, for export.

This is, indeed, government policy. Kazakhstan announced in 2013 it would pursue a "Green Revolution" aimed at ensuring that 3% of its energy in 2020 would come from renewables, that by 2030 that figure would rise to 10% and by 2050 to no less than 50%. The government announced it would commit one per cent of the country's annual GDP to achieving these goals.

The paradox that the owner of some of the world's richest fossil fuel resources should take such an approach was not lost on the Kazakh authorities. In June 2014, Kazakh Foreign Minister Erlan Idrissov, referring to the desire of some countries to pursue cheap electricity based on fossil fuels, notably coal, commented: "In many ways, it might seem strange that Kazakhstan is determined to go against this trend."10

He added: "We are among the world's top ten producers of oil and gas and home to the largest oil discovery in of the last four decades (the Kashagan field). Our fossil fuels have driven a ten-fold increase in our national GDP in the last 15 years, allowing us to invest heavily in modern infrastructure and the well-being and prosperity of our citizens."11

However, he argued, there were compelling reasons to promote renewables. He continued: "It is economics, not altruism, which must drive the green revolution to reduce carbon emissions. There is now a mountain of evidence showing that dealing with the impact of climate change will be much more expensive than the changes needed to slow down and halt it."[12]

One factor may counter this trend. The dominance of large scale state-run or state-backed energy companies in Kazakhstan makes it likely that there will continue to be major efforts to expand the existing centralized power distribution systems. So while renewables development will be actively encouraged as well, particularly in remote off-the-grid areas, there will be a natural tendency to promote and expand existing large-scale coal-fired electricity. If the country's gas balance does change significantly, not least as a result of its newly-created ability to pipe gas from fields in the northwest of country to the industrial cities of the southeast, it is possible that the Kazakhstan's state-directed energy companies may yet introduce at least a limited programme to use gas to replace some of the coal used in power generation.

4.4.2.Turkmenistan

Everything in Turkmenistan revolves around gas. The country holds Galkynysh, the world's largest onshore gasfield with this one field alone containing reserves estimated at a minimum 14.2 trillion cubic metres (tcm) and a potential of 21.2 tcm. Turkmenistan has no coal and, in terms of domestic fuel consumption, the only issue is the extent to which gas can be used as a source for liquid fuels and petrochemicals, as well as a source for export revenues, and whether the development of renewables can bring energy to some of the country's more remote regions.

4.4.3. Uzbekistan

A relative abundance of gas coupled with the limited indigenous petroleum resources ensures that Uzbekistan's largely industrialised economy must rely on gas to fuel its power and industry, and must also use it wisely to ensure that there is also natural gas available to secure much needed export revenues. This means there is considerable interest in, as well as potential for, renewables, notably wind and solar. These will likely be used to support gas, not coal, since Uzbekistan currently uses ten times more gas than coal.

4.4.4.Tajikistan and Kyrgyzstan

The substantial, hydropower resources available in these two countries ensure that an existing renewable source will continue to constitute the mainstay of energy development for the foreseeable future. The principal concern will be whether the climate emergency prompts the shrinking of glaciers to such an extent that the supply of water for hydropower is restricted.

5. Energy Security

Gas does possess one very distinct advantage that should last for at least the next decade, and perhaps for five or ten years after that: its ability to help countries and regions ensure their energy security. For the UNECE, and particularly for its principal energy importers, the availability of gas from a plethora of suppliers and via a variety of import routes is a major factor in energy security considerations. Likewise, for the UNECE region's producers, security of demand remains a critical factor. For both consumers and producers, of course, there is a need for security of transit, a factor that would be considerably improved where the bulk of the UNECE region to constitute an integrated market.

Laszlo Varro, chief economist at the International Energy Agency, argued recently that "Gas capacity remains essential for energy security." His comment was particularly significant since much of his address was devoted to the need to promote decarbonisation and the development of sustainable energy policies based largely on renewables.

6. Conclusion

It is a truism that investment plans need to be put in place now if energy demand is to be sustained in the UNECE region post-2030, let alone if it is to be sustained in an environmentally friendly manner. However, the world is entering a phase of greater political and technological disruption due to the rise of the climate emergency and advances in technology as more funding is devoted to renewable energy development and deployment. The modelling shows that a policy stance based on a Pathway to 2°C results in a radically different energy mix to a 'business as usual' scenario.

This is challenging the conventional wisdom that gas is needed as a transition fuel to decarbonise the economy. If anything, more powerful arguments for the use of gas are its role in the provision of both energy security and quality of life. It is readily available for a long time and its continued use involves a minimum of disruption to society. The fact that it dramatically reduces carbon emissions by comparison with other fossil fuels is not as powerful an argument if renewables are cheaper anyway.

Given the political and technological uncertainty, investments in energy cannot be taken for granted, particularly for gas, since these will entail additional, significant commercial risk. Such issues as the introduction of predictable long-term carbon price regimes and provision for both the granting and phasing out of government subsidies for new renewables technologies need to be in place if the natural gas industry is to be able to take advantage of a limited window of opportunity for it to supplant coal in much of the UNECE region.

In the near term, it appears that renewables will provide low-cost electricity in much of the UNECE region. This means that renewables will be favoured both by investors seeking to profit from the market and by governments and politicians seeking to benefit from the provision of low-cost energy to the public whilst limiting the burden on public finances. As a consequence, coal is on its way out, limited mainly by social costs.

The overall task of policy makers is now to judge how the political and technological changes will impact their region and develop flexible and adaptive policies to minimise the risks to their energy security and promote their economies.

Abbreviations

Bcm	billion cubic meters
CCS	Carbon capture storage
COP 24	Conference of Parties – United Nations Climate Change Conference in 2018 in Katowice, Poland
EU	European Union
GDP	Gross domestic product
GW	Gigawatt
IEA	International Energy Agency
IIASA	International Institute for Applied Systems Analysis
LNG	liquefied natural gas
MTOE	million tonne of oil equivalent
MWh	Megawatt hour
TWh	Terawatt hour

Reference

[1] Bjornson, Interview with Natural Gas World, 4 February 2016. Author's notes.

[2] Rogner, UNECE Pathways workshop, Geneva 16 May 2019. Author's notes.

[3] Matthew Gray, presentation, Chatham House, London, 4 July 2019.

[4] Carbon Tracker. *Powering down coal*, November 2018. www.carbontracker.org. On its interactive website, Carbon Tracker explains its reasoning as follows: "Where profitability is defined as revenues minus long-run operating costs, our analysis finds that due to high fuel costs 42% of coal capacity operating today could be losing money." See: https://www.carbontracker.org/reports/coal-portal/

[5] *BP Statistical Review of World Energy 2019*. London, June 2019. There is no precise compilation for the ECE region, but BP's figures (in terawatt hours), include the following: EU, 655.2; Turkey, 111.7; Ukraine, 47.7; Russia, 177.5; Kazakhstan, 70.2; other CIS states, 11.3.

[6] Carbon Tracker. https://www.carbontracker-coal-economics-portal.com

[7] Address in Skolkovo, Moscow, 18 June 2019

[8] Address in Skolkovo, Moscow, 18 June 2019.

[9] Edelgeriyev, Address in Skolkovo, Moscow, 18 June 2019.

[10] Idrissov. Article. The Diplomat. 12 June 2014. https://thediplomat.com/2014/06/why-kazakhstan-is-betting-on-a-green-future/

[11] Idrissov. Op Cit.

[12] Idrissov. Op Cit.