

Coronavirus and energy, a sector challenged by geographical concentrations



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Foreword

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Foreword

The health crisis generated by the coronavirus has already clearly gone beyond this single domain and urgently requires us to broaden our vision to the entire global economy and its key driver, energy.

This is the interest of the analysis written by Tristan Metz and the Groupe d'études géopolitiques, which looks in detail at the major upheavals in the energy sector over the last three months.

In terms of oil, the collapse of demand from 8 to 10 mbpd in just a few weeks was coupled with opportunistic strategies to increase production by various players (Russia, Saudi Arabia, etc.), all of which led to a plunge in the price of crude oil to \$24.88 per barrel on March 18th, an all-time low!

The result is there: a historic global oil surplus of 10 mbpd, or 10% of the world market, in perspective by April 1st. What an admission of the inability of conventional instruments (OPEC+, ...) to coordinate the reactions of producer countries: a matter of worry for the world economy!

If we transpose this lack of global regulation to the gas market, how can we not fear the risks of instability and major conflicts between and within a good number of producing countries, which are the embodiment of cascading aftershocks of the health crisis? How will countries that are still dependent on their fossil production be able to overcome this «double shock» both economically and in terms of health? And how, once the health crisis has subsided, can reason and vision be reintroduced into global energy choices?

This is also the interest of the GEG working paper, which precisely addresses the impact of the epidemic on the different compartments of energy transition and on its major projects (photovoltaic, wind power, batteries, etc.). With a major underlying question: will the reduction of CO2 emissions remain the necessary priority for post-coronavirus world economies? Won't the need for short-term stimulus sweep away global environmental objectives defined at COP 21? If so, will the purity of the waters of the Venice lagoon and China's urban skies remain like idyllic postcards of a suspended global economy?

This note concludes on a major question: how will the energy sector be rebuilt in the future? The author rightly concludes that there is a need for geographical diversification of value chains and an end to concentration in one country or another (oil in OPEC countries +; renewable energies in China, ...). But, beyond that, a certain vision of the Planet will undoubtedly have to be rethought, based on more indicators than GDP alone which, in line with the very definition of sustainable development, will have to be put in place. This New World will obviously have to be rebuilt around the well-being of citizens, respect for natural harmony, the provision of essential services and the development of common goods.

Already in 1972, in its famous Meadows report stressing «the limits of growth», the Club of Rome invited us to reflect on these subjects. But much work is still ahead of us, which in the coming decades will necessarily have to combine ecology, economics, social and political issues.

Executive summary

- The crisis initiated by the coronavirus (SARS-CoV-2) has revived the well know chorus of the dangers of globalization and the interdependencies it induces. Recent months have once again highlighted China's major role in the value chains of energy transition industries. At the same time, the price war on the oil markets has reminded us of the tension between their exposure to a small number of state actors and their importance for our economies.
- Conversely, our analysis, which is necessarily imperfect, of the initial economic effects of this energy crisis appears to outline another conclusion: the need for geographical diversification of energy value chains and not their concentration in a given country or region (China, France, the United States or elsewhere). However, this diversification is by no means self-evident and other factors, economic but also environmental and social, could legitimately obstruct it.
- Although the oil sector is experiencing a demand shock of unprecedented magnitude since the 2008 crisis, the fall in the price of crude oil which now threatens the balance of players rather seems to be the consequence of the indirect conflict that Russia and Saudi Arabia have been engaged in since March 8th. Indeed, the 1.8 million barrels per day (b/d) drop in world consumption over the first quarter induced by Chinese measures to counter the epidemic led to a fall from \$60 to \$50 per barrel in February - a sustainable price for the sector and the producing countries. The anticipated increase in production of more than 3 million b/d by Saudi Arabia (supported by its allies Kuwait, Iraq and the United Arab Emirates) led to a barrel at less than \$25¹ - a much less sustainable level. Similar effects can be seen in gas markets. The market power of these ten players appears to be directly responsible, even if the demand shock provides a particularly favourable context for its exercise.
- In this context, renewable energies and electric mobility are in turn praised or seen as new sources of dependence. While some analysts see them as a response to our societies' exposure to geopolitical conflicts and their after effects on oil and gas markets, others stress the dependence of these sectors on China.
- However, the consequences on the energy transition sectors and their value chains are more complex to assess and do not only involve supply constraints. They result from the non-trivial interaction of the disruptions in each chain, the conditions for granting subsidies in each country, and pre-existing tensions on production. The situation is therefore different between wind and solar, but also between the market in China and outside China. The Chinese situation illustrates in particular that locally producing panels or battery is not enough to be immune to a crisis of this magnitude.
- Ultimately, the crisis is expected to be felt in the transition sectors mainly through macro-economic effects. Indeed, the situation could lead to greater financing difficulties, a drop in energy demand, or changes in policies on the part of states or companies. The battery and electric vehicle sector is a very good example. In this context, any national production would not be spared either.

1. However, hasty interpretations should be cautious of the fact that these effects are non-linear and cumulative in this case. There is no reason to think that the increase in production alone would have led to a price of \$45 per barrel, for example.



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Energy Engineering and Economics, École polytechnique (X14), UC Berkeley (2019)

Coronavirus and energy, a sector challenged by geographical concentrations

While the coronavirus is increasingly affecting our economies, it is also upsetting the energy sector and its balance. Although many uncertainties remain and any definitive conclusion is currently futile, the current crisis is a perfect reminder of the economic, industrial, geopolitical and environmental issues that underlie the sector. We offer here an analysis, necessarily imperfect, of these issues in the oil and gas sector, but also in the photovoltaic, wind and battery sectors, which are crucial to the implementation of the energy transition on a global scale. By highlighting the effects of an excessive geographical concentration of value chains in the energy sector in particular, we believe this analysis underlines the need for a geographical diversification of these chains - and not their reterritorialization and confinement to a particular country or region in a territorialist reflex ignorant of the risks of too much centralization.

Measures taken by China, soon followed by other countries, have profoundly disrupted the flow of goods and people as well as the country's production.

Initially emanated in December 2019 in Wuhan, capital of Hubei Province, the SARS-CoV-2 virus quickly spread to all Chinese provinces and abroad. As of 26 March, more than 480,000 cases of contamination have been confirmed (including 81,000 in China) and more than 21,000 people have died as a result.¹ In the hope of limiting the spread of the virus, Chinese authorities have put particularly drastic measures in place. On January 23rd, the city of Wuhan (9 million inhabitants in 2018) was placed under quarantine. On January 27th, the government decided to extend the length of the Chinese New Year holiday to

reduce the flow of people returning home after the holidays. Some cities, including Beijing and Shanghai, suspended bus services between cities and provinces. At the end of January, several airlines announced that they were suspending flights to China, while consulates of foreign countries stopped issuing visas. As their employees were unable to return home, many companies were unable to resume production, while strict government-imposed site protocols further delayed any resumption of activity.^{2,3}

In the short term, demand for mobility, both land and air, has collapsed and is still well below its 2019 level. Between January 10th and February 18th, the number of passengers in all modes of transportation fell, year-on-year, by 50% to 80% depending on the source.⁴ Nearly 13,000 daily flights (87% of traffic) from China were cancelled in the space of 3 weeks.⁵ Road and rail transport suffered similar fates. While the situation seems to be improving, as evidenced by congestion levels in Beijing,⁶ it will not return to normal before restrictions are lifted.

At the same time, industrial activity has declined sharply.⁷ The industrial purchasing managers' index fell to less than 36 on February 29th, compared with 50.3 a year earlier, reaching an even lower level than during the 2008 crisis. The non-manufacturing sector is even more affected (29.6 against 54.4).⁸ If the situation seems to be improving, return to normal will probably be gradual. Chinese plants were operating again at more than 70% of their capacity in mid-February and nearly 91% of them could be fully operational again before the end of March. At the beginning of March, several factories in Wuhan, the epicentre of the epidemic, even announced that they would resume production while President Xi Jinping visited the region.⁹ However, significant disparities are likely to continue to persist along the supply chain. It is the recovery of the weakest player (typically a small or medium-sized company) that will ultimately control the efficiency of a value chain.

1. Coronavirus disease 2019 (COVID-19), World Health Organization, 14/03/2020.

2. Coronavirus: How the outbreak has shaken up the tech industry, The Verge, 21/02/2020.
3. As coronavirus idles China's factories, desperation grows for workers, clients and owners, Fortune, 11/02/2020.
4. Beijing metro traffic down 91%, China car sales down 90%; Shanghai stocks raising, Forbes, 21/02/2020.
5. 13,000 missing flights: The Global Consequences of the Coronavirus, The New York Times, 21/02/2020.
6. Beijing traffic report, TomTom.
7. The Purchasing Managers Index is a composite indicator that reflects the confidence of corporate purchasing managers. It aggregates the percentage of respondents reporting an improvement in the situation (P1) and those reporting no change in the situation (P2) according to $PMI = P1 + 0.5 \cdot P2$. For example, if the situation is unchanged, $P1 = 0$, $P2 = 100$ and $PMI = 50$. If the situation deteriorates for a majority of companies and does not improve for any of them, $P1 = 0$, $P2$ is below 100 and PMI is below 50. Conversely, if the situation does not worsen for any company, the SMME will be greater than 50 ($P1 + P2 = 100$, $SMME = 50 + 0.5 \cdot P1$ with a positive $P1$).
8. Coronavirus Latest: China Factory Activity Weakest on Record, Bloomberg, 28/02/2020.
9. Coronavirus: China says disease 'curbed' in Wuhan and Hubei, BBC, 10/03/2020.

Meanwhile, the virus has spread to other countries and continents. As a result, some governments have in turn introduced measures similar to those adopted in China and their effects are gradually being felt in the energy sector,¹⁰ offsetting any improvement which might occur in the Chinese situation. On March 15th, Germany announced the closure of its border with France, while France ordered the closure of all public areas and «non-essential» businesses during the week. Italy had announced the same measure a few days earlier and the closure of all non-essential industrial activity on March 22nd. While these countries are «energetically» small compared to China, their greater number could offset the crisis resolution in China and prolong its collateral effects. In fact, China's annual primary energy consumption in 2018 will amount to 3280 million tonnes of oil equivalent (Mtoe) compared to 2050 Mtoe for Europe. California announced on March 19th that it was encouraging the population to reduce travel while many companies were implementing teleworking measures. The State of California alone consumes just over one million barrels of oil per day.

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With the drop in Chinese and soon to be global energy demand, the oil market has been plunged into the uncertainty of an unprecedented demand shock.

As a result of the collapse in China's demand for mobility and production, the demand for energy has declined, whether fossil fuels (motor fuel, heavy fuel oil, natural gas, etc.) or electricity. The International Energy Agency (IEA) has thus announced that it expects oil demand to fall by 435,000 barrels per day (b/d) in the first quarter of 2020 compared to 2019 - a first since the 2008-2009 financial crisis¹¹ - or c. -5% on a total demand of nearly 100 million barrels per day worldwide. In the March edition of the Oil Market Report, the IEA published an alternative projection that global oil demand would decline relative to 2019 for the first time since 2009, by 90 000 b/d, a more severe revision than the previous one of 825 000 b/d demand growth. The decline due to the virus itself would amount to 1.1 million b/d in the first quarter and 345 000 b/d in the second quarter. There is still considerable uncertainty today about the evolution of these scenarios.

In China, this drop in demand has directly translated into the utilization rate of Chinese refineries. It was varying between 60% and 80% depending on the region earlier this year, sometimes dropping by 20 to 30 points as storage capacity for refined products reaches its limit.¹² On a global scale, the effect on world prices was immediate, with WTI going from \$62.7 to \$50.9¹³ between Ja-

nuary 6th and February 6th, while Brent dropped from \$68.9 to \$54.9¹⁴ before reaching, on February 28th, its lowest level since the summer of 2017 at \$44.8 and \$50.5 respectively. Refined product prices saw drops of up to 25%. Obviously unforeseen, these falls have once again undermined the positions of market traders and oil majors who could not anticipate this crisis.¹⁵ The situation is all the more peculiar in that market players had been confronted in recent years more with negative supply shocks (tensions in the Strait of Hormuz between Iran and Saudi Arabia and attacks on Saudi oil installations) than with positive supply shocks or shocks affecting demand.

Unable to convince Russia to reduce its production, Saudi Arabia played its hand and increased its production to drive down oil prices, seizing the opportunity of atrophied demand.

Against this bearish background, OPEC and Russia (OPEC+) met for an extraordinary summit in Vienna on 5 March to decide on a possible reduction in production volumes. This position was supported in particular by Saudi Arabia.¹⁶ At a previous meeting in February, participants seemed to have agreed on a 500 000 b/d reduction in world oil production. However, some analysts were already doubtful as to its real capacity to limit the fall in prices because of the relative structural overproduction in the sector.¹⁷ According to the IEA's latest World Energy Outlook published in November 2019, the main factors influencing global oil supply over the next few decades are, on the one hand, non-conventional production in the United States, which in less than ten years has established itself as a flexible production relay (c. 7 million barrels per day in 2019) and, on the other hand, the prospects of non-OPEC countries such as Norway and Brazil, which are benefiting from major discoveries of exploitable resources. As for global demand, while it has relatively increased as a result of economic growth in emerging countries, particularly India, and demand for motor fuels, its growth forecast for 2020 had been revised to +1.5 million barrels per day, with the IEA betting on the slowdown in importing economies, such as the United States, China, South Korea and European states. In this context, Saudi Arabia and its allies were campaigning for a further reduction in the cartel's production of around one million barrels per day. The aim was to offset the drop in demand that would result from the spread of the coronavirus to new countries and the slowdown in the world economy.

However, this proposal did not convince Russia, which in recent years has once again become a key player on

10. Coronavirus Travel Restrictions, Accross the Global, the New York Times, 16/03/2020.

11. Oil Market Report - February 2020 - Analysis, Agence Internationale de l'Energie, 02/2020.

12. Chinese state refiners cut runs further, Argus Media, 17/02/2020.

13. Crude Oil Price Today | WTI OIL PRICE CHART | OIL PRICE PER BARREL, Bu-

siness Insider, 03/2020.

14. Oil posts best week since June as OPEC and allies announce deep production cut, CNBC, 06/12/2020.

15. Oil traders hit by unexpected slump in gasoil, Reuters, 03/03/2020.

16. Oil Erases Wednesday Gains With Investors Awaiting OPEC Signals, The Wall Street Journal, 16/03/2020.

17. Analyse de l'introduction en bourse d'Aramco, Le Grand Continent, 17/02/2019.

Crude Oil Prices (WTI, Brent) Historical daily data March 2010 - March 2020 (\$US)



Chart: Willy Chevalier \ GROUPE D'ÉTUDES GÉOPOLITIQUES, 2020 • Source: Boursorama

the international oil scene. It has in fact benefited from the relative loss of influence of Saudi Arabia, and more generally of OPEC, whose ability to influence oil prices through production restrictions has deteriorated sharply and whose market shares in world production have continued to decline. Refusing any further restrictions on production, the Russian government has also indicated through its Energy Minister, Alexander Novak, that it does not intend to renew its agreement to production restrictions decided in December 2019 and due to expire at the end of March. While the Kremlin has hid behind a recent drop in production in Libya and the difficult estimation of the impact of the coronavirus crisis, it is highly likely that the Kremlin has mainly considered the geopolitical opportunity to allow prices to collapse in order to jeopardise US oil producers. American unconventional oil players are therefore all the more vulnerable to these violent fluctuations as their production costs are higher than conventional oil. Underlying the Russian decision, led by Rosneft Chairman Igor Sechin, is the desire not to lose market share to independent American producers. In the event of an OPEC+ agreement, the latter would obviously not restrict their production and would even benefit from the rise in oil prices. In this context, prices once again started to fall after a slight increase when negotiations began.¹⁸

In an attempt to strengthen its position against Russia, Saudi Arabia finally announced on Sunday, March 8th an increase in production from 9.7 to just under 12.5 million b/d^{19,20} and a drastic reduction in its official selling price for April. This announcement triggered an immediate drop of nearly 30% in oil prices, which on March 18th approached \$26.7 for Brent and \$20.8 for WTI, a record level since 2003. It remains difficult to estimate the impact that this high volatility could have on the sector. While it had not really been subject to a negative demand shock since the 2008 financial crisis, the positive supply shock initiated by Saudi Arabia puts the market in a situation it has not experienced at least since 1998, during the oil war between Saudi Arabia and Venezuela. This radical decision by Saudi Arabia is a reminder of its unique place in the global energy balance of power and its role as a swing producer. Indeed, it is one of the few producers capable of rapidly adjusting its production level, which is well below its real capacity, estimated at 12 million barrels per day.

The price war between Saudi Arabia and Russia could seriously affect the entire sector, from Chinese refineries to supermajors and independent American producers.

18. Oil Erases Wednesday Gains With Investors Awaiting OPEC Signals, *The Wall Street Journal*, 04/03/2020.
19. Saudi Arabia to hike oil output above 10 mln bpd in April after OPEC+ deal collapse, *CNBC*, 08/03/2020.
20. US markets crater as coronavirus, oil prices trigger brief halt of in trading, *The Washington Post*, 09/03/2020.

The position of the oil sector today is worrying because this exceptional crisis could weaken a significant number of public and private sector players. Chinese refineries could be among the first to be affected. For several years now, their margins have been particularly low in a Chinese context of systemic overcapacity.²¹ Moreover, their 'consortium' financing method could propagate the default of one independent refiner to another.²² Indeed, several refineries could pool together to apply for a loan and mutualise their risk. By doing so, they could improve the risk profile associated with this loan but by guaranteeing each other, they would expose themselves to the financial health of other refineries.

The next victims of the situation could be independent US shale oil producers. Their marginal cost could indeed prove to be too high in relation to the market, while some of them are heavily indebted. In fact, if the majority of production could support a barrel at \$45, no independent producer will be able to support a barrel at less than \$30 in the long term. A number of independent producers have reduced their exposure to market fluctuations through long-term contracts or futures, thereby providing them with some breathing space.²³ With these contracts, they were de facto able to ensure a constant selling price, at least in the short term. Since no one could predict the sharp fall in prices, these contracts were in all probability concluded at prices above current market prices. In spite of this, however, some players are currently trying to obtain financial support from the US administration, although a positive response does not seem to be forthcoming. The political cost of a Shale Out could indeed be relatively high and such a decision would be difficult to reconcile with the initial reaction of the US President: «Good for the consumer, gasoline prices coming down!».²⁴

However, the situation should not reassure potential investors and creditors when the non-conventional oil sector is already out of favour. In so doing, independent American producers could see their investment capacity reduced in a move which would affect the entire oil sector. Even supermajors (Exxon, Chevron, BP, Shell, Total, Conoco) are suffering the repercussions of the fall in prices with capitalisations down 15% to 20% on Monday March 9th, despite much stronger fundamentals than during the previous crisis in 2014-2016.²⁵ In this context, supermajors will find it even more difficult to solve the equation of maintaining dividends and making new investments in fossil fuels and renewable energies (particularly for Eu-

21. China oil refining profits plunge 42% in 2019 as overcapacity grows - industry, *Reuters*, 02/03/2020.
22. Oil Trader Collapse Raises Alarm Over China's Private Refiners, *Bloomberg*, 28/02/2020.
23. Oil Crash; why Saudi Arabia has started a global crude price war, *Financial Times*, 08/03/2020.
24. Oil Industry push for Trump bailout draws political headwinds, *Politico*, 11/03/2020.
25. Saudi Arabia price war wipes billions from value of major oil firms, *The Guardian*, 09/03/2020

ropean majors). The spectre of a lack of investment in extraction in the short term and a lack of production in the future thus seems to materialise increasingly.

However, it is difficult to predict how long the crisis will last. Neither Russia nor Saudi Arabia have an a priori interest in its persistence. Indeed, the economies of both countries would be strongly impacted by low oil prices. Although Russia is also exposed in absolute terms, Saudi Arabia needs a higher price per barrel than Russia in order to maintain a balanced budget (its fiscal equilibrium²⁶ cost is \$88 per barrel).²⁷ Moreover, the country is unlikely to be able to hold this position for long without alienating its allies within the cartel. Their public sector is indeed at least as dependent on oil revenues as that of Saudi Arabia. Finally, the latter will very quickly see its economic room for manoeuvre limited by the prolonged duration of current price levels. However, within the framework of the Vision 2030 plan, Mohammed bin Salman is politically betting on a strong modernization and diversification of the Saudi economy which will require significant investments. Economic rationality would therefore require that a solution be found quickly in order to limit the haemorrhage. However, authoritarianism and the myth of the strong statesman cultivated by both Vladimir Putin and Mohammed Ben Salman should not help to establish a new agreement.

The Chinese gas market and the globalized liquefied natural gas market are also affected, questioning the applicability of the Sino-US LNG²⁸ tariff agreements.

At the same time, natural gas demand in China has also fallen, leading to a revision of annual consumption in 2020 from 330 billion cubic metres (bcm) to 316 Bcm.²⁹ While industrial activity and mobility needs are reduced, gas demand for industrial production, power plants, and transportation are the most severely impacted (accounting for around under two-thirds of Chinese consumption). City gas - China's second largest consumer with a quarter of total demand according to the IEA - could escape the trend. Indeed, while the tertiary sector should reduce its demand, this could be accompanied by increased consumption in residential demand. It will nevertheless be difficult to compensate for the overall development.

Because of their relative flexibility compared to other Chinese supply sources (pipelines or domestic production), imports of liquefied natural gas are the most impacted by this drop in demand. The growth in Chinese demand for LNG over 2020 could thus be halved, from 10-13% to 4-5%, depending on the source. Usually fluctua-

ting around 80 Bcm it would already have contracted by 10% in January and around 6% in February compared to 2019.³⁰ However, it is still too early to draw clear conclusions on the volumes actually affected.³¹ However, several Chinese buyers have activated force majeure clauses to get out of contracts with their suppliers (Shell and Total in the lead) even if a final decision has not yet been taken on the subject. The price of gas followed a similar trajectory to those of the oil markets, with the Henry Hub dropping from \$2.14 to \$1.86 between January 6th and February 6th, reaching a low of \$1.68 on 28 February. The LNG market was particularly affected, with the JKM reaching \$3.5/mmbtu, losing 50% at the end of February compared to its October level.³² The situation is all the more unusual in that the winter was relatively mild and gas consumption lower than initially forecasted. These changes in demand and the inability to deliver the expected LNG volumes to China resulted in an immediate change in gas freight flows, with LNG carriers abandoning China in favour of South Korea, India and also Europe.³³

At the same time, the fall in Chinese demand seems to render the agreements with the United States in order to put an end to the trade war between the two powers de facto obsolete.³⁴ The sale of energy was to account for a quarter of the \$200 billion in additional imports that China had agreed to make over 2017.³⁵(33) The first phase of the agreement, signed in January, provided for an increase in energy imports of 18.5 billion dollars in 2020 and 34 billion the following year (increases of +250% and +500% compared to 2007). Such figures already seemed unrealistic for analysts in the sector. In particular, American LNG is still subject to customs tariffs, while Chinese demand already seemed to be satisfied by strategic or long-term contracts signed with Russia or Saudi Arabia. The current situation therefore provides a perfect excuse for China to explain the non-compliance with this agreement by factors beyond its control - it has, in fact, complied with all the demands made - even though the US administration still seems to be waiting for full compliance with the agreement.³⁶

At a time when oil and gas markets are severely disrupted, some see renewable energies as a way to reduce the exposure of our economies to these markets.

26. This is the price at which a barrel ensures a national budgetary equilibrium.

27. Analyse de l'introduction en bourse d'Aramco, Le Grand Continent, 17/02/2019.

28. Liquefied Natural Gas.

29. China's gas demand to fall by 6-14 Bcm in 2020, Kallanish Energy, 12/02/2020.

30. Coronavirus to slash Chinese LNG demand, US LNG tariff lift could save the day, Oil & Gas Middle East, 09/02/2020.

31. Shell Sees Coronavirus Eroding Chinese Natural Gas Demand, The Wall Street Journal, 20/02/2020.

32. Asian LNG Price Plunges to Record Low as Virus Crimps Demand, Bloomberg, 03/02/2020.

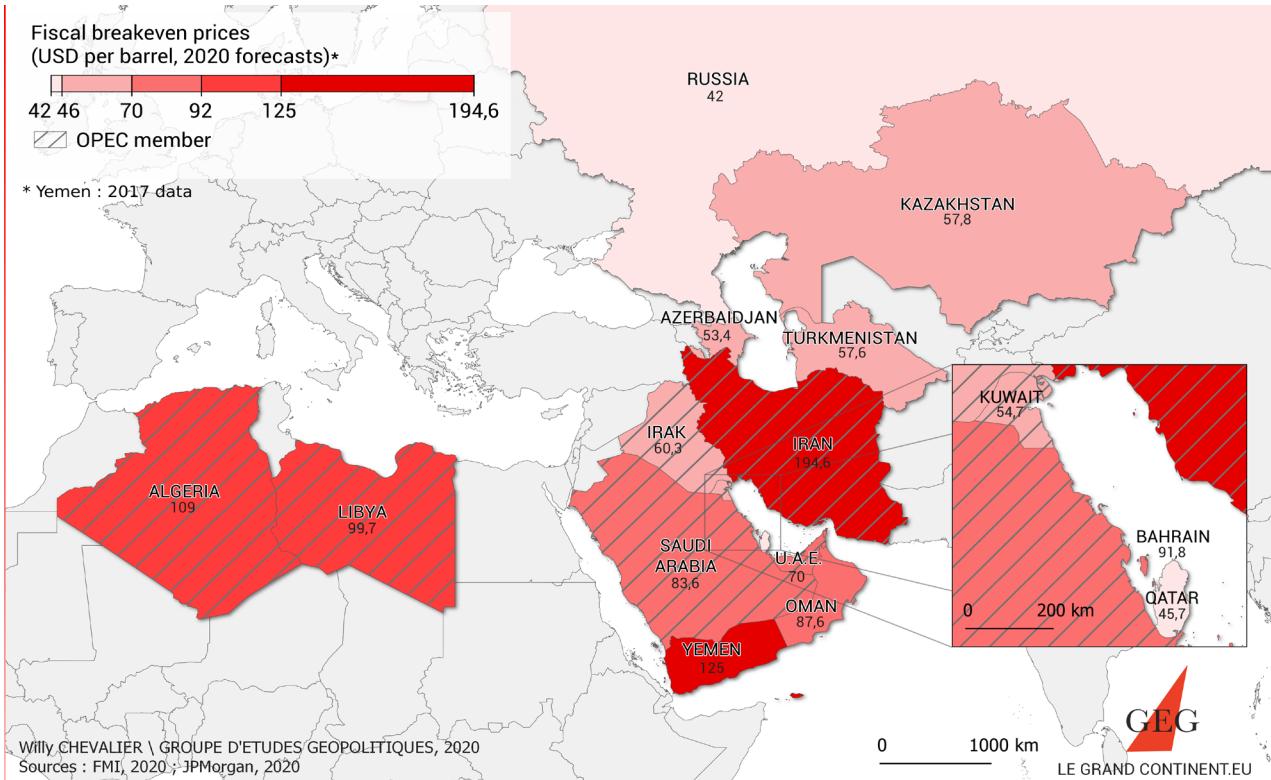
33. Freight Rate Volatility on the Rise as Coronavirus Strands Vessels on Open Seas, Natural Gas Intelligence, 19/02/2020.

34. Coronavirus Will Kill Trump's Big Energy and Agricultural Trade Deals, Foreign Policy, 13/02/2020.

35. Part 2: Plunging oil prices, pandemic having dramatic downstream impact, S&P Platts, 13/03/2020.

36. Coronavirus outbreak may force US, China to rework trade deal implementation, The Hill, 08/03/2020.

Fiscal breakeven oil price by country



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While the crisis highlights the market power of a reduced number of players on the oil and gas markets, some see renewable energies as a response to the exposure of our economies to the instability of these fossil markets.³⁷ According to their analysis, the decentralised nature of primary renewable energy sources (solar and wind) would make renewable projects and their industries less exposed to manipulation motivated by geopolitical considerations. Indeed, the current crisis is part of a decade of price instability motivated in part by tensions between countries (whether the opposition in the Persian Gulf or with Iran) and political instability within producer countries (Venezuela, Libya). Moreover, once setup, renewable energy production would provide relatively predictable revenues because of the long-term contracts which are de facto an industry standard. Similarly, society would benefit from fixed electricity prices and improve its resilience. With this in mind, and in order to reduce our dependence on oil, electric mobility would have to play a much more important role than it does today.

At this stage, a first remark can already be made. While wind and renewable energy generally benefit from fixed prices thanks to the regulations in place or the use of Power Purchase Agreements³⁸, these are not specific nor intrinsic to them. Indeed, it is quite possible to protect oil production in the same way by using (standardised) futures or long-term (OTC) contracts. Some US shale oil producers have protected themselves against a fall in oil prices by this means. Moreover, when renewables are subject to market laws (i.e. when they are not covered by these long-term contracts but their electricity is sold on the «spot» market), they are a priori exposed to the higher variability of electricity markets (in addition to being subject to the intermittency of elements). Electricity prices are traditionally seen as unstable due to the need to balance supply and demand in real time and the limitations of large-scale storage. Moreover, nothing prevents electricity markets from being also confronted with the strong market power of a small number of players (the best known example being probably the Californian market in 2000 and 2001).

Finally, some commentators will point out that such a transition would amount to a change in dependency rather than its disappearance. Indeed, while primary energy resource (wind and sunshine) is better distributed geographically, other links in the value chain are not necessarily so distributed. The extraction of certain critical minerals is concentrated in a small number of countries (the best known example being cobalt, of which the Democratic Republic of Congo is a major producer) while

their processing (e.g. the production of cobalt oxides and sulphates) is often done in China. Similarly, the production of turbines, panels and batteries is still mainly concentrated in China. Although the real degree of risk remains difficult to assess and is the subject of much debate, this imbalance has raised the question of industrial autonomy and exposure to the geopolitical stakes of the energy transition sectors. However, this point is again not intrinsic to the sector, since there is no obligation for this production to take place in China. It is moreover likely that there will be a territorial rebalancing of production in favour of other countries. For quite some time, the European Union and the United States have been attempting to rebalance these value chains geographically through various initiatives. For instance, the EU supports a battery pilot plant with Saft in the framework of the European Battery Alliance while the United States setup tariff barriers on Chinese photovoltaics. In the short term at least, the first few months of the crisis in China have made it possible to interrogate this possible dependence in the battery storage and renewable energy sectors.

While the Chinese Photovoltaic sector is expected to be moderately affected by production disruptions in China, many players in importing countries could be weakened, which will reopen the debate on the need for a better distribution of global production.

Solar energy is expected to be moderately impacted in the medium term by COVID-19, even though strong uncertainties remain.^{39 40} Many factors come into play here and make macroscopic analysis difficult. Some factories and stages of panel production are indeed largely automated. In parallel, some plants likely built up stocks of raw materials and finished products. Lastly, the ability to maintain logistics flows and secure the supply of raw materials is a key factor that is not easy to assess a priori. In this game, small players will be the first affected because of their reduced leeway, and they will dimension the impact of the crisis on the entire value chains.

However, even in the event of tension on the supply side, the impact on installed volumes should be limited. Indeed, the Chinese photovoltaic activity is reduced at this time of the year. The decrease in Chinese subsidies planned for the year 2020 should, for example, have more significant consequences. In fact, the majority of projects planned for the first quarter should nevertheless see the light of day in the first half of the year, shifting the discussion to another issue: maintaining eligibility for certain preferential rates in the event of deployment delays. Indeed, in order to benefit from advantageous rates initially provided for in the authorities' calls for ten-

37. From mild to wild: Coronavirus impact on China's power and renewables sector, 19/02/2020, IHS Markit.

38. A Power Purchase Agreement (PPA) binds an independent power producer with a seller (e.g. EDF) or a large consumer (a company in the case of a Corporate PPA) through a long-term contract with a guaranteed price (other conditions can be added).

39. Analysis: Coronavirus has temporarily reduced China's CO2 emissions by a quarter, Carbon Brief, 19/02/2020.

40. Solar Industry Waits to Assess Ripple Effects From China's Coronavirus Outbreak, Green Tech Media, 31/01/2020.

Natural Gas Spot Price - Historical weekly Data, 2014-2020 (\$/MMBTU)

Weekly variation of gas spot prices (Henry Hub) and futures contracts (C1, C4)

— Henry Hub Spot — Contract 1 — Contract 4



Chart: Groupe d'études géopolitiques • Source: Energy Information Administration

ders, projects must meet certain delivery dates. The crisis could ultimately make difficult. The decisions of Chinese authorities, both provincial and national, and their rigidity with regard to this constraint will therefore have to be monitored closely.⁴¹ In addition, China has announced that it will postpone several calls for tenders for solar energy initially planned for this year. Coupled with greater flexibility in the dates of connection to the networks, this announcement could lead to a shift in the installations to the year 2021.

However, impacts could be more significant outside China, where more than 70% of global capacity is produced.⁴² Many foreign module producers could be impacted in the longer term by the lack of available parts. Real effects are expected to be felt as the tremor, propagated along the value chain, begins to reach project developers.⁴³ In addition, factory production seems to be starting up again in China, making any major impact in the long term unlikely (at least for logistical and value chain reasons).

Not all countries will be affected in the same way. South East Asia and India rely heavily on Chinese production to meet their needs for new capacity. For example, several Indian developers appear to be exploring the possibility of declaring 'force majeure' - which a recent statement by the Indian government seems to encourage, or at least facilitate - in order to avoid the penalties that threaten them in the event of construction delays (which can amount to as much as USD 2 billion for a 3GW project).⁴⁴ In the United States, players are slightly less exposed because they had already rebalanced their supply of panels in response to import taxes set up by the US administration. However, cases of force majeure have already been declared by NextEra and Invenenergy, major American developers, for a cumulative 450 MW destined to American utilities.⁴⁵ However, the industry's problem remains similar: to ensure that any delays will not jeopardise tax advantages they were counting on. Anticipating the decline in these advantages from 2020 onwards, the various installers had set up different strategies to benefit from these advantages for the longest possible time by pre-qualifying a certain number of projects. However, these strategies will likely be affected by a potential supply constraint, leading to losses for developers.^{46,47} Thus, it

appears that the disruption, however real, of photovoltaic value chains in China only poses a serious risk for the sector to the extent that it interferes with the timetables of the multiple public support measures of States whose companies import Chinese panels. Greater government flexibility on this point could help reduce the effects of such disruptions.

The global wind energy market is facing similar uncertainties but consequences could be more severe in China due to pre-existing tensions on production, despite the localisation of production in the country.

Disruptions on the wind energy value chain in China could have greater consequences than in the solar sector. The context in which these disruptions are taking place is peculiar, as the industry is operating at the limit of its capacity with 100 GW ordered in 2019 (half of which will be in China). Indeed, China will end subsidies for onshore wind power in 2021.⁴⁸ In order to benefit from subsidies as much as possible, developers sought to launch as many projects as possible before the aforementioned deadline, and turbine production was in fact under strain. Not only will this supply tension reduce the players' room for manoeuvre, but it will be difficult to make up for lost time by increasing the pace. If the industry pleads for an extension of the programme because of the coronavirus, 10% of the planned capacity could be compromised (3 GW out of 30 planned). The effects of the crisis should be overall reduced outside China.⁴⁹ However, the United States could be an exception with 6 GW at risk, again for reasons of eligibility for the Production Tax Credit and Investment Tax Credit, two tax credits reserved for industrial-scale wind power and which expire in December 2020 (48). Players in the American sector joined the American government in mid-March to include an extension of the deadline to benefit from these tax credits in the recovery plan that was then looming.⁵⁰ Once again, the interaction between disruptions and developments in support measures for the sector is key here. Moreover, the Chinese sector is not spared, despite significant domestic production, which may suggest that it is not enough to benefit from production on one's own territory to mitigate the effects of such a crisis.

41. China could 'cut slack' to wind and solar firms amid coronavirus 'stab in wound', Recharge News, 04/02/2020.

42. Could the Oil Price Collapse Drive More Investment into Renewables?, Green Tech Media, 13/03/2020.

43. Could the Oil Price Collapse Drive More Investment into Renewables?, Green Tech Media, 13/03/2020.

44. India solar groups weigh force majeure to cope with coronavirus, Financial Times.

45. China's wind energy sector faces significant impact due to the coronavirus, Wood Mackenzie warns, CNBC, 17/02/2020.

46. Solar Industry Waits to Assess Ripple Effects From China's Coronavirus Outbreak, Green Tech Media, 31/01/2020.

47. In order to benefit from tax incentives, developers had to justify that the project had started before 2020, which they could do by demonstrating that 5% of their final cost had already been incurred in 2019. A common strategy was

then to take delivery of the equivalent of 5% in panels of the total price, which qualifies the project, and to store this volume until the actual deployment of the panels where the remaining 95% will be completed by panels purchased later. If the supply of panels were finally to be reduced by the crisis, developers would then have to draw on their reserves of «qualified» panels to complete already qualified projects, thus reducing the importance of the tax credit on the projects to which the panels were initially allocated.

48. India solar groups weigh force majeure to cope with coronavirus, Financial Times.

49. Coronavirus spurs 'domino effect' of wind, solar delays, Wind Watch, 11/03/2020.

50. Battery Market Faces Supply Crunch as Coronavirus Slows Output of China's Factories, Green Tech Media, 13/02/2020.

The battery sector is expected to be more affected by a decline in global demand for electric vehicles than by local production problems.

Like solar and wind power, battery production has been affected by the epidemic. This impact led to fears of a drop in battery cell production of around 10% (i.e. a capacity of 26 GWh) compared to previous forecasts.⁵¹ Tesla's Gigafactory in Shanghai, for example, did not reopen until February 10th, while LG Chem announced a similar schedule. However, production constraints should ultimately prove to be minimal: the industry benefits from excess capacity and is relatively automated. As a result of this overcapacity, the industry will be able to compensate for its delays as soon as measures are relaxed or lifted. The impact is expected to be greater on the demand side. While electric vehicles (EVs) and consumer goods account for 90% of battery usage, their sales and production could be severely affected. In any case, the evolution of battery prices will remain difficult to predict. Some suppliers may seek to compensate for less efficient logistics or production by slightly increasing prices (as Ganfeng has done, for example),⁵² while a drop in demand argues for a reduction in prices. In addition, it is very likely that car and battery manufacturers have signed long-term agreements to protect themselves respectively, which would reduce price movements in the short and medium term. This lower demand for batteries is also expected to result in lower prices for cobalt and lithium. However, this is not expected to be immediate due to the long-term contracts in place. If the crisis persists, however, an increase could be envisaged due to the disruption of supply, but it seems far too early for such speculation at present. In particular, if the virus was to strike severely in Africa (and the DRC) or South America while production is restarting in China, tensions on supply could emerge and materialize in price increases, on cobalt or lithium for example. This is of course highly hypothetical, all the more so as demand is expected to fall in the coming months and stocks of raw materials may have been built up during the Chinese slowdown. In any case, the disruption of production observed in January could encourage a diversification of geographical footprint to other countries in Asia, Europe or the United States.

As mentioned above, the electric vehicle sector is expected to be particularly impacted for several reasons. From a purely operational point of view, the sector is facing real challenges due to restrictions put in place by the government. Hubei, whose capital Wuhan is the epicenter of the epidemic, is one of the main Chinese regions producing cars and parts for electric vehicles in particular. While manufacturers are likely to have built up stocks in

anticipation of the New Year, they are currently exposed to the difficulties of their suppliers beyond the first third parties (typically small parts companies) as explained at the beginning of this article. In addition, the spread of the virus to Europe and the United States augurs further disruptions - and indeed Renault, Nissan, and Fiat announced last week that they would halt production in Spain. Demand should also be affected due to the strong dependence of the automotive industry as a whole on the macroeconomic context. The situation for electric vehicles is more complex to assess. Sales could be affected by travel restrictions. The collapse of oil prices and therefore of prices at the gas station could also increase the attractiveness of internal combustion vehicles. In Europe, however, new European regulations on emissions from new vehicles and fuel taxes should support sales. In China, the introduction of a baseline price on fuel could play a similar role but the government could also choose to relax vehicle emission regulations to support the sector as Bloomberg was reporting. Once again, it is difficult to make a definitive statement.

As with batteries and electric vehicles, the strongest effect of coronavirus on the solar and wind sectors could come from macro-economic factors external to those sectors.

While the impact of the virus on production appears to be limited or in the process of being overcome, concern is now focused on demand.⁵³ Indeed, a global recession seems increasingly likely, and this is likely to lead to lower demand for electricity as well as a reduced availability of capital.

Rather than a direct drop in volume, this drop in demand could translate for wind and solar developers into a drop in the selling price of their electricity. Indeed, the decrease in demand should lead to lower electricity prices on the markets and a likely reduction in the prices on long-term contracts that developers could obtain. These lower prices would then make it more difficult to launch new projects. In addition, the drop of industrial production in Europe and China could lead in the short and medium term to a drop in the price of carbon permits on the carbon markets (EU-ETS type) - all the more so if these markets bear the brunt of business support policies that could be implemented. In this context, the cost of producing electricity from fossil fuels could decrease, thus strengthening the competitiveness of these sources and further lowering the price of electricity.⁵⁴ In the United States, lower natural gas prices could also increase the competitiveness of gas and lower electricity prices on the

51. Battery Market Faces Supply Crunch as Coronavirus Slows Output of China's Factories, Green Tech Media, 13/02/2020.

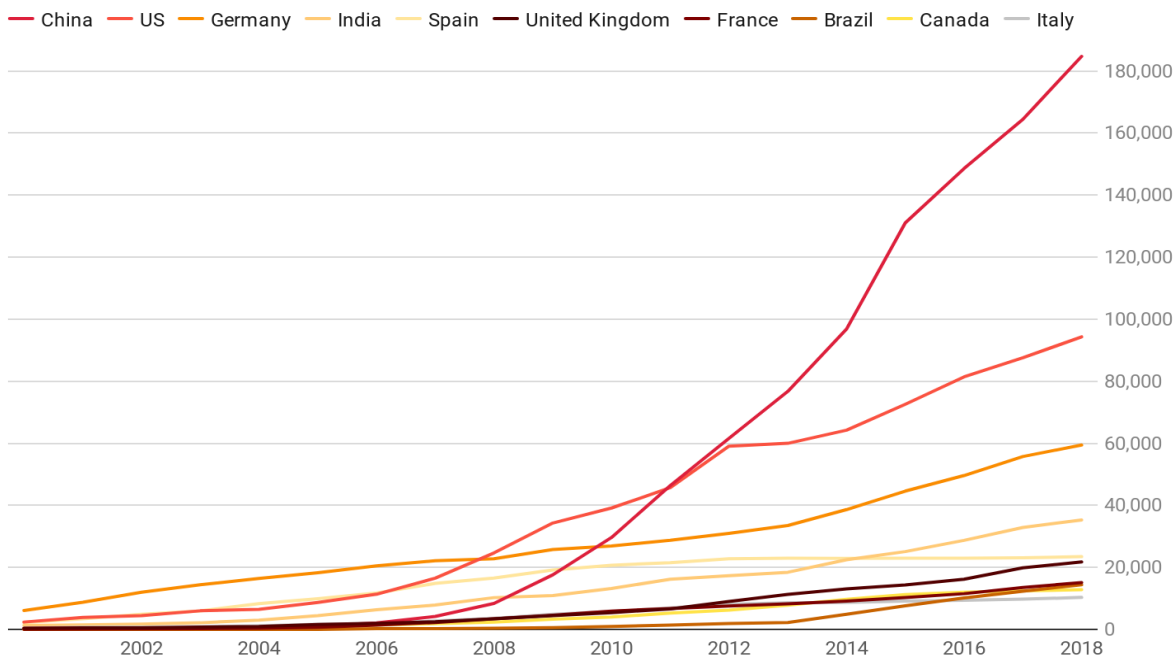
52. Ganfeng Lithium affected by coronavirus but share price keeps on rising, PV Magazine, 13/02/2020.

53. Battery Market Faces Supply Crunch as Coronavirus Slows Output of China's Factories, Green Tech Media, 13/02/2020.

54. In markets such as the European market and some American markets, the price of electricity is set by the marginal cost of the last power generation unit called. If the production cost of this unit decreases, the market price decreases.

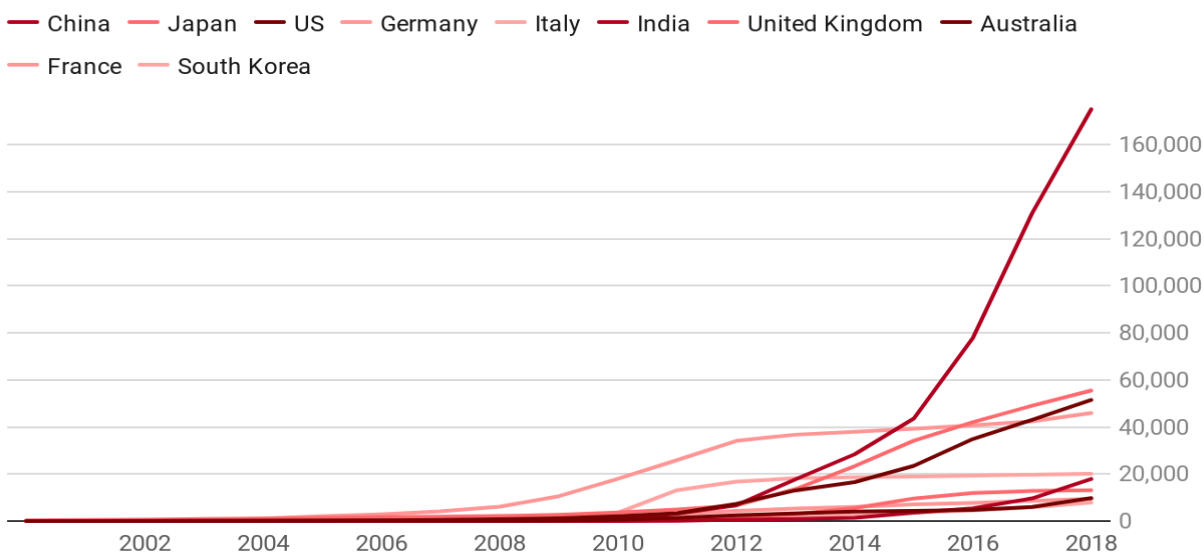
Cumulative installed wind turbine/ photovoltaic capacity (MW), 2010-2018

Top 10 countries in total installed capacity in 2018



Source: BP Statistical review, 2019

Top 10 countries in total installed capacity in 2018



Source: BP Statistical review, 2019

markets (in the United States, the marginal unit is often a gas-fired power plant).

In addition, some investors may forego financing new projects. Indeed, it would not be surprising if some choose to wait until the economic situation becomes clearer or to forego financing capital-intensive assets with relatively long payback periods. At the same time, these investments seem to remain attractive because their return would be relatively uncorrelated with that of other assets.⁵⁵ More local and national effects could also come into play. For example, in the United States, the current subsidy mechanisms (TPC and ITC mentioned above) are only interesting for financial players who have relatively high taxes to compensate. Indeed, they finance projects and benefit from tax credits that reduce their effective taxation. To the extent that their income could decrease in the event of a crisis, their taxes would also decrease and this could reduce their incentive to finance renewable assets.

The attitude of oil supermajors could also be particularly interesting. Indeed, the sector is increasingly actively exploring renewable energies and low-carbon mobility, whether through equity investments in renewable energy developers and projects, as is the case for Total and Shell, or through acquisitions (to mention only them, the battery manufacturer Saft by Total, Chargemaster by BP and Greenlots for Shell in the recharging of electric vehicles). However, one of the main impediments to this diversification has been the lower profitability of these activities in relation to oil projects. In a context of low oil prices, this brake could be loosened in the short term, according to some analyses.⁵⁶ The fall in fossil fuel prices could in fact severely reduce the profitability of oil projects to a level comparable to that of renewable projects. As these projects are less risky because of the guaranteed prices associated with them (although this is debatable, as mentioned above), European oil companies could logically favour them in their future investment decisions. In a reverse move, these same majors could reduce their investments pending a return to normal and their investments in renewable projects would be directly impacted. In addition, they could be led to direct available capital in priority towards fossil fuel projects in order to anticipate a potential price increase due to looming production constraints. In this context, Total's announcement of the acquisition of Global Wind Power France (1 GW installed capacity) on March 20th could be interpreted as an encouraging sign.

Finally, the economic crisis which appears to be emerging could divert States and regional organizations from climate and low-carbon technology commitments. In-

deed, the review of support mechanisms in the United States was not included in the \$2 trillion stimulus package announced on 25 March by the US Senate,⁵⁷ while the German Environment Minister was concerned that the attention of policymakers would be focused exclusively on coronavirus at the expense of decisions to be taken on the development of renewables in Germany.⁵⁸ As mentioned above, China could also relax its environmental standards in the automotive sector.

Thus, concerns seem to have shifted from value chain disruptions in China to macroeconomic issues of demand, financing, and public support. In such a global context, domestic production is unlikely to provide significant advantages over a supply chain organisation where production located in multiple countries around the world (provided there is enough geographic diversity in the choice of these countries).

In a context that is difficult to clarify, only one conclusion seems possible at this stage: the energy sector will change profoundly under the effects of this crisis, in particular through a better geographical distribution of the value chains of the energy transition.

The COVID-19 pandemic is therefore a reminder of the multiple economic, geopolitical, industrial and environmental mechanisms of the energy sector. While many uncertainties persist and obscure any analysis, it is more than likely that the sector will emerge strongly changed. By placing the oil market in an unprecedented demand shock, the crisis has led to the outbreak of a price war led by Saudi Arabia in order to mark its influence on the sector, particularly vis-à-vis Russia. This conflict underscores, the exposure of our economies to a limited number of state actors and, for some analysts, the need to get out of fossil fuels as quickly as possible. For their part, renewables could see their value chain diversify geographically in order to reduce the exposure of international project developers to China.

This diversification is in line with the desire of States and regional organizations to reduce their exposure to China. However, this reorganisation will not only be subject to this desire for diversification and risk reduction. Indeed, it could influence, positively or negatively, several other dimensions, first and foremost environmental, social and economic issues. Companies could choose to bring final and even intermediate production closer to the demand basins, for example to reduce logistics costs. They could also be motivated by a reduction in greenhouse gas (GHG) emissions associated with their product, and extend this consideration by favouring countries with

55. Ganfeng Lithium affected by coronavirus but share price keeps on rising, PV Magazine, 13/02/2020.

56. Social Distancing? You Might Be Fighting Climate Change, Too, 13/03/2020.

57. Senate Strikes Deal on Coronavirus Stimulus Package That Excludes Help for Renewables, GreenTech Media, 25/03/2020.

58. Coronavirus no excuse for renewables gridlock, says German env min, Clean Energy Wire, 16/03/2020.

low-carbon electricity.

Bringing production centers closer to the countries where companies' headquarters are located could also promote better responsiveness and visibility on the operation of sites, but also of the value chain as a whole - aspects whose importance and challenges have been strongly recalled by the current crisis. Ensuring the resilience of production as well as compliance with labour standards and workers' rights could be facilitated. On the other hand, a deconcentration of production would likely make monitoring these aspects more complex by increasing the number of sites to be monitored and the diversity of laws to which they would be subject. From a purely economic point of view, this shift could generate additional costs, whether due to increased complexity of value chains, changes in manufacturing costs (e.g. higher labour costs), or the reduction in economies of scale made possible by concentration. Indeed, this China-centric organization, imperfect as it may be, can be interpreted as a case of applying Ricardo's theory of comparative advantage and is part of two decades of cost optimization. It is therefore likely that its questioning would induce additional costs which, without prejudging the overall benefits it could induce, would make it more difficult to put in place (not to mention the necessary investments). In this context, the underlying question facing our societies - and

ourselves as consumers and citizens - is that of our willingness to potentially pay more for a product (and here we are talking about energy) on a day-to-day basis in order to improve the resilience of its production and reduce the externalities associated with it. The answer to this question is far from obvious, especially if, as seems to be the case today, the main challenge for the transition sectors lies in the overlap of a demand crisis, the timeline of changing support measures, and harder access to financing. In the longer term, this reorganisation could open the door to a reduction in greenhouse gas emissions from concerned value chains and thus be part of the long list of climatic consequences of this pandemic. However, it is still impossible to seriously assess the real and long-term effect of this pandemic on the climate at this stage. here are simply too many uncertainties and mechanisms will be complex to modelize and measure (particularly with regard to changes in behaviour).

While emissions are obviously expected to fall in the short term, it remains unclear whether this will be the final effect of infrastructure-based recovery plans, greater distrust of public transport, more widespread use of telework, or the possible relaxation of environmental regulations by governments. ◀