

Oil Prices in Negative Territory? In Power Markets Frequent Negative Prices Could Become the Norm

BY CRISTIAN STET

Introduction

With most world economies having imposed different forms of lockdowns or isolation measures, it is by now clear that Covid-19 has a great impact on most of us. As industries must rethink their strategies, millions of people are adapting to working from home, and others are pushed into temporary unemployment. Some industries, such as hospitality or outdoor leisure industries, are being hit very hard as supply of such services was curtailed through legislative imposed measures. For other industries, the decreased societal mobility led to expansion opportunities, as their products act in these moments as substitutes for the curtailed products. The first examples that tend to come to our minds are the so-called stay-at-home companies, such as Amazon, Zoom or Netflix. Since there are less possibilities to go to malls, online shopping is increasing. Since in person meetings are restricted, the usage of online videoconferencing tools is growing. Since cinemas are closed, online movie streaming platforms are attracting more clients. While not identical, another example comes from the oil industry. Because of the Covid-19 restrictions put in place around the world, over the past weeks we observed unprecedented low oil demand levels. As a result, as oil refineries are operating at a lower capacity, traders had to look for places to store the excess oil that is being produced. This situation led to oil storage companies suddenly seeing the values of their stocks and products rise substantially. On the other side of the table, oil producers struggle to place their products in this overflowed market.

Through a spiraling of events, the current oil market arrived into a situation where market participants were trapped with positions that they could not physically comply with. As a result, the prices of WTI crude oil futures for delivery in May 2020 settled for a few hours way below the level of 0 USD/barrel.

Negative oil prices explained through what we know from power markets

In this exceptional event, the main question that arises is why this situation occurred? The answer to this question represents a story of flexibility and storage. Though storage providers are benefiting from the current oil market state, their upside potential is limited since the world's storage capacity is close to being reached. Next, storage expansion is a costly and lengthy process. The other obvious alternative for stabilizing the market is reducing supply. Leaving aside the geopolitical and strategic thinking hurdles

that affect the supply reduction equation, a major reason for which oil companies are not willing to cut production is that such a process is extremely costly. In some cases, closing a well could permanently damage it. Thus, such an action can lead to losses far greater than the profitability damage incurred by temporarily selling the produced oil output at a price below the marginal cost or even below 0. What this ultimately means, is that at least some of the oil producers are inflexible as they do not have the technical or economical ability to quickly ramp up or down production when needed.

The second question that arises is: can we see negative oil prices again? As long as storage possibilities are limited or extremely costly, supply and demand is relatively inflexible, and a big oversupply is temporarily present, there are good reasons to make us believe that negative oil prices might reappear. To better understand this answer, we should look towards power markets. In electricity, price patterns that we see in oil markets over a timeframe of decades, can be spotted within only one day. Electricity is a commodity that is often traded in an environment similar to the actual oil markets. This happens because power storage is extremely costly and largely insufficient, demand for power is relatively inflexible, and various power markets are being catered to a certain extent by inflexible producers. Storage in power markets is still in early phases as economically feasible utility scale batteries are still generally out of reach. Power demand has been historically inflexible, and it is only recently that new ideas got more traction, ideas such as shifting the consumption or transforming the excess power produced into other products such as hydrogen. In addition to the inflexibility of demand, same as for the oil market, some producers are not flexible enough to be able to ramp up or down production in a fast and economically efficient way when a sudden change in demand occurs. In such a market, a high demand drop often leads to temporary oversupply as the inflexible suppliers are not able to act fast enough to restore the balance. All these factors create the favorable climate for negative prices to occur. Therefore, while negative oil prices are regarded as black swan events, in power markets such negative prices appear frequently.

With the characteristics presented above, power markets serve as the perfect example for at least partially explaining what oil markets are going through in the present months. What makes the two markets more comparable nowadays is that at the moment, in

Cristian Stet is with the Erasmus School of Economics

See footnotes at end of text.

both markets storage options are limited. This is not the case in normal market conditions. Storage in oil markets is able to provide in normal market conditions a relatively cost-efficient solution to short term changes in the balance between demand and supply. Most of the times, storage availability makes it easier for the oil market to smooth the prices and to avoid extremes. Consequently, while negative oil prices might appear again, they are unlikely to appear over the next few years.

What about negative prices in power markets?

Because of the constant absence of enough storage capacity or demand-supply flexibility, power markets already for years experienced negative prices. Those prices do not seem to go away anytime soon. On the contrary, we should be aware that the frequency of negative power prices could grow significantly in the future if markets remain inflexible. While the blame for the inflexibility of the power markets is often given to conventional producers, such as coal generators, that have technical difficulties to quickly ramp up or down production, this is only part of the story. The other main reason for the inflexibility of the power markets is embedded in the business model of the variable renewable sources, namely wind and solar power plants. Variable renewables have close to 0 marginal costs, making them the cheapest producer of electricity when bidding in power markets. Moreover, on top of having very low operational costs most, wind and solar power installations are further propelled by various subsidy schemes, from feed-in tariffs to green certificates. These aspects lead wind and solar renewables to being profitable even when power prices are negative. Essentially, we could almost say that subsidized renewables have a negative marginal cost. Thus, in some markets there is a strong incentive for variable renewable producers to generate the maximum output possible even when prices get negative. This is in line with what energy economics literature predicts: on average, the more wind and solar output we have in a power market the lower the prices we observe.

In addition to their cost structure, another aspect that favors the occurrence of extreme low prices is the dependency of wind and solar output on weather conditions. The variability in production output of these two technologies create supply shocks on daily basis, in addition to demand shocks that we are already used with. Therefore, with the higher integration of variable renewable sources in power markets, as the average level of electricity prices gets lowered, the supply-demand imbalances lead more often to extreme low prices than to extreme high prices. In a study conducted together with my colleagues Ronald Huisman and Evangelos Kyritsis¹, by analyzing empirically the German day-ahead market, the biggest power market in Europe and one having a high share of wind and solar installed, we prove that

higher levels of the share of variable renewable supply lead to less frequent extreme high prices and more frequent extreme low, sometimes even negative prices. Additionally, in another work developed along with Ronald Huisman² we show for the same market that the higher the level of variable renewables the more extreme the low power price spikes appear to be.

Covid-19 lesson on negative prices in power markets

Based on the academic evidence, as the share of variable renewables is set to increase in many power markets, if there is not enough flexibility in critical moments, negative prices will occur more and more frequently. Besides learning this from academic studies, the same lesson can be drawn from current Covid-19 situation. With the temporary closure of businesses in the recent weeks, demand for power fell by even over 20% in some European markets. At the same time, wind and solar operational capacity remains at the same levels. This leads to power markets suddenly operating into a much higher share of variable renewables environment. Thus, we have in front of our eyes a unique experiment: the current situation fundamentally represents what power markets would be in the future if the only thing we change is adding more wind and solar output to power markets.

The results? Continuing with the example of the German day-ahead power market, while for the period 23rd March – 22nd of April 2019 the average share of generated wind and solar production was 30%, for the same timeframe in 2020, the last month, the average share of variable renewables grew to 44%, with recorded values of over 60% for certain days within the past month. While a small part of this wind and solar share increase is due to some new installations that came into the market over the past year, the main factors that temporarily increased the share of variable renewables is the lower demand and favorable weather conditions. With an increased wind and solar output, over the last month there were various moments when the German day-ahead prices fell below or close to -80 EUR/MWh. While we already observed in the past such negative prices on this market, the frequency of the negative prices increased. In total, over the past month, 49 hours were settled on the German day-ahead market with negative prices. Over the same period in 2019, only 10 hours traded with negative prices, and, on average, the monthly number of negative prices in 2019 was under 18 hours/month. Similar increase in the numbers of hours with negative settled prices can be observed across most European markets during the past few weeks. In some markets the negative prices appeared as a result of an increased share in variable renewable output. In some other markets, negative prices were propagated through cross border transactions. One example comes from the Hungarian day-ahead power market

where in the last month already 9 hours were traded in negative territory, compared to only 1 such observation for the entire year of 2019. Similar situation can be found in The Netherlands, with 37 hours traded with negative power prices in the past month as opposed to 5 such observations for the entire year of 2019. Another example from earlier this year comes from the Swedish and Finnish power markets as they documented for the first time in history negative prices. The list can go on, but the message is clear: in a world of subsidized and prioritized variable renewable supply, without adequate flexibility in place, we will have to get used to more frequent negative prices.

Is there anything else we can conclude?

While power prices are not driven only by the output of variable renewable sources, the final cleared prices being formed based on a multitude of fundamentals, we know already from academic literature and practice that wind and solar output changes the electricity price patterns. The behavior of the European power markets in recent times teaches us that, while striving to integrate more renewables in our markets, we should also make sure that power markets are flexible enough to cope with it. Working on improving storage or demand shifting possibilities is one welcomed, a path

that is extensively considered. In addition to that, we should also reconsider the way we operate wind and solar plants and decide if the current subsidy schemes, which served their purpose in the past, are still a viable solution for the future. Moreover, while prioritizing variable renewable supply for dispatch is desirable from an environmental point of view, we should also consider if the flexibility benefits of temporarily and locally curtailing the production from renewables outweigh the costs. Ultimately, extreme prices are not desirable for a functional market. Even if from a consumer perspective low or negative power prices are appealing, if power prices fall too low, they will affect not only the conventional polluting producers but also the investments in new installations of renewable supply, as the attractiveness of such investments will decrease. Thus, without a change in policy or technological developments, the transition to a carbon free power market will continue to be tied up to public financial aid.

Footnotes

¹ R., Huisman, E., Kyritsis and C., Stet, 2020. Fat Tails due to Variable Renewables and Insufficient Flexibility.

² R., Huisman and C., Stet, 2020. The stronger variable renewable supply impact on extreme day-ahead electricity prices.