

15 June 2023

El Niño: big impact but lower energy prices

Newspapers are increasingly making headlines about this year's El Niño coming up. The infamous weather phenomenon is causing temporary additional global warming on a global scale. At the same time, 'the Christmas child' - or literally 'the little guy' - is causing exceptional weather conditions in various parts of the world. Whereas Australia and Indonesia in particular will experience more drought, Brazil and the North of the United States will generally get warmer. In Europe, direct weather effects are less significant. Nevertheless, the chances of lower energy prices in Europe due to El Niño are increasing. In this theme report, we explain what El Niño means and look at its possible effects on energy markets.

What is El Niño?

El Niño is the name for a weather phenomenon that originates off the coast of Peru but has a major impact on weather worldwide. The weather phenomenon occurs on average every two to seven years and alternates with its counterpart La Niña, which literally means 'the girl'. On average, an El Niño lasts about 12 months. Normally, there is a high-pressure area off the coast of Peru and a low-pressure area off the coast of Australia. During an El Niño, the opposite becomes a reality. In short, it creates a wind flow that brings warm air and thus ocean water from Australia to South America.

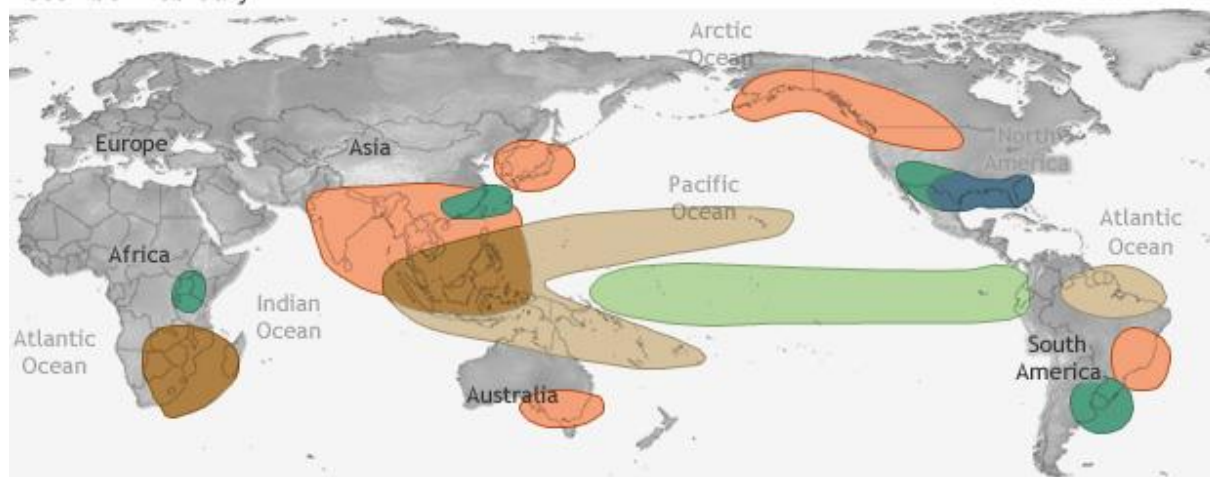
Due to the interconnectedness of the Earth System, this significant weather phenomenon in the Pacific Ocean causes local weather changes all over the world. While some areas actually get warmer or drier, others experience wetter or even colder periods. Still, the general trend during an El Niño year is for global temperatures to increase by a few tenths of a degree. This could even cause us to exceed the 1.5-degree warming limit set by the Paris Agreement as early as 2024. However, that depends on the strength of the upcoming El Niño. The latest models give an 84% probability for an average El Niño. The probability for a severe El Niño is estimated at 56%.

The naming of El Niño also originates in Peru. The phenomenon takes effect off the coast of that country around Christmas. This is also the reason Peruvians refer to it as 'the Christmas Child'. Although the phenomenon indeed starts to come on strength around Christmas, the effects work minimally through the following summer. The map below from the *'National Oceanic and Atmospheric Administration'* shows the most evident effects in the winter and summer months. Translating to this year's El Niño, these include winter starting in December 2023 and summer 2024. It becomes clear that in the months of December to February in particular, the west coast of North America, the east coast of South America, the south coast of Australia and a very large part of Southeast Asia and India become warmer than normal. At the same time, Indonesia and southeast Africa become drier than normal. A few areas become wetter than normal, including the area around Uruguay and eastern China. Finally, the area around the Gulf of Mexico becomes cooler than normal.

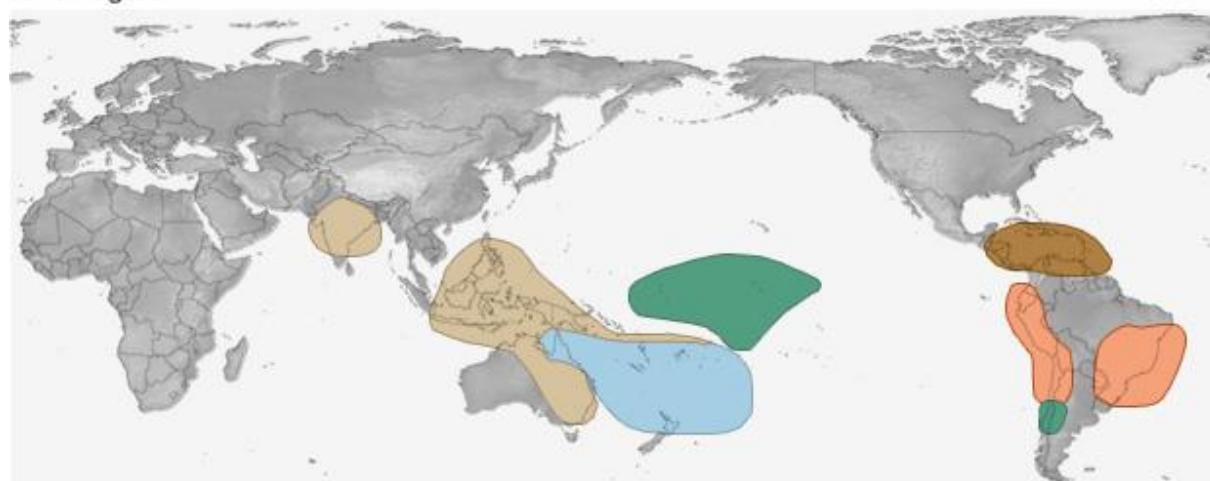
Looking further at the weather effects of El Niño in the months of June to August, the first thing to note is that the greatest observable effects are still mainly in the southern hemisphere. The extreme heat in Southeast Asia has moved away, according to the map, but it has given way to drought in India. Moreover, the above-average drought in Indonesia continues. In addition, Australia will also succumb further to extreme drought during these months. On the other side of the Pacific, we see South America experiencing warmer-than-normal weather on both the west and east coasts. Finally, we see extremely hot and dry weather in northern South America.

EL NIÑO CLIMATE IMPACTS

December-February



June-August



Source: National Oceanic and Atmospheric Administration

So all in all, the direct weather effects of El Niño in the northern hemisphere and Europe do not seem to be too bad. Yet [research](#) by the Royal Dutch Scientific Weather Institute (KNMI) shows that strong El Niños can also have a direct weather effect in western and central Europe, and thus in the Netherlands. The spring following a strong El Niño here is characterised by a wet spring stretching from southern England, through northern France, the Netherlands and Belgium to Germany.

Different forms of impact on energy markets

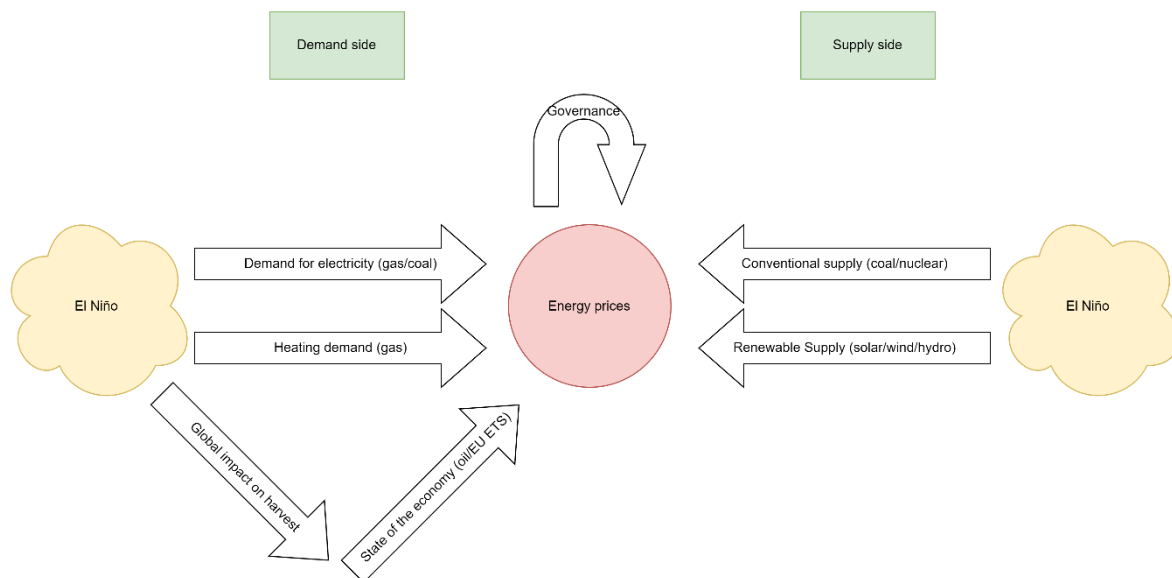
El Niño weather effects can have a direct effect on energy prices, both through the supply side and the demand side. The months in which the weather effects occur are also important. Warmer or colder than normal weather therefore does not always lead to the same direct demand or supply effects. Indeed, a warmer-than-normal winter in north-western Europe will lead to a reduction in gas demand because in these months gas is fired for heat supply. On the other hand, a warmer than normal

summer in the same area may actually lead to higher consumption of electricity with which it also leads to higher gas demand. This is because higher than normal temperatures in these months actually create additional electricity demand for cooling.

At the same time, there are also indirect effects of the weather phenomenon that can affect energy prices. For instance, local weather variations can have a major impact on agricultural harvests and hence the agricultural sector. An extremely dry growing season can cause crops to fail. Especially in countries where the agricultural sector is large, this effect of crop failures will have a large negative economic impact. Not only farms will lose income, the effects will also be felt further down the chain, right down to the consumer. Lower agricultural yields will mean scarcity of agricultural products, thus causing higher prices and inflation. This negative economic shock will spill over into the economy and reduce demand for other products and services. Eventually, economic growth will decline and with it the demand for energy, mainly due to a reduction in industrial demand. This reduction in demand in turn has a depressing effect on energy prices.

These are just a few examples of possible direct or indirect effects of an El Niño on energy prices. What becomes clear from this is that there are a number of different aspects that determine final price effects. So, first of all, there is a difference in whether an effect is direct or indirect. In addition, there is a difference between the same direct weather effect in summer or in winter. At the same time, it is also possible to distinguish between an effect via the demand or supply side of commodities or goods. To clarify these different origins of price effects, a schematic is outlined below.

Schematic view



Source: PZ Energy Research & Strategy

Then, of course, it cannot be ruled out that different forms of these effects may occur simultaneously. So different effects can reinforce each other, or counteract each other. A possible amplifying effect could, for instance, occur during a warmer-than-normal summer in the northern hemisphere. The same weather conditions could cause large forest fires to break out, making gas production sites unpassable. At the bottom line, you then have both an increase in gas demand and also a decrease in supply due to the same weather conditions.

On the other hand, therefore, simultaneous weather effects can also smooth each other out. For instance, a windy winter may increase gas demand for heating due to a lower wind chill, thus pushing

up the gas price. At the same time, the same wind will cause less gas to be needed for electricity generation. Although the former effect is likely to be larger, there is partial smoothing of that effect.

Finally, there is a possible indirect price effect that could come from policy interventions in energy markets, even if this possibility is less obvious in relation to weather variations. As we have seen particularly in 2022, social events can create major shocks in energy markets. Once again, this showed that energy was thereby largely politically driven. While the markets were doing their job of establishing the right price level at different levels of demand and supply, politicians adapted policies. Actual policies, as well as policy processes, had a major impact on energy markets. For example, European Commission President Von der Leyen's announcement to fill gas storages at any cost contributed to the sharp rise in gas prices in the summer of 2022. In principle, policy interventions are not the first thing you think of in relation to a weather phenomenon. Yet it cannot be ruled out. In 2022, for instance, Norway appeared to consider export restrictions due to extreme drought and consequently low reservoir levels.

What precedents can we learn from?

Because El Niños occur on average every two to seven years, it is a phenomenon that is difficult to study extensively using data. To illustrate, ten El Niños ago, in 1983, Ronald Reagan was only halfway through his first term as president. Three El Niños ago, in 2007, we had no idea of an upcoming financial crisis. So studying El Niños is very time-bound and comparisons between different El Niño years should be made with caution. Nevertheless, there is a handful of scientific literature that finds statistically significant correlations between El Niño events and economic variables such as inflation, Gross Domestic Product (economic growth) and energy prices.

Brunner (2002)¹ writes in the *Review of Economics and Statistics* that 20% of commodity price inflation movements in the years studied (1963 - 1997) were due to El Niño. Moreover, it notes that, in light of commodity prices, El Niños are in principle associated with price increases, while La Niñas are associated with price decreases. However, it is explicitly mentioned that this effect is particularly rooted in price increases of agricultural products due to the direct correlation of weather with agricultural harvests. In addition, the author finds that an El Niño shock causes an increase in GDP of almost 0.5 percentage points in G7 countries. A certain explanation for this is lacking, but possible explanations point to infrastructure investment spending due to natural disasters, or the increased demand from developing countries for expertise and implementation strength from G7 countries in dealing with natural disasters.

Furthermore, Cashin et al (2017)² in the *Journal of International Economics* write that a number of countries in Southeast Asia, including major economies such as India, Indonesia and Japan and Australia are actually facing a brief recession (economic contraction). At the same time, these researchers also find that the same weather phenomenon in the United States, and indirectly in Europe, leads to a positive effect on economic growth. Finally, they conclude that energy prices and prices of goods are rising in several countries around the world. The authors also zoom in on impacts and conditions for specific countries. For instance, they write that drought in Australia is causing a reduction in wheat exports and therefore has an upward price effect on world wheat prices. In addition, Indonesia, that is hydropower-dependent, faces difficulties in mining and exporting nickel due to drought, which has an upward price effect on steel prices. An upward price effect for steel prices is also a result of Chile's reduced access to its mines due to heavy rains.

According to these authors, the United States in particular seems to benefit. For instance, agricultural harvests in a wetter-than-normal California are favoured, the Northeast experiences a warmer-than-

¹ Brunner, A. D. (2002) El Nino and world primary commodity prices: warm water or hot air? . *Review of Economics and statistics*, 84(1), 176-183.

² Cashin, P., Mohaddes, K., & Raissi, M. (2017). Fair weather or foul ? The macroeconomic effects of El Niño. *Journal of International Economics*, 106, 37-54.

normal winter and the hurricane season is less extreme. The latter two effects in particular are also relevant to energy markets. The fact that the northeastern US faces a warmer-than-normal winter means that weather-dependent demand for natural gas is depressed. In addition, violent hurricanes have occasionally curbed oil production in the Gulf of Mexico in the past, which could cause upward price effects. With the expectation of a calm hurricane season in the Gulf of Mexico during an El Niño year, those price risks are less significant.

Opportunities and risks for energy markets

Now that we have explained what the weather phenomenon means, how it can affect different energy markets and what actual effects it has already had in the past, we can look ahead to possible opportunities and risks for the energy markets next year. In doing so, we will go through the oil markets, gas markets, electricity markets and CO2 market successively.

Oil markets

In the oil markets, two different types of relevant developments can emerge from an El Niño. Both via the demand side and the supply side, with the supply side interpreting a more direct effect. As we described above, the Gulf of Mexico faces a higher probability of a lower-than-normal hurricane season. The hurricane season there pretty much runs from June to September. So by this we are referring to those months in 2024. The hurricane-prone Gulf of Mexico is an important region for US oil production. The sea is home to many drilling and gas platforms. When weather extremes assume such degrees of severity, as in the case of intense hurricanes, workers from the rigs are evacuated and production is thus shut down. As seen below, this can involve, albeit temporarily, significant production reductions. Those production cuts can temporarily cause upward price shocks. Because El Niño generally ensures a less extreme hurricane season in the Gulf of Mexico, these risks of upward price shocks are muted.

Oil production in Gulf of Mexico regularly shut down during hurricane

X 1,000 barrels of production per day



Source: US Energy Information Administration (EIA)

On the other hand, oil prices can also be influenced via the demand side. The outlook on the state of the global economy plays a decisive role here. In particular, publications on (expectations of) economic figures from major economies can trigger price movements. Traditionally, figures from China, the US or Germany are influential. It is difficult to attach upward or downward price risks to these in advance. Several scientific studies bring different conclusions about the effect of an El Niño on the global economy. On the one hand, positive effects of an El Niño year on the economy are reasoned from the fact that there are disaster recoveries that spur the economy. At the same time, negative effects on the economy are reasoned from the fact that a greater proportion of agricultural crops fail rather than succeed and, as a result, lead to higher prices.

Yet a very recent study by Callahan and Mankin (2023)³ shows that El Niño persistently reduces countries' economic growth. As described earlier, crop failures cause higher prices. In particular, inflation that may arise will drive up costs, which may reduce economic activity. Decreased economic activity will reduce demand for oil and ensure lower prices. At the same time, it is not inconceivable that central banks may consider interest rate hikes to fight inflation. This will make money more expensive and make investment more difficult. Yet, those interest rate hikes may in turn affect the oil market. With every rise in interest rates, economic growth is counteracted. Economic growth is linked to energy demand. In other words, not only a decline in economic activity itself, but also a rise in interest rates can therefore cause oil prices to fall.

Gas markets

The market for natural gas was much more of a regional market before the war in Ukraine than it is today. Europe depended on Russia for some 40 per cent of its natural gas supplies. With that supply largely gone, much of Europe's natural gas demand is now satisfied by intercontinental LNG supplies. A higher degree of dependence on the global LNG market could create additional vagaries in the European gas market in an El Niño year. This is because both weather-induced local demand and supply shocks affect the same global market. In the situation before the gas crisis, a temporary reduction in production in the United States would not immediately lead to a price shock in the TTF price because Europe mainly used other sources of origin of natural gas (local production and imports from Russia). In the current situation where, at a more global level, natural gas supply and demand have to find each other, the same production cut in the US will cause a bigger price effect in Europe.

In an El Niño year, two price effects can occur that originate in the United States. A warmer winter, especially in the northern region of the country, will cause lower local gas demand and price, as was evident during the 2016 El Niño (U.S. EIA, 2016)⁴. This allows the country to ship a greater amount of natural gas via LNG carriers to other markets. As winters in the US coincide with European winters, this could create a welcome price depressing effect in Europe. Gas demand in Europe in winter is met, on the one hand, by tapping gas storage facilities. Yet gas demand, especially temperature-related demand, is higher in winter than what can be withdrawn from the gas storage facilities. A larger LNG supply can thus depress the price at a time when it is relatively high in Europe. At the same time, as in the oil market, a calmer-than-normal hurricane season in the summer of 2024 may reduce supply shocks in the gas market.

In Asia, the effects of an El Niño are mainly felt in the amount of precipitation. The continent faces additional drought. In theory, this could negatively affect hydropower production and nuclear power for generating electricity. Demand for gas, as a substitute, may increase as a result. Yet this possible effect remains largely unreported in the literature. In South America, we see that northern Brazil initially faces additional drought. The country is about 75% dependent on hydropower for its electricity supply. With that, the drought may cause lower hydropower reservoirs, although most of the country's hydropower plants are concentrated further south. On the contrary, in the months of June to August 2024, an extreme heat will prevail over much of the country. Possibly lower water levels in the hydropower reservoirs due to the drought and higher demand for electricity through air conditioning in the heat could thus increase the country's gas demand.

Electricity markets

In the electricity market, the implications go beyond temperature and precipitation alone. If we look at the locations of high and low pressure areas, we can deduce whether cloudy or clear skies predominate. Normally, northern Europe predominantly experiences low-pressure areas due to

³ Callahan, C. W., & Mankin, J.S. (2023). Persistent effect of El Niño on global economic growth. *Science*, 380(6649), 1064-1069. <https://doi.org/10.1126/science.adf2983>

⁴ Strong El Niño helps reduce U.S. winter heating demand and fuel prices (2016). <https://www.eia.gov/todayinenergy/detail.php?id=25952>

atmospheric circulation cells. Southern Europe, on the other hand, more often experiences high-pressure areas. In an El Niño year, that atmospheric circulation cell is affected in such a way that the distribution roughly reverses. In other words, northern Europe becomes generally drier and warmer, while southern Europe faces rather squally weather. In the first place, this could lead to large solar energy production in the Netherlands. Currently, we already have almost 20 GW of installed solar PV capacity in the Netherlands, while base demand is around 14 GW. This means that The Netherlands exports or even switches off a lot of renewably generated electricity in times of sunny weather. This will create low and even negative prices in the day-ahead market and it imbalances markets. At the same time, an early expectation of a lot of solar generation could also bring down the prices of monthly electricity contracts in northern Europe additionally.

On the other hand, dry and sunny weather could affect water levels in rivers. When water levels decrease due to heat and drought, risks to coal and nuclear power generation follow. Coal resources may not be able to reach the power plant and nuclear power plants cannot run at full production due to lack of cooling water. On top of this, hydropower reservoirs are less replenished in the same weather conditions, so production from them may also be scaled down. What is striking about this is that while solar power production increases, three different forms of controllable power are at risk with regard to production capacity. Opportunities and risks related to wind power production are more difficult to predict because wind is mainly the result of differences between high and low pressure areas.

Emission allowances (EU ETS)

In the pricing of European emission allowances, a number of different effects happen simultaneously. Some of these factors include the development of economic growth, weather-related energy demand and renewable energy generation, which is actually a synonym for weather-related energy supply. The latter two in particular are difficult to aggregate at the European level. In an El Niño year, although there is a greater chance of warmer and drier northern Europe due to a high-pressure area, on the other hand, southern Europe faces a greater chance of wetter and cooler weather due to a low-pressure area. More certainty can then be given about the effect of economic growth on the price of emission allowances. As we pointed out with effects on the oil market, it is not inconceivable that economic growth could slow down in an El Niño year and interest rate hikes could be implemented to combat inflation. Reduced economic growth, or even a depression, will have a price-depressing effect because there is lower (industrial) demand, which is associated with fewer emissions.

Summary - lower energy prices in Europe due to El Niño

El Niño is upon us again. The infamous weather phenomenon will peak in December, after which the weather effects will be felt across the globe at least until the following summer. With now more than a 50% chance of a severe El Niño, major effects on energy markets can also be expected. Weather can affect different energy markets in a myriad of ways. Here, some simultaneous effects can have a smoothing effect, but there are also effects that can reinforce each other. There is a handful of scientific literature that has examined the relationship between El Niño and energy markets, but different studies have a different focus and conclusions are not unanimous.

If we reason out the impact of various weather effects on the main energy markets, there are nevertheless a number of salient effects. For instance, in the oil market, on the one hand, we see some increased production stability in the United States during the hurricane season. Still, the overall impact of El Niño via failed agricultural harvests seems to have a negative effect on the global economy in particular. Therefore, the price of oil - and, for consumers, petrol and diesel can be depressed. On the European gas market, which has become much more of a global gas market since the war in Ukraine, weather effects are going to have an increasing impact globally. In particular, a warmer winter in the US could create a price-depressing effect. Finally, in the Dutch electricity market, we see opportunities for solar power generation due to a greater chance of high-pressure areas here, possibly resulting in lower electricity prices.

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