LONDON POLITICA

Strategic Assessment of the Commodity Markets

1st March, 2022

Comprehensive political risk and market report focusing on 16 of the world's most critical raw resources

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Edited by Thomas Woodlock

EXECUTIVE SUMMARY

Thomas Woodlock

This report is for anyone involved in producing commodities, want to trade or invest in them, buy them for a business or simply want to understand the things they consume on a daily basis. The report is international in nature. The 14 members of the team at London Politica who contributed to this report hail from 11 different countries, each of them synergising their unique perspectives and backgrounds to provide comprehensive insights into the energy, metal and agricultural commodity markets. They identify the uses, producers, consumers, exporters and importers of 16 key commodities. This includes analysis of oil from Middle East, natural gas from Russia, rare earth metals from China, lithium from Chile, corn from the US, cotton from Burkina Faso and wheat from Ukraine amongst others. They have also explored the supply and demand dynamics of each commodity, helping demystify the underlying market fundamentals that determine prices in the markets. The political, economic and climate risks associated with each commodity have also been analysed.

We have all become accustomed to living in an era of unprecedented globalisation with goods and services crossing borders with relative ease. However, geopolitical events within the global system are making this increasingly precarious. Russia's invasion of Ukraine is the latest example of a continuous string of political events that have major ramifications for commodities and by extension, financial markets. It would be prudent for anyone with any form of exposure to the commodity markets to read this report diligently and apply these insights to their daily operations, be it risk management or opportunity exploitation.

The total demand for all commodities is fundamentally a function of two things, the number of people and their income. If a country has a GDP per capita under $5000, it can be assumed the population will spend the majority of its income on the basics such as food, clothing and shelter. Governments of these countries struggle to raise sufficient capital to finance commodity intensive public infrastructure like power plants and roads. On the other hand, any income above roughly $20,000 is generally spent on things that need only small amounts of commodities such as education, health and recreation. Moreover, governments of countries at this income level have already built the bulk of their infrastructure. In between these two income levels there is a "sweet spot" for commodity demand. Countries that surpass a GDP per capita of roughly $5000 are typically an industrialising and urbanising society. These factors create a strong relationship between economic growth and commodity demand.

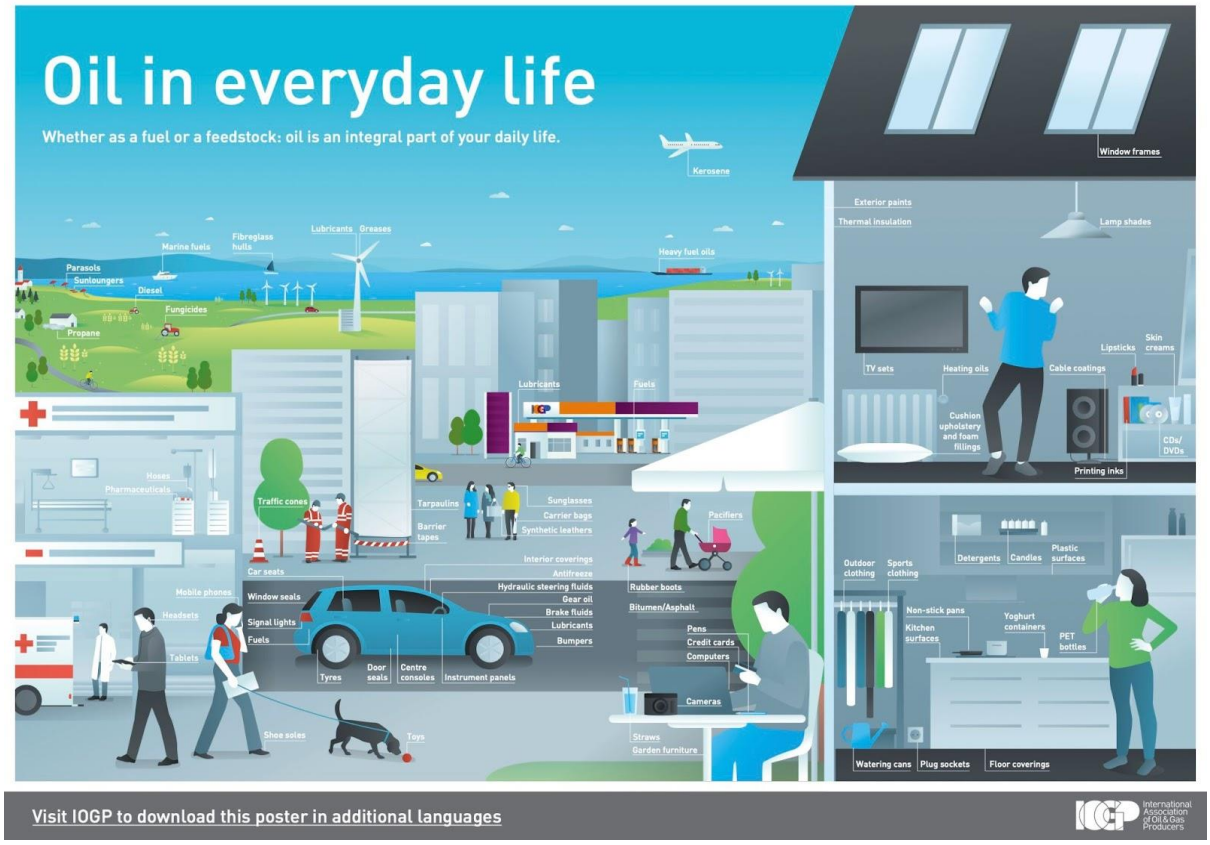
In 2001, China joined the World Trade Organisation and its GDP per capita was roughly $4000. China entered the aforementioned "sweet spot" and for the last 20 years China's economy grew exponentially, as did its veracious appetite for natural resources. This explosive growth caused a commodity "super-cycle" where the price of raw materials has been well above the long run trend, lasting beyond a normal business cycle. As the factory of the world, China is now the dominate player for the majority of commodity markets and this significance is highlighted throughout the report.

ENERGY

Oil

Marko Cem Zurunyan & Vincent Wu

Oil is used for a variety of different products. The predominant use, however, is for transportation fuels (gasoline and jet fuel) and heating and electricity generation, accounting for approximately 75% of petroleum oil usage in the USA, for instance. A more specific observation of petroleum usage shows it is used across 14 different product categories. Those categories encompass vehicles, construction, clothing, accessories (such as handbags and jewellery), fuels, household and cleaning, beauty, medical equipment and medicine, furniture, sports equipment, electronics, office items, toys, and agriculture. Thus, oil refinement and separation processes make petroleum a versatile material that is not only used in fuels but also in plastics, pesticides, and pharmaceuticals.



(Please use zoom feature to look more in depth) Source: IOGP

Global Oil Market

The global oil market is one of the most profitable commodities, and makes up an integral part of daily life. Oil is the most exported product in the world, making up 5.44% of global trade in 2019. Global oil production in 2020 averaged 76.1 million barrels per day (b/d), with the top 10 countries accounting for 71% of that amount. Those countries ranked in order (*OPEC producers italicised)* are the USA (11.3m b/d), Russia (9.7m b/d), *Saudi Arabia (9.3m b/d)*, Canada (4.2m b/d), *Iraq (4.1m b/d)*, China (3.9m b/d), UAE (3.1m b/d), Brazil (2.9m b/d), *Iran (2.7m b/d)*, and *Kuwait (2.6m b/d).*

The oil supermajors are BP, Chevron, Eni, ExxonMobil, Shell, TotalEnergies, and ConocoPhillips. However, the largest oil producer and also with the highest market cap is Saudi Aramco, Saudi Arabia's national oil company, with $2.2 trillion.

Leading Countries by Exports and Imports of crude petroleum (2019)

Exporting Country	Value (USD)	Importing Country	Value (USD)
Saudi Arabia	$145B	China	$204B
Russia	$123B	United States	$123B
Iraq	$73.8B	India	$92.7B
Canada	$67.8B	South Korea	$67.4B
United States	$61.9B	Japan	$64B

Source: OEC

Increasing concerns about climate change and its consequences have created a global policy paradigm shift towards the energy transition, net zero, and decarbonisation. This will have profound implications towards the geography of oil production, how oil companies operate, and production technologies.

Risks

The oil industry is fraught with geopolitical risk and is ultimately driven by major headlines. Increasing tensions and conflict risk disrupting oil production and exports. As a high-demand global commodity, fluctuating oil prices have significant implications for the global economy and energy security. Key geopolitical risks are discussed, where potential disruptions to output and supply chains generally present a price-bullish view.

Russia had just launched an invasion on Ukraine at the time of writing, after months of rising tensions. Oil prices immediately surged above $100 due to supply shock fears, with Brent crude jumping by 9% to $105.79 a barrel. Prices dropped back to the $95 range once it was clear that US President Joe Biden would not pursue energy sanctions, instead imposing financial sanctions. This demonstrates the vulnerability of oil to price shocks, oil's price volatility, as well as the energy interdependence between Europe and Russia. Moreover, OPEC has limited capacity to increase output and supply due to increased demand following the easing of worldwide Covid restrictions. As a result, any physical supply disruption between Russia and Europe would immediately drive up oil prices, with output unable to immediately adjust. This would exacerbate existing global oil supply scarcity and generate inflationary pressures.

The complex geopolitics of the *Middle East* have profound implications for regional security, foreign policy, and energy security. Oil underpins the economic and political structure of the Middle East.

Middle Eastern countries' role as oil exporters has shaped geopolitical relationships across the region, including US foreign policy, Russia's energy diplomacy, and the increasing soft power of Saudi Arabia, Qatar, and the UAE. However, the region is vulnerable to global price declines, like in 2020 after the onset of the COVID-19 pandemic, as well as instability and conflict, creating potential supply issues. These include religious tensions between Saudi Arabia (Sunni majority) and Iran (Shia majority), regional conflicts (Israel-Palestine), civil war (Yemen), and vulnerability to terrorism and attacks on energy infrastructures.

Focusing on *Libya*, domestic tensions have caused concerns about supply risks to oil production, with the North African country characterised by political and military instability since Gaddafi's death. Political chaos has led to disruptions, from blockades on oil fields, sabotage and looting. Delays to Libya's presidential election (originally planned to be held in December 2021) have fuelled uncertainty. Inconsistent output does not bode well for supply stability, which can lead to higher oil prices. Despite the political risk due to instability, reductions in Libyan oil output can be compensated by increased production by their OPEC counterparts.

After experiencing record lows in 2020, the oil market has rebounded to a new high above $100 for the first time since 2014, straining stockpiles across the globe. This highlights the tight market environment in which the oil sector currently finds itself, where the price difference between the best bid and offer is very small. It also underlines the influence of the geopolitical instability surrounding Ukraine. The potential for prices to reach up to $125 is a major concern because of the knock-on costs on petroleum-based products and supply chains in a high inflation environment across the world.

The oil sector has different regulatory requirements across the world's geography, but there are common developments and trends among oil-supplying countries. The risk of criminal sanctions in the oil sector increases each year. For instance, supply chains in the oil sector are often prone to corruption and bribery, which recently resulted in a US$853.2 million fine against Petróleo Brasileiro SA, under the U.S. Foreign Corrupt Practices Act in the so-called Car Wash bribery scandal. An additional concern for companies in the oil industry subject to such criminal charges is the severe reputational damage.

There are also various regulatory regimes in place in Western economies aimed at reducing greenhouse gas emissions and guiding the green shift away from the oil sector. In the US, the Environmental Protection Agency (EPA) sets out rules for schemes such as carbon credits whilst the EU operates the Emissions Trading System. The EU ETS functions on a 'cap and trade' basis: there is a limit set on the total greenhouse gas emissions allowed to all participants in the System and this cap is converted into tradable emission allowances. Since the Paris Climate Agreement in 2015, many states have also passed net-zero legislation, effectively binding oil companies to decarbonisation strategies from national industry authorities. In the UK, the Oil & Gas Authority now puts the onus on oil companies to invest in carbon capture and storage projects as well as a clean hydrogen production.

An emerging challenge to oil companies comes from judiciaries across Western legal systems after the Dutch courts established the ground-breaking precedent that Royal Dutch Shell was legally obliged to align its corporate policy with the Paris climate agreement. German courts were quick to respond to the waves of the Dutch precedent, as they ruled in the past year that the Bundestag's climate change law had to be revised in order to clarify details on how greenhouse emissions would be reduced by 2030.

The ongoing transition to sustainable investment directly impacts oil companies, who are now pressured to reform their corporate strategies and capital expenditures. To put into scope, an alliance of the world's largest pension funds and insurers ($2.4 trillion assets under management) announced it would transition portfolios to net-zero emissions by 2050. Since then, shareholder activists have challenged numerous oil companies, including Exxon, Shell, Chevron, and BP.

Exxon notably conceded to the activist campaign launched by US hedge fund Engine No.1, who managed to secure three board seats and a mandate to shift Exxon's emissions reduction strategy. Shell is currently facing ongoing pressure to split into standalone companies after activist hedge fund Third Point has used its large stake to criticise the company's incoherent and slow capex strategy for renewable energy. A majority of Chevron shareholders overpowered the company's board with a 61% vote supporting an activist proposal from Follow This to force the group to cut its carbon emissions. Finally, BP has also been pressured by Follow This after a 21% vote in favour of their proposal to bring BP's policies in alignment with the Paris climate targets meant that, per the UK corporate governance code, they were forced to go back to investors and discuss their concerns.

The midstream side of the oil industry faces the risk of operational accidents like spills, explosion, and leak pose reputational, financial, and regulatory risks. Although these risks often arise due to weather phenomena like hurricanes or storms, an estimated 30-50% of oil spills are attributable directly or indirectly to human activity. In terms of environmental impact, it is obvious that oil spills are major sources of pollution and especially damage marine ecosystems. Nevertheless, oil spills also pose an immediate fire hazard and the death of oil rig workers can possibly give rise to corporate criminal responsibility.

One new emerging operational risk for the oil industry involves cyberattacks on sites such as pipelines. The ransomware attack on the USA's Colonial Pipeline has ignited concerns about the safety of the oil industry's digital security. Without actions taken to mitigate the cybersecurity risk on oil operations, consumers could face prolonged delays and shortages in petroleum supply and other oil-based products.

The environmental effects of climate change affect oil infrastructure across all parts of its supply chain, from extraction and refinement to storage, transportation, and distribution. The Environmental Research Laboratory at Greece's National Centre of Scientific Research "Demokritos" has published an overview (Table 5) describing the impact of climate change, focusing on temperatures, hurricanes, high winds, lightning strikes, storm surges, and flooding.

Oil has an inelasticity of demand, resulting in a market that is unresponsive to price changes. The reason for this is the prevalence of oil in so many everyday products. Oil's diverse usage means it is used to satisfy the three main needs of mankind: food, shelter and clothing. For example, consumers are unlikely to change their necessary habit of using a car every day because of rising prices. A reduction in the demand for oil will instead stem from unique circumstances, such as lockdowns during the pandemic or threats of full-scale war, such as between Ukraine and Russia. However, the ongoing generational shift from baby boomer to millennial vehicle owners shows a shifting consumer tendency showing preference for a fuel's environmental impact, convenience, and user experience as opposed to brand and price.

Oil supply is even more inelastic because oil extraction equipment is typically very expensive and cannot be diverted for other productive activities. This gives oil companies no option but to continue oil production with their equipment even during price drops to avoid a complete loss on large investments.

Trends

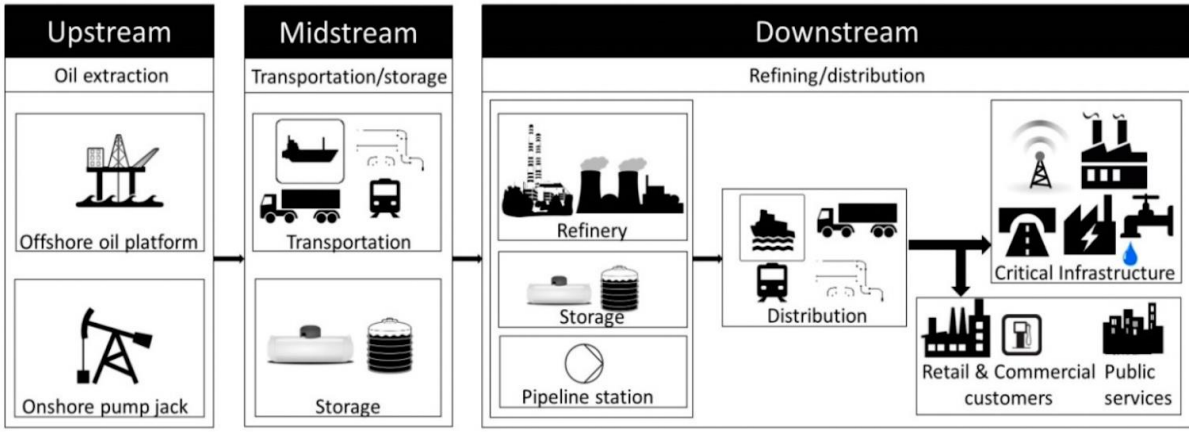
Global crude oil demand is predicted to have exceeded production in the final quarter of 2021 for the sixth successive quarter in a row. Since the third quarter of 2020, global petroleum stock withdrawals have been 1.7 million b/d (barrels per day) on average. However, an anticipated increase in production from OPEC+, US oil, and other non-OPEC countries is expected to achieve balance between supply and global oil consumption.

A particular focal point for increased oil demand in 2022 is Asia with a projected rise of 1.7 million b/d. China and India are at the forefront of this resilient growth, as countries across the continent look to revive economic activity after imposing stricter Coronavirus restrictions throughout the pandemic than the majority of Western economies.

Supply Chain and Trade Routes

Oil is transported globally through various modes of transportation, using tankers, barges, pipelines, railroads, and trucks. The oil supply chain is fraught with security risks, including geopolitical vulnerabilities, terrorist attacks, oil spills, logistics, and conflict, and risk reputational damage to the oil producers. Examples include the Deepwater Horizon spill in 2010, persistent conflict and tensions in Libya, and logistical difficulties to increase supply due to supply chain shortages for production inputs, with disruptions to oil production and output driving up global oil prices.

The oil supply chain, from upstream to downstream.



Source: Katopodis and Sfetsos (2019)

Maritime routes make up almost two-thirds of global oil trade. Chokepoints are a crucial part of global energy security and are unavoidable due to geographical constraints. Even temporary blockades to a chokepoint have the potential to increase total energy costs and global energy prices. Oil is produced in the world's most volatile regions, so understanding the location of key chokepoints is important during times of uncertainty.

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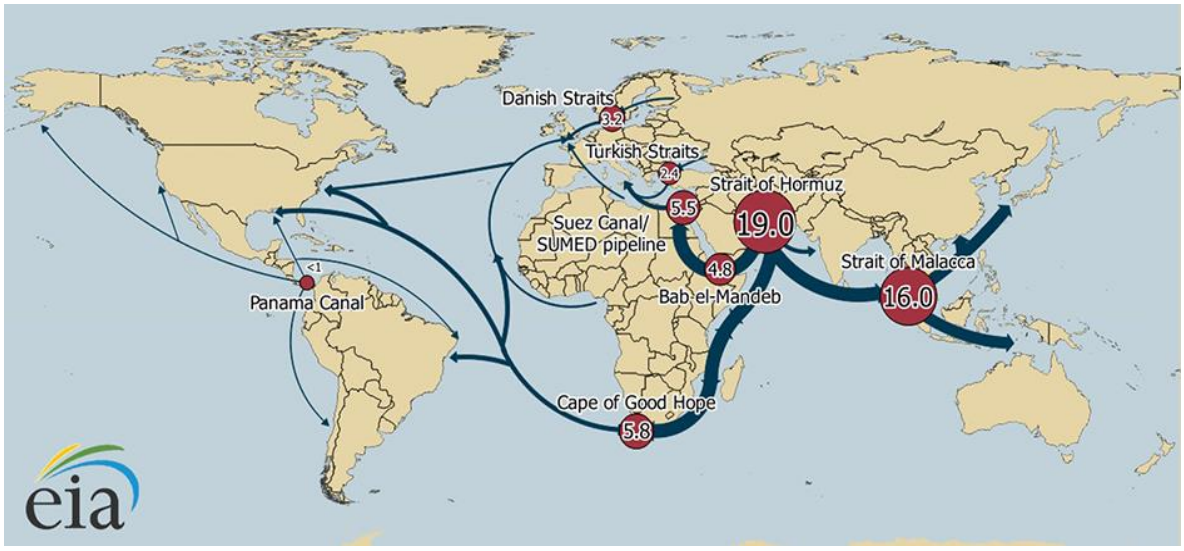
Daily transit volumes through key world maritime oil chokepoints (million b/d)



Source: EIA

Approximately 35% of seaborne oil exports travel through the *Strait of Hormuz*, where is the main maritime route for Persian Gulf exporters (Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the UAE) to ship oil to external markets. These countries are dependent on oil revenues to fuel their economic growth. As a result, supply disruptions due to geopolitical developments and subsequent price fluctuations would lead to a loss of oil revenues and economic instability. Risks to this route include the flaring up of tensions between Sunni and Shiite countries, and Iran has in the past threatened to close the strait as leverage in response to US sanctions. The lack of alternative export routes makes it difficult to reduce dependence on the Strait of Hormuz, and countries have built security alliances, most notably with the US, where it receives 18% of its oil imports from the gulf.

The Russian invasion of Ukraine has caused the Black Sea to emerge as a flashpoint between Russia and the West. The Black Sea is an important trade route connecting to the Mediterranean and southern Europe. Black Sea ports are among the primary oil export routes for Russia, Azerbaijan, and Kazakhstan. The route has significant geo-economic implications for Russia and Ukraine, as they rely heavily on the ports for agricultural and industrial exports. Following Russia's February 24 attack, commercial shipping from Ukraine has been suspended, causing major supply disruption and driving commodity prices to new records. Turkey, which borders the south of the Black Sea, faces a conundrum as it has close ties to both Russia and Ukraine, and has so far opposed imposing economic sanctions against Russia, in contrast to its NATO allies. As the situation evolves, the supply shock will cause commodity prices to surge in the short-term as buyers seek alternatives. Heightened Russian military presence and further tensions in the Black sea may lead to reduced shipping traffic in the Black Sea in the medium-term because of increased reluctance of Western companies willing to ship through the region.

Although the Suez Canal is a critical and symbolic chokepoint, the March 2021 blockage did not cause widespread oil supply disruption nor a volatile price reaction. This was because the blockage occurred at a time where global COVID-19 lockdown restrictions were beginning to ease. Low oil prices and relatively high inventories accrued over the pandemic had a muted effect on global oil supply. However, as economies recover and oil demand rises, the canal will become more important as oil is transported in both directions, serving markets in the United States, Europe, and Asia. As such, potential disruptions in the near future are expected to be more severe as demand returns to normal levels.

Natural Gas

Frank Stengs

Natural gas is used to generate electric power, which is cleaner and emits green-house gases than coal and oil, for transport, mainly by cars, trucks and busses, for heating residential and commercial buildings , and for industrial purposes in process heating, as a lease and plant fuel, and as a raw material.

Mapping the market

Exports within the gas industry generally tend to be divided into two fields; those of LNG (liquified natural gas) exports, and those of pipeline exports. Pipeline exports are dominant and account for 755.8 billion cubic metres (BCM) of the export market, while LNG exports account for 487.9 BCM of the export market (statistics from 2020; source BP).

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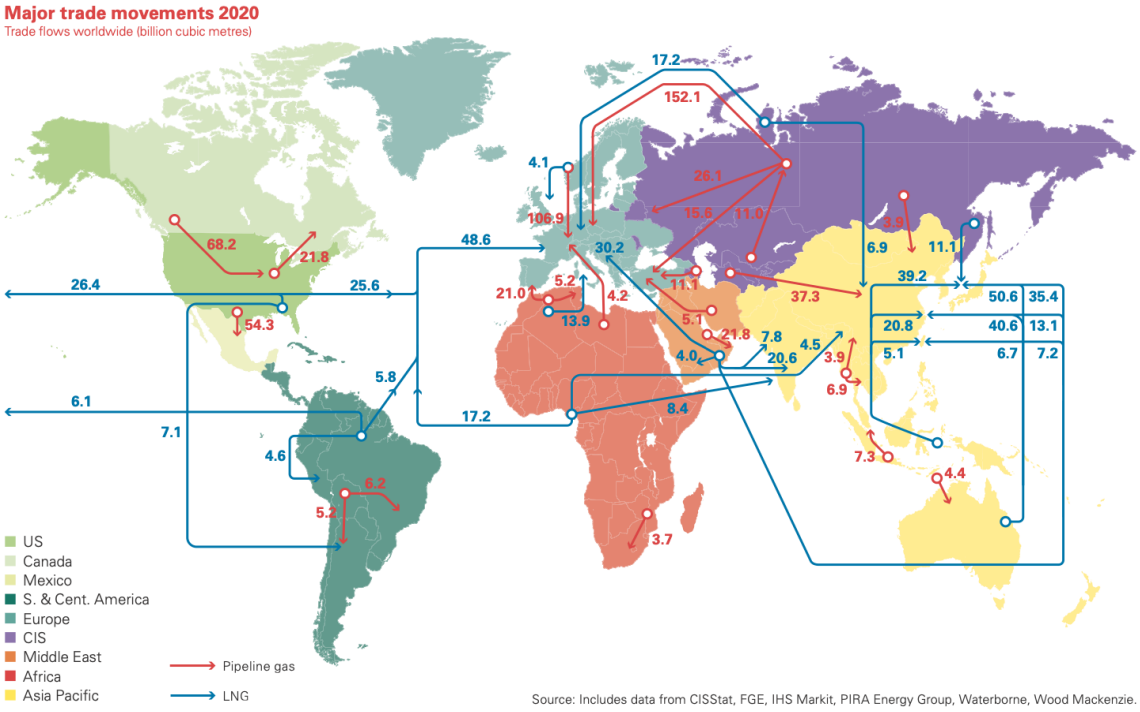

Source: BP

Leading Countries by Exports and Imports of LNG (2020)

Exporting Country	Share of export market	Share of import market	Value (USD)
Australia	21.8%	Japan	20.9%
Qatar	21.7%	China	19.2%
US	12.5%	South Korea	11.3%
Russia	6.7%	India	7.3%
Malaysia	6.7%	Taiwan	5%

Nigeria	5.8%	Pakistan	2.7%
		Total Asia Pacific	*70.7%*
		Spain	4.2%
		France	4%
		United Kingdom	3.8%
		Turkey	3%
		Total Europe	*23.5%*

Source: BP

Not taking into account political risks, global LNG trade growth is projected to slow to 4%. According to the IEA, China remains the largest contributor to import growth, but growth rate drops to 9% in 2022 (becuase of ramp-up pipeline flows from Russia and slowdown in gas demand growth). India LNG imports are projected to grow by 12%. European inflows are expected to remain elevated with high restocking needs. As demand for LNG in Asia and Europe surges, exports are expected to increase, with the US set to become the top LNG exporter of 2022.

Leading Countries by Exports and Imports of LNG (2020)

Exporting Country	**Share of export market**	**Share of import market**	**Value (USD)**
Russia	26.2%	US	9%
Norway	14.1%	Mexico	7.2%
US	10.1%	*Total North America*	*19.1%*
Canada	9%	Germany	13.5%
Turkmenistan	4.1%	Italy	6.7%
Netherlands	3.7%	Netherlands	5%
Algeria	3.4%	Turkey	4.2%
Qatar	2.8%	United Kingdom	3.9%
		France	3.4%
		Total Europe	*59.1%*
		China	6%
		Total Asia Pacific	*8.6%*

Source: BP

Risks

A complete curtailment of Russian gas supplies to Europe, by Moscow, which is unlikely to happen. This would only happen in the face of heavy international sanctions. Both Moscow and Gazprom, Russia's state-owned gas corporation, would be hit extremely hard as well, even if the curtailment were to be sustained for several weeks or months. Moscow is dependent on the taxes of gas production and exports, which account for a significant part of its federal budget. Curtailment would pose a financial risk in the short-term, with tax losses on production and exports. For Gazprom the consequences would be even worse. Gazprom is more dependent on sales revenues from Europe, than is the Russian government on natural gas taxes. Moreover, Gazprom has pursued a commercial strategy of selling long term contracts instead of selling volumes on the spot market. In the winter of 2021-2022, when Russia (and Gazprom) was accused of intentionally manipulating the gas market, Gazprom told buyers to buy more long-term contracts. Any breach of existing contracts would cause Gazprom to be viewed as an unreliable partner, severely harming its reputation and making it impossible to sell Europeans long-term contracts in the future.

A complete curtailment of Russian gas supplies by Europe, which is also highly unlikely to happen. For starters, there would be grave economic consequences for Europe. Curtailment would lead to steep increases in already high gas prices. In the case of curtailment, Europe has to scale up its imports from other suppliers. Since the potential for scale-up in existing pipeline exporters is limited, Europe probably has to look to global LNG markets, increasing LNG prices and impacting LNG importers elsewhere. More importantly, both (non-Russian) pipeline exports and LNG exports are not enough to fill demand left by the Russians. The high prices & shortage of gas would severely harm European economies. Combined with the fact that EU sanctions have to be unanimous, it is highly unlikely for the EU and Europe to come up with a sanction package targeted at Russian gas exports.

Banning Russia from SWIFT would have severe consequences for the financial communication between the West and Russia. This would likely result in a (large) curtailment of gas flows by Gazprom, as it would be unable to receive financial payments. As a consequence, a ban from SWIFT is unlikely to be included in a sanctions package. According to US and EU officials SWIFT already has been excluded from the potential sanctions package.

The certification of Nord Stream 2, has been halted by the German government. This limits the amount of new gas supplied from Russia. It also has repercussions for German plans to switch from coal and nuclear to natural gas and other resources. Because of 1) the increase in demand for German & European policy plans, 2) a tight market with other suppliers, supplying almost on full-capacity and 3) the Russians, supplying little on the spot market, LNG imports are likely to increase as a consequence.

Curtailment of Ukrainian gas flows, which is unlikely to happen as a consequence of the Ukrainian government. With tensions running high, the Ukrainian government will not curtail gas flows, for fear it would lose European supporters. (Partial) curtailment of Ukrainian gas flows, however, is likely to happen as a consequence of military conflict, which increases the possibility for damage on the pipelines. Especially if that military conflict plays out on ground where the main pipelines run through, which would be the case with a wider/full-scale invasion.

LNG exports. In light of the Ukrainian-Russian tensions, the US, Australian and Qatari governments have released statements to ensure European energy security. Although LNG exports might relieve some of the stress on the European gas market, it will not be enough to fill the demand left by Russian supplies. The vast majority of LNG exports was sold through long-term contracts, with a small fraction being sold on the spot market.

In the case of Australia, funnelling all the spot output would probably require government intervention. According to experts, Qatari exports will also not play a decisive role in ensuring European energy security. Its commercial strategy of long-term contracts has left little room for manoeuvre on the spot market. Doha also has a focus on the Asian market and will try to prevent causing political tensions through its gas exports. Even US LNG exports to Europe, which have reached a record-high in the first months of 2022, are not enough to fill the gap left behind by Russian supplies (IEA).

Algeria. Although Algeria makes up a minor role in the European energy market, it has the potential to impact Southern regions more than others. With tensions running high between the West and Russia, Algeria could potentially alleviate some of the pressures by exporting more gas through pipelines. So far, however, Algeria's role is undecided. Potential conflict with Morocco is looming, and Algeria does not want to risk antagonising its partner, Russia, unnecessarily.

Algeria is unlikely to export additional gas to Europe. Its domestic demand is increasing, but more importantly, in its conflict with Morocco, Algeria has tried to isolate the kingdom by blocking its gas supplies. Recently, however, Spain, supported by the EU, agreed to supply Morocco with natural gas. Ironically, the majority of Spain's natural gas comes from Algeria. So indirectly, Algeria is now supplying Morocco with gas. The recent move by Spain and the EU make it unlikely Algeria will move beyond its contractual obligations (Arab weekly).

Green agendas are a political risk to investments in the gas sector. While many consider natural gas necessary for the energy transition, in order to shift away from coal, it remains a green-house gas emitter. The most impactful and ambitious green agenda comes from the EU. The European Commission is now considering whether it should classify natural gas as a 'green-project' or not. The 'taxonomy complementary delegated act', which the EC currently is drafting, guides and mobilises private investment in activities that are needed to achieve climate neutrality in 2050. The act will shape the landscape in the gas sector for the next decade(s). In Japan, the world's biggest LNG importer, natural gas usage in the energy sector is scheduled to decrease by 50% in 2030.

China, on the other hand, which is on track to surpass Japan in LNG imports, aims to use more natural gas in order to reach its climate goals. In the coming decades, the country plans to shift away from coal in the coming decades. Within the US demand for natural gas in key sectors is expected to decline, due to state-level decarbonization policies. However, as demand for LNG in Asia and Europe surges, exports are expected to increase, with the US set to become the top LNG exporter of 2022.

US foreign policy. The US transformation into a net exporter of energy has revolutionised US foreign policy, according to the former US Secretary of Energy. It allows the United States to use energy cooperation as a tool to advance foreign policy aims. In Europe, dependence on Russian gas has consequences for foreign policy calculations. In this light, US LNG exports have been well-received to diversify their energy imports. The current trends in LNG exports, however, have been met with

criticism in the US senate. In the beginning of February, some US senators pushed for limiting LNG exports in order to divert the price surges at home. These suggestions have the potential to seriously undermine US foreign policy. With Russian aggression in Ukraine, we should not expect limitations to US LNG exports any time soon.

Coal

Phaedon Angelopoulos & Mansi Rathore

There are various types of coal, each with its own characteristics, efficiency and carbon footprint. Carbon use accounts for 40% of fossil fuel emissions and 25% of greenhouse gas emissions, while accounting for 25% of global Primary Energy and ⅓ of its electricity. Its only use is energy, mainly in electricity and to a lesser extent, heat, transport, cooking, writing, but also for industrial chemical production, industrial lubricant. Thousands of different products have coal or coal by-products as components: solvent, plastics, fibres, etc. Coal is divided into two main categories: metallurgical that is used mainly to make steel and thermal that is mainly used for energy through electricity and steam. Coal supports various non-energy industries including steel and cement production, coal-to-chemicals, rare earth element extraction, industrial electrodes and many others.

Based on the amount of carbon the coal contains and on the amount of heat energy the coal can produce, coal is classified into four main types, or ranks: Anthracite, Bituminous, Subbituminous, and Lignite.

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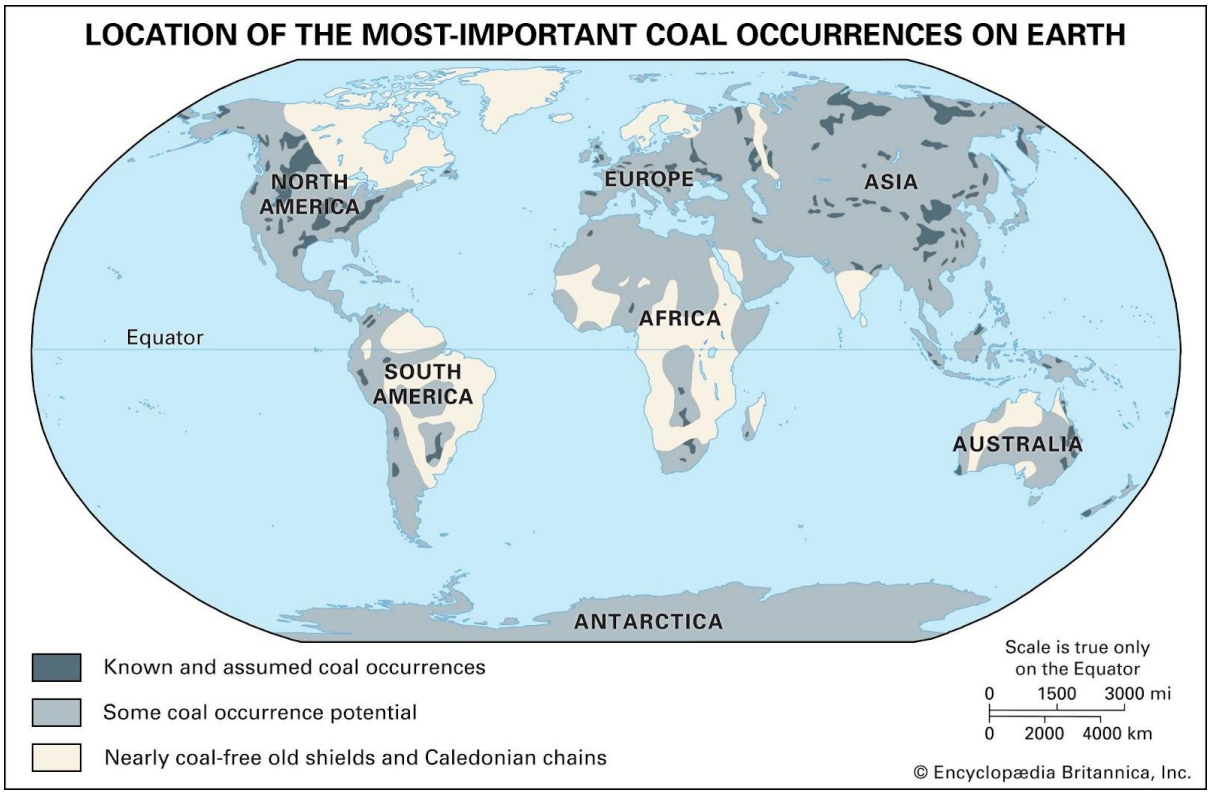

Source – World Energy Council

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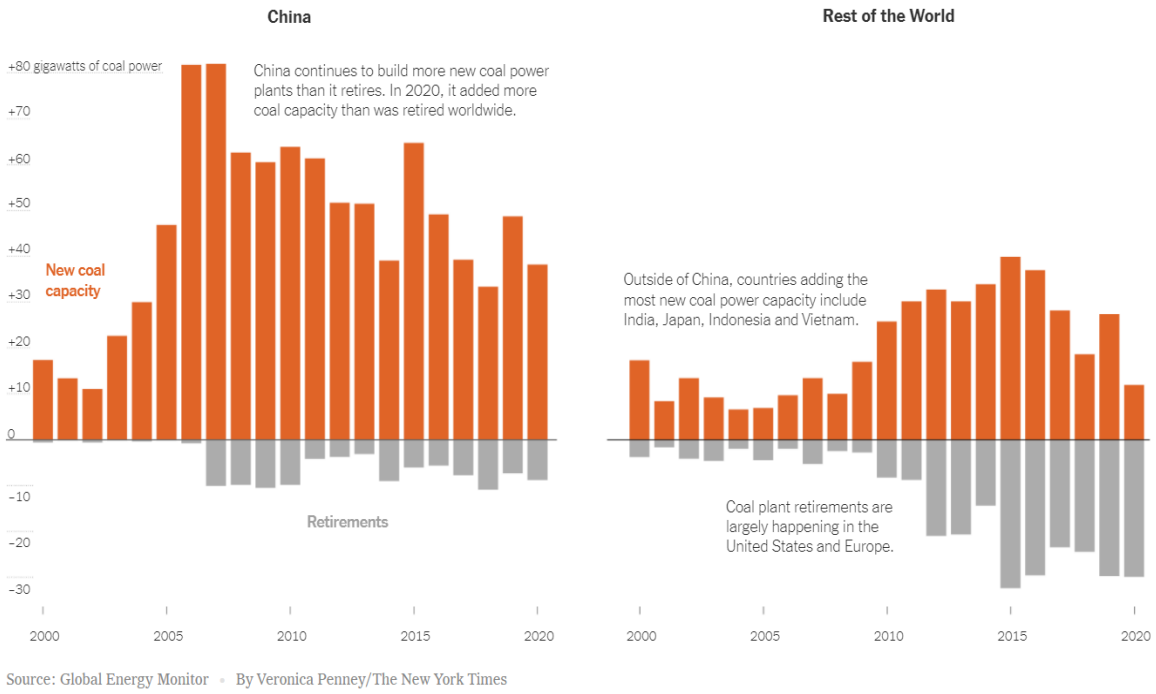
Global Coal trade; China and Rest of the World



Source – NY Times

Supply

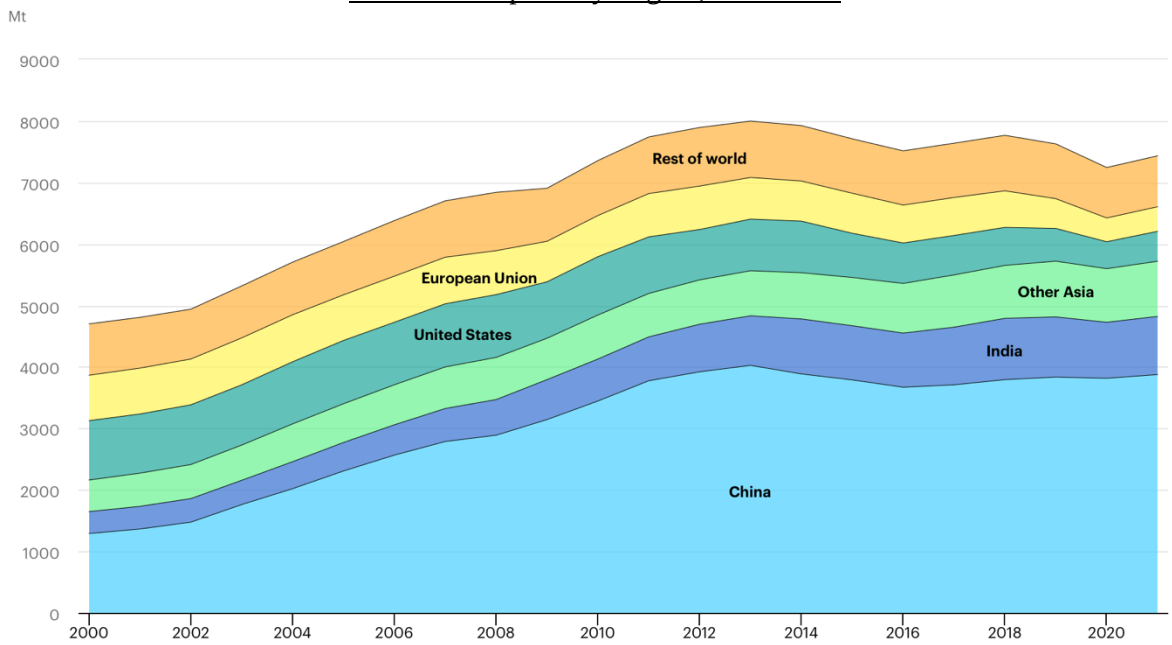
China is by far the largest producer of coal, with such a large production capacity that has the ability to essentially control the global market, single-handedly. Current production is 4.07tn tonnes, a 4.7% increase compared to 2021. Supply has recovered to pre-pandemic levels and is currently the highest ever. Current consumption sits at 50.5% of global consumption. India is the second largest producer and consumer, with 11.3% of global consumption and a production of 74.78 million tonnes, a rise of 6.7% compared to 2019. Liquid Fuels from coal can provide a viable alternative to conventional oil products and can be used in the existing supply infrastructure. Several coal-to-liquids [CTL] demonstration plants are now being developed in China.

Biggest exporters of Coal in the world: Indonesia (455 Mt) and Australia (395 Mt).
*Statistics from 2019, subjective to change

Biggest importers of Coal in the world: China (308 Mt) and India (249 Mt).
* Statistics from 2019, subjective to change

(Please use zoom feature to look more in depth)

Coal Consumption by Region, 2000-2021



Source - IEA

The largest consumers of Coal in the world are; China (51.7%), India (11.8%) and the US (7.2%).

The demand for metallurgical coal is synonymous with the demand for steel. As a result of the pandemic, construction ground to a halt, resulting in a fall in the demand for coal. China is the main market for hard coal with 1.01 billion mt raw coal consumption in 2021. China is by far the country with the largest impact over the coal industry, being the biggest consumer, importer and producer, followed by India. Specifically, China's coal use for power generation alone accounts for ⅓ of all global coal consumption, where India and China combined account for ⅔, and this consumption is set to rise to record levels in both countries.

Fluctuations in the price of coal within China have a great impact on the global price, due to its status, controlling a very vast amount of the commodity. Coal prices have skyrocketed since April 2021, reaching a peak in May, before slightly dropping to 200% the price it was prior to that spike. The trend seems to have closely followed that of the Chinese coal price, whose spike began in February of the same year and is currently sitting at 65% increase.

Even though Chinese demand is mainly related to demand for energy, the construction boom, further fuelled by the post-pandemic energy and economic crises, and industries rebounding, have led to estimates for demand, supply and production to rise to record levels in the next two years. Despite this, the demand is set to outpace supply, pushing prices even higher. Demand in China may slow in coming years, due to political instability in regions within China where coal is sourced, such as Inner Mongolia, which could in turn raise the price and suppress demand. At the same time, the construction industry is heavily indebted, with building entire cities that remain empty, large scale projects with no buyers or that are left incomplete and generally an overabundance of supply that simultaneously fails to meet demand.

The EU has a very small -and still shrinking- consumption and supply for hard coal. Almost the entirety of it is sourced in Poland and is mostly consumed in Poland and Germany. The same trend is true for brown coal, used for energy, with Germany making up 44% of the EU consumption and an overall decrease of 33% between 2018 and 2020. Simultaneously, the EU's consumption is mostly related to industrial use, which is set to recover this year to pre-pandemic levels, even showing slight growth. That is to say, different types of coal are affected and respond differently to market fluctuations, supply, demand and supply chains.

In other words, the derived demand for Metallurgical or Hard Coal is linked with the demand for steel, mainly in construction, while for all other types of coal it is linked with demand for energy. At the same time, the rise of Hydrogen Direct Reduced Iron, a more costly alternative to steel production can mean that industrial use of coal is going to be phased out, especially as direct reduced iron (DRI) costs fall long term. Nevertheless, the global trendsetter for coal prices, including supply and demand, is dictated by China and to a much lesser extent, India.

The elasticity of demand for coal is relatively elastic, if the prices rise substantially, consumers may shift to other viable options. New greener fuels are now gaining momentum in developed countries like France and the UK. But it is not viable to say that the increased prices of coal are due to the clean energy transition. The blame may lie at the feet of economic recovery post pandemic and other multiple factors.

Risks

The transition towards a sustainable and green economy, in accordance with the Paris Agreement, has led to several nations vowing to reduce their CO2 emissions by shifting to renewable energy sources. Decarbonization of the power sector has led to a 50% decline in demand for coal. The development of new coal-fired power plants have been shelved in countries like Vietnam, South Africa and Bangladesh due to changes in climate policies. In countries like India, existing coal plants are running way below capacity and losing money. In others, including the United States, they are being decommissioned faster than ever.

Climate Risks*:* According to McKinsey's MineSpans database, mining regions such as Northern Australia, Indonesia and India, not accustomed to water stress, are projected to become increasingly vulnerable. On the other hand, regions like China and South America are struggling with extreme heat, decreasing worker productivity and raising cooling costs.

Coal-dependent communities economic activity and jobs are at risk due to the phasing out of the global coal trade. For example: 26 US counties are classified as "coal-mining dependent", meaning the industry is an important contributor to local government finances. The European Union has devised a defence machination; capitalising a fund with over USD 20 Billion to support economic diversification and assist affected areas and workers.

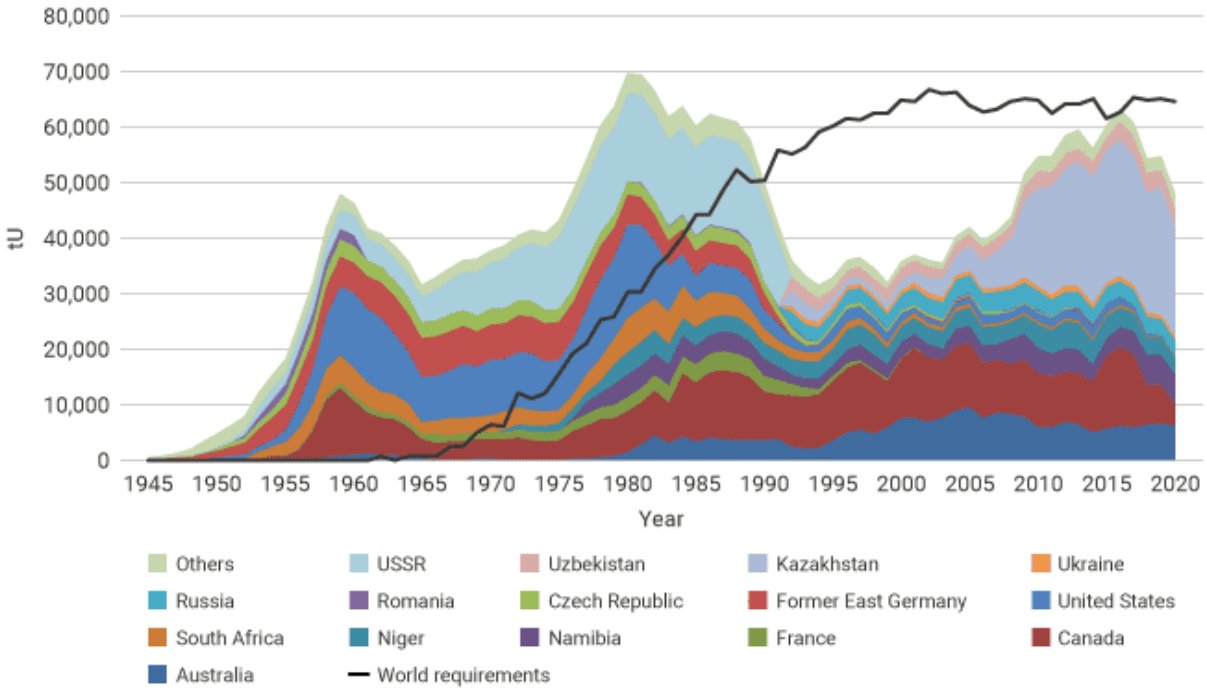
Uranium

Marina Kutumova-Sidwell

Uranium is a slightly radioactive heavy metal with silvery-white tint. It is a naturally occurring element that can be found in soil, rock and water. Its commercial extraction comes from minerals such as uraninite. Due to its ability to provide nuclear fuel in order to generate low-carbon electricity in nuclear power stations, uranium is widely used in the energy sector around the world. Additionally, as uranium is a high density element, it is also used in the production of yacht keels and counterweights for aircraft control surfaces.

Each year, around 74,000 tonnes of uranium oxide concentrate with around 62,500 tonnes of uranium (tU) from mines are required to run 440 reactors with a total capacity of around 390 GWe. According to 2019 data major requirement needs come from North America, European Union, East Asia and Europe (non-EU).

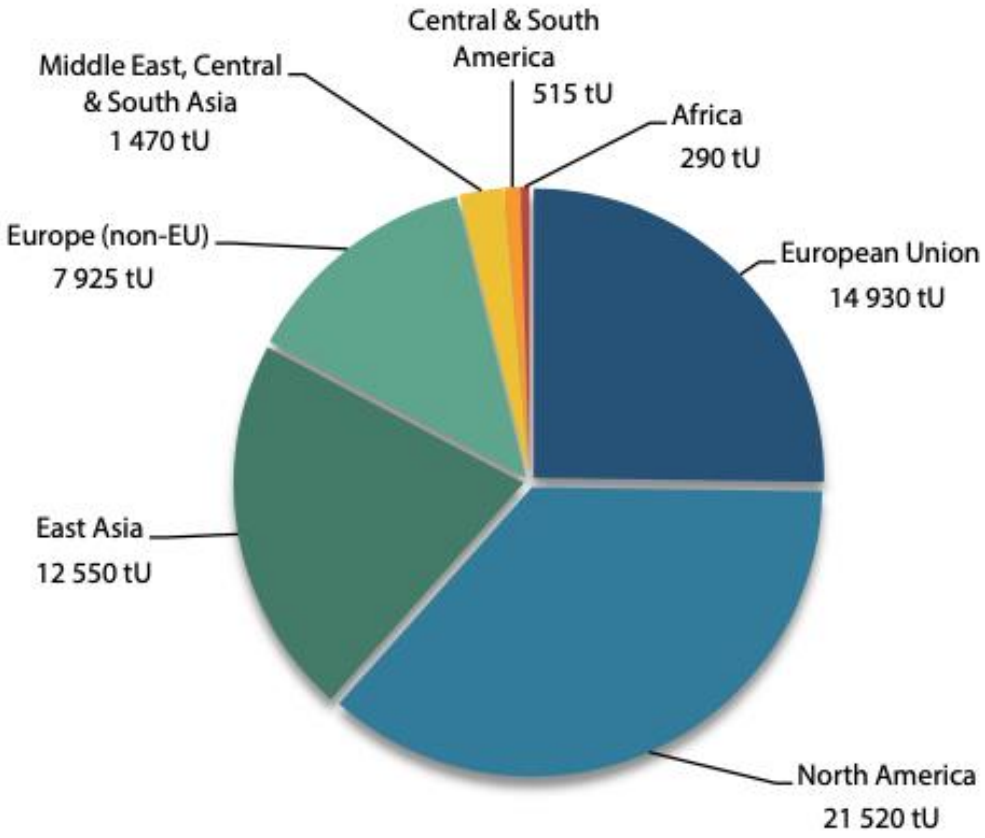
World Uranium Production and Reactor Requirements (tonnes U)



Source – World Nuclear Association

As the reactors are run more efficiently, with increased capacity capabilities and power levels of reactors, these factors dampened overall demand levels for uranium. To illustrate, such improvements led to a reduction of uranium demand per kWh output in Europe by 25 per cent over the past 20 years. Hence, although uranium is seen as a valuable commodity, the uranium market has experienced contraction as a result of which major producing countries decreased their total uranium production in recent years. Nonetheless, the main growth for uranium demand can still be seen in Russia and China.

World Uranium Requirements (2019)



Source - NEA

The global production of uranium reached 53 516 tU as of 1st January 2019 with 16 countries declaring being active in uranium production. OECD reports that globally, uranium mine production fell by almost 11% in the period from 2017 to 2018 with a slight recovery of 1% in 2019. The majority of the world's production of uranium from mines comes from Kazakhstan with a share of over 40% of world supply in 2020. Kazakhstan is followed by Australia and Canada with their uranium production shares being 13% and 18% respectively.

Having achieved the status of the world's largest uranium producer in 2009, Kazakhstan is also aiming at selling value-added fuel rather than simple uranium. It has built a major nuclear fuel pellets plant with 49% Chinese equity in order to meet its goal. Apart from China, Kazakhstan has also established major strategic international collaborations with Russia and Japan.

Worldwide imports of uranium or thorium ores and concentrates exceeded $233 million in 2020 based on the available statistics of 24 countries, a slight decrease from $274 million in 2019. The major importer of this commodity group is India with over 67% of the total world imports equalling to $158 million. India is followed by China with 17.5% ($41 million) and USA with 13.7% ($32 million).

Risks

As the leading uranium producer, Kazakhstan has long been seen as one of the most stable countries in the Central Asian region. However, a recent rare outbreak of violent protests that took place in the whole country in January 2022 highlighted Kazakhstan's vulnerability and potential susceptibility to such events. In order to resolve the situation in the country, Kazakhstan's President Kassym-Jomart Tokayev had to declare a country-wide state of emergency as well as request assistance from the Collective Security Treaty Organisation (CSTO).

Although the production of uranium during this civil unrest remained unaffected, it is important to take into account the fact that potential issues of political stability in Kazakhstan may seriously affect the supply of uranium worldwide if it causes disruptions to its uranium production. As Kazakhstan plays such a central role in the uranium market, any such disruption would require a collective effort from other uranium producing countries to meet the demand. To further illustrate the effects of civil unrest in Kazakhstan, the threat of disruption also led to a brief increase of global uranium prices the consequences of which were felt among Australian and North American companies, which witnessed their stock prices rise during the week of protests in Kazakhstan.

Green Hydrogen

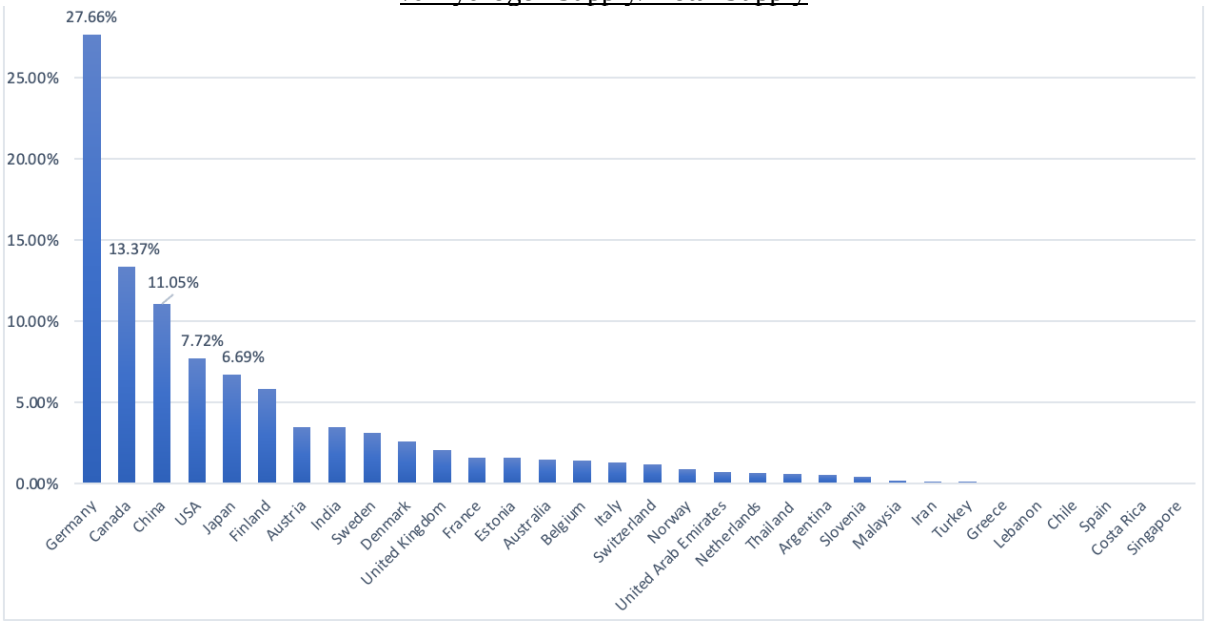
Güzide Sofi & Frank Stengs

Hydrogen is a gas that can be used as fuel. It is a clean alternative to natural gas, since it emits no greenhouse gases. The production of hydrogen, however, requires a considerable amount of energy. Hence, hydrogen is divided into different groups. Green hydrogen is produced with no greenhouse gas emissions (e.g. solar, wind or hydro-power). Blue hydrogen is produced out of natural gas, which is split into hydrogen and CO2, with the latter being captured and stored. Grey hydrogen, on the other hand, is produced out of natural gas, without the CO2 being stored. Grey hydrogen is currently the most used and produced form of hydrogen.

Hydrogen has 3 main uses: transport, industry and domestic. It is used as fuel, in particular for fuel cells of electric vehicles (FCEV). However, they currently only account for 0.5% of new low-emission vehicle sales, but the market for FCEVs is beginning to flourish. For instance, recently, Hyundai has announced that it will be manufacturing 500,000 hydrogen vehicles by 2030. Similarly, Paris has begun developing taxis that run on this fuel and several European cities (Scotland, Netherlands, Germany, France, Belgium) have pilot programmes for their waste collection vehicles to be powered by this technology. In industry, it is mainly used in 2 sectors; chemical industry for manufacturing ammonia and fertilisers, petrochemical industry to produce petroleum products. Additionally, it is starting to be used in the steel industry. For domestic use (electricity and heating), there are already several projects underway that aim to replace the natural gas network with a green hydrogen network.

In 2020, at 30 kt H2, green hydrogen (hydrogen by water electrolysis) accounted for 0.03% of total annual hydrogen production, according to the Global Hydrogen review by the IEA. In 2022, there are 145 Operational Plants worldwide in 32 countries, with total estimated normalised capacity of 26.1 kt H2/y, according to the hydrogen projects database of IEA.

% Hydrogen Supply/ Total Supply



Source – IEA

In 2017, only Japan had a national hydrogen strategy. Today, while production remains low, more than 30 countries have developed or are preparing hydrogen strategies, indicating growing interest in clean hydrogen. By August 2021, governments around the world allocated around $65 billion in targeted support for clean hydrogen for the next decade, with France, Germany and Japan making the most significant commitments. These amounts are sizable, but they are low compared to other energy sector subsidies, which amounted to $634 billion in 2017, 70% of which supported fossil fuels.

The EU plans to invest $430 billion in green hydrogen by 2030, while countries such as Chile, Japan, Australia and Saudi Arabia are all making investments into the technology. In Japan, alongside government investment in hydrogen and fuel cell technologies (around $670 million in 2020), policymakers have set mobility targets of 800,000 FCEVs and 900 hydrogen refuelling stations by 2030. South Korea's Green New Deal has a target of deploying 200,000 FCEVs by 2025, which is about 20 times more than in 2020. The US government's Infrastructure Investment and Jobs Act of 2021 contained a $9.5 billion budget to boost clean hydrogen development. This was followed by the launch of the Hydrogen Earthshot programme, which aims to cut the cost of clean hydrogen to $1 per 1 kilogramme in 1 decade. In November 2019, Australia launched its national hydrogen strategy, "H2 under 2" target, which aims to reduce production costs. This strategy has already attracted AU$370 million in state support.

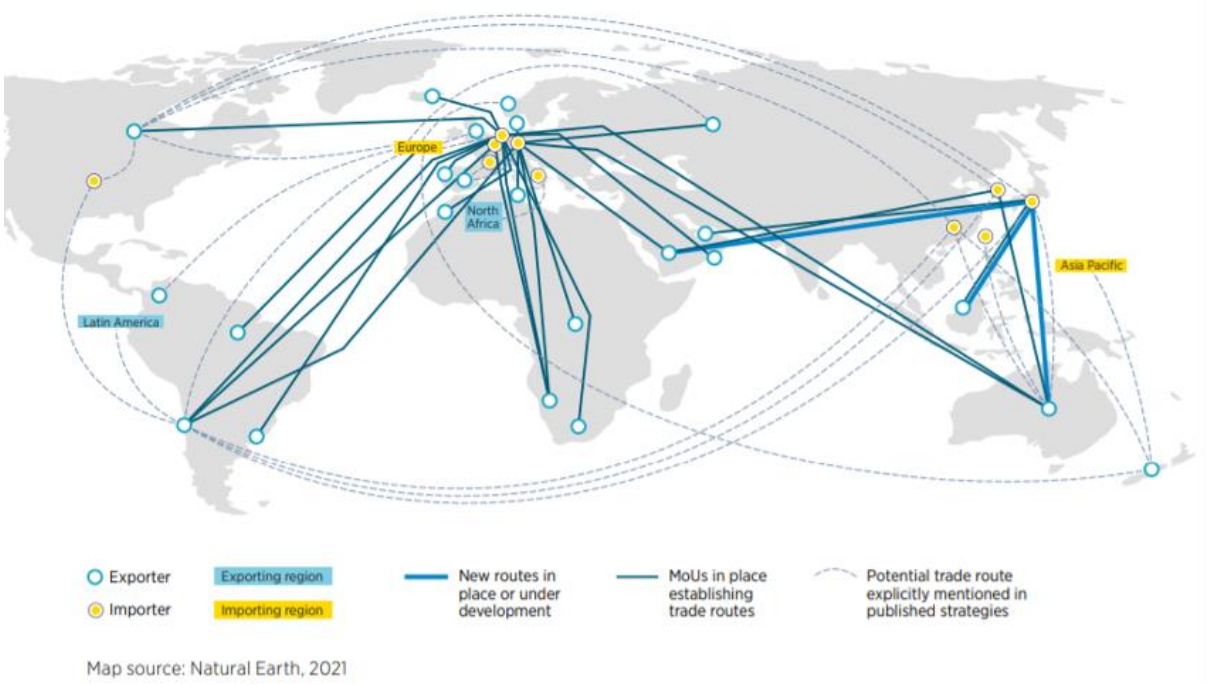
Supply of green hydrogen is elastic. In the short run, capital stock is fixed so disruption in supply would increase prices disproportionately. Also, because energy production is capital-intensive, supply price elasticities are larger or more elastic in the long run than in the short run.

In 2020, the total demand for hydrogen was around 90 Mt. Since 2000, total demand has grown over 50%, with the majority of demand coming from refining and industrial uses. Chemical production accounts for 45Mt of total demand with around 75% used in ammonia production and 25% used in the production of Methanol. Refineries account for 40Mt of hydrogen demand, and 5Mt is used in steel-making. World-wide consumption is dispersed. China accounts for more than 25Mt of total demand, the US a little bit more than 11 Mt, the Middle East 11Mt, the EU 7Mt, India 7Mt, Canada 3Mt, Latin America 3.5Mt, Africa 3Mt, Japan 2 Mt, Korea 1.8 Mt. According to SP Global, demand is set to take-off in the mid 2030's, accounting for approximately 12% of global energy use in 2050. For green-hydrogen it is projected to be competitive with fossil-fuel hydrogen in the mid 2030's as well, and even earlier in some countries.

Trade

Today, hydrogen is a very local business. About 85% of hydrogen gas is produced and consumed on-site within a facility rather than bought and sold on the market. (15% is transported via trucks or pipelines.) Even where hydrogen is sold, it is usually not transported across large distances because of the logistical difficulties and costs. Over time, hydrogen could become an internationally traded commodity. Currently, green hydrogen does not seem to be a traded commodity. When trade becomes more common, as the cost of renewables differs significantly across regions, the price of hydrogen will also differ. From an economic point of view, green hydrogen will be optimally produced in locations that have a combination of abundant renewable resources, available land, access to water and the ability to transport and export energy to large demand centres. The number of hydrogen partnerships around the world is increasing and is likely to grow even further. Current plans/agreements and therefore possible future routes are below:

An expanding network of hydrogen trade routes, plans and agreements



Source - IRENA

Risks

As the current leading producer, there are a few existing barriers Germany is facing or could possibly face. Firstly, the expansion potentials for renewables in Germany are limiting domestic hydrogen production potentials. Secondly, production (energy) costs are lower and the climate is better suited to green hydrogen production in Africa, giving Germany an economic disadvantage. Lastly, a recent event involving Germany and Morocco illustrates the political risks to Europe's green hydrogen supply. Germany and Morocco agreed in 2020 to cooperate on green hydrogen, but Morocco broke off the partnership after Berlin attempted to bring the issue of Morocco's disputed territorial claim to Western Sahara before the United Nations Security Council.

Japan, as the current 3rd largest producer of green hydrogen, lacks the natural resources needed to deploy sufficient levels of wind or solar to generate clean hydrogen at scale. However, in order to combat this, it is currently developing long-term supply agreements to import hydrogen from overseas, showing the limitations of future supply of green hydrogen from Japan.

Germany, the Netherlands and France have begun to work on green hydrogen production in collaboration. North Africa, Ukraine, and Russia are also seen as potential suppliers according to Germany's national hydrogen strategy. The feasibility of exporting large quantities of green hydrogen from North African countries is also another issue, since the population growth rates are high and electricity demand is expected to continue to grow.

Supply Chain Risks. There are two main modes for transporting hydrogen across borders: pipelines (short distances) and ships (liquid hydrogen, liquid organic hydrogen carriers, ammonia). Hydrogen transport costs are still very high, but they are set to come down due to economies of scale, lower project risks and improvements in technology.

Country Risk Investment. Setting up infrastructure for trade carries risk on both sides. From the exporter perspective, revenue security is vital. It must be sufficient to cover the costs of electrolysers or solar and wind parks, and transport and storage infrastructure. Various projects for green hydrogen production and exports are under development across Australia, the Middle East, North and Southern Africa and South America. While these projects plan production of millions of tonnes of clean hydrogen, they face uncertainty since global demand for clean hydrogen is only just emerging. Additionally, the list of countries that aspire to become hydrogen exporters is much longer than those planning imports, which means the competition will be intense for exporters. From the buyers/importers perspective, security of supply is critical. Importers need to feel confident that the green hydrogen production will be sufficient. As mentioned previously, several aspiring hydrogen exporters face rising domestic demand for energy due to population increase and increased electricity demand. Now, with the green agenda of many countries, they are tasked with reducing fossil fuels while also trying to meet the increased demand.

Investment risk. While many hydrogen export projects have been announced, they could experience delays due to several factors, including permitting processes. Overall, higher investment risks translate into higher project finance costs.

Technical failures and political disruptions. The first part includes technical (failures in equipment or infrastructure), human (errors, accidents or malign acts), or natural (hurricanes, earthquakes or floods). The consequences of such disruptions may be more severe in this case due to the flammable nature of green hydrogen. Disruptions may also occur when states attempt to leverage energy trade and interdependence as a tool for geostrategic purposes. In the early days of international green hydrogen trade, the number of trading partners will be limited, and both suppliers and importers are likely to be locked into long-term contracts. Any disturbance will affect supply and prices to a great extent.

Rare raw materials for production. Lastly, raw materials are needed for hydrogen technology so the discussion also expands to material security. Rapid growth of hydrogen will lead to rising demand for nickel and zirconium for use in electrolysers. And since hydrogen will cause increased utilisation of renewable technologies like solar and wind, it will also raise demand for the minerals used in such technologies. However, some materials used for electrolysers are scarce and the markets for many of these materials are inelastic in the short-term.

Altering power relations in the long-run. There is a huge potential for “green hydrogen” in countries where the production of renewable energy is relatively cheap. To be “export champions", however, countries also require large freshwater resource endowments as well as high infrastructure potential. Oil & natural gas exporting countries in the Middle East, for example, benefit from existing infrastructure, such as harbours and networks fit for transporting fuel. However, they are limited by their freshwater resource endowments. On the other hand, countries such as Morocco, Mexico, the US, Indonesia and Australia satisfy all the right conditions to be an “export champion”: renewable energy, freshwater resources, and infrastructure. It is likely that international political relevance could shift from the Middle East, with high fossil fuel reserves, to hubs of green hydrogen. New geopolitical dynamics

could emerge also given that green hydrogen could allow for a diversification in import locations. Most countries are dependent on a tiny number of countries with abundant oil and gas reserves. Green hydrogen has the opportunity to increase the number of countries that export energy resources, diversify the group of suppliers, and decrease dependence.

Green hydrogen as a novel technology has captured the attention of countries worldwide. Many are vying to establish themselves as the global leader. Europe, for example, viewing China's dominant position in solar panels, is gearing to develop technological leadership in green hydrogen. At this stage, however, green hydrogen is not ready to be applied on a large, let alone global scale. Firstly, it is expensive. Moreover, at current technological levels, the transition of green energy to hydrogen leads to a high loss of energy, making direct electrification through renewables seem like the more efficient and cheaper option.

METALS

Lithium

Raadhika Tandon & Francesco Galdiero

The market for lithium is rapidly expanding and is expected to grow forty times in the next twenty years. Although there are many different uses for lithium, the biggest industry is battery production, specifically for use in cars. These lithium batteries are also used in most electronic devices, and face increasing demand as consumption levels rise.

While more research is being conducted on the possible side-effects of large-scale lithium mining, a few countries have emerged as the largest producers of lithium whose collective output annually rakes in 85,000 tonnes of lithium.

Australia

According to the United States Geological Survey, with an estimated 42,000 tonnes of lithium produced in 2019, Australia by far, remains the biggest supplier of lithium. While it is only the fifth largest reserve of lithium in the world, the country, thanks to large-scale extraction projects like the Greenbushes Lithium Mine in Western Australia, is billed as the largest lithium mining project in the world. Most of Australia's lithium is supplied to China, which remains, to date, its biggest market.

Chile

A key part of the formidable lithium triangle comprising Argentina and Bolivia, Chile remains the third largest reserve of the element in the world and its second-biggest producer. While its reserves are estimated to be around 9 million tonnes, Chile's annual production amounts to roughly 18,000 tonnes (as of 2019). According to a report by NSEnergy, the Salar de Atacama remains the motherlode for lithium extraction in Chile, with several lithium-mining companies having set up shop there.

China

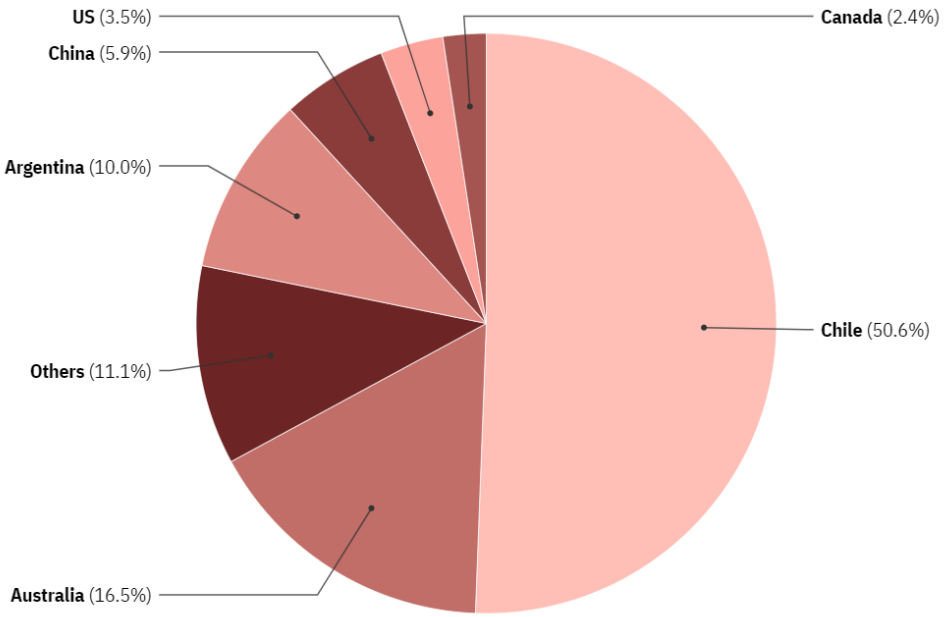
According to BloombergNEF, China controls 80% of the world's lithium refining and 77% of the world's cell capacity producing 10,000 tonnes yearly. Despite being one of the largest producers of lithium, China is also its single largest consumer. For this reason, China imports a considerable amount of its lithium, particularly from Australia.

Argentina

The fourth-largest lithium producing country in the world, Argentina is also the country with the second-largest lithium reserve (the largest being Bolivia with an estimated 21 million tonnes of data, representing almost 50% of world reserve). However, political instability and lack of proper industrial infrastructure have kept Argentina from being the top producer in the world.

Regarding lithium export, according to a UNCTAD document, In 2018, the top 5 exporters of lithium oxide and hydroxide were China (US$398m), United States (US$102m), Chile (US$95m), Canada (US$68m) and the Russian Federation (US$67m). While according to OEC, regarding the lithium carbonates, Chile ($880M), Argentina ($236M), China ($161M), Belgium ($81M), and the Netherlands ($53.1M) were the key world exporters.

Lithium reserves by country, 2020

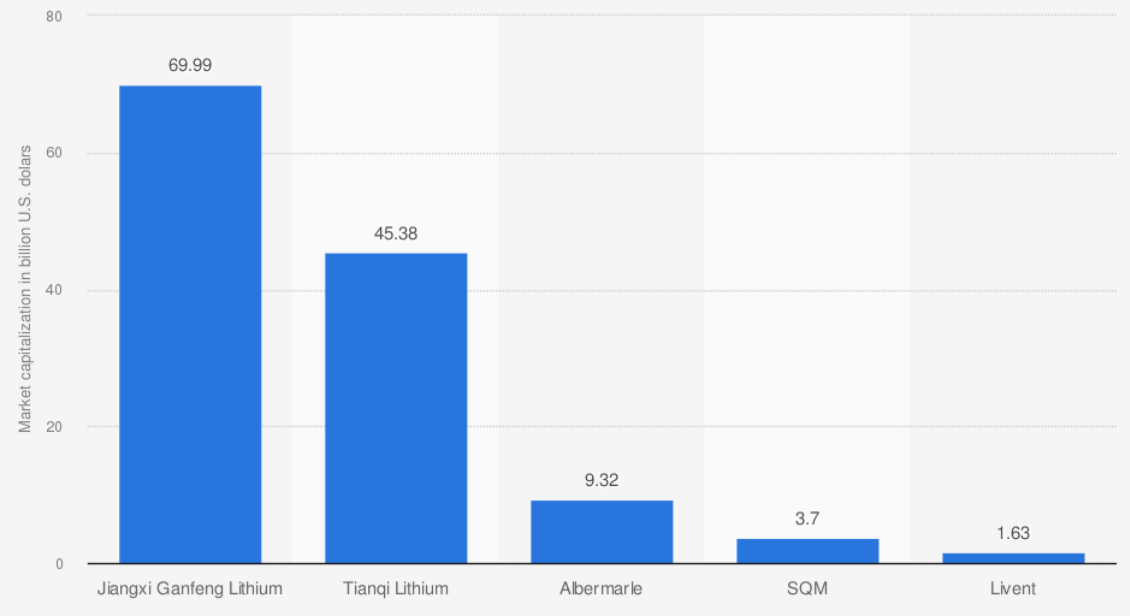


Source - Mining Global Data

Lithium Production

Lithium production is mainly conducted by the mining industry, and the market is cornered by a few large companies. By market cap, the five biggest lithium producers are: Jiangxi Ganfeng Lithium Co. Ltd (Chinese), Albemarle (American), Tianqi Lithium (Chinese), Sociedad Química y Minera de Chile (Chilean), and Livent (American).

Market capitalisation of the leading lithium mining companies worldwide, 2020



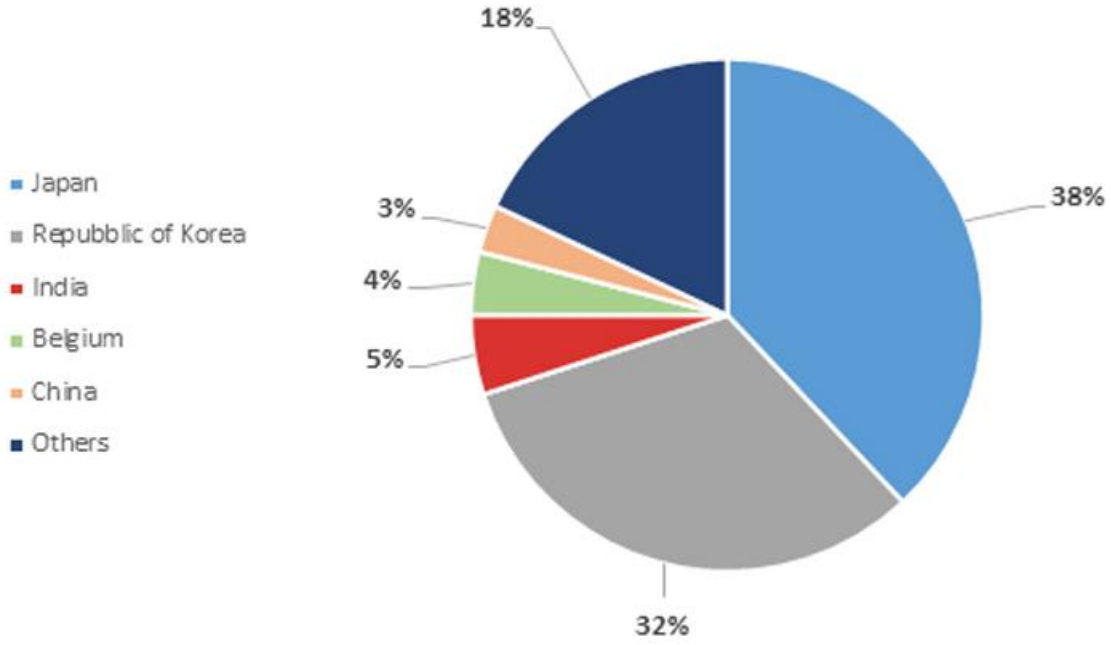
Source - Statista

While the largest mining companies may originate from a certain country, they are not limited in where they undertake projects. With the large reserves in South America, where governments do not have the capacity to extract lithium themselves, several of these outside mining companies are highly active. This access brings additional global power, and with China's overwhelming lead in this market, the United States is working towards increasing its capabilities for mining and supplying lithium. This increasing value of lithium has also led to the development of the world's first ever lithium-exchange traded fund, called the Lithium & Battery Tech ETF.

The Lithium Road between South America and Asia

On the other hand, In 2019 the top importers of Lithium carbonates were South Korea ($419M), Japan ($292M), China ($235M), Belgium ($124M), and the United States ($105M). Japan, China and Korea dominate the lithium market by importing 70% of the lithium mined. In 2018, 70% of lithium imports arrived at these three Asian countries. The South American - Far East axis represents the main line of trade.

Lithium carbonate import destinations, 2019



Source - OEC

The Role of China in the World Lithium Trade

China has a central role as both an importer and exporter of lithium. The rising supply of high-quality lithium and the competitive prices offered by China have contributed to the expansion of Chinese exports. China not only became an essential producer of lithium but also a relevant consumer, thanks to the growing demand of batteries in the consumer electronics and transport sectors. The development of the lithium battery represents a priority for the Chinese government and is part of the development program of the quinquennial plan 2021-2024. Due to this solid green transition policy and to a strong demand, a closed loop supply chain has been created.

Lithium Consumption

Lithium purchasing is a two-fold process. Raw lithium is used in ceramics, pharmaceuticals, and aluminium and magnesium alloys but batteries are the biggest market. Lithium for batteries must first be processed, however, so the mineral is either sold to a processing plant or transferred over from the mining operation, depending on how vertically integrated the mining corporation is. Once processed into batteries, lithium is then sold in its usable form, mostly to industries who will then use these batteries. As such, electronic manufacturing and automotive industries are two of the largest purchasers of lithium batteries. With the ongoing green energy transition, electric car batteries are quickly becoming the most important use of lithium batteries. Companies such as Nissan, Tesla and Volkswagen are therefore amongst the largest consumers of lithium.

Risks

The world is betting on electric vehicles, so lithium has become a strategic product. An irreplaceable mineral in EV batteries: the main component of the vehicle final cost. The price of lithium has skyrocketed and in the next few years the supply will struggle to keep up with the demand, also because the mining of the mineral has a relevant environmental impact.

The battery production destined for the automotive market is often criticised due to the mining methods. Such implications also apply to many other minerals which are strategic for the EV sector, like copper, cobalt, nickel and manganese, whose extraction usually leads to socio-political repercussions. As quoted by the UNCTAD report, the major part of the global reserves of these critical minerals are located in developing countries. The mines are located in unstable regions where production could be abruptly interrupted due to political and social disorders.

The lithium found in Australia is extracted from mines, whilst the Lithium in Chile and Argentina is situated in salty deserts called brines or salt pans. Lithium is present in the water of the underground lakes, which is carried to the surface and is evaporated in large tanks. Such a process involves high water usage. In Chile, almost 65% of the hydric reserves are in the region of Salar de Atacama, one of the most arid regions in the world. This has caused the exhaustion and pollution of the subterranean waters, causing environmental degradation and soil contamination.

Investigations into the extraction of lithium in the salt marshes are commonplace. In some areas, inhabitants complain of rising aridity which then strains livestock production and dries vegetation. According to different experts, it is not clear if the prolonged drought is actually associated with the extraction of lithium, however, notwithstanding the above, a feeling of social unease is evident. What is certain is that potable water is not necessary to produce lithium; but the problem is to what extent the extraction of salt water leads to a flow of fresh water and how this can affect the water-bearing strata on the edge of the salt pans.

Lithium as a strategic weapon: assessing economic risks in emerging markets

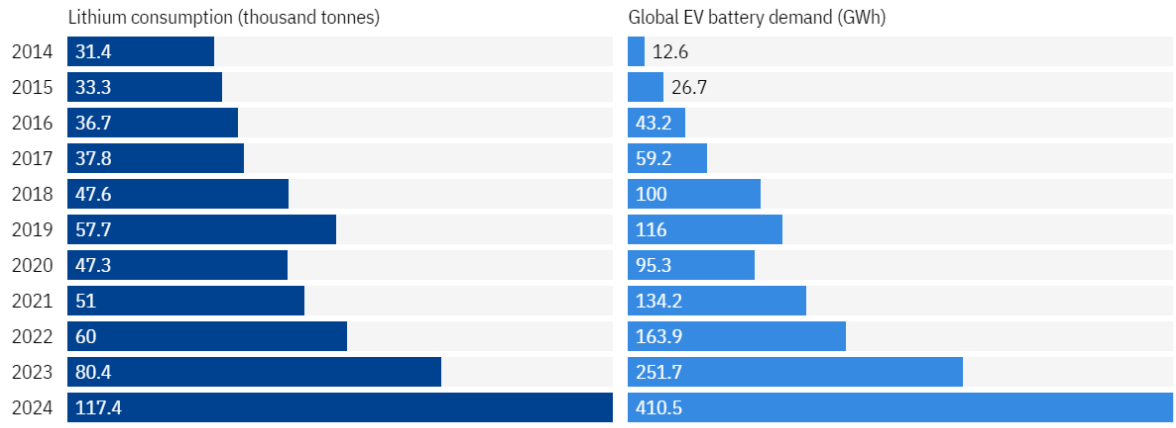
The political and economic equilibrium linked to the lithium market could have strong repercussions on developing countries. These regions, mainly characterised by a mining economy, strongly depend on the demand of the great world players like the US, China and Europe. In this context, the economic and diplomatic influence of China plays a key role. The Asian giant has established important political relations with key African countries. The development of the Belt and Road Initiative has also

contributed to the creation of supply chains with South American states, like Chile and Argentina. The search for low cost and high quality minerals will have a direct impact on the lithium battery market and by extension, the cost of EV's. The major risk is that the world's great players and importers of lithium will stabilise a closed loop supply chain. This will constrain small exporting countries' ability to diversify markets. Furthermore, the flow of investment by the superpowers towards these countries and especially the mining sector entails high economic risks for the recipient countries. The cost of the mining infrastructures to meet the imposed standard of production of the importing countries and other type of aid and loan by the investing states, (which are commonly implemented to grab and secure access to mining licences), could lead to the creation of an accumulation of debts difficult to be recovered and to a dangerous economic state of dependency with the investing actors.

The demand of lithium is extremely inelastic because of such strong demand for EVs and since lithium is the key material of their batteries. The report "Commodities at a glance: Special issue on strategic battery raw materials" published by the UNCTAD in 2020 underlines how the demand of commodities which are used in EV batteries, will increase directly according to the spread of EVs. According to data gathered by Statista, the global demand of lithium will rise from 269,000 t in 2018 to 820,000 in 2024, while the supply will rise from 346,000 to 814,000 tons. In terms of value, the lithium market would rise from 7 to 58 USD billion between 2018 and 2024.

The derived demand for lithium, or its correlation to a related industry or product, is incredibly high because of its use in lithium batteries. Lithium is a critical metal for the technology revolution so as demand for electronic goods and new electric cars increases, so does the demand for lithium.

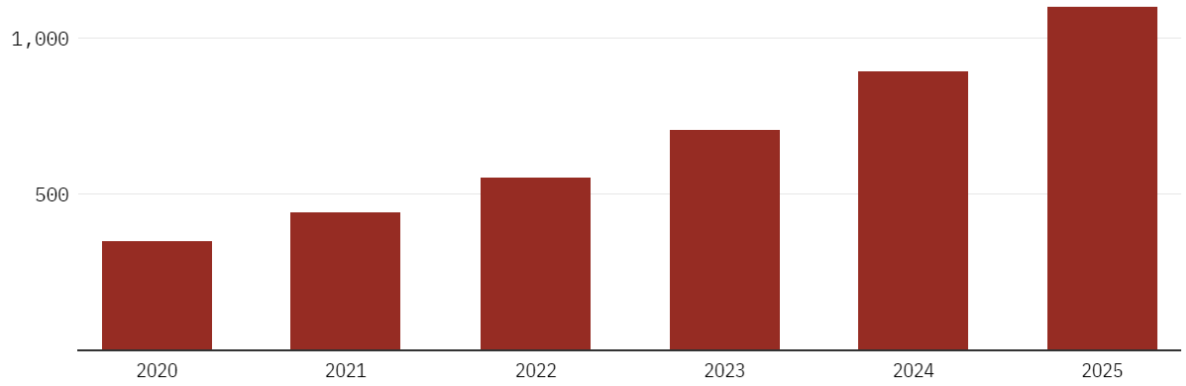
Global EV battery demand vs lithium consumption, 2014-2024*



Source - Global Data

Lithium demand is therefore forecasted to continue increasing, especially as global economies begin to recover from the pandemic and prices surge.

Total demand, thousands of lithium carbonate equivalent tonnes, 2020-2025*



Source - Benchmark Mineral Intelligence

Price per metric tonne of lithium carbonate equivalent ($)

Source - Benchmark Mineral Intelligence

Lithium Supply Chain

For its use in batteries, most lithium is mined and then processed into a usable compound. When developed into batteries, however, lithium is considered a hazardous material and requires proper handling when transporting and recycling. Lithium processing is an incredibly energy-intensive process that requires high levels of energy and water, making it impractical for producer countries without adequate capabilities to conduct their own processing. Most processing plants are located in China, which has geopolitical implications, as China's global dominance already poses a significant threat. China is also increasingly focusing on vertical integration to widen their hold on the market. The importance of lithium as a global commodity therefore makes Chinese market control the biggest supply chain risk and makes it more important for countries like the United States and Australia to step up and domesticate their lithium processing. It is important to note here, however, that Tesla's lithium processing plants are in Japan, which serves as another possible alternative for companies.

Copper

Matheus Mora Machado

Copper is a metal that is seen, alongside iron and steel, as a 'base metal of everyday use'. Notable properties of copper include its malleability, ductility, corrosion resistance, strength, conductivity, and the ease with which it can be alloyed. These properties allow copper to be used in a wide range of industries for a multitude of applications. Historically, copper's light-weight nature and malleability have made it an ideal metal for the production of coinage worldwide. Additionally, those features– paired with copper's excellent conductivity–make it highly prevalent in the production of electrical equipment, such as conductors, wiring, transformers, and more. Copper is also an essential part of several alloys, including bronze, brass, cupronickel, and sterling silver. Contemporarily, copper is becoming increasingly significant. It is a critical element in solar, hydro, thermal, and wind energy infrastructure worldwide. For instance, solar and wind farms use approximately 5 and 4.32 tons of copper per megawatt of energy produced. Moreover, copper is also critical to electric vehicle production, which requires more copper than producing a regular combustion car.

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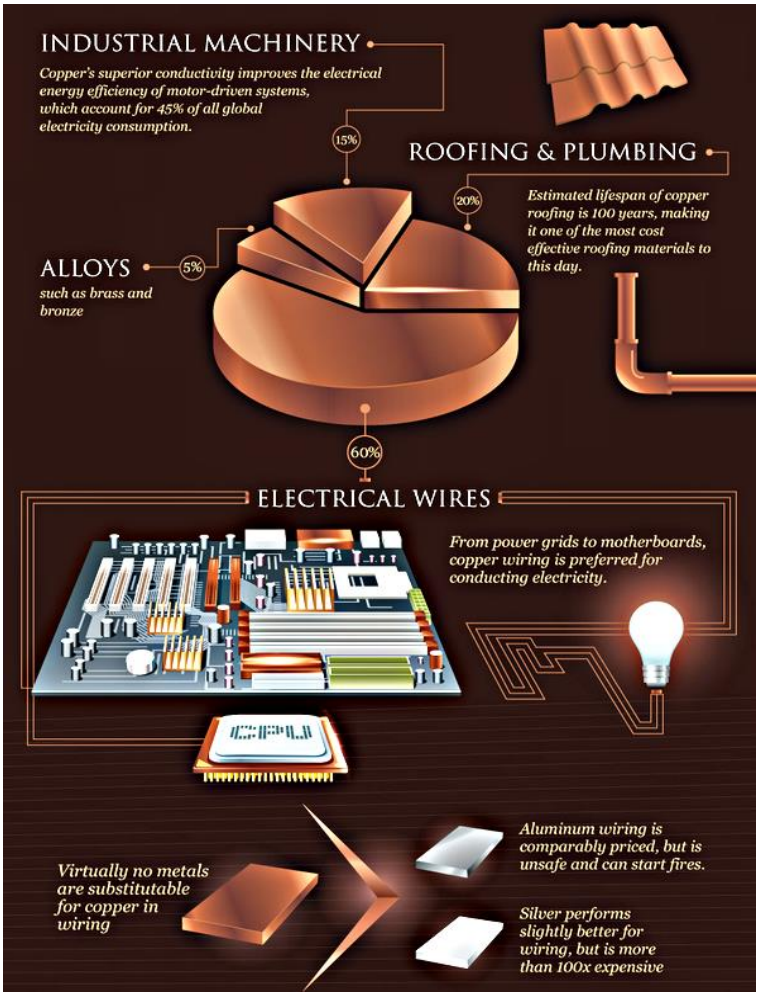
Uses of Copper



Source – Metalcon Blog

Supply and Producers

Known worldwide copper ores stand at an estimated 2,866,009,408 tonnes, of which 12 per cent has been mined. The world's largest producers of copper worldwide in 2020 were Chile (estimated at 5,700,000 tons), Peru (estimated at 2,200,000 tons), China (estimated at 1,700,000 tons), and the Democratic Republic of Congo (estimated at 1,300,000 tons). The largest exporters of copper in 2020 were Chile (estimated at $15.71 billion), Germany (estimated at $11.53 billion), Japan (estimated at $9.35 billion), and the Democratic Republic of Congo (estimated at $9.25 billion). Copper operations –which encompass copper exploration, mining, and processing–are heavily capital intensive and subject to time-consuming delays. First, an economically viable reserve must be discovered and developed; at this stage, a fall in the price of copper can severely jeopardise projects, especially if the fall is perceived to be persistent. Second, even where a mine is established, producers must often overcome delays that include equipment shortages and permitting problems. As such, the process of producing copper is not only expensive, but generally lengthy. Thus, copper's supply is generally inelastic to changes in its price.

Copper is currently thought to be in a period of structural undersupply. Although the commodity is abundant and fully recyclable, supply issues stem from complications relating to bringing high-quality copper to market. Indeed, the copper industry suffered from a period of significant under-investment since the last wave of notable investment in the 1970s. Presently, the COVID-19 pandemic has exacerbated existing supply concerns. Notably, in South America–home to the world's two largest copper-producing countries–strict lockdowns caused many large copper mining facilities to temporarily shut down, and ensuing capital expenditure cuts and heavy revenue losses have diminished the capacity of producers to restart full-scale operations for some time. Accordingly, the copper market saw a deficit of 530,000 metric tons in 2020, and 900,000 tons in 2021. Low existing copper inventories exerted upwards pressure on spot copper prices throughout 2020 and 2021, when average closing prices were $2.80 and $4.24 respectively.

Risks

Short-term risks to copper projects in some of the world's largest producers also present challenges to supply. In Peru and Chile, poor relations between foreign and domestic mining companies and local communities–who provide a notable portion of workers in mines situated close to their towns–have been known to sour from time-to-time. Furthermore, in Peru, lax environmental regulations in the late 20th century have led to a poor environmental legacy for miners in the country. This, in turn, allows anti-mining activists to more easily oppose mining investment. Indeed, in 2019, the Peruvian government suspended the certification of a new mine by the Southern Peru Copper Corporation following Elmer Cáceres's ascension to Regional Governor of Arequipa on an anti-mining platform. Therefore, copper companies seeking to invest in Peru and other South American countries should seek to maintain consistently positive community relations by ensuring work for locals, minimising environmental degradation, and catering to that particular community's economic needs.

There are, however, conflicting forecasts on the future state of copper supply. Thomas Rutland, an S&P Global Market Intelligence commodity expert, expects consumption to outstrip production until 2024, and, consequently, predicts a rise in copper prices. However, other analysts forecast that the copper market will be in a 'significant surplus' in 2022, assuming a 3.9% increase in refined copper output. Ultimately, any bounce-back will depend on copper prices. It is expected that prices will remain high

as a deficit persists in 2022, hence incentivising producers to invest in new mining facilities. As will be explored in the following section, demand for copper is likely to outstrip supply until 2030.

Demand and Importers

The largest importers of copper worldwide in 2019 were China (estimated at $48.55 billion), Germany (estimated at $10.12 billion), the United States (estimated at $9.06 billion), and Italy (estimated at $6.19 billion). Derived demand for copper is expected to increase in light of an increasingly digital economy, the trend towards electric vehicles, and a need for clean power. Furthermore, demand for copper as an investment asset has grown as of late, exerting more upward pressure on copper prices. Given copper's supply shortages over the past two years and expected shortages until 2030, copper prices are therefore expected to continue rising until then. This will present a significant challenge to world leaders seeking a transition to green energy–notably, to American President Joe Biden and British Prime Minister Boris Johnson, both of whom have pledged to 'build back better' by investing significantly into green energy.

Risks

A significant risk to copper prices stemming from copper demand is China's influence over worldwide demand for copper. Amidst the Great Recession, copper prices reached then-record highs as the Chinese government and Chinese investors began stockpiling the commodity, partially because it is seen by the CCP and investors as a hedge against the US dollar. Rapid Chinese industrialisation in the early 2010s increased worldwide demand for copper and existing copper supplies could not meet demand, causing copper prices to hit an all-time peak of $4.58 per pound in February 2011. Since 2012, Chinese demand for copper has grown by 3.5 million metric tons annually. And in 2020, during the breakout of the pandemic, China's State Reserve Bureau amassed significant deposits of excess copper, making the market 'fundamentally tight'. Therefore, China has the capability of artificially raising copper prices–and because copper is seen as a strategic commodity to the Chinese government, the CCP is likely to continue building upon existing stockpiles to raise prices and make it increasingly more difficult for nations to obtain copper. Although copper has a price elasticity of demand of approximately -0.4, as illustrated earlier China accounts for much of global demand for the commodity, and a persistent increase in Chinese demand is therefore readily capable of raising prices.

Iron Ore

Mansi Rathore & Frederico Fróes

Iron ore is the source of metallic iron, used in the iron and steel industries. 98% of iron ore is used in steelmaking after being smelted in blast furnaces and turned into pig/crude iron. Steel, in turn, is an essential industrial resource used in manufacturing and construction, it can also be found in items as varied as houses, cars, and appliances. Besides steelmaking, iron is also used in smaller proportions in coal wash plants and cement making.

According to the United States Geological Survey, iron ore is produced in about fifty countries. Australia is by far the top producer of usable iron ore, with more than twice as much yield as second-placed Brazil. China comes in a close third place, followed by India, Russia, and Ukraine. Together with Canada, Kazakhstan, South Africa, Iran, the United States, Sweden, Chile, Mexico, Peru, Turkey, the aforementioned countries make up 97% of global mining.

Estimated usable ore mine production in 2021 (1000 metric tons)

Australia	900,000
Brazil	380,000
China	360,000
India	240,000
Russia	100,000
Ukraine	81,000
Canada	68,000
Kazakhstan	64,000
South Africa	61,000
Iran	50,000
United States	46,000
Sweden	40,000
Other countries	158,000

Source: USGS 2022 Mineral Commodities Survey

Key Iron Ore Industry Companies

Name	Country	Output (million tonnes, 2020)
Vale	Brazil	300
Rio Tinto	UK/Australia	286
BHP	Australia	248
Fortescue	Australia	204
Anglo American	UK	61

Source: Mining.com

According to a report by Fitch Solutions, world consumption of Iron Ore is predicted to grow at an average 3.6% over 2021 and 2025 ; China, Japan, South Korea and Germany are among the top consumers. China is the largest consumer of Iron Ore in the world, becoming the world's largest steel producing country.

The demand for iron ore is derived from the demand for steel, which in turn is derived from the demand for manufacturing and construction. This suggests demand ought to be inelastic. Prices of Iron Ore may also fall, due to excess supply. Future demand for iron ore is also influenced by intra-technology choices as well as the degree to which governments commit to a low-carbon future.

Global Iron Ore Demand (Mt), 2014-2024*

Source – Global Mining Review

The current Steel market is marked by the lack of adequate steel substitutes for many industries. With further lack of competing technologies for steelmaking, Iron ore experiences demand shocks solely influenced by steel production and demand. The Australian Iron Ore industry is such an example: which experiences an astronomical growth of 382% for iron ore prices since 2005. Use of Aluminium, however, is now being considered as an alternative to steel mainly due to it being recyclable.

In 2020, Iron Ore saw decreases in production, trade, and shipments leading to a global reduction in steel consumption and production due to manufacturing recession during COVID-19 pandemic. Firm iron ore demand from China has been a key contributing factor in rising global iron ore prices since 2018. The robust contribution from major end-use sectors like construction and automotive is also to be credited to the resurgence of the industry. China's crude steel production has risen steadily to 1.065 billion mt in 2020. India, although on a smaller scale, has also seen strong growth in the steel sector, resulting in the country's annual steel production hitting the 100 million mt mark in late 2019.

However, iron ore supply is lagging the rising demand. Brazil has struggled to meet its stated targets, thwarted by mining accidents, extreme weather and unexpected maintenance, as well as the pandemic. According to PlattscFlow, iron ore shipment data, export volume from Brazilian miner Vale was down by 18.9% in 2019 and 2.4% in 2020, in year-on-year comparison. With demand having risen so dramatically, many observers expect the market to remain tighter than in the past, at least until sizable new production starts coming out of West Africa.

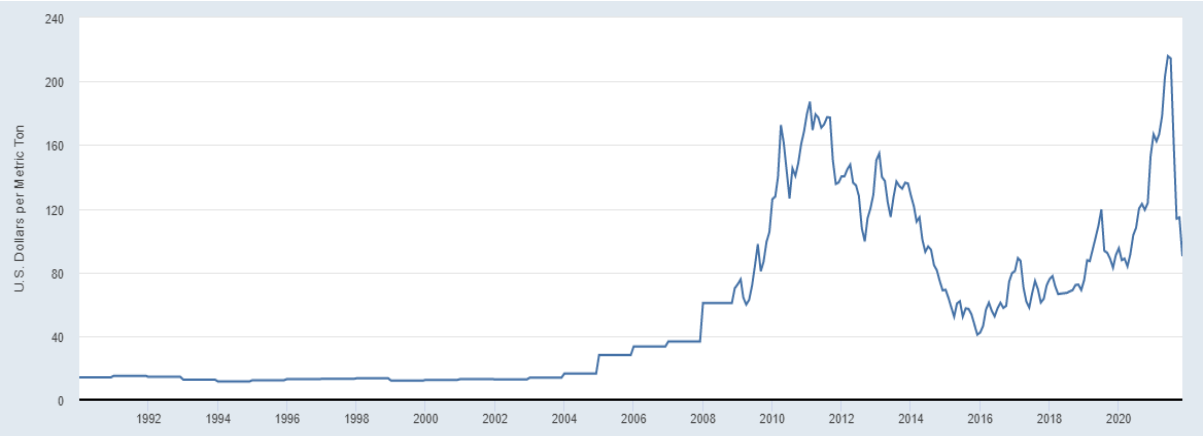
World trade data of Iron Ore (2019)

Top Exporters	Value
Australia	US$67.5 billion
Brazil	US$23 billion
South Africa	US$6.73 billion

Top Importers	Value
China	US$83.1 billion
Japan	US$8.99 billion
South Korea	US$6.02 billion

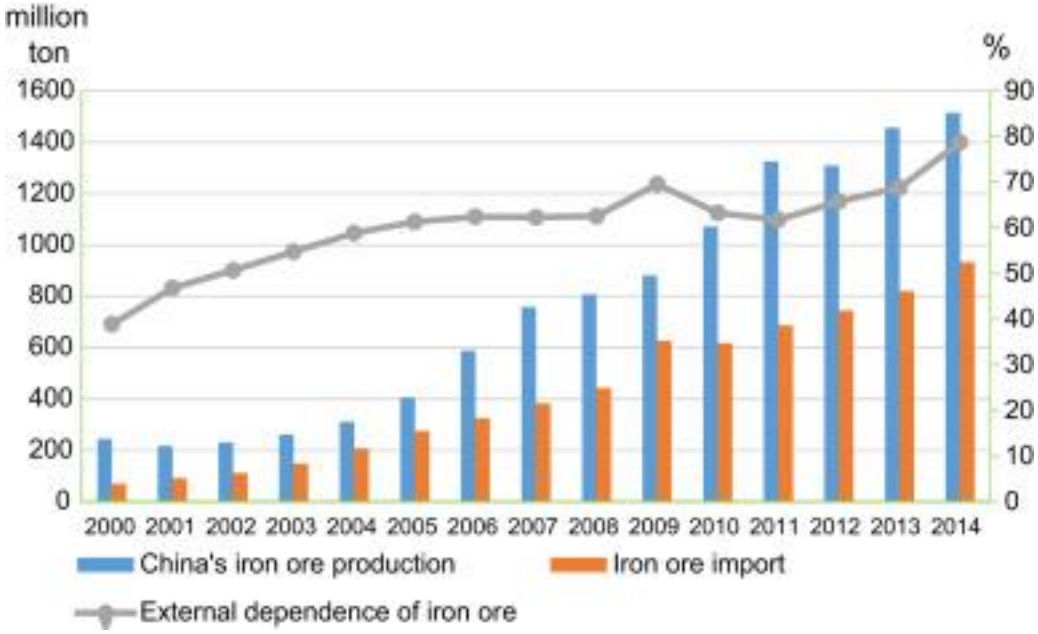
Source - OEC

Global prices of Iron Ore



Source – IMF

Production, imports and external dependence of Iron Ore for China



Source – Chen et al

Risks

As the COVID-19 pandemic is reined in and global economic activity resumes, rising global consumption is set to spur increased baseline demand for iron ore; however, political factors may interfere with the recovery of global iron ore markets to varying degrees of impact.

Russia-Ukraine Conflict: The recent Russian invasion of Ukraine, for one, is indicative of the geopolitical risks to international markets. Russia and Ukraine combined accounted for 7% of global iron ore production in 2021 and nearly 5% of global exports in 2019, flowing in large part to China and the European Union. Although the two warring countries are relatively minor suppliers of Chinese and European imports, the Russian invasion of Ukraine may increase global prices and force trade partners to look elsewhere as production shuts down, sanctions are placed, and supply routes are closed.

Changing international order: Looking at future risks beyond the Eurasian flashpoint, global demand for iron ore is driven primarily by China, which in 2019 accounted for nearly 70% of all imports. Here, increasing geopolitical tensions surrounding Taiwan and the South China Sea may affect international trade, especially with its primary supplier, Australia, being opposed to the expansion of Chinese influence over the Asia-Pacific region. It is worth noting that the BRICS countries (Brazil, Russia, India, China, and South Africa) control nearly half of global iron ore production, while the Global North and industrialized nations are significantly reliant on imports. In the present context of increasing multipolarity, one must be aware of the potential for decreased international trade integration and the decoupling of import-export partners.

Emerging market risks: The second and fourth-largest producers of iron ore are Brazil and India. The two, when combined, account for nearly a quarter of global production. Although they may not be outright authoritarian regimes like China and Russia, they still have imperfect political institutions, as is evidenced by their classification as flawed democracies by the Economist Intelligence Unit's 2022 Democracy Index. The V-Dem Institute's 2021 Democracy Report, meanwhile, classifies Brazil as an

electoral democracy and India as an electoral autocracy in addition to rating the two among the "top autocratizing countries" of the last decade. As such, institutional deficiency is indicative of economic activities being vulnerable to domestic political risk, another factor that must be accounted for when considering the stability of international iron ore markets.

Supply Chains

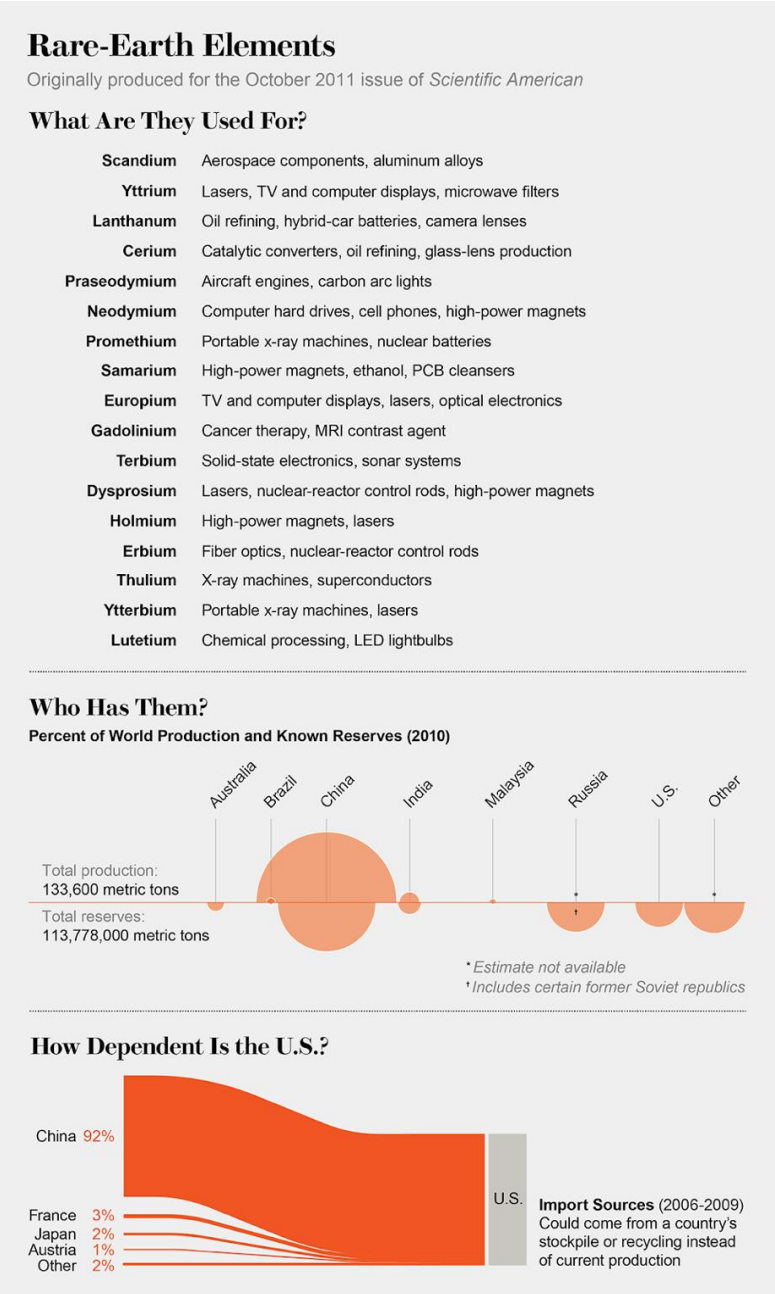
Iron ore can be transported by truck, train, ship, or even through slurry pipelines. However, the top exporters of iron ore are located in Oceania and South America, while the top importers are located in Asia and Europe, meaning the most significant trade routes are maritime and inter-oceanic. The ore often arrives in ports for export after being transported from the mines by train. Mining companies may operate their own vessels, harbours, terminals, and railways. In Europe, the recent Russian invasion of Ukraine has cut off overland rail transport and maritime shipments via the Black Sea.

Rare Earth Metals

Francesco Galdiero & Matheus Mora Machado

Rare earths are 17 minerals (Lanthanum, Cerium, Praseodymium, Neodymium, Samarium, Europius, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Tulium, Ytterbium, Lutetium, Yttrium, Promethium and Scandium) used in a wide range of products. They are used as industrial catalysts but also in cars (lanthanum and cerium); in glass, to shield from ultraviolet rays, and in batteries and screens of smartphones and computers; in lasers, optical fibres, and high-efficiency lamps. But other uses make these minerals increasingly strategic both from an economic and commercial perspective and from a military point of view.

(Please use zoom feature to look more in depth)



Source - Scientific American

One of the fields of greatest interest is in fact that of "permanent magnets" - i.e. metal alloys composed of iron and rare earth oxides such as neodymium and praseodymium which are first extracted, separated, and then reworked - capable of generating higher performing and more resistant magnetic fields. Hence, their use in the EV sector and wind turbines is a fundamental element in decarbonization and the simultaneous ecological transition to which global industry is moving. "Permanent magnets" are fundamental for low carbon technologies, since they are used in 90% of electric cars. Tesla also makes use of them. However, they are also fundamental in the offshore wind industry, because they can guarantee unparalleled performance.

Distribution and top producers

The most important rare earth deposits are concentrated in China, where experts estimate that one-third of the world's reserves of REEs are located, and Brazil, Russia, India, Vietnam, Australia, Greenland, and the United States, as well as the African region have a considerable amount of these strategic minerals. The Chinese are the main producers of rare earth elements and Beijing alone has about 80% of them. Another 15% are distributed between the United States and India. More specifically, In 2019 the top exporters of Rare-Earth Metal Compounds were China ($332M), Malaysia ($222M), Japan ($204M), Myanmar ($146M), and the United States ($82M). In the same year, the top importers of Rare-Earth Metal Compounds were China ($320M), Japan ($246M), Vietnam ($148M), United States ($141M), and South Korea ($66.1M).

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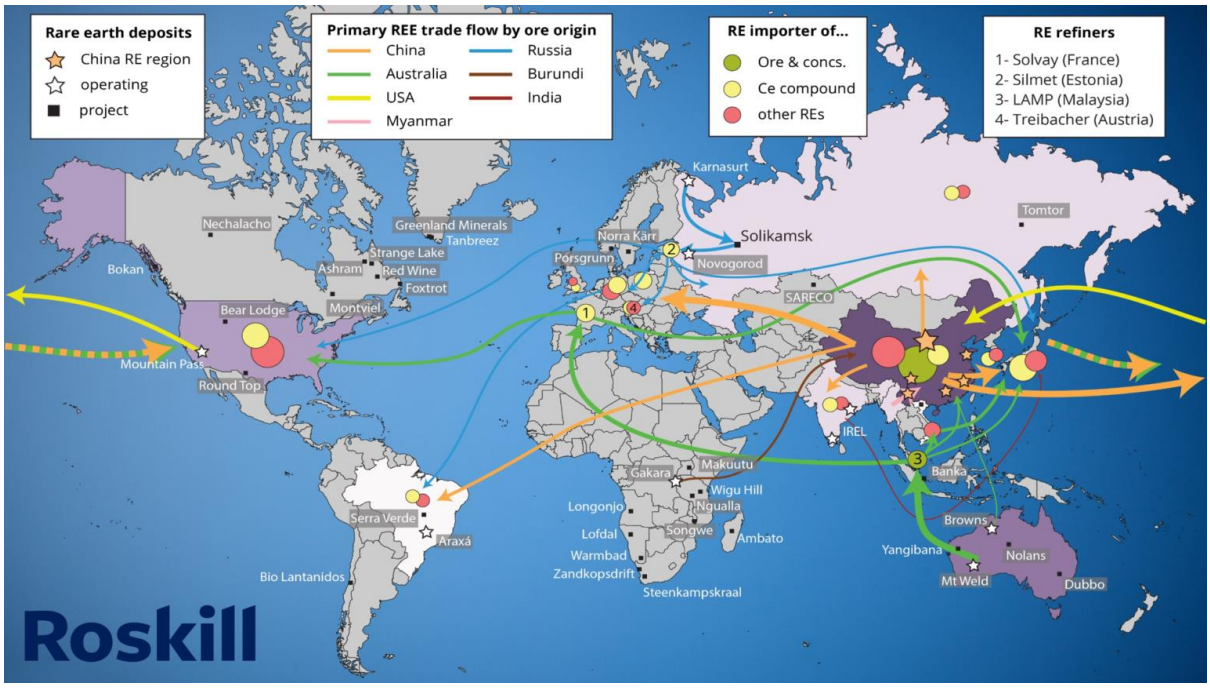
World map of rare earth deposits, production and trade flow, 2019.



Source – Green Car Congress

It is important to dwell on China, which in fact can boast almost a monopoly on the REE. Beijing is in such a position thanks to a mix of factors, starting with the presence on its territory of a large number of metals. Alongside natural reasons, however, we find much less stringent laws than those of the West concerning the exploitation of territories and an excellent *know-how* in regard to processing. Beijing is also the only player in the world capable of handling the entire supply chain of rare earths, from extraction to processing through to export all over the planet. The Dragon supplies 97% of the world's total REE, while the United States, just to make a comparison, while also producing this resource, is forced to import almost 80%, mainly from China.

Today, China, while holding 35% of its reserves, can boast 60% of the output of rare earth oxides. "In 2010 Beijing had a production of rare earths of 90%, but then for industrial choices, it started reducing it, both for issues related to environmental impact and for the reasoned choice to focus on the downstream stages of the value chain thus consolidating control over that segment of the industry". The new giant of the Dragon State will be called China Rare Earth Group and will be born from the merger of three companies already engaged in the processing of rare earths, China Minmetals Corp., Aluminium Corp. of China Ltd. and Ganzhou Rare Earth Group Co, in Jiangxi Province in southern China. According to the WSJ, the "state giant" will help "further strengthen pricing power" and at the same time "avoid infighting between Chinese companies."

The dark side of REEs: The elephant in the room of the green transition

Despite the name, in reality, these are minerals that are present in conspicuous quantities in the earth's crust. However, not all deposits are easily exploitable, or more often the exploitation is not convenient and economically sustainable. Certainly, Beijing has been able to exploit, more than the others, a series of "advantages" that democratic governments - fortunately - do not have. Like that of having enjoyed for many years a milder regulation on the environmental impact of its industrial activities and cheap labour and few rights.

There are therefore two obscure aspects related to the theme of rare earths. The first concerns the lack of adequate infrastructure to collect and recover the elements already used. All this means that, according to some estimates, the recycling rate of REEs is below 1%. The other point to emphasise is closely related to the extraction and processing of the same rare earths. The environmental and social costs are very high, and not all countries have the intention or possibility to cover them. After all, we are talking about strategic but not renewable resources. In addition, REEs are found in nature in a hundred minerals associated with other elements. It is, therefore, obligatory to refine these resources, to separate the individual elements. The downside is that such processes involve heavy environmental impacts, including soil and groundwater pollution. To be more specific, working a ton of metals produces about 2000 **tons of highly toxic waste** for groundwater and soils. Also for this reason and under stricter environmental standards than the US and China, **Europe has decided not to process rare earths**. According to the China Water Risk Report (2006), an average of 60,000 cubic metres of gaseous waste is produced for every ton extracted. To these are added 200 cubic metres of acids that are generally poured into rivers or that filter into underground aquifers and 1.4 tons of radioactive materials, deriving from compounds previously bound with the element to be refined: a process that is anything but *green*. The substances that are released also pose a threat to environmental balances and consequently to biodiversity.

Environmental conflicts in Greenland

The case of Greenland symbolically represents the heated debate that divides public opinion and political choices about rare earths. The rapid melting of the ice due to climate change made it possible to discover on the Arctic Island a potential hidden treasure such as to be able to compete with the consolidated Chinese monopoly. If Greenland has long been a coveted territory by the US, as reconfirmed by Trump's attempted negotiations in 2019, now other powers are also hoping to have access to its resources.

The area that arouses the most interest and ignites the local debate is the locality of Kuannersuit whose REE and uranium mining project is managed by the Australian Greenland Minerals and Energy (GME), acquired for 12.5% by Shenghe Resources Holding Ltd of Shanghai.

Independence and socio-economic improvement are the goals of everyone on the island, but the recent elections of April 6 of this year, have seen another development impose itself: the indigenous party Inuit Ataqatigiit, IA, (Community of Men) led by Múte Egede recently won (with 37% of the votes) 12 of the 31 seats of the Inatsisartut, the local legislative assembly. For several years IA strongly opposed the project, criticising the conduct of GME, with accusations of lack of transparency and false promises of sustainable development. AI channels the concerns of part of the local community, which is alarmed by the potential environmental damage, the need to import foreign labour for the mine, and the risks to the health and traditions of the place.

Is the clash on REEs only an economic matter?

In the past, China has repeatedly used the threat of blocking exports as a weapon of retaliation for diplomatic and strategic issues, for example, in 2010 against Japan for a dispute over the Senkaku Islands. In 2012 there was considerable tension because the People's Republic allocated a share of 30 thousand tons to exports against a demand of 60 thousand. But even more recently in 2019 Beijing made no secret, for the first time, of being able to use rare earth exports in the escalation of the trade war with the United States. However, the real risk with rare earths for Western countries is that China's demand can absorb almost entirely the global supply capacity, so if refining and separation industries outside the People's Republic of China are not developed on a large scale, any mining project could not go through without Beijing, which would remain the only outlet market.

REE Supply and Supply Chains:

The process of mining, separating, and processing REEs is critical to understanding REE supplies and supply chains. REEs are found together in parent ores, meaning that any singular ore containing one REE will contain at least one other REE, and will often contain more than two REEs. When an ore is mined, that ore must be milled and concentrated, at which point the REEs within that ore are separated and processed. This creates rare earth products–which can be sold in elemental form or in compounds (such as oxides, chlorides, and carbonates), or further processed into downstream goods that include REEs, like mobile phones and magnets. As a whole, the process is highly capital intensive, requires much technical expertise, and is generally intensely regulated. Moreover, Chinese price competition on REE sales mean that there are high barriers to entry to REE mining and processing.

Global REE prices are generally low because REEs are co-mined–as alluded to earlier, they are found in parent ores, and as such it is impossible to increase production of a given REE without also increasing the production of other REEs. Thus, the supply of a given REE is dependent on the total ores mined

and the concentration of that REE in an ore. This acts as a significant limiting factor to any increase in the supply of a given REE. Indeed, given that companies attempt to sell as many REEs as possible after co-mining, if they were to raise production to attempt to meet demand for a given REE, they would flood the market with other REEs acquired through co-mining, and hence would reduce the prices for those REEs and the profitability of mining. As a consequence, certain REEs are vulnerable to shortages, and thus to rising prices: the price of lithium carbonate, which is used in lithium-ion batteries in mobile phones, has increased 400% in 2021, for instance. However, the largest risk to REE supplies and supply chains is China's dominance over global REE supplies. China accounts for 35% of the world's REE supplies and, in 2020, produced 140,000 metric tons of rare earth oxide equivalents, equating to 58.3% of global supply. The peak of Chinese dominance over REE supplies was in 2010, when it satisfied 97% of the world's demand for REEs. China's grip over REE supplies allows it to restrict REE exports for political, economic, and military leverage. For instance, following a diplomatic spat with Japan over the Senkaku Islands in 2010, China banned REE exports to Japan for two months and slashed overall exports by 37%. This presents serious national security risks to several countries, prominently the United States, because REEs are used to manufacture and assemble several significant pieces of military hardware, including critical weapons, defence, and communication systems.

Asides from being naturally endowed with more than a third of the world's REE suppliers, two factors account for China's grip over REE supplies. Firstly, the CCP has invested heavily into REE mining facilities, techniques, and more since the 1960s. Secondly, until recently, the REE mining industry in China featured lax regulation, allowing producers to mine without adhering to stringent environmental and safety regulations featured in other countries, and thus to offer lower prices. Accordingly, it would be extremely challenging for other countries to attempt to rival China's hegemony over the supply of rare earth elements. Although the United States has begun to invest in REE supply chains, it should be noted that investment is hampered by complex regulation and the need for intense workforce development.

REE Demand:

Demand for REEs doubled to 125 tons in 15 years, and demand is projected to reach 315,000 tons in 2030. Currently, demand for REEs is outstripping supply by approximately 3,000 tons per year. The source of demand for REEs is contingent upon the type of REE in question and whether the REE or REEs is or are being used to manufacture final, finished products, such as phones and laptops. Where demand for REEs is direct–that is, not derived demand–the largest importers by nation in 2019 were China ($320 million), Vietnam ($148 million), the United States ($141 million), and South Korea ($66.1 million). That year, the most sought-after REEs were mixes of certain REEs, yttrium, scandium, and cerium compounds. Sectors with the largest direct demand for REEs are those engaged in the production of permanent magnets, metal alloys, and catalysts; however, in recent years, REEs have become increasingly important to the production of batteries used in mobile phones and electric vehicles. Much derived demand for REEs therefore stems from high-tech industries: they are used in the production of goods ranging from TVs and refrigerators to nuclear reactors and lasers. In these industries, the importance of neodymium, dysprosium, lithium, and other REEs cannot be understated, as they are generally essential to the production of permanent and non-permanent batteries and magnets. Where such goods are concerned, the automotive and wind energy industries are particularly at risk of demand, and thus price, rises. Indeed, those developing and producing green energy technology worldwide will need to account for rising REEs prices. British Prime Minister Boris Johnson's efforts to turn the UK into the 'Saudi Arabia of wind', for instance, will likely face serious difficulties, as 26,000 tons of REEs would be needed to build the number of turbines he envisions.

Aluminium

Vincent Wu

Aluminium is a versatile metal with various uses in industrial, commercial, and domestic applications due to its conductivity, resistance to corrosion, and lightweight properties. As such, the consumption of aluminium reflects development, as urbanisation and industrialisation naturally increase the demand for aluminium for construction, electric grid expansion, infrastructure and transportation. Although there are several minerals available in the world from which aluminium can be obtained, bauxite ore is the most common raw material in aluminium production.

Aluminium is often used as an alloy due as it is both lightweight and strong, making it efficient and reliable in the construction of parts of airframes, parts of car, train, and ship bodies, as well as engines and fuel systems. Within modern construction and building, it is an indispensable material because of its lightness and non-corrosive properties. The material provides the framework and structure for skyscrapers, facilities, and residential buildings. Moreover, aluminium is an effective electrical conductor and is often used in power transmission lines, as it is cheaper and twice as conductive as copper on a unit basis. Aluminium is also essential in the packaging industry as it is recyclable and non-toxic, and is most commonly used to directly produce aluminium foil and beverage cans.

The aluminium value chain can be divided into three segments, upstream, midstream and downstream. The upstream segment involves the producers of primary aluminium and its alloys, from mining bauxite, refining it to produce alumna and further processing it to produce raw aluminium. Rusal (Russia), Alcoa (US), Rio Tinto (UK/Australia), Chalco, Hongqiao, Xinfa (China) are amongst the world's largest primary aluminium producers. The midstream and downstream segments convert raw aluminium into value-added semi-finished or finished aluminium products. Midstream operations generally convert aluminium into aluminium sheet plates and foils for manufacturing purposes, whereas the downstream segment refers to engineered products and solutions, in which there are thousands of downstream companies in the world. The largest of those include Novelis (US), Rexam (UK), Constellium and SAPA (Europe), producing aluminium cans, foils, and parts for the automotive, aerospace, consumer electronics, construction and packaging industries.

Leading Countries by Exports and Imports of aluminium and articles thereof (2019)

Exporting Country	**Value (USD)**	**Importing Country**	**Value (USD)**
China	$26.3B	United States	$22.5B
Germany	$16B	Germany	$17.3B
United States	$10.8B	Japan	$7.77B
Canada	$8.43B	France	$7.62B
Russia	$6.51B	Netherlands	$6.

Source: OEC

Aluminium consumption demand increases as countries urbanise and industrialise. China satisfies its own demand for primary aluminium with its own production, producing and consuming 58% of global aluminium, and has considerable influence in the global aluminium market. The US, European and Japanese markets consistently demand large volumes due to the advanced level of their industrial development. Growing urbanisation rates in Asia and Africa suggest they are key regions of growth for the increased consumption and demand for aluminium.

Risks

Russia/Europe - as Europe is an important export destination for flows of Russian aluminium, escalating tensions in the Ukrainian conflict will trigger further Western sanctions against Russia. The risk of this supply chain issue puts continued upward pressure on aluminium prices, through the potential reduction of the flow of both refined metals and raw materials including bauxite and alumina from Russia to European smelters and refineries. Furthermore, Europe is dependent on Russia for 40% of its natural gas, which is used to make electricity, an input in aluminium production. The Russian invasion and potential supply disruptions through broader sanctions have caused European gas prices to surge and subsequently raise aluminium production costs, constraining smelter output. These factors would tighten aluminium supply and exacerbate the existing global aluminium deficit.

China - climate, political and supply chain risks threaten to constrain medium-term production capacity for the largest aluminium producer in the world. Power shortages and policy-driven rations in mid- to late- 2021 have restricted the output and capacity of coal-fired smelters. Moreover, China's continued zero Covid policy even following the Olympics means that potential outbreaks and subsequent targeted restrictions in key areas of production will reduce output and disrupt transportation of aluminium products. Persistent tightness in supply will reduce inventories and contribute to the growing aluminium deficit and drive up aluminium prices.

Guinea - the West African nation is the world's second-largest producer of *bauxite*, and a military coup in September 2021 had raised the risk of disruption. China is heavily dependent on this source of supply as half of its bauxite comes from Guinea. Mining exploitation is heavily politicised in Guinea, accounting for 15% of its GDP and 80% of exports. Despite mining operations being largely left alone by political unrest, future tensions and instability may disrupt output and potential future projects in Guinea. Such outcomes threaten to disrupt crucial supply chains, increase the aluminium's price volatility and expose businesses and investors to price fluctuations.

On the demand side, a paper published by the Federal Reserve of Dallas shows that aluminium demand is relatively price inelastic over the long-run, suggesting that the metal is rather important to manufacturing output. Moreover, aluminium is the preferred substitute for different materials including copper, steel, glass, and composite materials in manufacturing production, especially if prices for other materials increase.

The derived demand of aluminium is currently driven by the automotive industry in relation to major economies' pursuit of decarbonisation and green economic recovery following the COVID-19 pandemic. Driven by growing concerns about climate change, favourable government policies and shifting consumer attitudes have created a major growth opportunity for aluminium, especially for downstream manufacturers. Aluminium is preferred over steel due to its lightweight properties that

improve performance and safety, and is part of the solution for meeting increasingly stringent regulations on vehicle emissions and fuel efficiency. The energy transition has facilitated rapid growth of the EV market and the phasing out of traditional vehicles. The IEA predicts that EVs in use will rise from 5.2 million vehicles in 2018 to 120 million in 2030, or from 0.07% to over 7% of the global car fleet. However, these projected figures vary and depend on the impact of future government policies and regulations. For those reasons, the derived demand for aluminium is fundamentally driven by solutions and policy responses to climate change, and demand is expected to remain strong over the next decade.

The supply of aluminium is price elastic due to input costs. Energy accounts for 34% of aluminium's production cost, so an increase in natural gas and thermal prices drives up power prices which subsequently increase aluminium prices. Indeed, recent rising energy costs in Europe have increased production costs, leading to production cuts or shutdowns in France, Germany, Spain, Netherlands, Romania, and Slovakia. Moreover, the supply disruptions due to Europe's energy crisis and China's power rationing was a factor in driving the metal's price to a 13-year high of $3,326 per tonne in early February.

AGRICULTURE

Rice

Ines Pham & Arslan Sheikh

Rice is an edible starchy cereal grain and a staple diet for virtually all of East and South-East Asian countries. Around 95% of the world's rice crop is consumed by humans as food. It is eaten alone and in a great variety of soups, side dishes, and main dishes in Asian, Middle Eastern, and many other cuisines. Other products in which rice is used are breakfast cereals, noodles, and alcoholic beverages such as Japanese sake. The brown rice is a rich source of thiamine, niacin, riboflavin, iron and calcium. The by-products which we get by milling including bran and rice polish are sometimes used as livestock feed. Oil is processed from the bran for both food and industrial uses. Broken rice is used in brewing, distilling, and in the manufacture of starch and rice flour. Hulls are used for fuel, packing material, industrial grinding, fertiliser manufacture, and in the manufacture of an industrial chemical called furfural. The straw is used for feed, livestock bedding, roof thatching, mats, garments, packing material, and broom straws.

Rice is the world's 154th most traded product with a total trade of $24.7B. Between 2018 and 2019, the exports of rice decreased by -7.23%, from $26.6B to $24.7B. Trade in rice represents 0.14% of total world trade. In 2019, the top exporters of rice were India ($6.9B), Thailand ($4.35B), Vietnam ($2.44B), Pakistan ($2.25B), and the United States ($1.89B). The top 5 rice exporting countries (India, Thailand, Pakistan, United States, Vietnam) account for 71.4% of the total value for the internationally exported cereal. Over a 5-year timespan, the value of globally exported rice increased by 18.4% from the $20.7 billion worth of rice shipped during 2016.

Major Exporters of Rice (2020

RANK	EXPORTER	2020 RICE EXPORTS	2019-20
1.	India	$7,980,028,000	+17.3%
2.	Thailand	$3,688,850,000	-12.3%
3.	Pakistan	$2,101,268,000	-7.7%
4.	United States	$1,888,783,000	+0.6%
5.	Vietnam	$1,822,898,000	-25.1%
6.	China	$916,643,000	-13.4%
7.	Myanmar	$773,175,000	-1.2%
8.	Italy	$715,232,000	+15.5%
9.	Brazil	$503,580,000	+37%
10.	Cambodia	$470,665,000	+11.8%

Source - World's Top Exports

Global demand for imported rice resulted in US$25 billion worth of sales in 2020. The overall value of rice imports from all buyer countries expanded by an average 23% since 2016 when worldwide rice purchases cost $20.3 billion. Year over year, global rice imports appreciated by 0.5% from 2019 to 2020. The top 5 importers of rice are China, Saudi Arabia, United States, Iran and Philippines. Combined, those 5 international buyers of rice account for almost one quarter (23.6%) of worldwide demand for imported rice.

Major Importers of Rice (2020)

RANK	EXPORTER	2020 RICE IMPORTS	2019-20
1.	China	$1,459,294,000	+16.4%
2.	Saudi Arabia	$1,404,237,000	-0.8%
3.	United States	$1,284,207,000	+18.2%
4.	Iran	$881,029,000	-40%
5.	Philippines	$862,013,000	-14.6%
6.	Iraq	$640,781,000	-25.2%
7.	Benin	$635,898,000	+11.4%
8.	United Kingdom	$619,909,000	+16.8%
9.	Malaysia	$589,519,000	+30.2%
10.	France	$588,105,000	+8.8%

Source – World Top Exports

Risks

Volatile prices and volumes traded. A number of factors make rice prices more volatile than most other commodities. Much of the Asian rice production is subject to monsoon climates, leading to uncertain rice production and supplies. The demand for rice is price inelastic, therefore it is mostly unresponsive to changes in price. This is a result of it being a staple food. Global rice trade is also highly segmented by rice type, degree of processing, and quality. “The combination of a high degree of protection, geographic concentration, market segmentation, inelastic supply response to price and an inelastic demand response to price and income results in volatile rice prices and volumes traded” writes Eric Wailes for the World Bank.

Rice as a political crop in producing countries to achieve food security. Governments in Asia go to great lengths to insulate rice sectors from instability in world markets. "The first sign of civil unrest can often be traced to rising rice prices," says International Rice Research Institute economist, Dr. Mahabub Hossain. With urban workers and rural landless spending about 50-70% of their total income on rice, they cannot sustain drastic price increases. Which is why most Asian countries follow the same food

security strategy: they try to be self-sufficient, maintain a public-sector monopoly in external trade and hold rice stocks to dampen sharp price fluctuations. Dr Hossain believes that countries do not necessarily need self-sufficiency to achieve food security: for instance, Malaysia imports 40% of its rice, and Singapore and Hong Kong, which do not produce any rice, have better records of food security than their rice-producing neighbours. This explains the degree of high protectionism in rice-growing countries, and why trade accounts only for 6.5% of rice consumption.

Security risks affecting rice production. Armed conflict has also negatively affected rice production. For instance, in Mali and Nigeria, internal conflict has disrupted the supply and distribution of agricultural crops, led to price shocks and to massive displacement of labour. In the beginning of the Mali War in conflict-affected zones, disruptions to the supply chain prevented farmers from receiving their fertilisers, water pumps were stolen by the rebels, rebels also controlled the supply of gas in Timbuktu. More recently in October 2021, a terrorist group started destroyed a paddy field in Niono in Mali, and has since been regularly attacking supply chain trucks.

Impact of climate change in Southeast Asia. In Indonesia, the Philippines, Thailand and Viet Nam, the annual average temperatures are projected to increase by 4.8 °C and the global mean sea level will rise by 70cm by 2100. A number of countries have already started to see a gradual stagnation in production levels brought about by production constraints in Southeast Asia. Temperature changes affects the growth duration, pattern and productivity of rice crops. A decrease of 10 percent in rice yield has been found to be associated with every 1 °C increase in temperature. Moreover, rice production relies on large water supply, is thus very vulnerable to drought stress. For instance, in 1997-1998, droughts caused massive crop failures and water shortages in Indonesia, Lao PDR and the Philippines. Lastly, while rice thrives in wet conditions, it cannot survive when submerged under water for a long time. Rising sea levels and more frequent tropical storms will negatively affect rice production. For instance in late 2011, a number of typhoons swept through Southeast Asia, causing floods that destroyed 12.5% of Thailand's rice farmland, 12% in Cambodia, 6% in the Philippines, 7.5% in Lao PDR, and 0.4% in Vietnam.

Wheat

Arslan Sheikh

Wheat is one of the oldest and most important of the cereal crops. The most important variety of wheat which is known as Triticum aestivum is used to make bread. Its other varieties such as Triticum Durum is used in making pasta while Triticum Compactum (club wheat) is used in making cake, crackers, cookies, pastries, and flour. Moreover, wheat is also used by some industries to produce starch, paste, malt, dextrose, gluten, alcohol, and other products.

Wheat is the world's 85th most traded product. In 2019, the top exporters of wheat were Russia ($8.14B), United States ($6.94B), Canada ($5.97B), France ($4.54B), and Ukraine ($3.11B). The three biggest wheat exporters (Russia, United States, and Canada) exported 45.8% of the overall value of exports of wheat. Below is the list of ten countries that exported the highest dollar value worth of wheat during 2020.

Major Exporters of Wheat (2020)

RANK	EXPORTER	EXPORTED WHEAT (US$)	2019-20
1.	Russia	$7,918,294,000	+23.7%
2.	United States	$6,318,111,000	+0.8%
3.	Canada	$6,301,250,000	+17%
4.	France	$4,534,437,000	+4%
5.	Ukraine	$3,595,472,000	-1.7%
6.	Australia	$2,712,736,000	+7.9%
7.	Argentina	$2,117,434,000	-13.6%
8.	Germany	$2,087,380,000	+66.4%
9.	Kazakhstan	$1,137,140,000	+13.4%
10.	Poland	$1,045,944,000	+142.4%

Source (World's Top Exports)

In 2019, the top importers of wheat were Egypt ($4.67B), Indonesia ($2.31B), Turkey ($2.15B), Italy ($1.69B), and Philippines ($1.63B).

Major Importers of Wheat (2020)

RANK	IMPORTER	WHEAT IMPORTS (US$)	2019-20
1.	Egypt	$2,693,851,000	-10.9%
2.	Indonesia	$2,616,037,000	-6.5%
3.	Turkey	$2,334,510,000	+1.4%
4.	China	$2,260,233,000	+150.8%
5.	Nigeria	$2,056,507,000	+62.3%
6.	Italy	$2,043,025,000	+12.1%
7.	Algeria	$1,640,608,000	+11%
8.	Philippines	$1,573,208,000	-8.3%
9.	Japan	$1,525,035,000	+3.5%
10.	Morocco	$1,423,722,000	+48.2%

Source – Worlds Top Exports

The long-run own-price elasticity for wheat stood at 0.372 as of 2016 whereas the short-run own-price elasticity stood at 0.035. These respective elasticities are estimated using a dynamic heterogeneous panel model. The elasticity of growing-area with respect to own-price depends on a country's share of global output, governmental domestic and trade policies, technology, random weather, input availability and use, the productivity of land, and price transmission of world prices to local prices, among other factors.

Risks

The current Russian-Ukraine conflict has created an uncertainty for the global economy which has been already hurt by the pandemic. Russia and Ukraine are major exporters of wheat, and this conflict could have a serious impact on global wheat supply as they provide more than a quarter of global wheat exports. The worsening tensions are expected to push wheat buyers to seek alternative shipments and increasing prices. The higher global food prices would lead to instability across the world and heightened political risks as food security could be a major driver of regime change.

The supply disruptions are already taking place and ships are avoiding entering the Black Sea which is the main route of shipment which in turn could badly affect the global availability of wheat. It could also lift demand for the bread-making ingredient from the United States and Canada. The Russian wheat export prices fell for a sixth consecutive week last week though the actual grain flows have not been affected so far. The freight could become more expensive with higher insurance premiums and some buyers could start taking into consideration other supplies if the conflict intensifies. The Russian wheat exports are down by 45% since the start of the 2021/22 marketing season on July 1 because of a smaller crop in 2021 and export tax that had been set at $91 a tonne for Feb 22-March 1.

Trade and Supply Chain Risks

There are various types of trading firms in the wheat Global Value Chain. The largest grain traders are often called ABCDs which are Archer Daniels Midland Co (ADM) (United States), Bunge Group (United States), Cargill (United States), and Louis Dreyfus (France). Other top firms that have emerged are Glencore Xstrata, which has activities in the energy and mining sector and is the largest multinational grain trader in Russia. Asian companies such as Mitsubishi (Japan); Marubeni (Japan); Mitsui (Japan); Olam (Singapore); and the state-owned China National Cereals, Oils, and Foodstuffs Corporation (COFCO) are also large players in agro-foods and commodity markets as well. These companies are aggressively investing globally in major producing regions in North America, Europe, the Black Sea, and Africa.

Wheat is traded on several major futures markets, including the US Chicago Board (CBOT) for soft wheat, the Kansas City Board of Trade (KCBT) market for hard wheat, and the Paris grain exchange (Marché à Terme International de France ATIF). Price formation generally occurs at these grain exchanges. Price variations between the grain exchanges and import prices occur due to factors such as transport costs, grain quality and variety, and tariffs. Most bulk grain transactions are based on contracts established by the Grain and Feed Trade Association (GAFTA) in London, an association founded by grain traders, brokers, and processors in seventy-six countries in 1971.

Climate Risks

According to FAO, climate change has already negatively affected wheat yields in many regions as well as globally. However, according to the Stockholm Environment Institute, the global wheat market appears to have the most promising outlook under climate change with a roughly balanced risk-to-opportunity ratio of 1:1. Production could potentially increase by 13.9%. The United States appears to be a critical source of transboundary climate risks in wheat trade, with a projected decrease of 64% which would surpass the decreases in Canada, Russia, and China. On the other hand, France appears to be a strong beneficiary for wheat production and trade, alongside Germany, Ukraine, Uzbekistan, and Argentina. Several countries in East Africa can anticipate significant decreases to wheat production. Several African countries are identified as particularly exposed to climate risks in US wheat production including Nigeria.

Corn

Phaedon Angelopoulos

Maize is predominantly used as biofuel / biomass, animal feed and for human consumption, either unprocessed or in the form of cornmeal, corn syrup and corn-starch. The largest producer is the USA (392.5 tn), specifically the states of Iowa, Illinois and to a lesser extent, Minnesota and Indiana. It is followed by China (257.3 tn) and Brazil (82.3 tn) as of 2018. The largest global exporter is the USA (27.4%), followed by Argentina (17.7%), Brazil (17%) and Ukraine (14.3%) in 2020. The majority of this is Maize Seed (65.1%), followed by Biomass (16.2%), Maize Bran (10.7%) and other corn products, according to figures from 2014-2018. 185 tonnes of corn were globally traded in 2020/21. The figures significantly vary depending on the corn derived product. For Corn and Seed imports, Japan and Mexico are the largest with approximate 3B USD, whereas for Biomass, it is Brazil, USA, Japan and Germany, with 0.75B USD approximate imports.

Risks

USA: Beyond the risk of climate change, mainly floods and droughts, crops are at risk of being reclassified by regulatory agencies. The vast majority of products are GMOs which are subject to food safety and other standards, depending on the product. As the understanding of long-term consumption of GMOs increases, certain yields may be reclassified, i.e. from human to animal feed and so on. Worth mentioning is weather as a risk to crops, where a colder than normal season can also prove catastrophic.

Brazil: Again, weather plays a major part, most importantly drought, but also how the planting season is timed. The biggest risk at the time of writing, however, is the skyrocketing prices of fertilisers. As farmers cannot afford the new prices, they will either plant a smaller area, more crops will be destroyed by pests and there will be smaller yields as a result. The cause of the price increase is reduced fertiliser production in China, citing energy costs. It is unclear whether this issue also affects China.

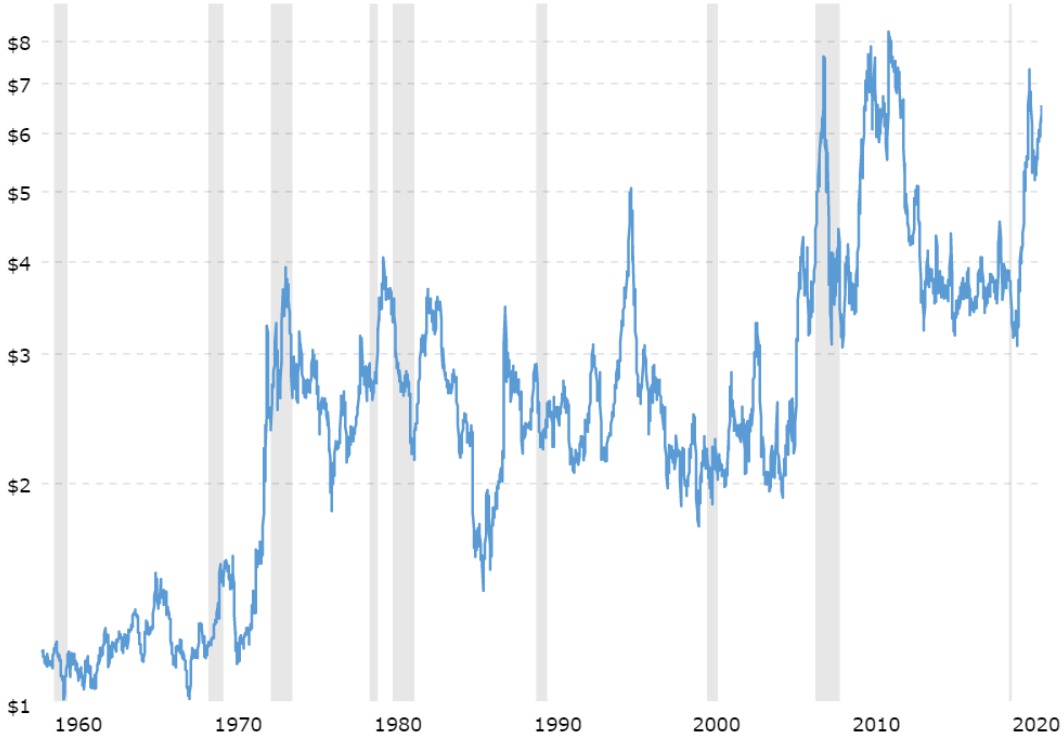
China: Large risk from climate change, mainly floods and droughts. Crops are mainly concentrated in the East, benefitting from the political stability of the area. Crops in the West and in Xinjiang region in particular, are at risk of instability, be it revolution, strikes, violent clashes or other forms of political instability, however a very small amount of corn comes from those areas. Similarly, the massive population and growing economy are an encouraging sign that consumption will continue to increase.

China has announced cuts in its corn production, signifying a decrease in demand and consumption. Soybean production is set to make up for the difference. Maize crops are significantly vulnerable to climate change, where up to 24% of yields may be lost until 2030. Among the regions that will mostly be affected by rising temperatures and decreased rainfall are some of the largest Maize producing regions in the Americas, China and South-East Asia. Regardless of the status of the world population, which is set to decrease in China but grow in America, the majority of Maize yields are used for biofuels. In light of the global shift towards electric vehicles, this massive reduction in yields may not be as catastrophic as it appears to be.

The majority of statistics available are US-centric, however, given that the bulk of production, exports and consumption of corn takes place in the US, it can still be utilised to infer global trends. Interestingly, fertiliser prices are directly linked with corn supply, with higher prices resulting in a smaller supply of corn. Thus, the price of corn also rises due to a decrease in supply. At the same time, a large amount of

corn yields go into producing Ethanol / Biomass, used as fuel. With the global energy crisis and rising price of other energy sources, the price of Ethanol has also risen in recent months. However, this can and is mitigated by increased supply, which may offset the increased cost of fertiliser. All that said, the price of corn has historically spiked from major world events, most recently the financial crisis and the pandemic. The corn supply and demand long term is more elastic than in the short term. It exhibits large elasticity in response to planted acreage, as well as institutional stances on Biofuels.

Corn Prices – Historical Chat



Source – Macrotrends

Like other grains, the price of corn is subject to supply and demand, as well as supply chains. Thanks to its long shelf life, it can be stored short, mid and long -term, where it is produced, processed and distributed, meaning that it is not affected by micro-fluctuations as much as products with a shorter shelf life. Again, the data is strongly focused on the USA, but again, they can be used to infer global trends. It should be kept in mind though that nuances in non-US markets may be entirely lost. It can be theorised that the demand for corn is set to rise, as a result of a rise in demand for alternative fuels, however, it is unclear whether this has reached the market yet and whether producers have responded by increasing supply. According to recent findings, US produced corn ethanol, which is routinely mixed with oil-based fuels, is more damaging to the environment than pure petrol. As such, future demand may be affected due to environmental policies, at least in the US.

Cotton

Ines Pham

Cotton is a white fluffy staple fibre that grows in a boll. It is one of the most popular textiles in the clothing manufacturing industry (T-shirts, blue jeans, dresses), home items (bedding sheets, curtains), woven fabrics such as canvas.

Cotton represents only a small share of world trade in terms of value. In UNCTAD export statistics by product, cotton ranked 170th on average 2004/05 values, accounting for 0.11% of world product exports in 2005 ($11.4 billion). In 2019, the leading cotton exporting countries were the United States ($6.13B), Brazil ($2.64B) and India ($1.1B). In 2019, the top importing countries were China ($8.91B), Bangladesh ($6.24B), and Vietnam ($4.46B).

Cotton is a very political crop because of its significance in world trade and improving the economies of developing countries. It is seen as playing a vital role in economic growth in Africa (37 of the 53 African countries produce cotton and 30 are exporters).

Share of cotton in product exports from selected African countries

Country	% of product exports	Rank of cotton
Burkina Faso	71.5	1
Benin	63.2	1
Mali	35.6	2
Zimbabwe	12.4	2
Togo	11.7	2
United Republic of Tanzania	6.4	4
Uganda	5.7	4
Cameroon	5.6	6
Zambia	5.4	3
Malawi	3.8	4
Sudan	2.5	4
Côte d'Ivoire	2.2	10
Burundi	1.8	4
Ghana	0.8	10
Central African Republic	0.7	8

Source: UNCTAD, cited in International Trade Centre

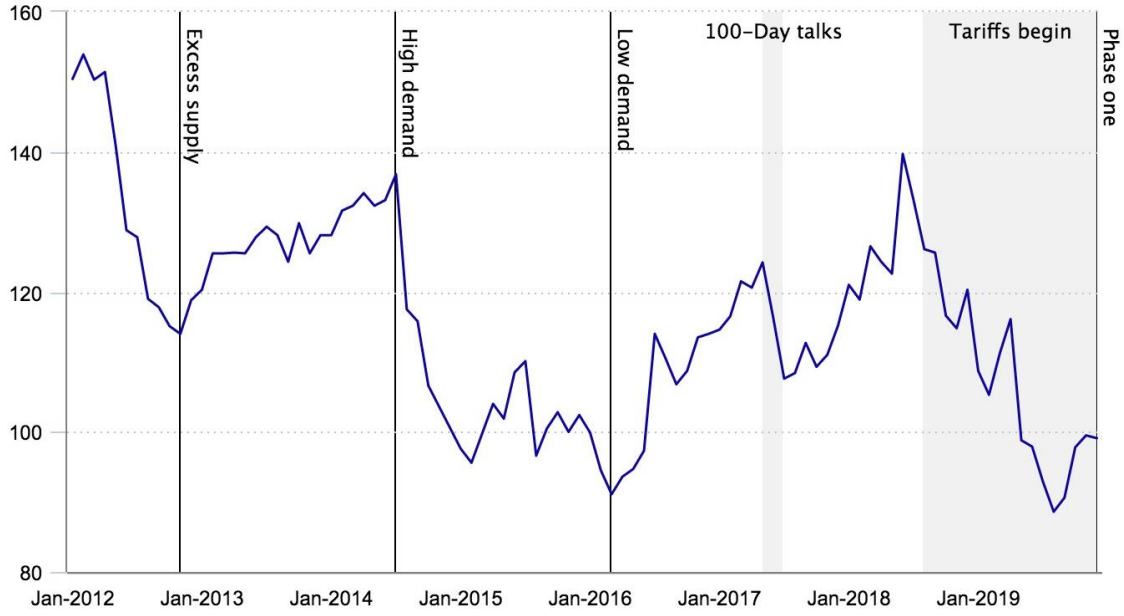
For instance, countries dependent on cotton exports formed the so-called 'Cotton-4' group (Benin, Burkina Faso, Chad and Mali) during the WTO Doha Round. They argued that the overall declining price of cotton in the global market was linked to developed country trade-distorting subsidies.

In 2002, Brazil, the United States' major cotton export competitor, brought a case to the WTO on the issue of the United States' subsidies on upland cotton. Brazil argued that the United States infringed its commitments on the Uruguay Round Agreement on Agriculture (AoA) and the Agreement on Subsidies and Countervailing Measures (SCM). The WTO dispute settlement body ruled against the United States.

Risks

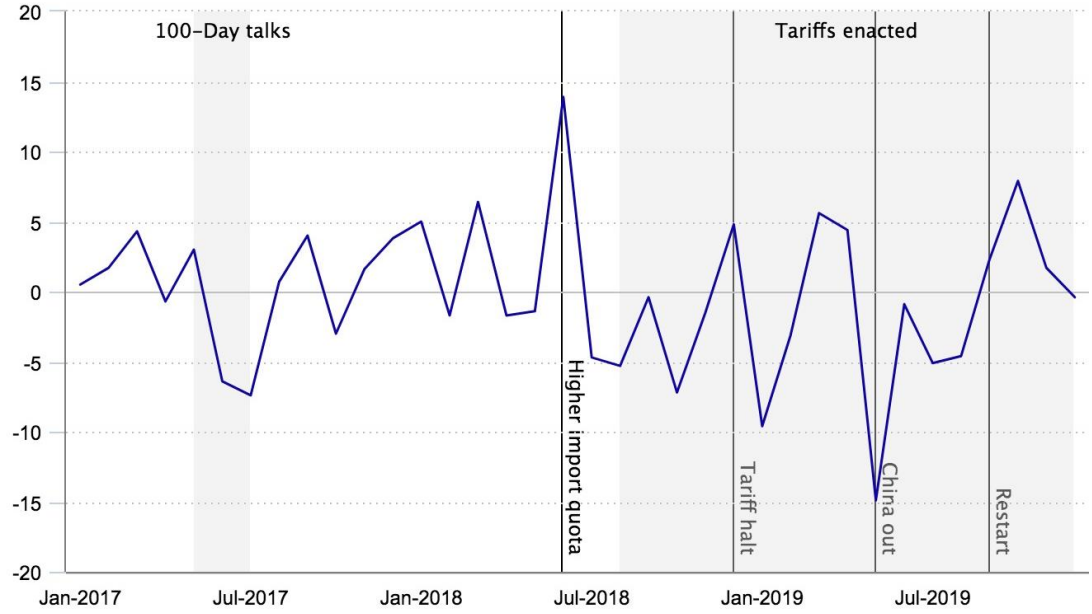
Cotton prices are becoming increasingly shaped by political factors. Price volatility for cotton in the global market used to be influenced mostly by supply and demand forces between 2012-2017, to trade dealings between the United States and China between 2017-2019.

Monthly Producer Price Index for raw cotton, 2012-19



Source: U.S. Bureau of Labour Statistics

Producer Price Index monthly % change for raw cotton, 2017-19



Source: U.S. Bureau of Labour Statistics

Political boycott of cotton-growing in Xinjiang region. Western countries have expressed concern over allegations that the Muslim Uighur minority group are being used as forced labour in Xinjiang. The EU, UK, US and Canada have introduced economic sanctions on China. In retaliation, China sanctioned persons and entities in Europe, banning them from entering the country or doing business with it. Brands such as Nike and H&M which have raised concerns, have faced backlash from China and banned from some Chinese retail platforms

More recently in December 2021, Joe Biden signed the *Uyghur Forced Labour Prevention Act* into law which assumes ("a rebuttable presumption") that all manufactured goods in Xinjiang were made with forced labour. The bill calls for the president to impose sanction on "each foreign person" who "knowingly engages in, is responsible for, or facilitates the forced labour of Uyghur" and/or "knowingly engages in, contributes to, assists, or provides financial, material or technological support for efforts to contravene United States law regarding the importation of forced labour goods from the Xinjiang Uyghur Autonomous Region. As Xinjiang produces 20% of all cotton worldwide, international fashion brands operating in China are thus navigating a politically turbulent situation. Brands exporting to the U.S. will look for non-Asian sources of cotton in order to avoid the sanctions under the *Uyghur Forced Labour Prevention Act.* For instance, as opposed to China and other major exporting countries in South and Southeast Asia (e.g., Bangladesh, Vietnam, and Cambodia), Turkey's supply chain from lint to finished fabric is mostly absent from Xinjiang lint.

Impact of climate change. Cotton production is both a contributor to and a 'victim' of climate change. According to the International Trade Centre (ITC), though China's agrarian land is expected to benefit from temperature rises, the production of cotton will suffer from unusual disasters (such as drought, floor, freezing events), and competition for water availability will be a major limiting factor as well. The impact of climate change in the United States is expected to vary geographically. The National Centre for Atmospheric Research found that the Great Plains and the Mississippi Delta would see increased yields, whereas the Midwest Corn Belt would suffer. However, availability of water will also be an issue in the Great Plains, as current water use already surpasses recharge. Brazil's cotton production depends on rainfall, and it is predicted thar arid and semi-arid areas will receive even less rain due to climate change. Lastly, current cotton production in Africa is concentrated in the Sudano-Sahelian belt. Production in these areas could decrease following reduced rainfall, and could possibly move southwards to more humid areas. Water availability will also be an important factor for cotton production, as well as the length and predictability of the beginning and end of the rainy season.

The rise of synthetic fibres. The use of synthetic fibres such as polyester is increasing at the expense of natural fibres such as cotton. Polyester presents several benefits over cotton: its production requires less water and no pesticides. Polyester is also easier to handle and mix with other fibres, and its production is less subject to climatic hazards.

Demand for more transparency in cotton production. Lack of transparency in the production of cotton has led to supply chain disruptions. For instance, Target, a U.S. retailer, discovered that its supplier Welspun India Ltd.'s "Egyptian-cotton" sheets were not made of cotton. Target since removed all products produced by Welspun India Ltd and refunded millions of dollars to their customers. Other retailers (e.g. JCPenney, Bed Bath & Beyond, and Walmart) working with the same supplier also investigated the issue.

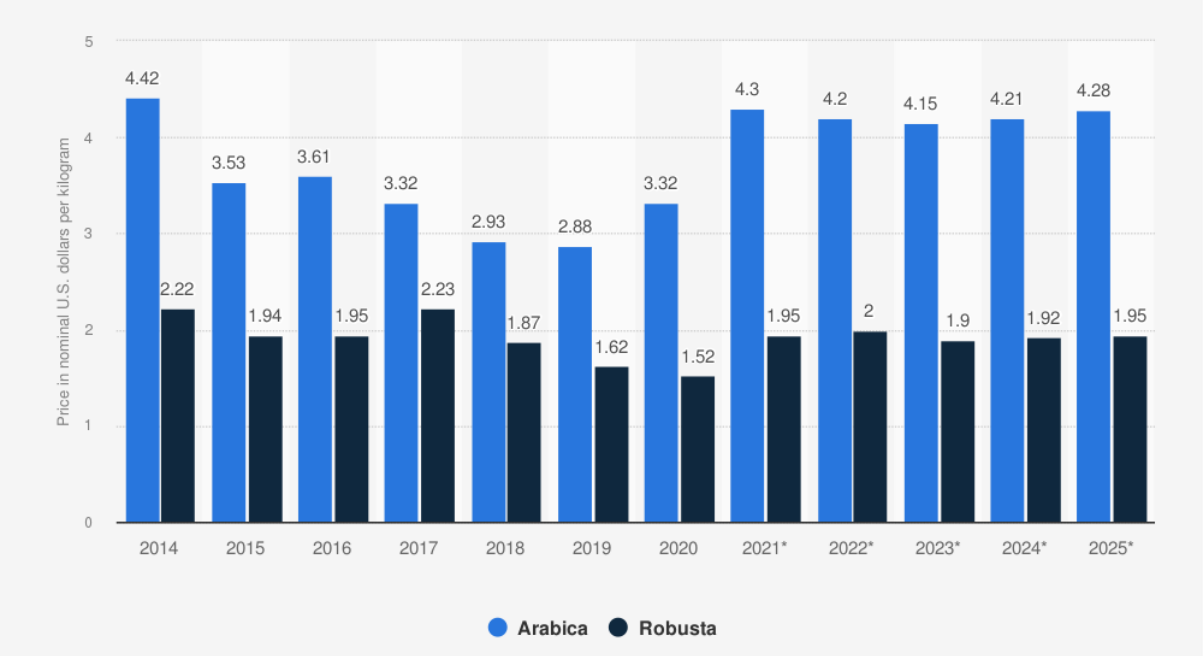
Coffee

Marina Kutumova-Sidwell & Güzide Sofi

Coffee is one of the most popular beverages around the globe and one of the most traded commodities. When traded as a commodity, it is defined as a uniform product that can be interchanged with another coffee of the same type. Coffee is classed as a soft commodity along with other soft commodities such as sugar, cocoa and fruit. Since coffee prices are seen as highly volatile, it is important that traders carefully evaluate a number of factors that affect coffee production and demand before making decisions about coffee futures. Unstable coffee commodity prices also mean that farmers find it difficult to plan and foresee their future.

There are four main types of coffee beans: Arabica, Robusta, Liberica, and Excelsa, with Arabica and Robusta being the most popular types among consumers and coffee futures traders alike. Commodity coffee is traded on the Intercontinental Exchange (ICE) in the US. Although its prices are set regardless of the quality of the product, Robusta is normally traded at lower prices than Arabica as the latter is considered to be more flavourful and premium when compared to the former, as shown below.

Average price/kg for Arabica and Robusta coffee worldwide (2014-2025*)



Source - Statista

Demand

The EU and the US are by far the largest importing markets of coffee followed by Japan, Russia and Canada. The US Department of Agriculture (USDA) reports that while coffee consumption has been experiencing steady growth since 2016, its production has reduced due to poor harvests in major exporting countries such as Brazil. This mismatch between demand and supply has led to substantial price rises of coffee – currently, coffee futures are at an all-time high over the past ten years.. Since developed nations such as the US and EU member states form the largest share of the worldwide coffee consumption, the demand for coffee is not expected to experience any major disturbances arising from

current prices due to its relatively inelastic demand characteristic in these countries. However, it is also important to mention that if coffee prices increase two-fold, it will be likely that consumers will shift to other substitute products such as tea due to its lower price tag.

Supply

At the end of 2020, the top 10 biggest coffee-producing nations held 87% of the commodity's market share. Brazil produces nearly 40% of the world's coffee supply. In 2020, the top five producers/suppliers were Brazil (63.4 Million 50-kg Bags, 37.4%), Vietnam (29.0, 17.1%), Colombia (14.3, 8.4%), Indonesia (12.0, 7.1%), and Ethiopia (7.3. 4.3%). Supply is likely to be price inelastic in the short run because it may be difficult for coffee farmers to expand output and to increase their use of factors of production such as land and capital. In the short run at least one factor input is assumed to be fixed, for example the available stock of capital equipment.

Trade

In 2020, Brazil exported nearly five billion U.S. dollars' worth of coffee to other countries, making it the world's leading coffee exporter by far. Switzerland followed in second place with a trade value of roughly 2.86 billion U.S. dollars. Switzerland was closely followed by Germany and Colombia. Without producing any coffee, Switzerland imports unroasted coffee and then exports roasted coffee. Vietnam took fifth place. (Data).

Risks

Brazil. Mostly due to climate change and deforestation, Brazil is facing one of its worst harvests in two decades due to frosts and drought and coffee output is expected to fall further. After low rainfall, the Brazilian crop, weakened by drought, was hit by extremely cold weather. The damage is so severe that some plantations in Brazil may need to plant new crops, which will take years to mature, damaging supply further.

Colombia. Coffee farmers in Colombia, the world's second biggest Arabica beans producer, could not deliver the previously agreed volumes this year (one million bags of coffee). This has led to around 10% loss in total output and left exporters, traders and roasters facing losses. This, in turn, causes the limited inventory to be sold at higher prices. Labour shortages are also another problem that has recently affected the supply of coffee in Colombia. In December 2020, coffee farms in the Antioquia region reported nearly 25% of the required labour force was nowhere to be found, mainly due to Covid-19 and the appeal of better-paying industries.

Transport/shipping costs. The lack of freight to transport coffee across the globe, caused by goods being stuck in transit due to congestion at ports and other delivery challenges, has also impacted coffee prices. Freight costs have increased, with the average global price of shipping a 40-foot container now costing almost $10,000. This is nearly three times higher than at the start of 2021 and 10 times higher than before the pandemic.

Covid and Lockdown. Covid-19 disruptions to shipping with containers out of place and an unexpected increase in the demand for goods have led to severe delays, increasing freight costs to the highest levels in a decade. Additionally, rising post-lockdown demand combined with supply-chain crisis have pushed the global coffee price to a seven-year high.

Climate change. With global temperatures on the rise, good coffee may become increasingly challenging to grow. On average, there is a one month delay from harvesting to drying, milling and shipping. Out of the 4 main species of coffee, Arabica is considered to be the best quality, attracting higher prices. However, Arabica is more sensitive to temperature increases, since it needs to grow at cooler temperatures. As climates change, the available fertile land for Arabica is decreasing. In fact, the Intergovernmental Panel on Climate Change (IPCC) has predicted a 10-20% decrease in overall crop yields by 2050.

Labour shortages. The average age of a coffee producer is growing and their numbers are falling. Children from coffee-producing families often choose to migrate to the city to find better opportunities. However, coffee production is labour intensive. Therefore, a lack of suitable workers creates an immediate challenge to coffee supply.

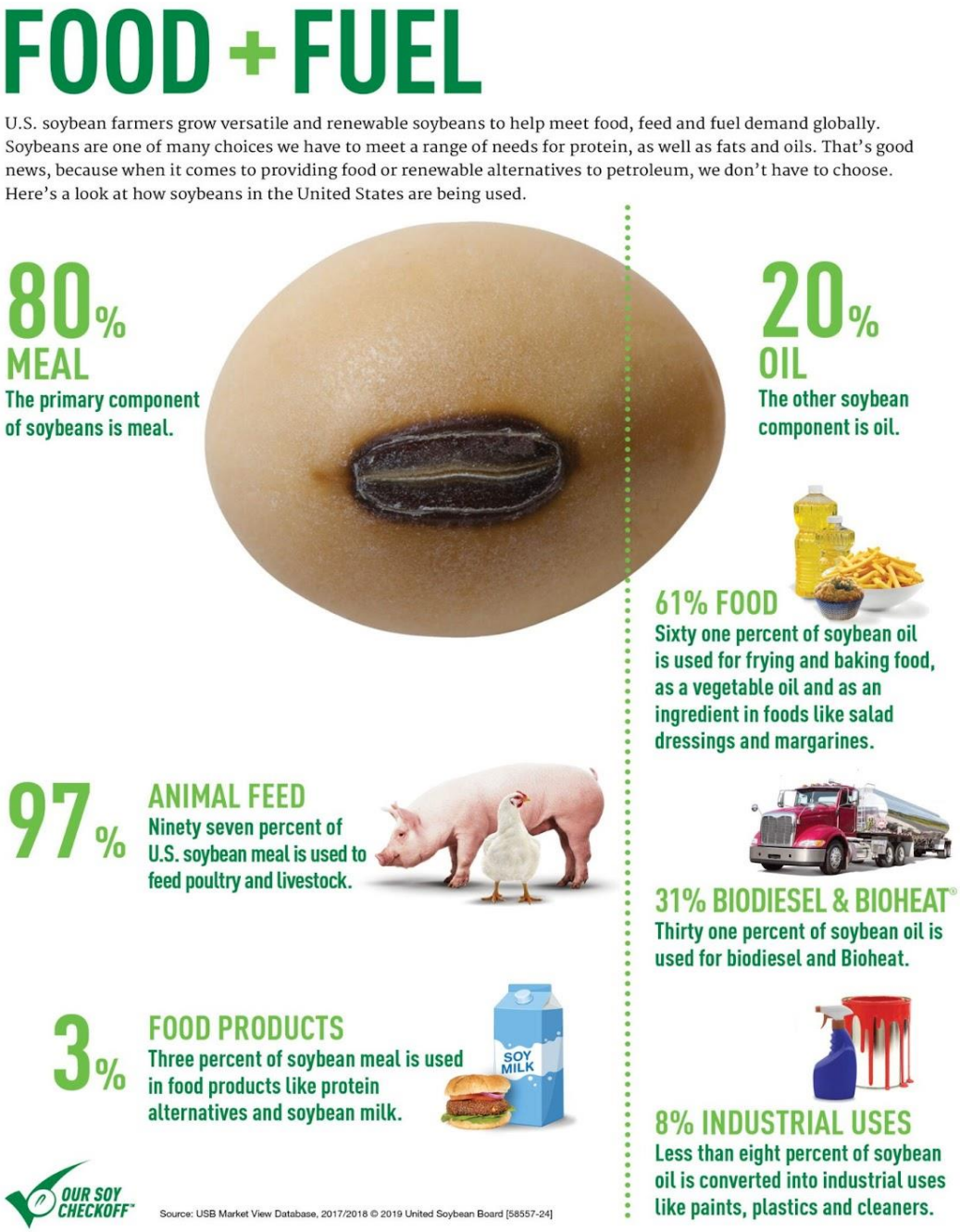
Price fluctuations. Both commodity-grade and specialty-grade coffee production are affected by price fluctuations. The commodity-grade price is based primarily on the NY Commodity Exchange, but this price fluctuates regularly. This price depends on the demand and supply relations, and not directly the cost of producing coffee. For instance from 2010 to 2013 in Brazil, coffee prices dropped to less than half while costs continued to rise. Due to these fluctuations, producers are unable to predict pricing trends and plan ahead, making production more costly overall.

Pests, diseases and fungi. Pests, diseases and fungi are an old but ever present risk to coffee production. An example of this was the coffee leaf rust, which affected Central America in 2012 and led to over $1 billion in damage.

Soybeans

Frederico Fróes & Marko Cem Zurunyan

Soybeans are the world's 59th most traded product. Soybeans are predominantly used to produce animal feed and are tightly associated with demand for livestock and poultry. Other uses for soybeans include the extraction of its oils for food, fuels, and industrial uses in building materials, lubricants, and household items. Soybean oil is seen as a sustainable and renewable alternative to petroleum in terms of its uses in fuel and industrial products.



Source: Mosey

Per the OEC, in 2019, the top exporters of Soybeans were Brazil ($26.1B), United States ($19.1B), Argentina ($3.47B), Paraguay ($1.58B), and Canada ($1.57B). The list of top exporters varies slightly from the world's top producers: United States, Brazil, Argentina, China, and India. In 2019, the top importers of Soybeans were China ($32.1B), Mexico ($2.09B), Netherlands ($1.6B), Egypt ($1.44B), and Japan ($1.41B).

Demand for soybean is growing globally. China's imports of soybeans from Brazil have surged by 2,000% since 2000. Other importers with growing demand for soybeans include Thailand, Turkey and Russia. Additionally, the EU expects steady growth in its livestock, for which it relies on 93% imports for soybean stock feed. Compared to February 2021, Brazil's soybean exports in February 2022 have almost tripled with major demand from China. The early surge in demand is tied to a three-week early harvest schedule in Brazil.

Risks

Geopolitical Tensions

War between Russia and Ukraine has a twofold impact on soybeans. Firstly, Ukraine and Russia are important players in the oilseed market, contributing to at least 3% of global exports in soybeans and exporting significant levels of rapeseed and sunflower oil. The impact of trade sanctions, uncertainty, and supply shortages stemming from this armed conflict is likely to be reflected in the price of soybeans. Moreover, both Ukraine and Russia are focal to global wheat production, another fundamental crop in commodities markets. Accordingly, the ripple effects of volatility in the wheat market could inevitably influence soybeans prices as well. Hours after the Russian invasion of Ukraine on February 24, soybeans futures for May jumped to $16.69 per bushel, the highest for a most-active contract since September 2012. Furthermore, Russia is a major producer and largest exporter of nitrogen and potassium fertilizers, critical inputs for agricultural production. A potential shortage of these items in the global market has already increased their prices by $200 per ton and could affect the yield and cost of future soybean harvests.

Although predictions of a continued surge in soybean prices are tentative, some analysts do not rule out the possibility of soybeans putting pressure upwards to $30. Observing soybean prices historically and accounting for inflation, the 1973 high of $12.90 in soybeans equates to $78.86 today. Thus, soybean prices are given a bullish forecast which will see them reasonably cross $20 mark at least.

Weather and Climate Change

La Niña, a weather pattern occurring every few years in the Pacific Ocean, has been recurring more frequently in recent years. According to the World Economic Forum, climate change has disrupted the cycle of La Niña as global warming continues to increase sea temperatures. During a La Niña year, winter temperatures are warmer than average in the south and cooler than normal in the north. In marketing years 2020-21 and 2021-22, La Nina has seriously reduced soybean yields in South America, especially because of droughts. In Brazil, losses have been as large as 134 million tonnes.

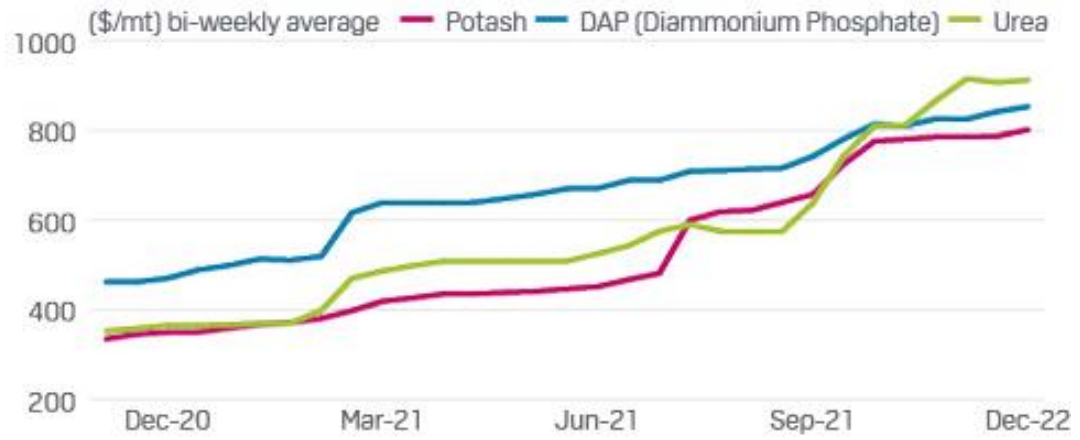
Another risk from an environmental view is that soybean monoculture is found to be a major cause of soil erosion, compaction, and nutrient depletion. This is tied to the fact that soybean production is nowadays increased by deforestation, and the planting of soybean on these lands causes water evaporation. In the future, erosion and compaction can result in soil infertility and could strain yields.

Governments and companies are being pressured not to source soybeans from deforested areas. This drive for sustainability may alter trade relations, and has already been a major point of contention for ratifying a trade agreement between the European Union and Argentina, Brazil, Paraguay, and Uruguay's Southern Common Market (MERCOSUR).

Input Challenges

Soybean production is often shaped by the acreage available alongside competing crops like corn and wheat. In the US, for example, corn has accounted for more acreage in the past 40 years except for one time in 2018. As such, even in situations where soybeans may be reaching record-highs, the price of other staple crops may be more appealing to farmers and cause supply deficiencies for soybeans. Furthermore, the risk associated with the acquisition of new acres is also the issue of deforestation, which can damage ecosystem health and cause soil infertility.

Fertiliser prices rise sharply over the last year in the US



Source - USDA

The trajectories of other natural resource markets pose direct risks to the soybean market. In 2022, key issues include surging natural gas and coal prices, and short-term export restrictions. Notably, natural gas is a raw material and fuel in the production of nitrogen fertiliser, whilst in some countries like China, coal is gasified into ammonia to be used in manufacturing fertilisers. The subsequent rise in fertiliser costs will be reflected in the price of crops like soybean and contribute to inflation of food products. Additionally, both China and Russia have temporarily banned fertiliser, including diammonium phosphate fertiliser in order to support domestic producers.

Currency Fluctuation

In the less-stable economies of major soybean producing countries like Brazil and Argentina, the increased export demand stemming from weak national currencies is a double-edged sword. As local farmers must absorb production costs for harvests before the level of demand is fully established, they face the risk of major losses. For these domestic farmers, the purchase of fertilisers and pesticides are imported products, whose prices are influenced by dollar value. As such, soybean demand is always constrained by the possibility that local farmers are unable to fully manage expensive production costs.

Trade Wars

Under the Trump administration, the American soybean industry felt the effects of China's 25% tariff on American imports amidst the highest ever level of Chinese soybean demand. Prior to the tariff war, American farmers exported about a quarter of annual soybean production to China. Afterwards, exports to China dropped dramatically to 15.7 million metric tons in 2018-19 and 13.0 million metric tons in 2019-20, each less than half the pre-2018 average. With the US and Brazil accounting for 85% of global soybean exports, and with them being the only two countries capable of meeting China's demand, Brazilian soybean producers capitalised on the tariff and increased prices. Trade wars are thus a global risk because they inevitably cause artificial price inflation.

Demand

Compared to other fundamental crops like rice, wheat, and corn, soybeans exhibit a higher price elasticity of demand in the short term, at an estimated level of 0.213. In the long-term, the elasticity of demand for soybeans rises higher, with China standing out in a 2010 study with an estimated 0.778 elasticity of demand. In the midst of worldwide inflationary pressure, the elasticity of soybeans could induce reduced demand in the coming year. In terms of other elasticity metrics, soybean has a negative cross-price elasticity of demand with corn as the two commodities are harvested during the same periods and therefore compete for the same acreage.

Demand for soybeans is strongly interlinked with demand for other commodities and products, including for livestock and poultry as well as for sustainable fuel alternatives. As global demand for meat consumption continues to grow, soybean demand will remain strong for the foreseeable future. Soybeans also derives some demand from the increasing demand for plant-based meat substitutes in North America and Europe, which use soy as a core ingredient.

Supply Chain Issues

Soybeans can be transported by truck, train, and ship. Infrastructure in South America may be precarious, yet investments have been made to accommodate the increased global demand of the 2000s commodities boom. In the case of landlocked Paraguay, shipments must often first arrive in neighbouring Argentina and Uruguay by river before reaching the international market.

Supply chains are vulnerable to risks at both ends. Upstream, it is dependent on fertiliser supply and favourable climate, while downstream, its demand is largely shaped by the demand for livestock feed, and consumers are increasingly concerned with the origin of and their environmental impact of the soybeans they consume.

Additionally, international soybean supply chains may be subject to changes stemming from international trade patterns. Last year's shipping container shortage, for instance, bottlenecked exports. Furthermore, China, as the world's largest soybean importer has been looking to diversify its suppliers and, as such, has been increasing investment in agricultural production in Africa, which may see stem export flows from its current partners.

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