Offshore Energy Update:

By Richard Brakenhoff (independent analyst)

Executive Summary

After a stressful year 2022, 2023YTD has been more 'normal'. Prices of fossil fuels have decreased, but metal prices recovered. Whereas the World Bank was rather negative in its global economic forecast in January, the outlook is now more positive, although there are still risks of ongoing high inflation rates and therefore rising interest rates. Governments' financing deteriorated significantly after the financial crisis in 2008/09 and the COVID-19 pandemic, which could lead to structural budget cuts in the coming years and/or governments running into financial difficulties. The financial problems at several US banks seems to be solved, albeit financial unrest could reappear quickly again.

In this update I will discuss global GHG emissions and what the world must take action quickly to keep global warming below 1.5°Celsius or at least below 2.0°Celsius. Annual installation of renewable energy capacity should be three times higher in 2030 compared to 2022. Investments also should more than tripple to USD 4 trillion per year in 2030. Taking into account higher interest rates and deteriorating governmental finances, but also a possible lack of metals, skilled staff, and installation capacity, the Paris Climate goal has become a mirage, I believe.

I remain conservative with my Brent oil price forecast for 2023-2027. Although the global economy is growing more than earlier anticipated, there are still a lot of risks that could push down GDP growth rates. Taking into account higher production by the non-OPEC countries, this could lead to oversupply and therefore lower prices. For 2023 I maintain my forecast of an average oil price of USD 82 p/b, decreasing to USD 64 p/b in 2027.

Thanks to revival of fossil fuels, the Oil Services market has recovered strongly. Particularly market conditions at the segments Drilling and Shipping improved spectacularly and will continue in the coming years. To sum up, I believe that the Oil Services market will improve further.

Table 1: Market conditions at different segments of Oil Services market between 2014 and 2024E

	2014	2016	2018	2020	2022	2024E
Survey/seismic	++/+	--	+	--	0	0
Drilling	++	0	--	--	-	0
Allround	+	--	-	--	+	++
Installation	+	+	0	--	-/0	0
FPSO	+	--	0/+	0	+	+
Shipping	+	--	--	--	0	+
Oil Services	++/+	0	-	--	0/+	+

Source: R. Brakenhoff; Please note: ++ is booming market conditions, + is favourable, 0 is 'normal', - is negative, and -- is very depressed

Table 2: Brent oil price forecasts (2023 - 2027)

USD per barrel	2023E	2024E	2025E	2026E	2027E
Brent	82	78	72	68	64

Source: R. Brakenhoff

Second release of Offshore Energy Update since I left Royal IHC

After publishing 26 Offshore Energy Quarterlies at the Rabobank, independently, and at Royal IHC, this is my second release since I left Royal IHC at the end of November 2022. In this Offshore Energy Update I will give my view on the current and expected developments at the global energy markets, including the necessity to reduce the use of fossil fuels quickly if the world wants to limit global warming to a maximum of 1.5° degrees Celsius in 2100.

Global oil demand is rising and could reach pre-COVID levels in 2023

At the table below, I have given the latest GDP growth forecast for the major oil consuming countries (source: IMF World Economic Outlook). This forecast is from April 2023. Despite the war in Ukraine and as a result high commodity (and consumer) prices, the world economy performed better than anticipated in 2022 (+3.4% YoY). However, IMF is less optimistic for 2023 (+2.8% YoY) due to ongoing high inflation rates. If Central banks are forced to tighten their monetary policies in 2023 to push down inflation rates and/or to 'rescue' banks, global GDP growth could be limited to only 2.5% YoY in 2023. As shown at the table below, GDP growth rates in 2023 will be limited in the EU, Japan, and Russia, whereas the Chinese economy should rebound strongly following the abolishment of all COVID-19 measures. Although global economic growth could be relatively low in 2023, the U.S. Energy Information Administration believes that oil demand could rise by 1.4m b/p/d to nearly 101m b/p/d, which is more or less equal to the level seen in 2019. Assuming slightly higher GDP growth in 2024, oil demand should climb by another 1.9m b/p/d to nearly 103m b/p/d.

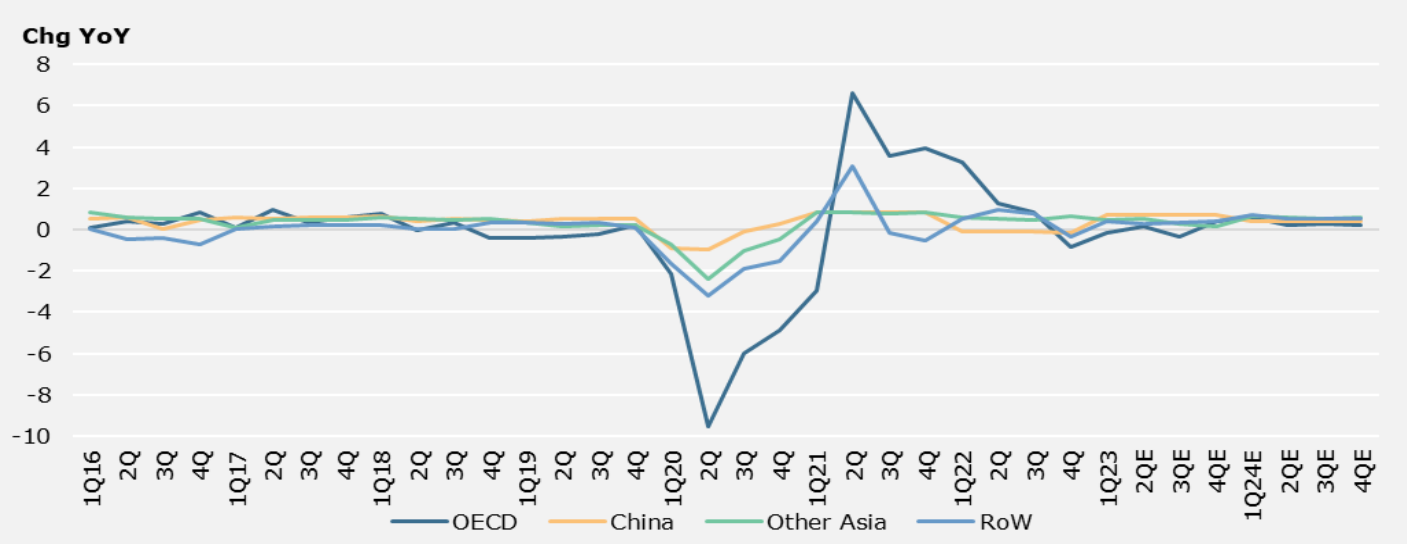
Table 3: Historial and expected GDP growth by country versus oil demand

Country	GDP growth 2009 vs 2008	GDP growth 2020 vs 2019	GDP growth 2021 vs 2020	GDP growth 2023 vs 2022	Oil demand in 2022 (m b/p/d)	As % of total
EU	-4.2%	-6.0%	+5.1%	+0.8%	10.9*	11.0%
USA	-2.5%	-3.5%	+6.0%	+1.6%	20.3	20.4%
China	+9.4%	+2.3%	+8.0%	+5.2%	15.2	15.2%
India	+8.5%	-7.3%	+9.5%	+5.9%	5.0	5.1%
Japan	-5.4%	-4.7%	+2.4%	+1.3%	3.4	3.4%
Russia	-7.8%	-3.0%	+4.7%	+0.7%	3.4	3.4%
World	-0.1%	-3.2%	+5.9%	+2.8%	99.4	

Source: IMF (April 2023), U.S. Energy Information Administration Please note: Global liquids demand (incl. biofuels) was approximately 99.4m b/p/d in 2022; *) Data estimated for year 2022

At the next graph I have given an overview of oil demand growth YoY between 1Q16 and 4Q24 according to estimates from the U.S. Energy Information Administration. The strongest drop in demand was at the OECD countries in 2Q20 (OECD countries are for instance USA, Canada, EU, UK, Australia, NZ, Japan, S. Korea). Whereas oil demand growth in China already resumed in 4Q20, it still decreased strongly at the OECD countries and at the rest of the world. In 2021 and the first three quarters of 2022 oil demand recovered strongly, but this came to a sudden stop in 4Q22. In 1Q23 global demand climbed strongly again, except for the OECD countries. For the coming quarters, the U.S. Energy Information Administration expects oil demand to go up again in all regions.

Graph 1: Growth oil demand in OECD countries, China, rest of Asia, and RoW (m b/p/d)

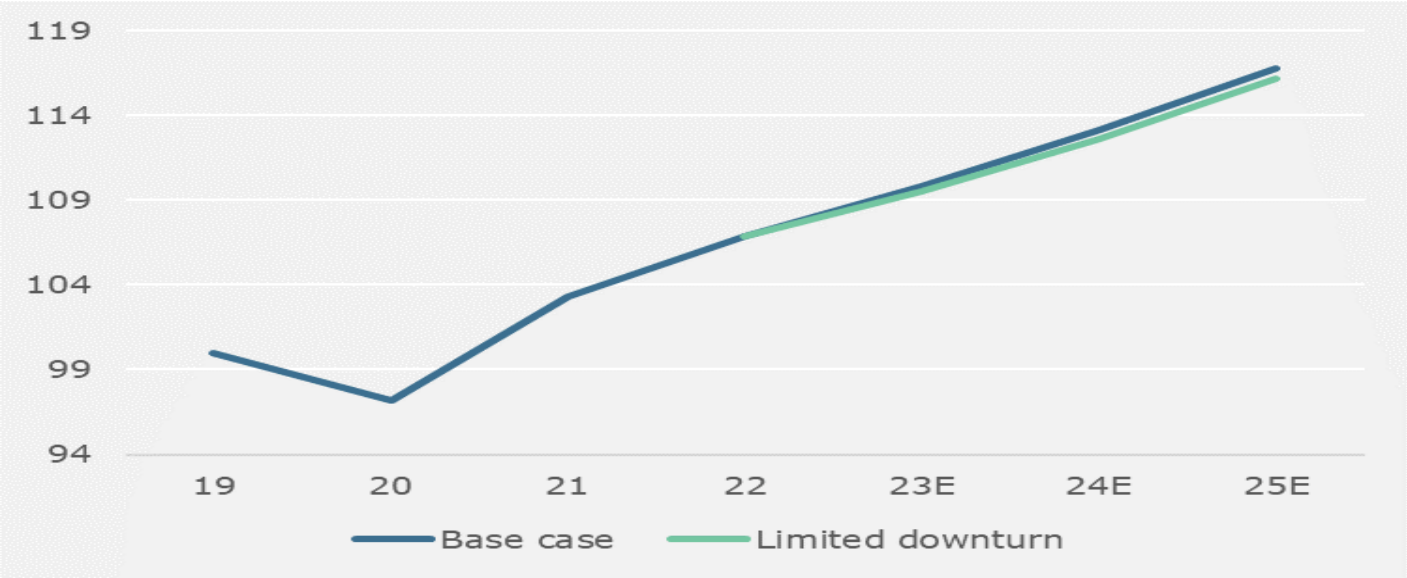


Source: U.S. Energy Information Administration Please note: RoW = rest of the world

Medium-term global oil demand growth using two scenarios

Contrary to World Bank's global economic forecast from January, the IMF is less pessimistic in its latest Global Economic Outlook. However, IMF also warns that there are more downward risks compared to upward potential. It gave also a global GDP forecast if central banks will tighten their monetary policies more than anticipated. Instead of 2.8% global GDP growth in 2023, this scenario would limit GDP growth to 2.5%. As a result, also global GDP growth in 2024 will be somewhat lower than forecasted. Of course, if the impact of the war in Ukraine increases again, leading to more turnoil on commodity markets and/or banks have to be rescued again (such as Credit Suisse), GDP growth rates will have to be lowered further.

Graph 2: GDP growth forecast 2019-2025E Base Case and Limited Downturn (Index: 2019=100)



Source: IMF April 2023 Please note: Index (2019 = 100)

Using IMF's Base Case scenario for the period 2023-2026, I believe that global oil demand could rise to 104.1m b/p/d in 2026. However, if IMF's slightly more negative scenario materialises, I expect global oil demand to go up slightly less. At both scenarios pre-COVID-19 levels will be surpassed in 2024.

Graph 3: Medium-term global oil demand growth using two economic scenarios

Source: R. Brakenhoff

Global oil supply clearly exceeded demand in 1Q23

At the table below I have summarized the global oil supply and demand growth (declines) in the last four quarters according to the short-term oil market outlook by the U.S. Energy Information Administration. Although COVID-19 is not an issue anymore, global oil demand in 1Q23 was still nearly 1m b/p/d lower compared to the pre-COVID-19 level seen in 1Q19 due to relatively high prices. Although OPEC and its allies (OPEC+) wanted to limit supply growth, OPEC's production still went up YoY in 1Q23, being offset by lower production in Russia. All told, supply exceeded demand by more than 1m b/p/d in 1Q23.

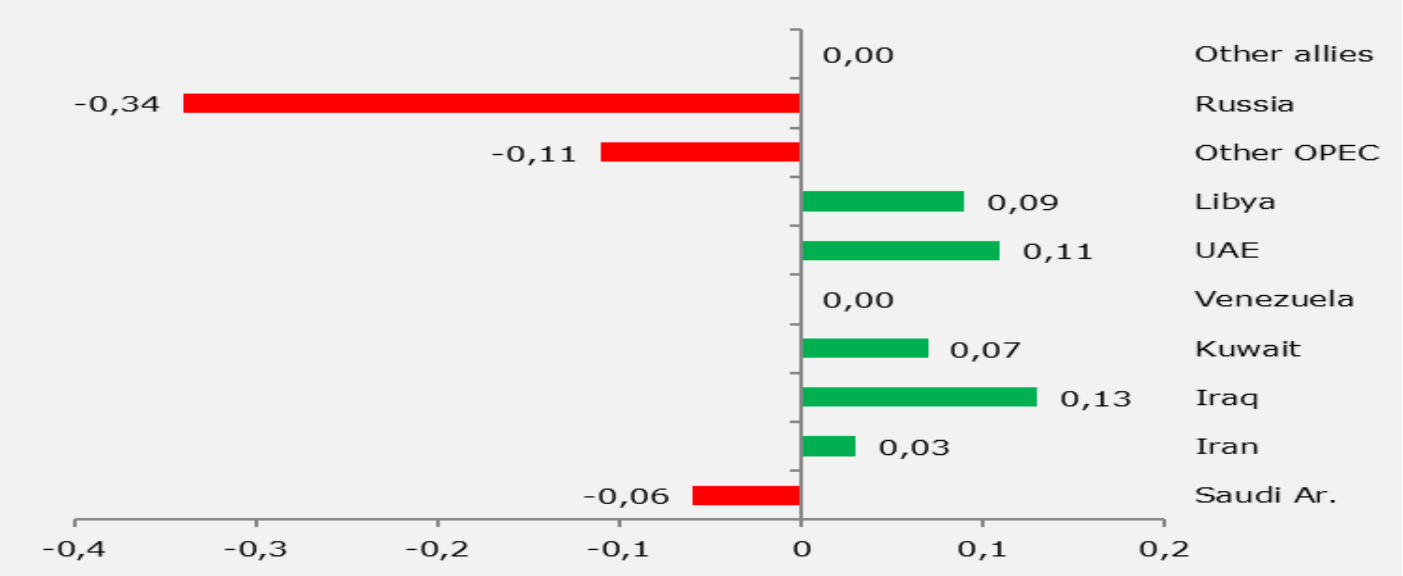
Table 4: Oversupply increased in 1Q23 due to OPEC, USA, and Brazil

Production (m b/p/d)	2Q22	Change YoY (m b/p/d)	3Q22	Change YoY (m b/p/d)	4Q22	Change YoY (m b/p/d)	1Q23	Change YoY (m b/p/d)
OPEC	28.33	+2.84	29.23	+2.39	28.92	+1.26	28.45	+0.26
USA	20.12	+1.07	20.60	+1.66	20.66	+0.79	20.90	+1.46
Total supply	98.75	+4.10	100.80	+4.21	100.94	+2.64	101.04	+2.21
Total demand	99.01	+2.68	100.40	+2.00	99.74	-0.69	99.97	+1.44
Over/(Under)supply	-0.26		+0.40		+1.20		+1.07	

Source: U.S. Energy Information Administration; Please note: Production figures USA including natural gas liquids (NGL) and condensates

In 1Q23 oil production rose by more than 2.2m b/p/d compared to 1Q22, of which the USA accounted for nearly 1.5m b/p/d. Furthermore, oil production increased in Canada and Brazil. At OPEC+ oil production – on balance - stabilised in 1Q23 (see graph below).

Graph 4: OPEC+ oil production stabilised YoY in 1Q23

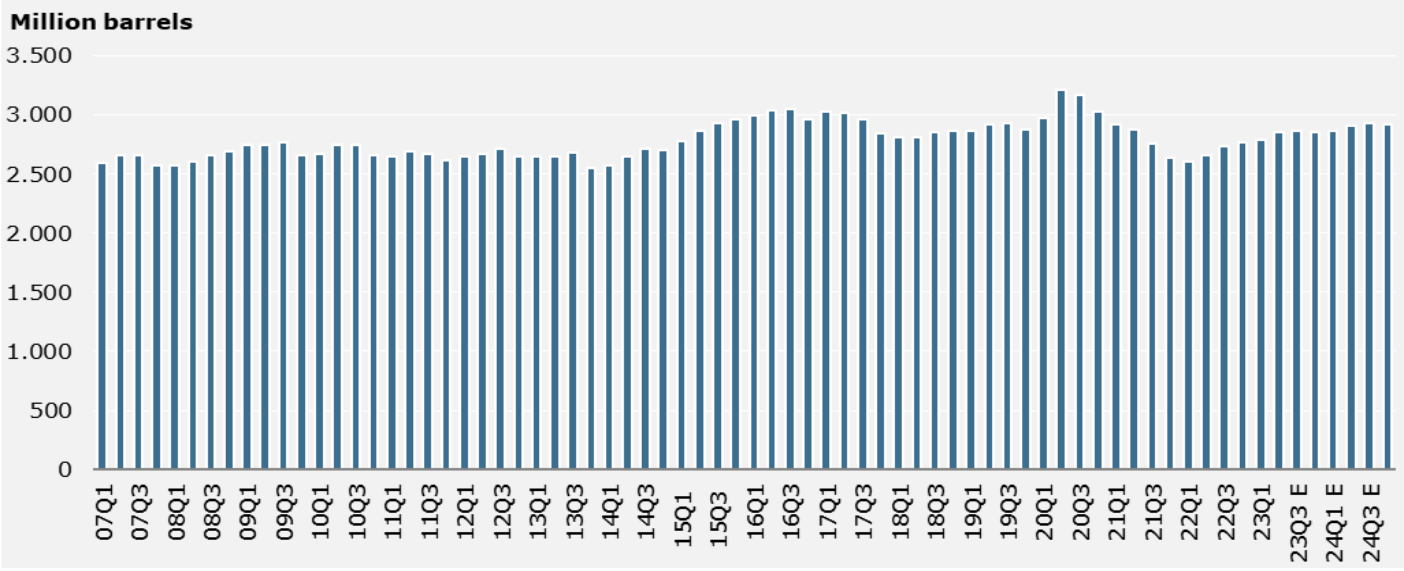


Source: U.S. Energy Information Administration, OPEC, R. Brakenhoff

Commercial oil inventories in OECD countries rose by nearly 1% QoQ in 1Q23

Whereas the level of commercial inventory of oil in the OECD countries fluctuated in a bandwidth of 2.5-3.0 billion barrels between 1Q07 and 4Q19, it peaked at 3.2 billion barrels in 2Q20. Thanks to oil production cutbacks and recovering demand, it dropped to 2.6 billion barrels at 4Q21. Rising oil production in combination with relatively weak economic growth in 1Q23 pushed up the inventory level to nearly 2.8 billion barrels in 1Q23. The U.S. Energy Information Administration believes that the inventory level will increase further in the coming quarters to more than 2.9 billion barrels in 2024 despite OPEC+'s recently announced additional production cutbacks.

Graph 5: Development commercial inventory of oil at the OECD countries (million barrels)



Source: U.S. Energy Information Administration

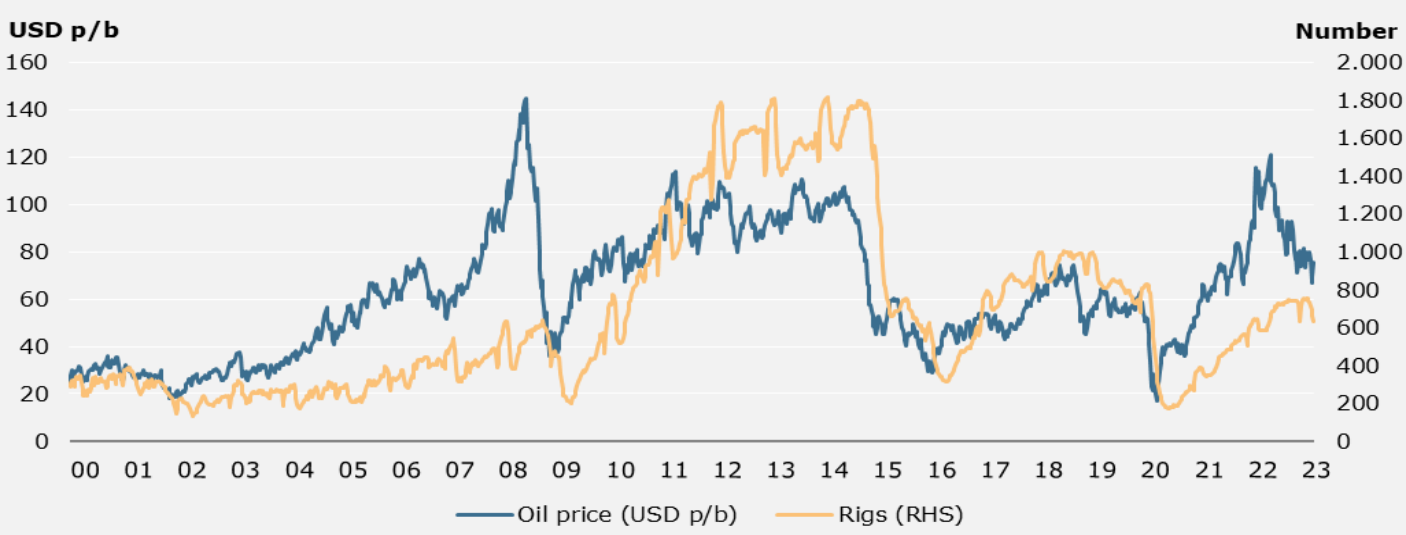
Also in the USA crude oil inventory level rose spectacularly until June 2020 (+26% compared to year-end 2019). Thanks to sharply lower oil production in the USA, the inventory level declined by 10% at the end of 2020. Recovering demand resulted in a further drop of 15% during the year 2021, but in 2022 rising oil production more or less equalled

demand growth, resulting in a marginal growth of inventory levels by year-end 2022. In 1Q23 inventory levels climbed by 12% due to nearly 9% YoY higher oil production whereas demand decreased by nearly 2% YoY.

Number of oil drilling rigs in the USA decreased 5% during 1Q23

Before the outbreak of the Coronavirus, the number of onshore oil drilling rigs in the USA stood at 670 units by the end of 2019 (which was well below the levels of more than 1,000 units in the years 2014 and before). During the first months of the Corona pandemic, the US (WTI) oil price collapsed in 1H20. As a result, the number of onshore oil drilling rigs dipped at 172 units by mid August 2020, 75% down compared to year-end 2019. Thanks to the strong recovery of the WTI oil price, the number of oil drilling rigs recovered to 267 units at year-end 2020, 480 units at year-end 2021, and 621 units at year-end 2022. In 1Q23 the number of oil drilling rigs went down by 5% in the USA, probably due to the weakening WTI oil price.

Graph 6: Development of number of onshore oil drilling rigs in North America

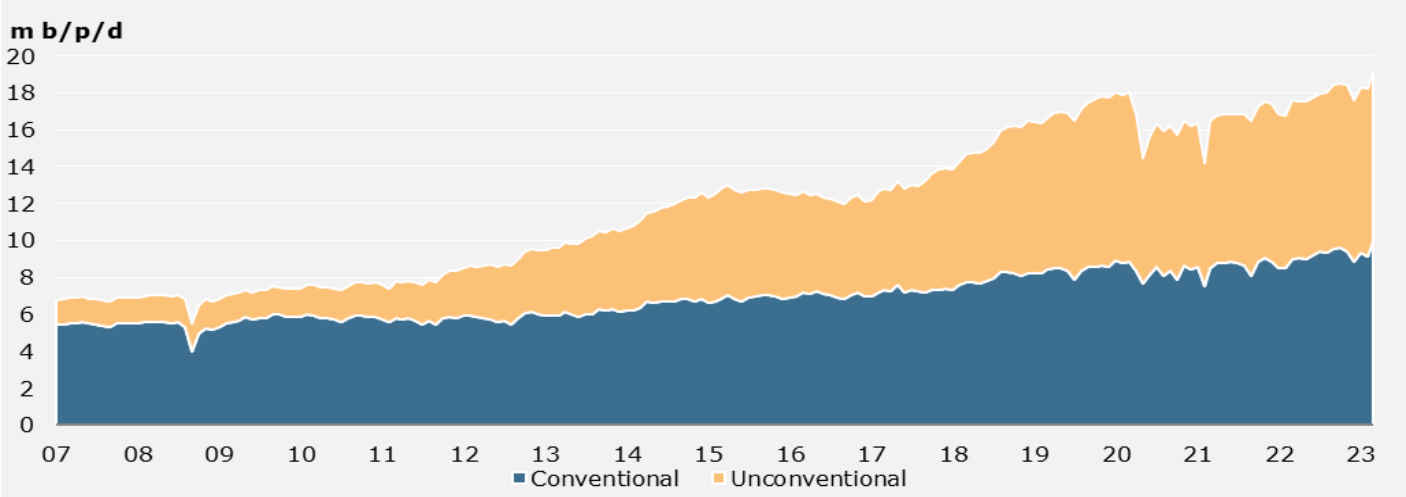


Source: Baker Hughes, Markets Businessinsider

With a certain time lag of around 6-12 months, the development in the number of drilling rigs in use impacts the oil (and gas) production in North America. After the spectacular drop in unconventional oil production in May 2020 (-20% YoY) due to COVID-19, production gradually recovered again in the following months. As of May 2021 unconventional oil production increased YoY every consecutive month. According to the U.S. Energy Information Administration unconventional oil production rose by more than 12% YoY in 1Q22, followed by +6% in 2Q22, +6% in 3Q22, and 5% in 4Q22. In 1Q23 unconventional oil production climbed by more than 8% YoY. In fact, oil production exceeded pre-COVID-19 levels for the first time! For April and May 2023 the U.S. Energy Information Administration expects that unconventional oil production will increase by approximately 9% YoY, i.e. it will climb by around 0.8m b/p/d YoY.

Looking at the development of the number of onshore drilling rigs in the USA, which continuously increased during 2022 (currently three times higher compared to the dip in August 2020), as well as the announced Upstream CAPEX budgets by the US Independent oil companies, I believe that the unconventional oil production will continue to go up in the coming quarters. Whereas unconventional oil production in the US already approached its pre-COVID-19 record high in the year 2022, new records will be set in 2023 and 2024. For 2023 and 2024, the U.S. Energy Information Administration estimates that total (conventional and unconventional) oil production will go up by 0.9m b/p/d and 0.5m b/p/d, respectively.

Graph 7: US oil production (including national gas liquids & condensates)

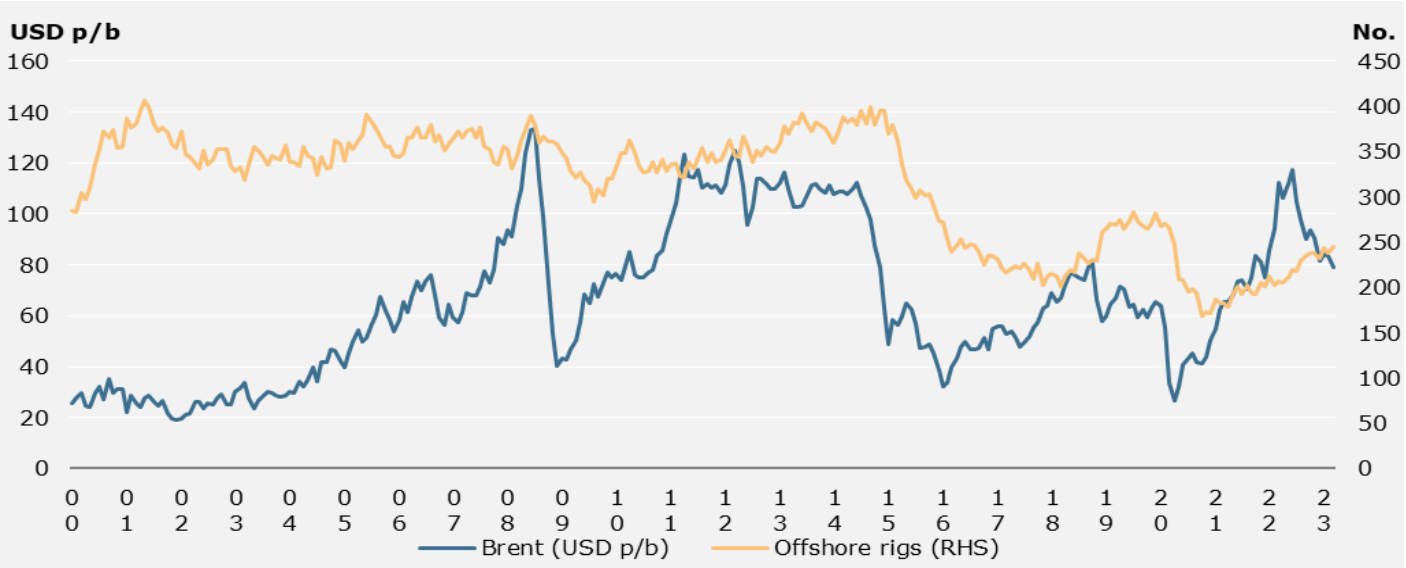


Source: U.S. Energy Information Administration

Number of offshore drilling rigs rose 18% YoY in March 2023

According to Baker Hughes the number of offshore drilling units (Jack-Ups, Semi-Submersibles, Drillships) rose by 18% YoY globally to 245 units in March 2023. This increase looks significant, particularly compared to the dip in December 2020 (172 units), but still wel below levels of nearly 400 units seen in the years 2014 or before. The largest YoY increases in March 2023 were seen in Africa (+44%), North America (+31%), North Sea (+21%), and Asia (+20%).

Graph 8: Development number offshore drilling rigs in the world versus Brent oil price

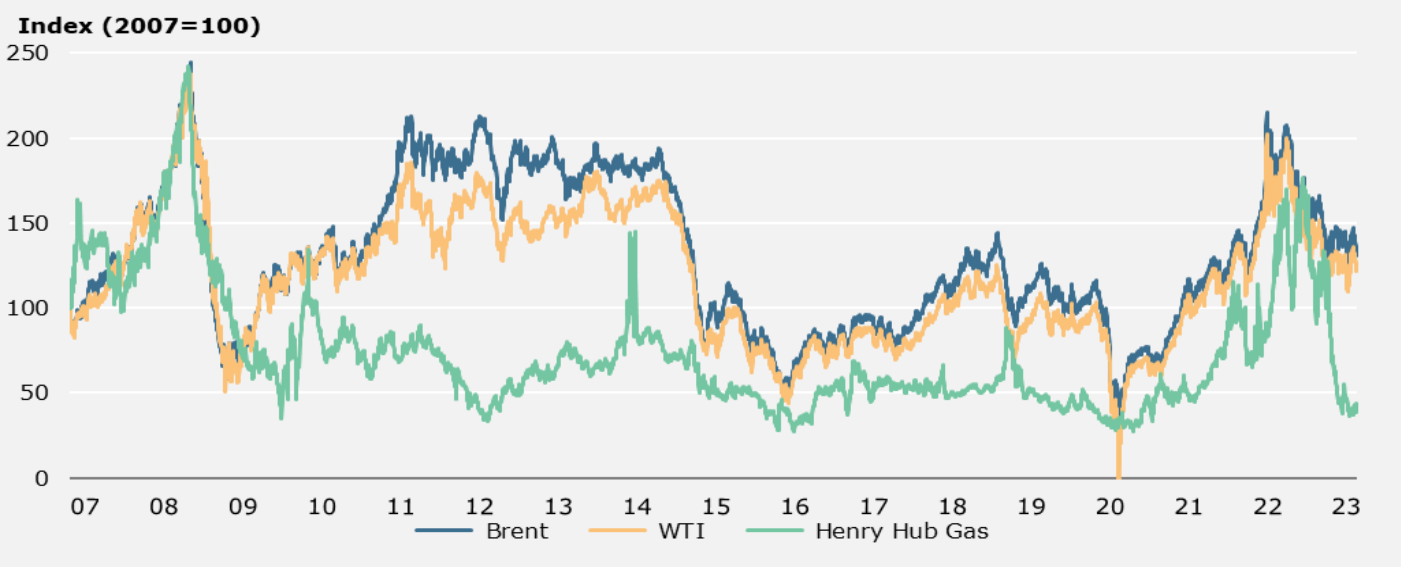


Source: Baker Hughes, Markets Businessinsider

Brent oil price climbed 3% YoY in 1Q23, but fell 7% compared to 4Q22

In 1Q23 the Brent oil price was on average USD 82.16 p/b, up 3% compared to 1Q22, but 7% lower compared to 4Q22. During 1Q23 the oil price fluctuated between USD 88.19 p/b on January 23nd to USD 72.97 p/b on March 17th. Worries about a possible global recession as well as financial difficulties at several banks in the USA and Switzerland pushed down the oil price during 1Q23. However, more economic optimism and an unexpected announced production cutback by the OPEC and its allies (OPEC+) has resulted in a strong recovery of the Brent oil price. In 1Q23 the average US WTI crude oil price amounted to USD 76.16 p/b, down 1% YoY.

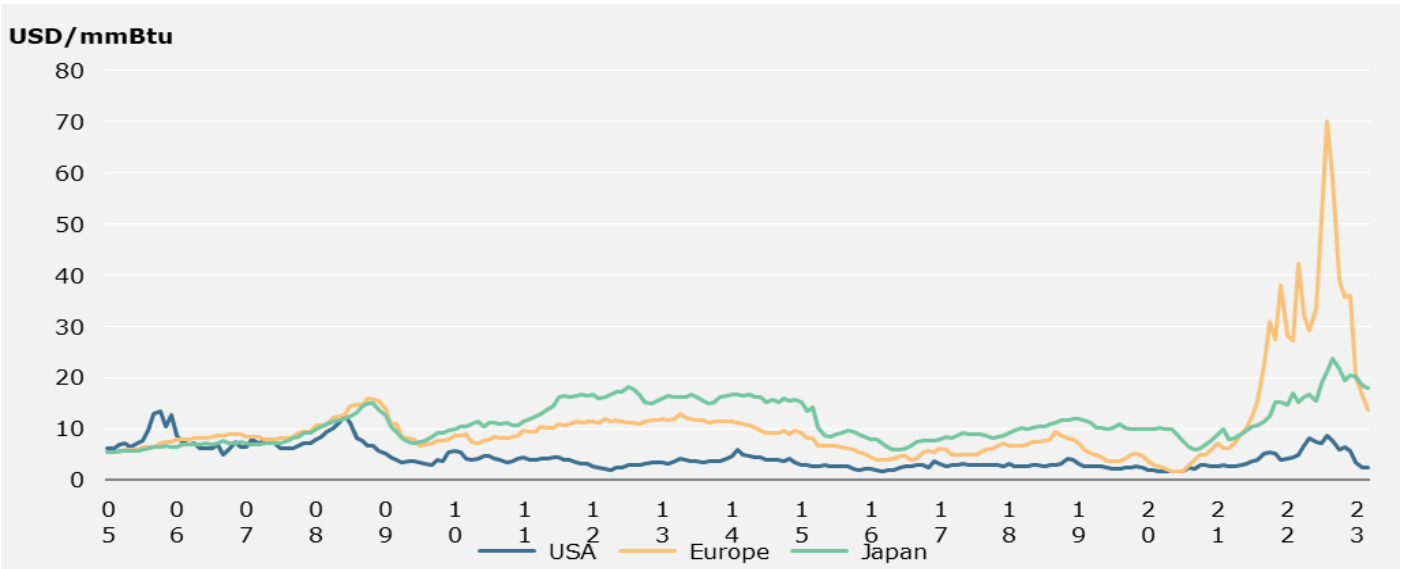
Graph 9: Development of oil and gas prices (Index: 1 January 2007 = 100)



Source: Markets Businessinsider

The price of natural gas in North America (Henry Hub) dropped 43% to USD 2.77/mmBtu in 1Q23 and even plummeted 55% compared to the previous quarter. Gas prices in Europe fell 48% YoY to USD 16.84/mmBtu in 1Q23. Compared to 4Q22 the European gas price even declined by 55%, but the current price is still relatively high historically. For the first time since 3Q21 was the European gas price lower compared to the Japanese LNG import price, which was historically usual.

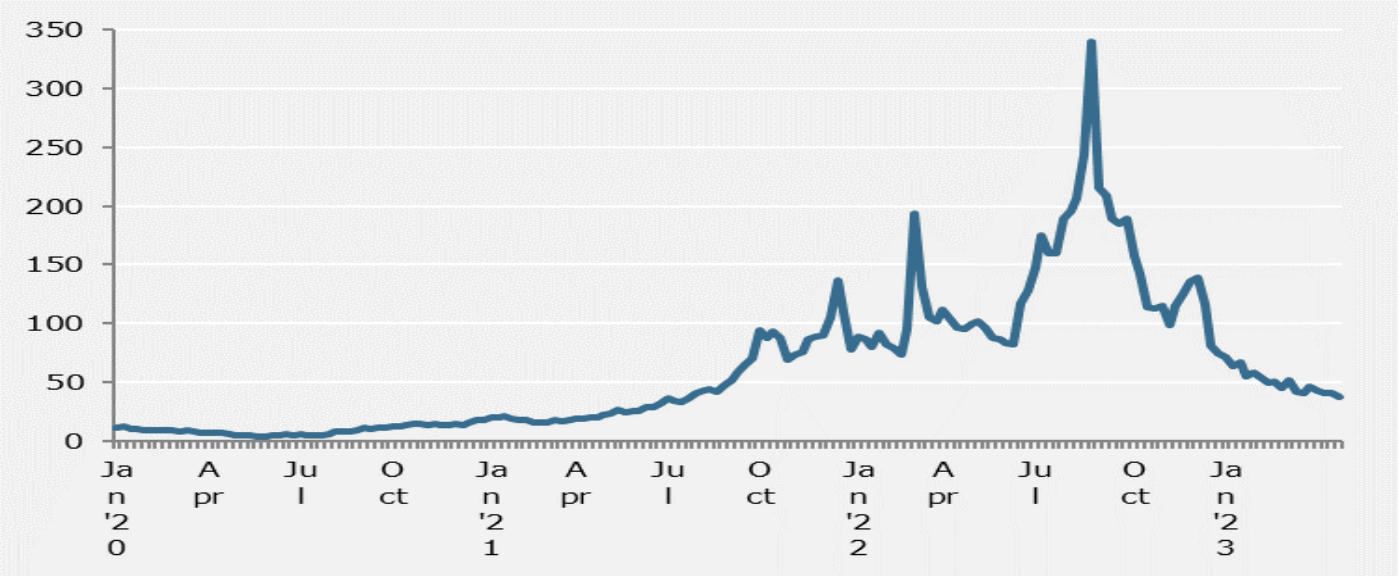
Graph 10: Development of gas prices in Europe, Japan, and North America



Source: Markets Businessinsider, World Bank

The spectacular jump and fall of the European gas price is also illustrated by the development of the bench mark gas price: The Dutch TTF gas future price measured in EUR/MWh (see graph below). After the peak seen in August at more than EUR 300/MWh, it dropped to EUR 38/MWh at the end of April 2023, which – in fact – is well below the price seen in April 2022 and equals the same level seen in August 2021.

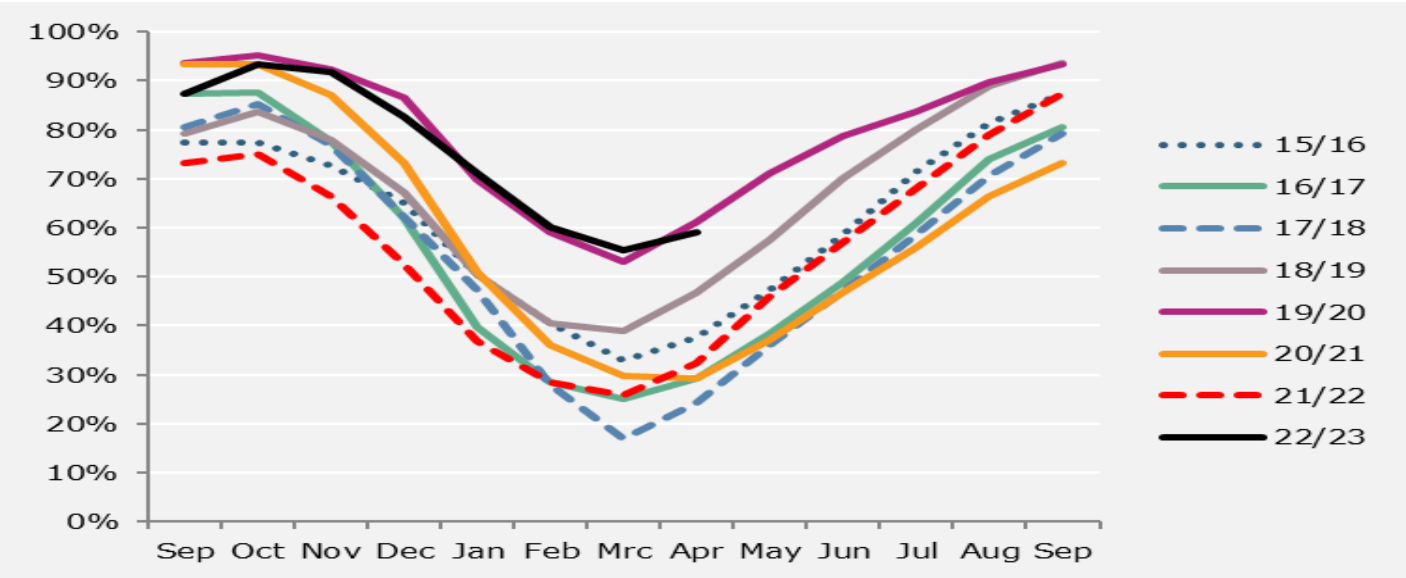
Graph 11: Dutch TTF gas future price in 2020, 2021, 2022, and 2023YTD (EUR/MWh)



Source: www.tradingeconomics.com

The sharply lower gas price in the EU is logical looking at the storage level. At the end of April 2023 storage was filled by 59%, which was only slightly below the peak level seen in fiscal year 2019-2020 (the COVID-19 peak year). It storage level was also substantially higher compared to April 2022 (32%). Although Russian gas imports will be minimal in the course of 2023, higher LNG imports in my view will be enough to refill the storage tanks to more than 90% in September/October, before the start of the Winter 2023/24. Therefore the risk of a price hike like in August 2022 in my opinion is very unlikely.

Graph 12: Natural gas storage levels in the EU



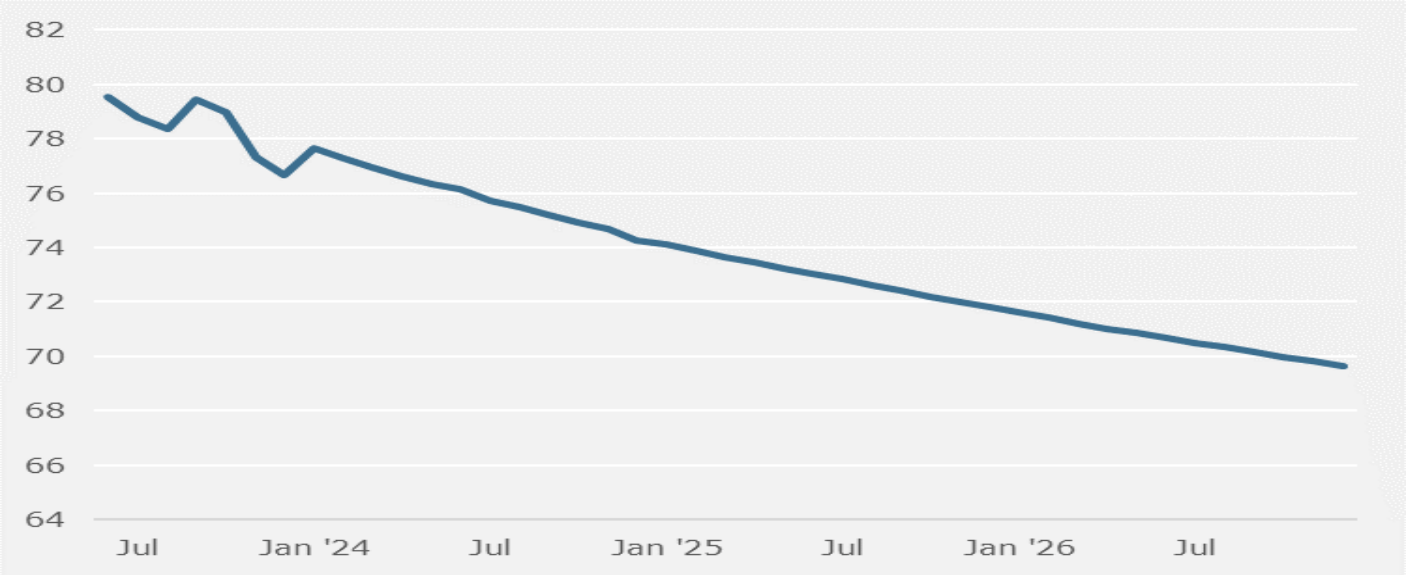
Source: Gas Infrastructure Europe

Besides declining oil & gas prices, also the price of coal fell QoQ in 1Q23 (-36%). Contrary to the energy prices, prices of metals (copper, iron ore, nickel, tin) recovered QoQ in 1Q23, which could indicate that the global economy is improving.

Brent oil futures points towards gradually declining prices in coming years

Oil price futures are often used to forecast oil prices, but they are not always accurate as forecaster. Current Brent oil price (May 1st) was below USD 80 p/b. The graph below shows Brent oil future prices. Buying a barrel of Brent in January 2024 would currently cost around USD 78 p/b. This price is only an indication at the moment, the actual price in January 2024 can be totally different. In the coming years the Brent oil price could go down to approximately USD 70 p/b in December 2026 (see graph below).

Graph 13: Brent oil future prices January 2023 until December 2026 (USD p/b)



Source: www.investing.com

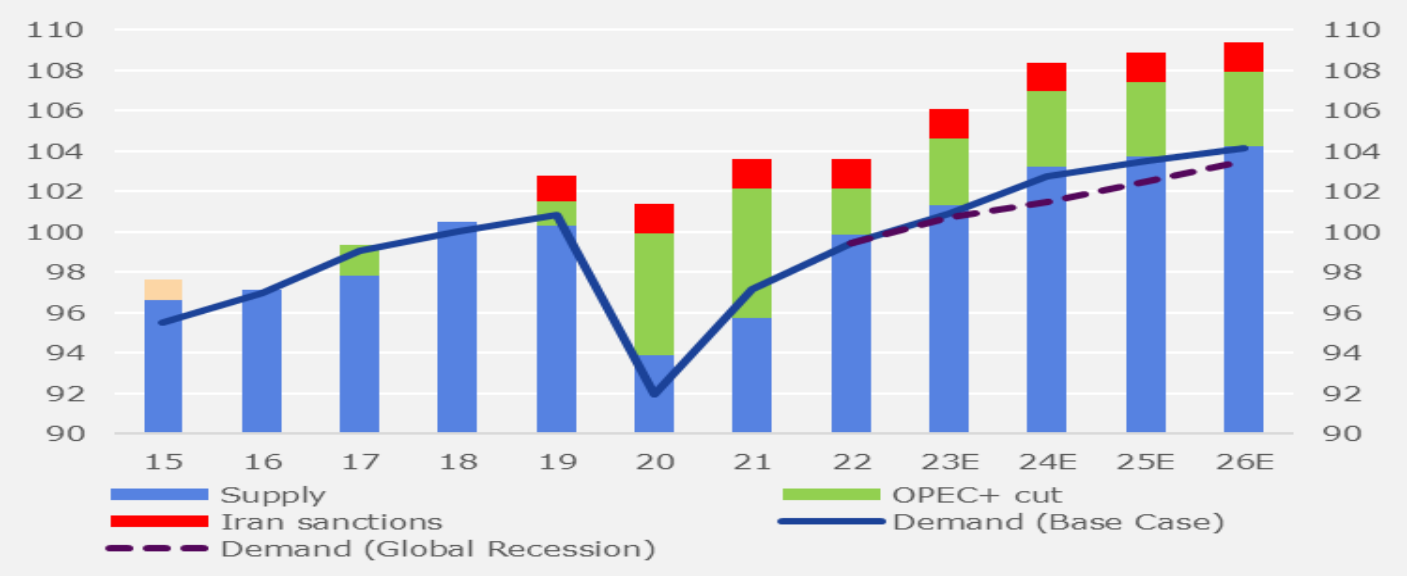
Looking at the Henry Hub gas price futures, the price is expected to go down to USD 3.59/mmBtu in December 2023 (December 2022: USD 5.77/mmBtu), recovering to USD 4.85/mmBtu in December 2026. During the year it will follow a seasonally pattern, i.e. lowest price in Q2 and highest in Q1. If a severe winter hits North America, gas prices will be clearly higher.

OPEC+ raises its production cutback as of May 2023

Above I had already discussed the outlook for global oil demand, now I will discuss the oil production outlook. In the coming years non-OPEC countries like the USA, Norway, Canada, Brazil, and Guyana will raise their production. Early April 2023 OPEC+ countries took the market by surprise stating to raise their production cutback by 1.16m b/p/d as of May 2023. This additional cutback is planned until the end of 2023 in an effort to restore oil prices. At first, the Brent oil price climbed 5%, but at the end of April the oil price returned to the level of end March.

Looking ahead at the period 2023-2026, if the base case scenario of the IMF materialises and the OPEC+ countries maintain their production cutback, I believe that the global oil market could be in an equilibrium in the coming years (see graph below). Although the risk of a global recession currently seems lower compared to my previous market outlook, there is still a risk that the global economy will grow less than anticipated, leading to lower demand and therefore oversupply. This situation would deteriorate even further, if the sanctions against Iran (and Russia) are lifted.

Graph 14: High risk of oversupply if Global Recession materialises (m b/p/d)



Source: World Bank, IEA, U.S. Energy Information Administration, R. Brakenhoff

In the table below I compared several oil price forecasts from market surveyors. The forecast by Bloomberg is the average based on estimates given by commodity analysts. To illustrate the uncertainty level in the market, the oil price forecast for 2023 is on average USD 87 p/b, but it ranges between USD 76 p/b and USD 115 p/b. Regarding the forecast for 2025, the range is also huge, i.e. the lowest forecast is USD 65 p/b and the highest is USD 114 p/b.

Compared to my previous update, I have not changed my Brent price forecast. I still expect an average Brent oil price of USD 82 p/b in 2023, assuming no global recession. If the world economy performs less than anticipated, the Brent oil price could fall to USD 75 p/b despite of further production cutbacks by OPEC+. For 2024 and beyond, I expect the Brent oil price gradually to go down to USD 64 p/b in 2027. However, there is more downside risk (disappointing GDP growth worldwide) than upside potential, I believe.

Table 5: Brent oil price forecasts (2023 - 2027)

USD per barrel	2023E	2024E	2025E	2026E	2027E
U.S. Energy Information Administration	85	81	n/a	n/a	n/a
World Bank	84	86	n/a	n/a	n/a
IMF	75	71	69	68	67
Bloomberg (commodity analysts)	87	88	83	81	72
Richard Brakenhoff	82	78	72	68	64

Source: U.S. Energy Information Administration STEO April 2023, World Bank (April 2023), IMF World Economic Outlook April 2023, Bloomberg (commodity analysts), R. Brakenhoff

For the second time, we also provide a forecast for the US Henry Hub gas price. In 2022, the Henry Hub gas price was on average USD 6.42/mmBtu, up 64% compared to the year 2021. At the table below I have given an overview of the forecasts from market surveyors. Looking at the average forecast made by commodity analyst, they expect that the Henry Hub gas price will decrease to USD 3.58/mmBtu in 2023. However, uncertainty remains very high: the range of estimates is between USD 2.50/mmBtu and USD 6.00/mmBtu. One thing is more or less certain, because of high gas demand in Europe, i.e. more LNG exports from the USA to Europe, the Henry Hub gas price will be relatively high historically (it hoovered between USD 2-3/mmBtu in recent years). Assuming a 'normal' winter at the Northern Hemisphere in 2024 and beyond, we believe that gas prices will gradually go down again, not only in the USA, but also in Europe and Asia.

Table 6: Henry Hub natural gas forecast (2023 – 2027E)

USD per mmBtu	2023E	2024E	2025E	2026E	2027E
U.S. Energy Information Administration	2.94	3.71	n/a	n/a	n/a
World Bank	2.70	3.70	n/a	n/a	n/a
IMF	2.87	3.59	4.20	4.37	4.36
Bloomberg (commodity analysts)	3.58	3.75	4.29	3.94	3.73
Rabobank International	2.98	4.05	4.71	4.75	n/a
Richard Brakenhoff	2.70	3.50	3.80	3.50	3.20

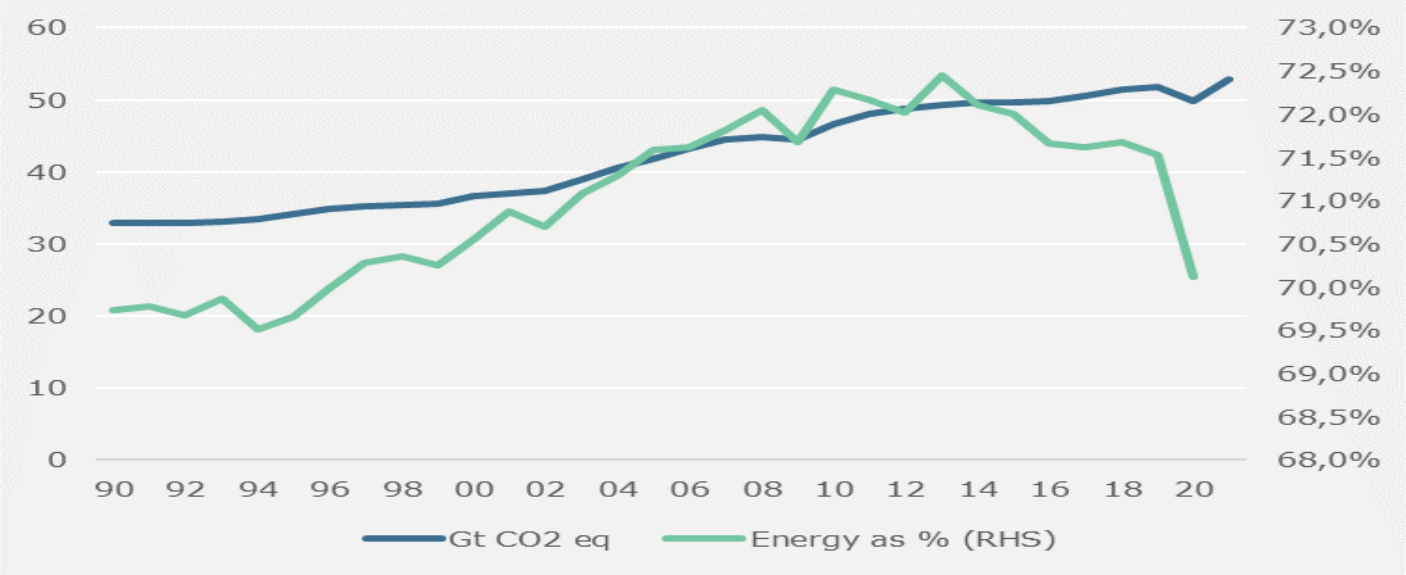
Source: U.S. Energy Information Administration STEO April 2023, World Bank (April 2023), IMF World Economic Outlook April 2023, Bloomberg (commodity analysts), Rabobank, R. Brakenhoff

Paris Climate Goals becoming a mirage?!?

Global GHG emissions set new record in 2021

After the temporary decline of global greenhouse gas (GHG) emissions worldwide in 2020 thanks to COVID-19, total GHG emissions excluding Land Use/Land Use Change/Forestry (LULUCF) rebounded to an estimated 52.8Gt in 2021 (see graph below). Of these GHG emissions, CO_2 accounted for around 72%, CH_4 for 19%, N_2O for 6%, and F-gases for 3%. Energy related activities are responsible for approximately 70-72% of total GHG emissions globally. In the year 2020 this percentage decreased due to sharp drop in (international) transportation.

Graph 15: Global GHG emissions measured in Gt CO_2 equivalent (1990-2021P)



Source: PBL, UN Emissions Gap Report 2022

The graph below shows the development of GHG emissions per Capita in the world between 1990 and 2021. In 2012 GHG emissions per Capita peaked, followed by a slight decrease. Based on the last available data per country, global GHG emissions per Capita amounted to 6.4 tons of CO_2 equivalent in 2020. However, this figure was much higher in the UAE (27), Australia (23), Saudi Arabia (22), Canada (19), USA (17), Russia (15), South Korea (14), and China (10). The average in the 27 countries of the EU stood at nearly 8 (Netherlands: 10).

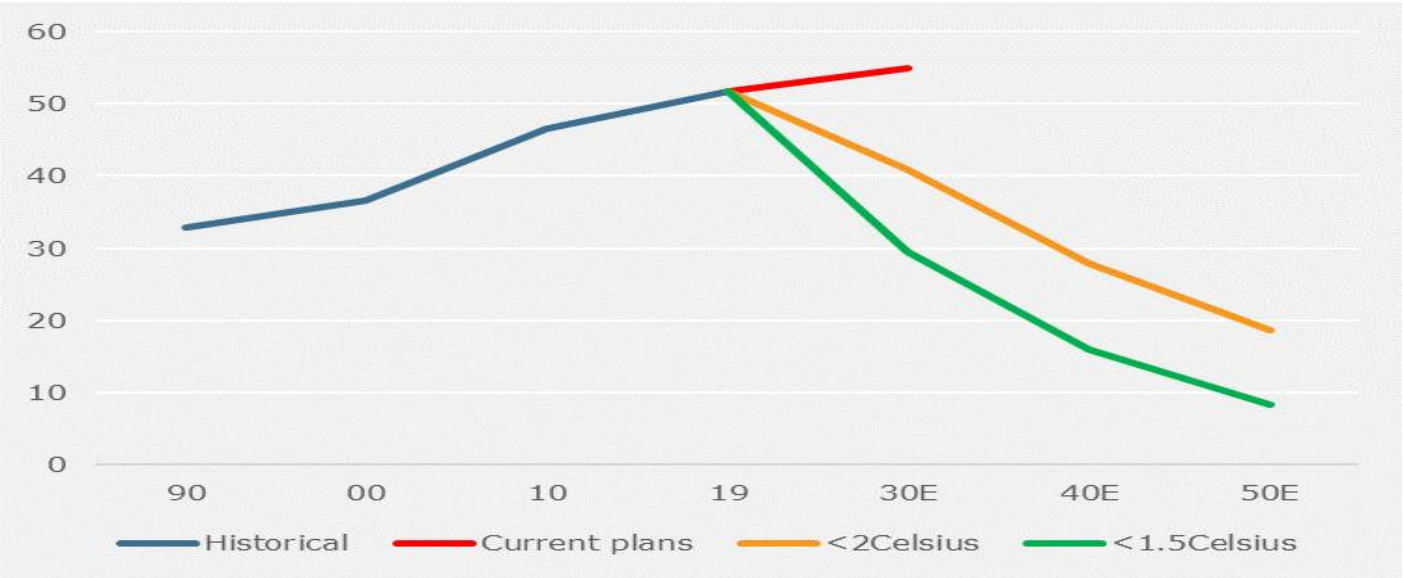
Graph 16: Global GHG emissions per Capita in tons of CO_2 equivalent (1990-2021P)

Source: PBL, UN

Global GHG emissions should drop by 21-43% in 2030 compared to 2019

In its Emission Gap Report 2022, the UN stated that global GHG emissions have to decline sharply in the coming decades if the world wants to achieve its Paris Climate goal: limiting global warming to less than 1.5˚Celsius in the year 2100. According to the UN global GHG emissions have to go down by 43% in 2030 compared to 2019, down 69% in 2040 versus 2019, and minus 84% in 2050 compared to 2019 (see graph below). Limiting global warming to less than 2˚Celsius in 2100, GHG emissions have to drop by 21% in 2030, 46% in 2040, and 64% in 2050 compared to 2019. However, looking at current plans, it is more likely that GHG emissions worldwide will increase further to 55Gt CO_2 equivalent in 2030. Because global GHG emissions are currently still going up instead of decreasing, the size of the future necessary drop in emissions will become bigger and bigger!

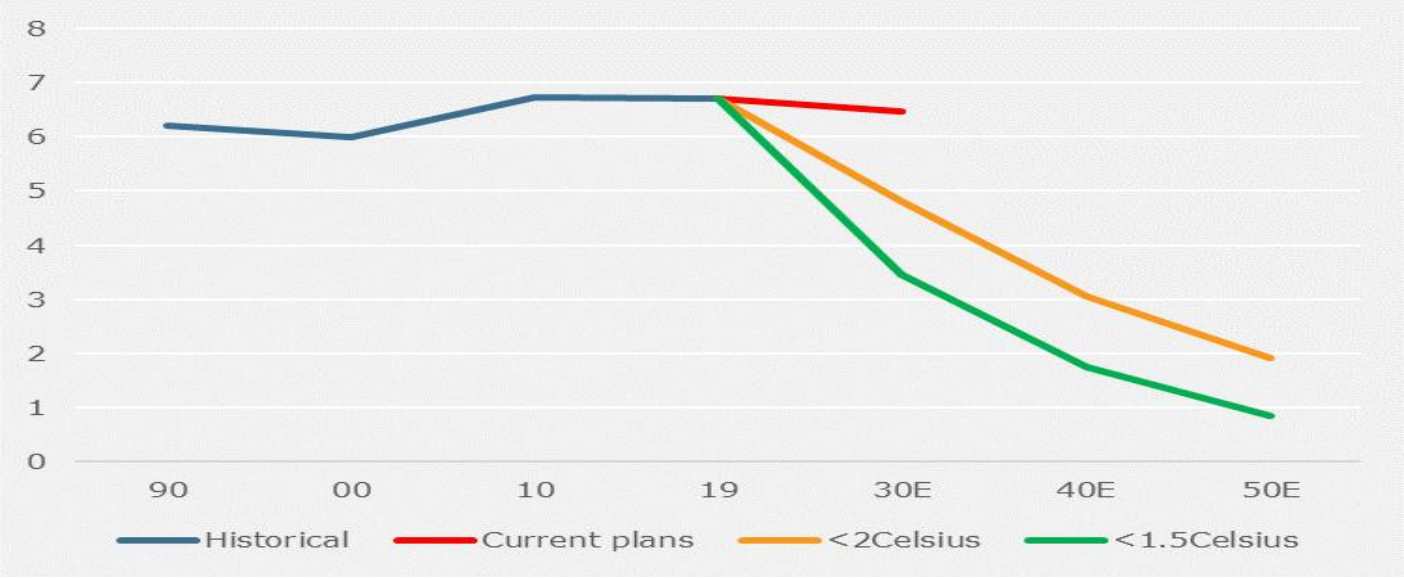
Graph 17: Necessary GHG reduction worldwide to limit global warming to 1.5-2.0˚C in 2100



Source: UN Emissions Gap Report 2022

The above-described challenge is already huge, but taking into account the forecasted growth of the global population to nearly 10 billion people in the 2050, the goals set in the Paris Climate Agreement has become a mirage, I believe. Expressing the maximum GHG emissions per Capita, the decline percentages are even higher (see graph below), i.e. governments should stop discussions at COPs, but use their efforts in reducing emissions now immediately!

Graph 18: Necessary GHG reduction expressed in maximum GHG emissions per Capita until 2050

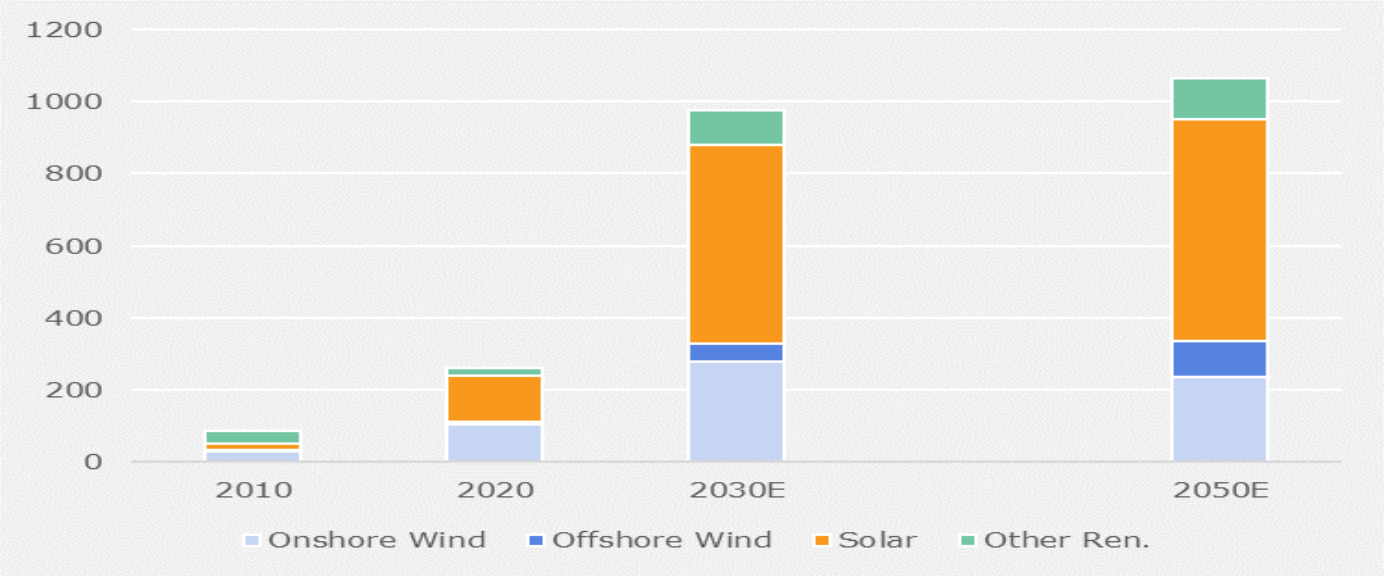


Source: UN Emissions Gap Report 2022, UN, R.Brakenhoff Please note: measured in tons of CO_2 equivalent

Annual installations renewable capacity should more than triple in 2030

Whereas in the year 2010 87GW of renewable capacity was installed globally, it jumped to 261GW in 2020 of which solar and onshore wind made the largest contribution. If the world still wants to limit global warming to less than 1.5°Celsius in the year 2100, the amount of new renewable capacity should more than triple according to estimates made by IRENA (see graph below). In the year 2030 nearly 1,000GW should be installed, rising to more than 1,000GW in the year 2050. These figures mean net additions, i.e. the actual number will be significantly higher as 'old' capacity will have to be decommissioned and replaced as well. This decade the installation of offshore wind measured in GW should rise tenfold (!!!), solar nearly six times, and onshore wind nearly three times. These increases do not seem realistic, probably trying to limit global warming to less than 2°Celsius in 2100 is more realistic.

Graph 19: Global annual installation of renewable capacity should more than triple in 2030 (GW)

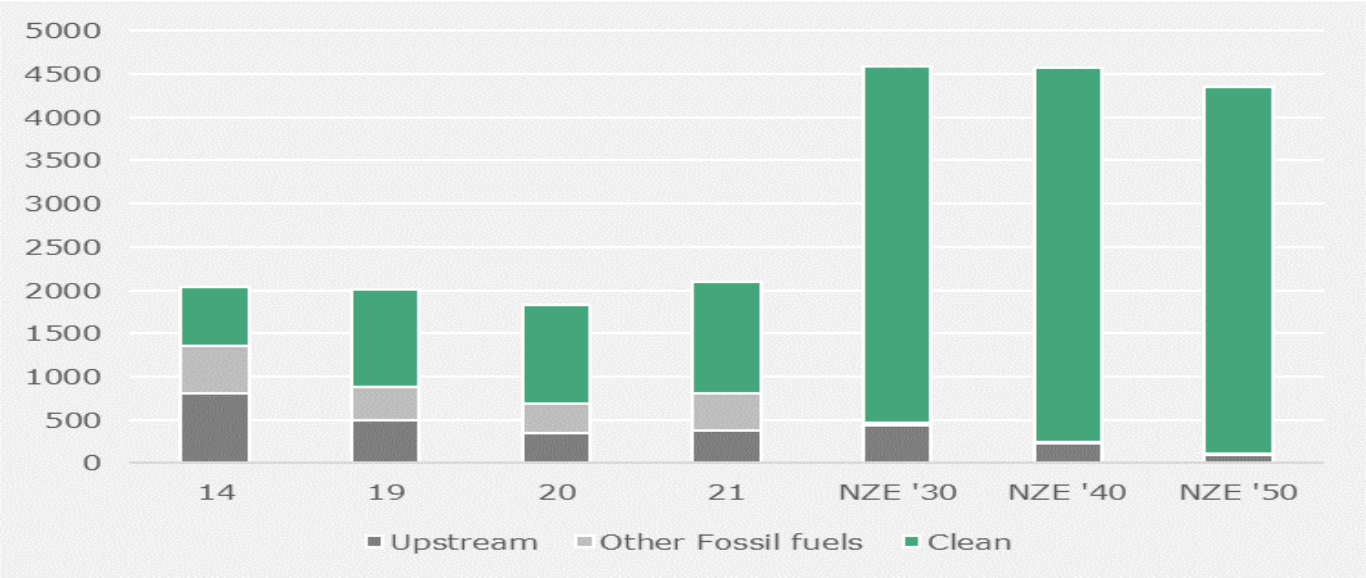


Source: IRENA World Energy Transitions Outlook 2023

Annual investments in clean energy should rise threefold by 2030

The above-mentioned figures in GW are already huge, putting necessary investment numbers on them are also impressive. According to the IEA, around USD 2.2 trillion was invested in the global energy system in 2021, of which fossil fuels (upstream, midstream, downstream) accounted for approximately USD 0.8 trillion and clean energy for USD 1.3 trillion. If the world wants to realize IEA's Net Zero Emissions (NZE) scenario in 2050, investments in clean energy have to jump to more than USD 4 trillion per annum by the year 2030 (see graph below). Although the use of fossil fuels should drop rapidly, still hundreds of millions have to be spend per year to keep production at a necessary level.

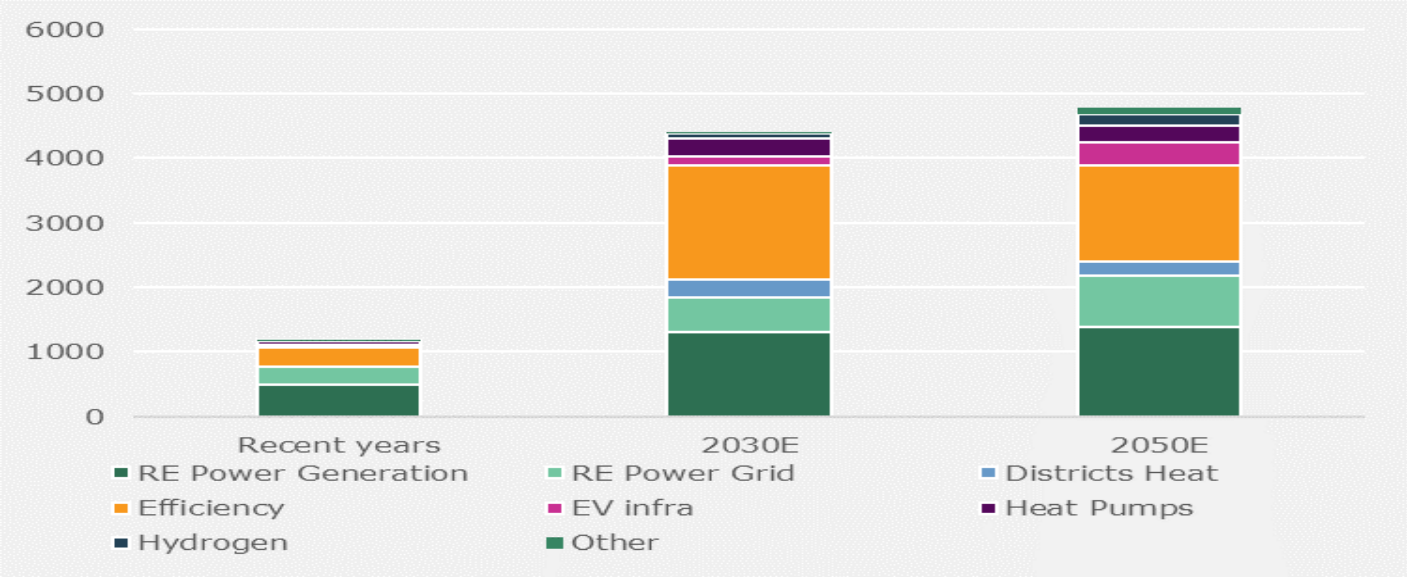
Graph 20: Historical CAPEX spending on Energy versus needed annual investment until 2050



Source: IEA World Energy Investment 2022, IEA WEO 2022; Please note: In USD (2021)

The next graph gives a breakdown of the historical and necessary future CAPEX spending on green energy. Figures do not exactly match with the graph shown above as different sources (IEA versus IRENA) are being used. However, the forecasted trend is similar. According to IRENA's World Energy Transitions Outlook 2023 investments in renewable power generation has to jump from nearly USD 0.5 trillion in recent years to USD 1.3-1.4 trillion per annum until the year 2050. In recent years these investments consisted out of solar power (USD 260bn per annum), onshore wind (USD 140bn per annum), offshore wind (USD 35bn per year), and other (USD 20bn per year) such as hydro, bio-energy, marine, geothermal, etc. The largest increase is forecasted for investments to improve energy efficiency. The challenge is big as in IEA's NZE scenario the global use of energy should decrease in the coming decades, whereas the global population will grow by an estimated 25% and the world economy will expand significantly more. Another important category are the investments in power grid to make the energy transition possible. Also in the Netherlands the current grid is not enough to make the energy transition possible, i.e. the onshore grid has to be expanded as well as the offshore network.

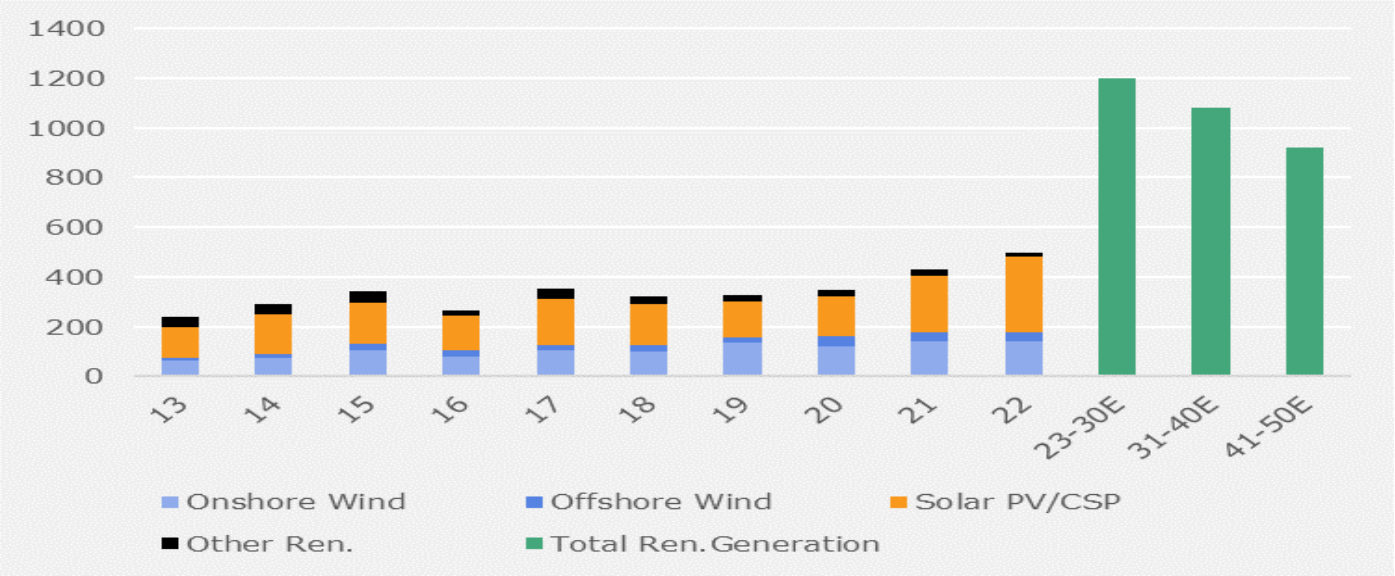
Graph 21: Breakdown historical and future CAPEX spending on clean energy until 2050 (USD bn)



Source: IRENA World Energy Transitions Outlook 2023

To give some extra flavor to the above-mentioned figures, global investments in Renewable Generation more than doubled to around USD 0.5 trillion in 2022, of which solar PV & CSP accounted for 62%, onshore wind for 28%, and offshore wind for 7% (see graph below). If the world wants to achieve net zero emissions by 2050, investments in renewable capacity generation should more than double again to USD 1.2 trillion on average per year in the period 2023-2030 (source: BNEF). Although renewable capacity installations will remain high after the year 2030, cost reductions should lead to somewhat lower CAPEX spending per annum until the year 2050 compared to the annual average between 2023-2030.

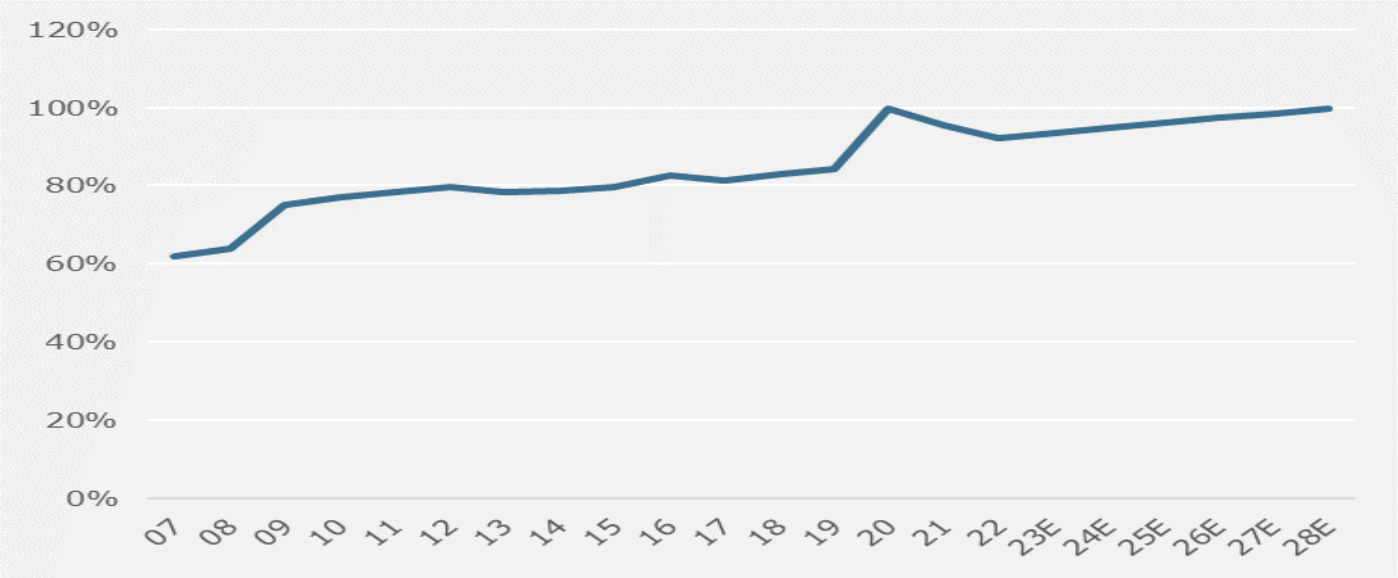
Graph 22: Historical versus needed future CAPEX spending on Renewable generation (USD bn/year)



Source: IRENA Renewable Finance, BNEF

As shown above necessary CAPEX spending has to be raised strongly. These investments can be done by the public and/or private sectors. Unfortunately, worldwide governments have suffered from the financial crisis (2008/09) and the COVID-19 pandemic, leading to a deterioration of country's financial situation. Using IMF data, combined interest-bearing debt of all countries expressed as a percentage of the global economy stood at 62% in the year 2007. This percentage deteriorated to 100% in the COVID-19 year 2020. As a consequence, governments financial room to finance the energy transition has decreased. In addition, the financial room to give subsidies to stimulate the energy transition has declined as well. Furthermore, the deteriorated finances of governments raises the chances of rising interest rates as investors' confidence is going down. All told, I believe that this deteriorated financial situation of governments could lead to a delay of the energy transition!

Graph 23: Financial situation governments has deteriorated significantly in recent years (2007-2028E)



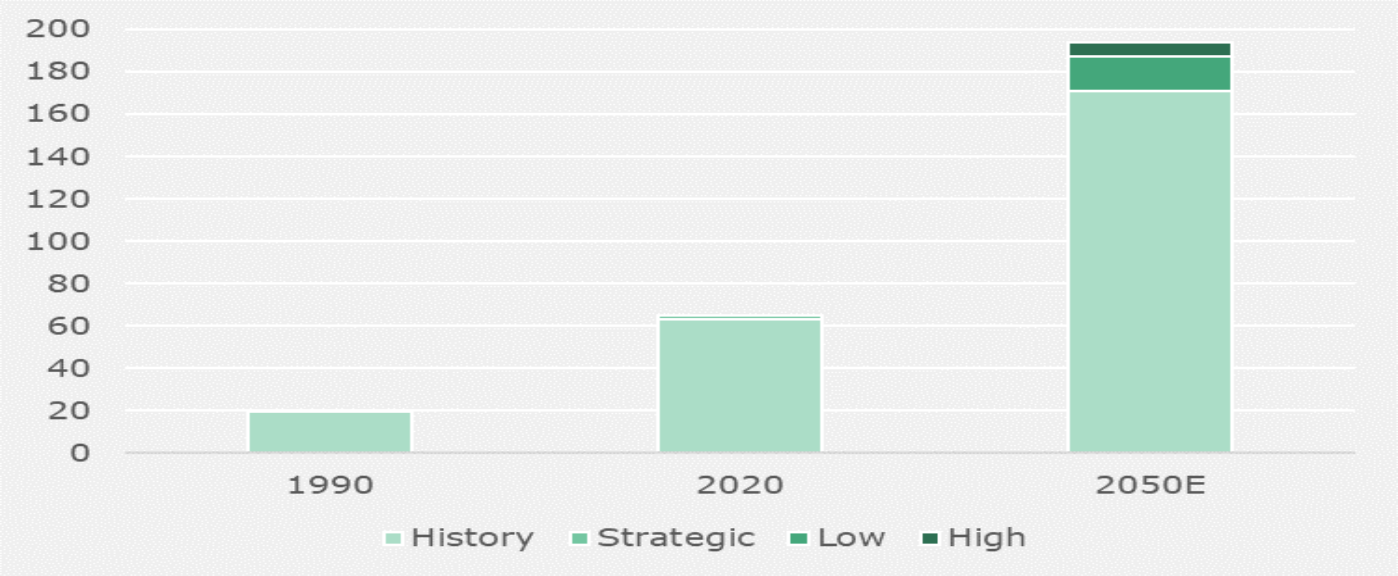
Source: IMF Fiscal Monitor April 2023

Even with sufficient financing, are necessary metals available until 2050?

A lot of metals are needed to realise the energy transition. Recently the European Commission published a report *'Supply chain analyis and material demand forecast in strategic technologies and sectors'*, whereby it predicted demand growth for certain critical metals for the year 2030 and 2050 using a High and Low scenario. The European Commission gave a forecast for materials like aluminium, copper, nickel, lithium, cobalt, silicon, platinum, graphite, and several rare earth metals (REE). These materials are being used in batteries, fuel cells, electrolysers, wind turbines, solar PV, heat pumps, hydrogen applications, data centres, smart phones/tablets/desktops, satellites, etc. At this paragraph I will give the historical global consumption of several of these metals as well as the demand forecast for 2050, both for a high and low growth scenario. In addition, I will look at the major producing countries, including their reserves of minerals. The availability of these minerals is critical to make the energy transition possible. Even if there are enough reserves available, often a huge amount of CAPEX has to be invested in the development of new or expansion of existing mines. Will those investments grow as fast as necessary to supply sufficient metals for the energy transition? Furthermore, it also determines the price of the energy transition. Scarcity of these minerals could push prices to levels, which could jeopardize the – necessary – speed of the global energy transition. Difficult is the possible impact of technological breakthroughs, such as for instance the replacement of cobalt in batteries by other minerals.

The global consumption of aluminium climbed from 19.3m tons in 1990 to 65m tons in 2020, whereby 58% was produced in China. Depending on a low or high growth scenario, total aluminium demand could jump to more than 193m tons in the year 2050 (see graph 22a below). Bauxite is the main raw material necessary to produce aluminium. The largest countries supplying bauxite are Australia (26%), China (24%), and Guinea (23%). Based on proven bauxite reserves, the global R/P (reserves/production) ratio stood at 81 years in 2022, i.e. assuming stable aluminium production current reserves are enough to produce aluminum for the coming 81 years. The R/P ratio was 134 years in 2010 and based on the estimated maximum demand in 2050, it drops to only 27 years.

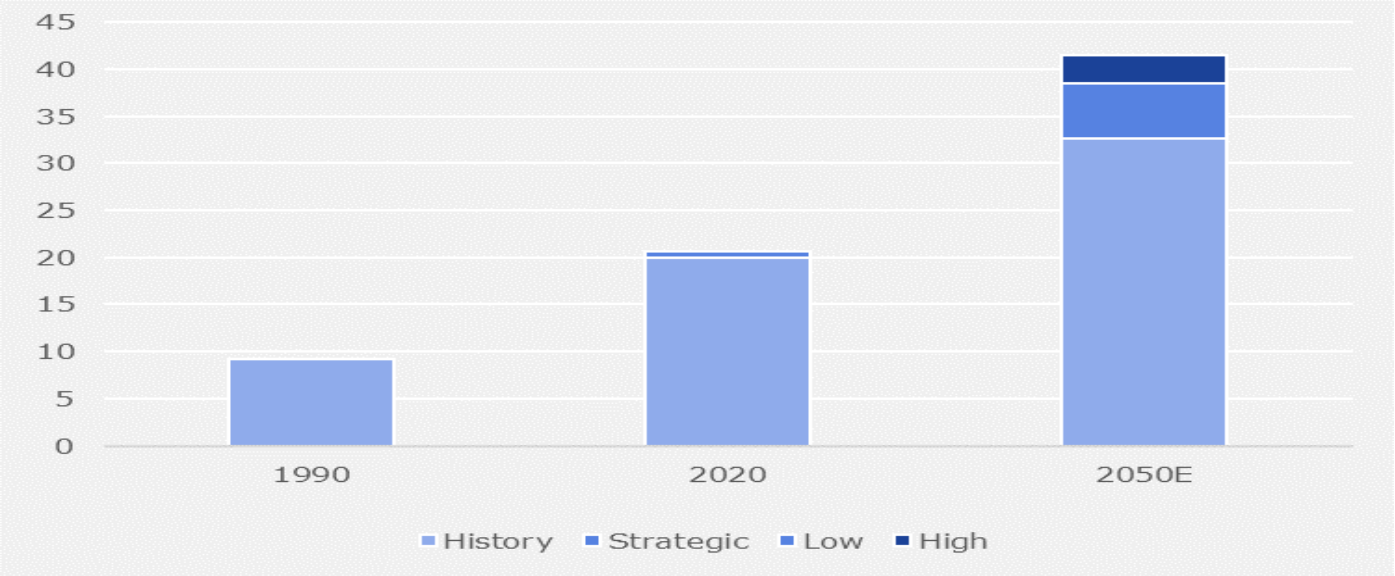
Graph 24a: Global demand for Aluminium (m tons)



Source: European Commission, USGS, R.Brakenhoff

The global consumption of copper rose from 9.6m tons in 1990 to 20.6m tons in 2020. Depending on a low or high growth scenario, total demand for copper could go up to more than 41m tons in the year 2050 (see graph 22b below). The largest countries supplying copper are Chili (24%), Peru (10%), and DR Congo (10%). Based on proven copper reserves, the global R/P ratio stood at 40 years in 2022, i.e. assuming stable copper production current reserves are enough to produce copper for the coming 40 years. The R/P ratio was also 40 years in 2010 and based on the estimated maximum demand in 2050, it drops to only 21 years.

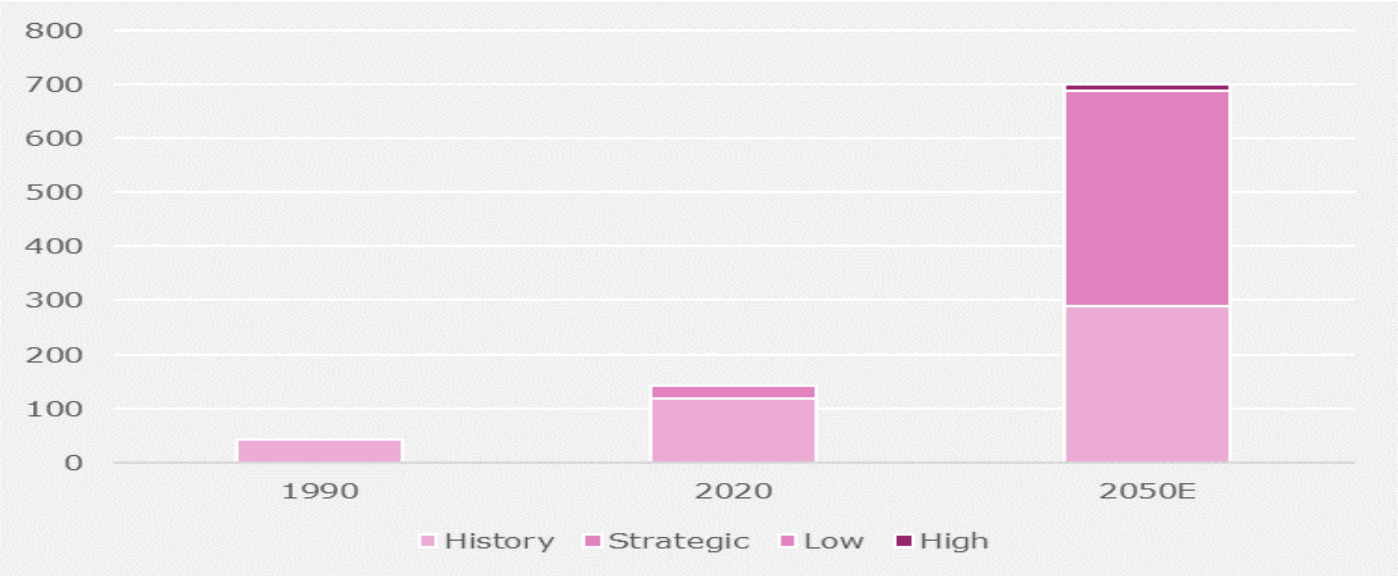
Graph 24b: Global demand for Copper (m tons)



Source: European Commission, USGS, R.Brakenhoff

The global demand for cobalt rose from 42,300 tons in 1990 to 142,000 tons in 2020. Depending on a low or high growth scenario, total demand for cobalt could jump to nearly 700,000 tons in the year 2050 (see graph 22c below). The largest countries supplying cobalt are DR Congo (68%), Indonesia (5%), and Russia (5%). Based on proven cobalt reserves, the global R/P ratio stood at 44 years in 2022, i.e. assuming stable cobalt production current reserves are enough to produce cobalt for the coming 44 years. The R/P ratio stood at 82 years in 2010 and based on the estimated maximum demand in 2050, it plummets to only 12 years.

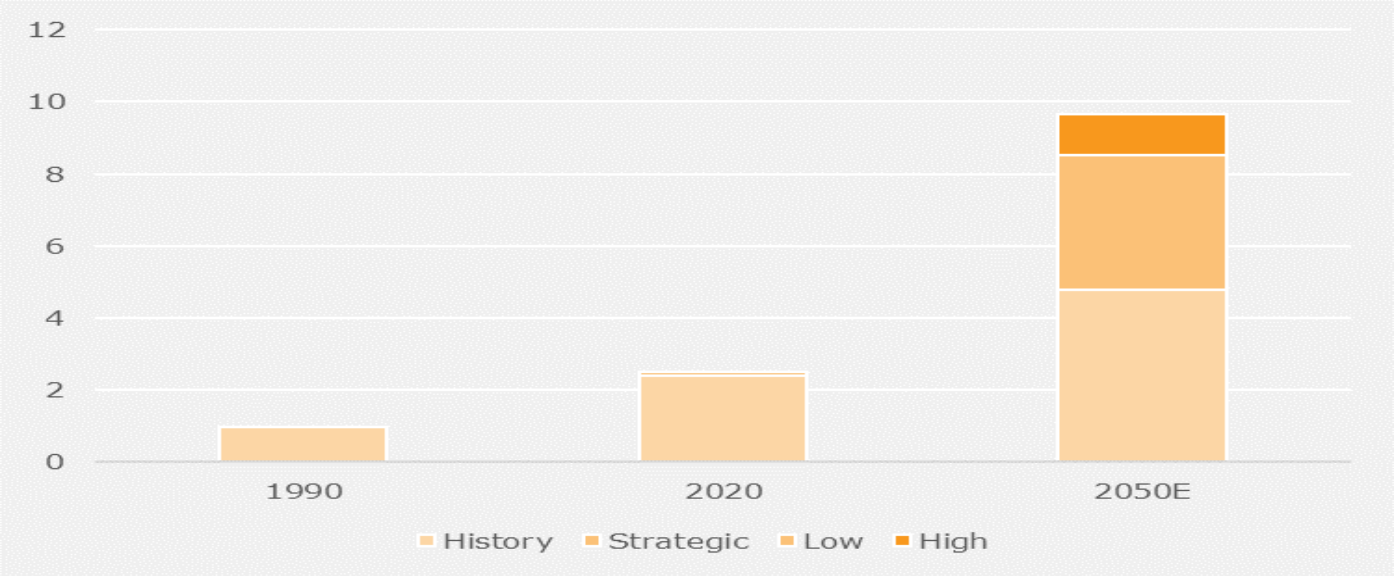
Graph 24c: Global demand for Cobalt (,000 tons)



Source: European Commission, USGS, R.Brakenhoff

The global consumption of nickel climbed from 1.0m tons in 1990 to 2.5m tons in 2020. Depending on a low or high growth scenario, total consumption of nickel could jump to 8.5m up to 9.7m tons in the year 2050 (see graph 22d below). The largest countries supplying nickel are Indonesia (48%), Philippines (10%), and Russia (7%). Based on proven nickel reserves, the global R/P ratio stood at 30 years in 2022, i.e. assuming stable nickel production current reserves are enough to produce copper for the coming 30 years. The R/P ratio was 48 years in 2010 and based on the estimated maximum demand in 2050, it fells to only 10 years.

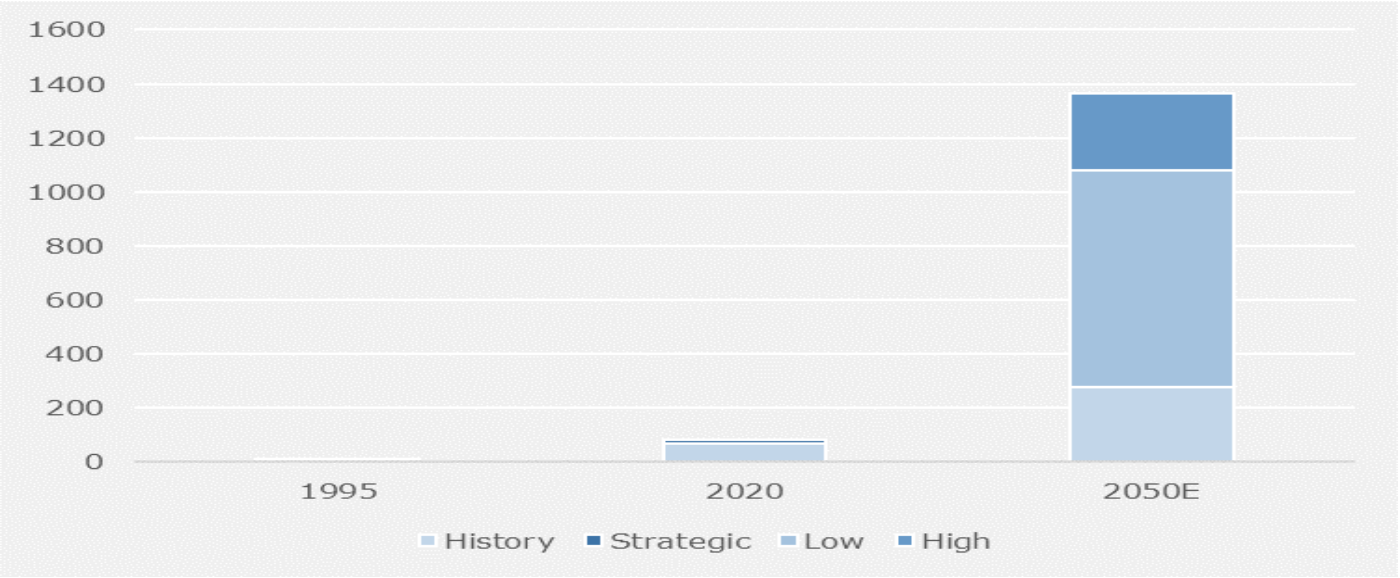
Graph 24d: Global demand for Nickel (m tons)



Source: European Commission, USGS, R.Brakenhoff

The global demand of lithium jumped from 9,500 tons in 1995 to 82,500 tons in 2020. Depending on a low or high growth scenario, total consumption of lithium could go up to 1.1m-1.4m tons in the year 2050 (see graph 22e below). The largest countries producing lithium are Australia (47%), Chili (30%), and China (15%). Based on proven lithium reserves, the global R/P ratio stood at 200 years in 2022, i.e. assuming stable lithium production current reserves are enough to produce lithium for the coming 200 years. The R/P ratio was 461 years in 2010. Because of the forecasted spectacular growth in demand in the coming decades, the R/P ratio drops to only 19 years.

Graph 24e: Global demand for Lithium (,000 tons)

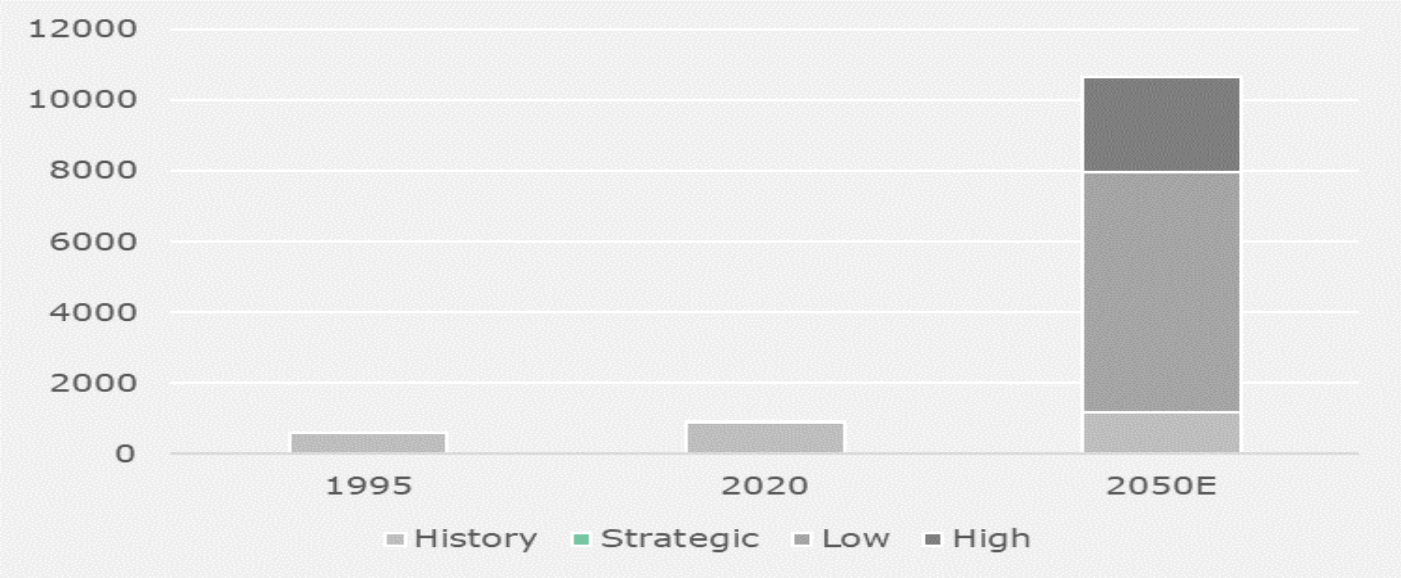


Source: European Commission, USGS, R.Brakenhoff

The global consumption of graphite increased from 587m tons in 1995 to 892m tons in 2020. Depending on a low or high growth scenario, total consumption of graphite could climb to 8,000m-10,700m tons in the year 2050 (see graph 22f below). The largest countries supplying graphite are China (65%), Mozambique (13%), and Madagascar (9%). Based on proven graphite reserves, the global R/P ratio stood at 254 years in 2022, i.e. assuming stable graphite production current reserves are enough to produce graphite for the coming 254 years. The latter means a strong

improvement compared to the R/P ratio of 72 years in 2010. However, based on the maximum demand forecasted in the year 2050, the R/P ratio deteriorates to 31 years.

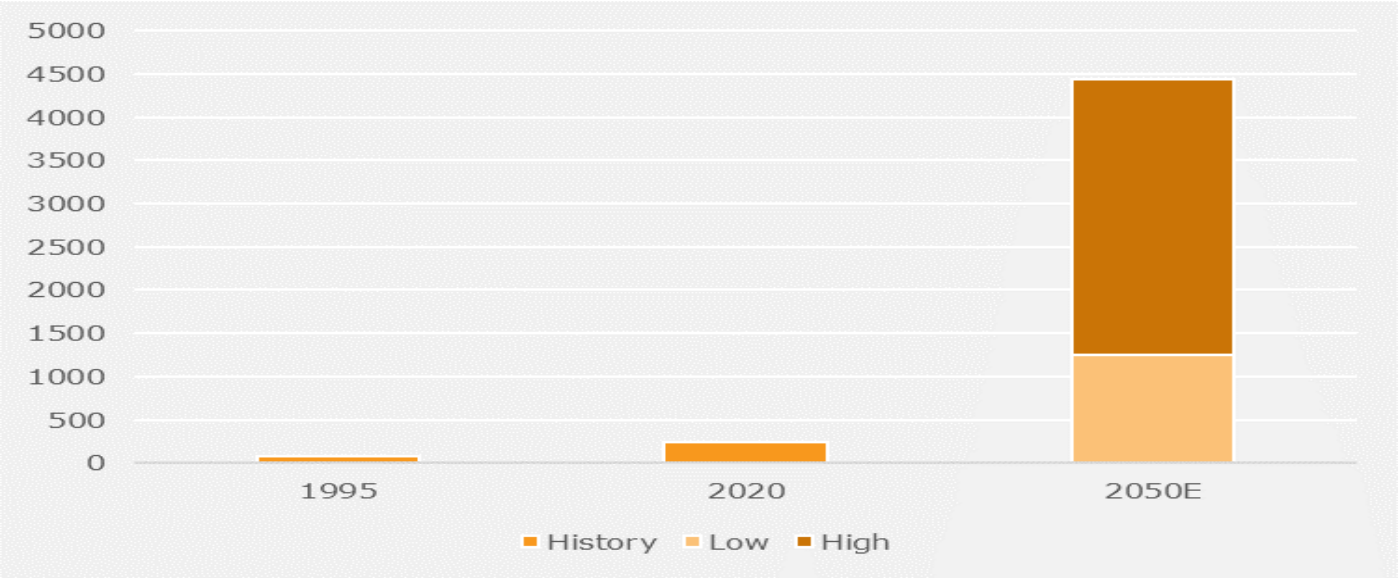
Graph 24f: Global demand for Graphite (m tons)



Source: European Commission, USGS, R.Brakenhoff

Finally, rare earth elements (REE) will play a critical role in the energy transition. REE consists of a group of 17 elements, such as praseodymium, neodymium, terbium, and dysprosium. Global demand for REE climbed from 77,700 tons in 1995 to 240,000 tons in 2020. Depending on a low or high growth scenario, total consumption of REE could rise to 1.2m-4.5m tons in the year 2050 (see graph 22g below), which bandwith indicates huge uncertainty. The largest countries supplying REE are China (70%), USA (14%), and Australia (6%). Based on proven REE reserves, the global R/P ratio stood at 433 years in 2022, i.e. assuming stable REE production current reserves are enough to produce REE for the coming 433 years. In the year 2010 the R/P ratio stood at 1134 years. However, based on the maximum demand forecasted in the year 2050, the R/P ratio declines to 29 years.

Graph 24g: Global demand for Rare Earth Elements (,000 tons)

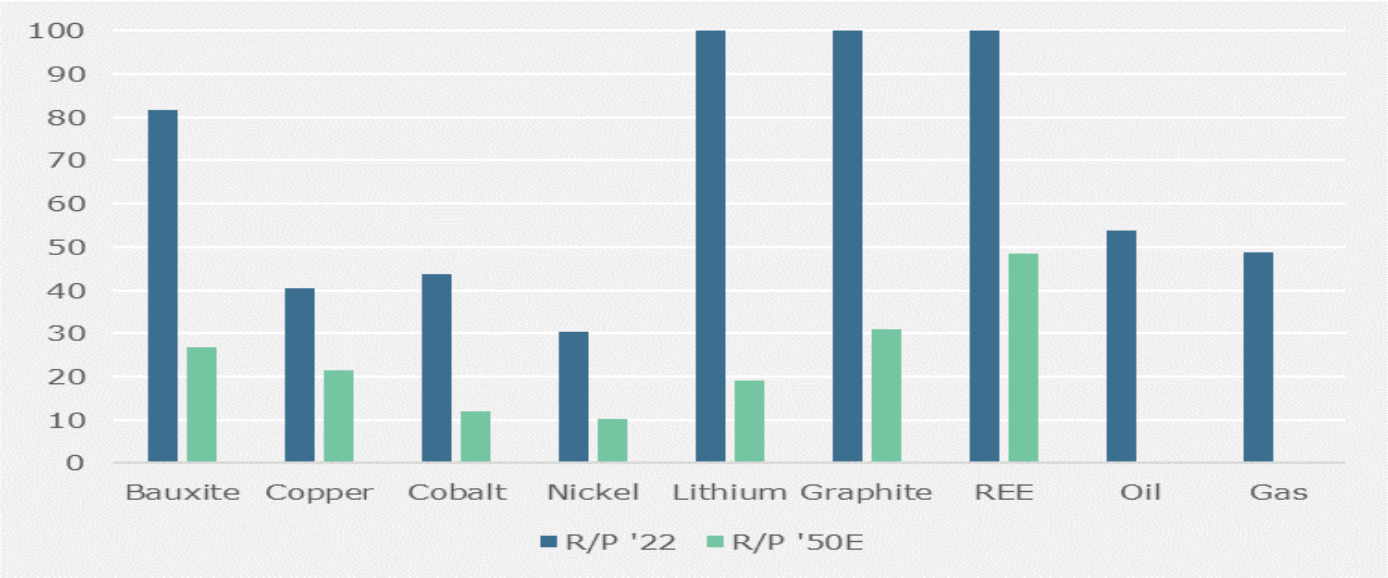


Source: European Commission, USGS, R.Brakenhoff

Availability critical metals until 2050 seems more than sufficient …

The graph below summarizes the R/P ratios of several critical metals in 2022 and in 2050 using the scenario of high demand growth. In addition, I compared these ratios with the R/P ratio of oil and gas. This graph gives a rather positive outlook, albeit R/P ratios of nickel and cobalt are low. However, on the one hand these R/P ratios are based on proven reserves. The USGS believes that proven and likely global reserves of cobalt and nickel are three times higher than only the proven reserves. If those likely or 'unproven' reserves are really developed, the R/P ratios will be much higher. On the other hand, these R/P ratios do not provide concentration risks, i.e. does the world really has access to those resources? I will discuss that below.

Graph 25: R/P Ratio metals versus oil and gas in 2022 and 2050E (years)



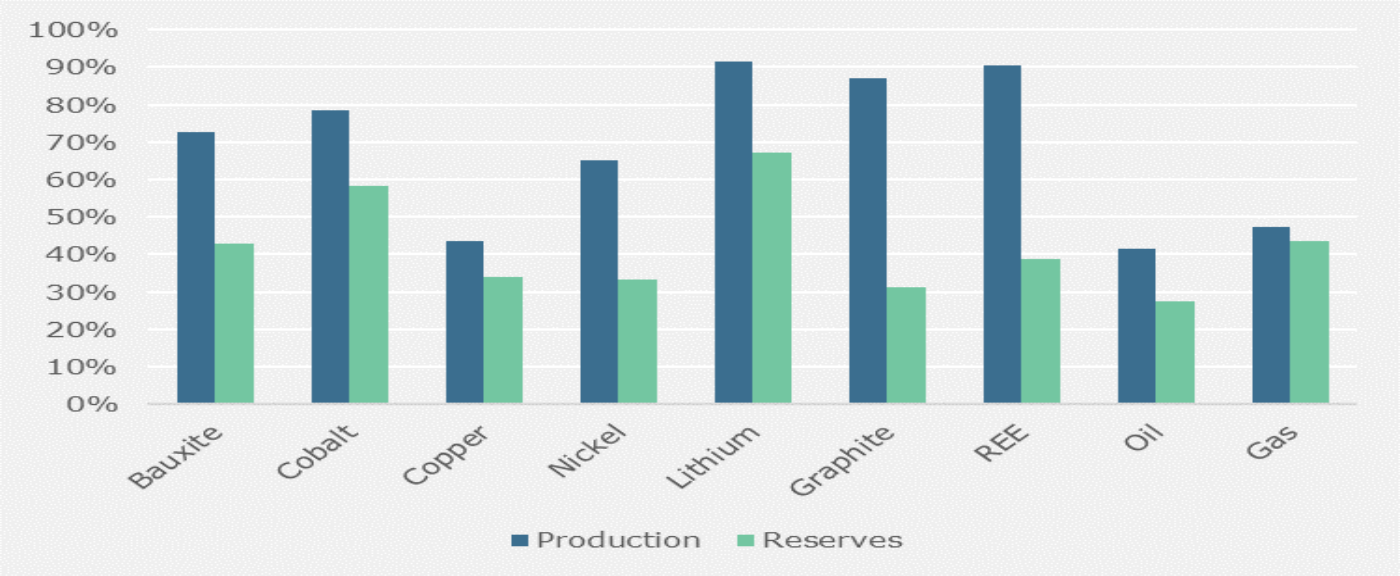
Source: European Commission, USGS, BP Statistical Data 2022, R.Brakenhoff

Please note: R/P ratio Oil and Gas based on 2021 reserve data; R/P ratio Lithium, Graphite, and REE exceeded 100 years in 2022

… But certain countries strongly dominate supply of critical metals …

The graph below shows the combined market share of the top 3 countries supplying critical metals in 2022. For comparison reasons, I also expressed the market share of the top 3 countries at oil and gas. Whereas the previous graph above gave some confidence in realising the energy transition, the graph below is much more worrying. Particularly the markets of lithium, REE, graphite, cobalt, bauxite, and nickel are dominated by the three largest producing countries. In case of the forecasted high demand growth in the coming decades, this could lead to sky-rocketing prices, but also to the possibility that certain countries will keep these metals only for their own consumption instead of exports. Regarding the oil market, the top three producing countries (USA, Russia, Saudi Arabia) do have a combined market share of more than 41%. However, looking at the OPEC+ countries only, their combined market share is 52%!

Graph 26: Global market share top 3 countries at production and reserves metals and oil & gas

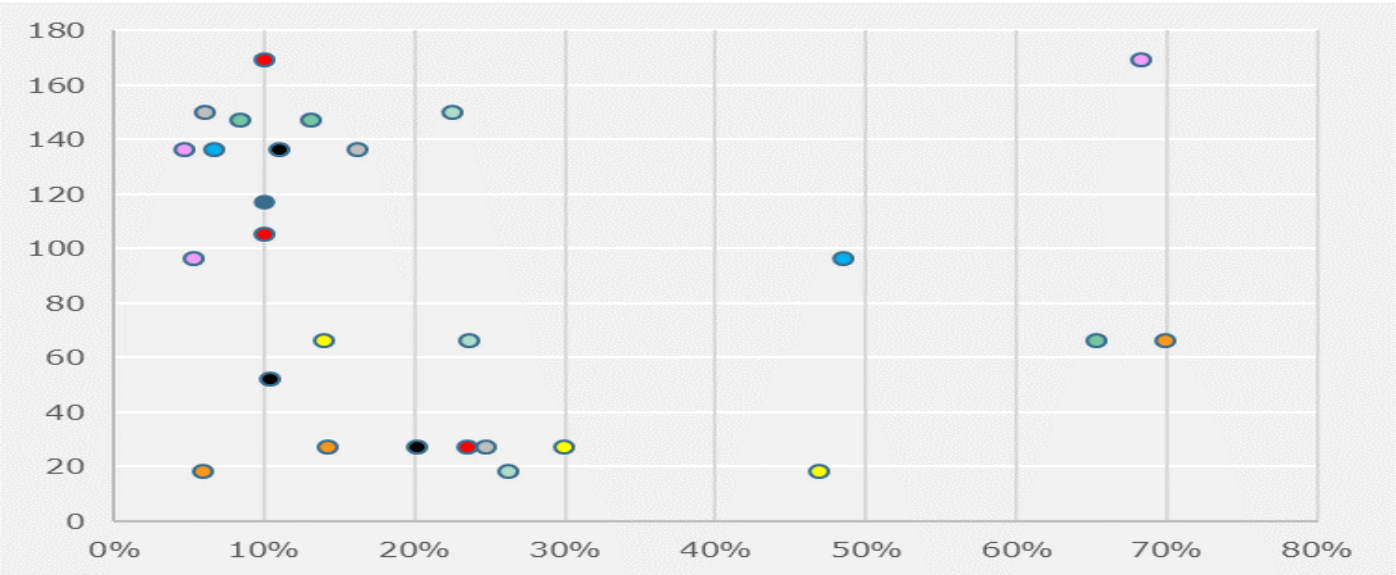


Source: USGS, BP Statistical Data 2022, IEA, R.Brakenhoff Please note: Oil and gas reserves based on 2021 data

… And score very high (negative) at the Corruption Perceptions Index

Unfortunately, the above-described picture is even worse looking at the Corruption Perceptions Index (CPI). Transparancy International ranks 180 countries globally, whereby 180 indicates most and 1 least corrupt. The graph below shows the three largest critical metals producing countries and their CPI ranking. I also did the same for the largest oil & gas producing countries. The graph clearly shows that a lot of countries producing critical metals ranks extremely bad at the CPI index, i.e. against what kind of 'concessions' can the world obtain the necessary metals in the coming decades? Of course, this graph is a snapshot of the global situation in the year 2021. Unfortunately, the CPI index does not show any improvement in recent years. If new discoveries are made in countries with a better CPI ranking the situation could improve. Although certain oil & gas producing countries score low at the CPI ranking, the switch from fossil fuels to green energy does not mean that the world becomes dependent on less corrupt countries!

Graph 27: Top 3 metals and oil & gas producing countries versus Corruption Perceptions Index

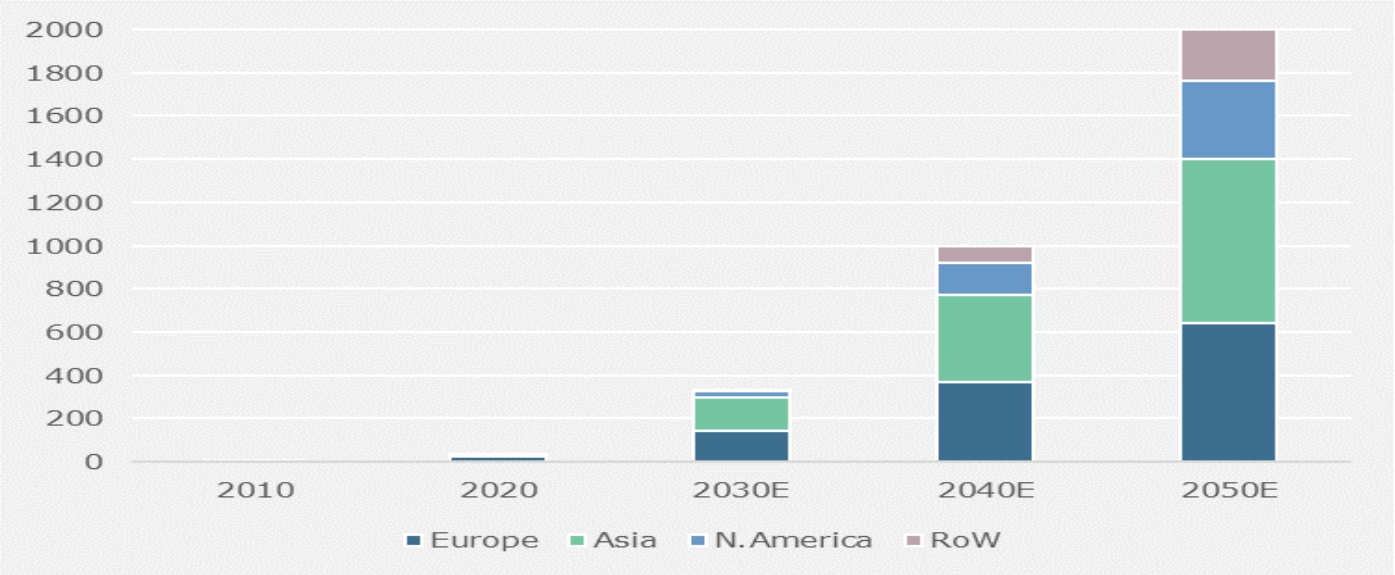


Source: Transparancy International, USGS, BP Statistical Data 2022, IEA, R.Brakenhoff Please note: X-Axis is market share; Y-Axis is ranking according to the CPI index (1 = least corrupt country; 180 = highest corrupt country). Dots: bauxite = light green; cobalt = purple; copper = red; nickel = blue; graphite = green; lithium = yellow; REE = orange; oil = black; gas = grey

Global offshore wind capacity should be 2000GW in 2050 to meet NZE scenario

According to IRENA and GWEC total installed offshore wind capacity should be 2,000GW in 2050 to meet the NZE scenario. Whereas total offshore wind capacity rose from 3GW in 2010 to 36GW in 2020 and 64GW in 2022, it must jump to 330GW in 2030 and 2,000GW in 2050. DNV estimates that around 15% or 300GW of total offshore wind capacity could consist of floating wind turbines. The graph below gives a possible breakdown. Most likely Asia will account for a larger part than shown at the graph, whereas North America will likely be smaller. This is the absolute amount, but in fact the challenge is even larger as in the meantime 'old' (25 years) wind mills have to be replaced as well. In other words, in the year 2050 all commissioned offshore wind parks worldwide today have likely to be decommissioned and replaced by new ones!

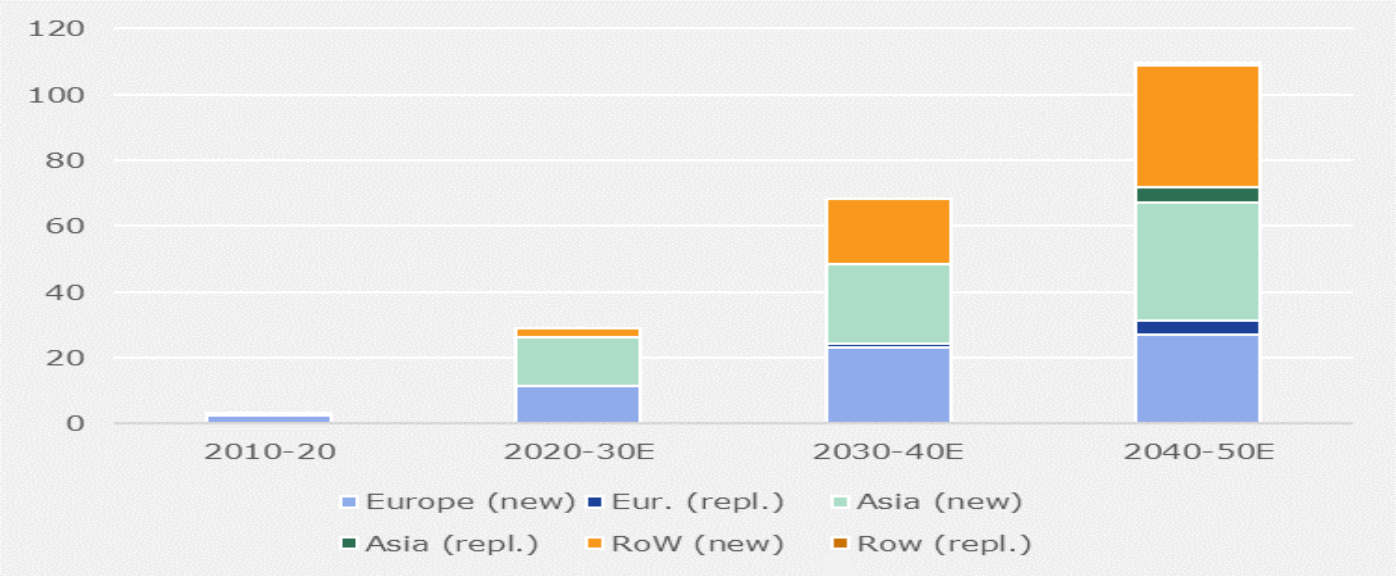
Graph 28: Growth offshore wind capacity worldwide between 2010 and 2050 (GW)



Source: IRENA, GWEC, R.Brakenhoff Please note: RoW = Rest of the World

Whereas on average around 3GW of new offshore wind capacity was installed worldwide between 2010 and 2020, it should jump to nearly 30GW in this decade, jumping to more than 60GW between 2030 and 2040 and even more than 100GW per year between 2040 and 2050. The graph also shows that between 2040 and 2050 'old' equipment has to be replaced by new wind farms, particularly in Europe and China.

Graph 29: Annual offshore wind installations necessary to meet NZE in 2050 (GW)

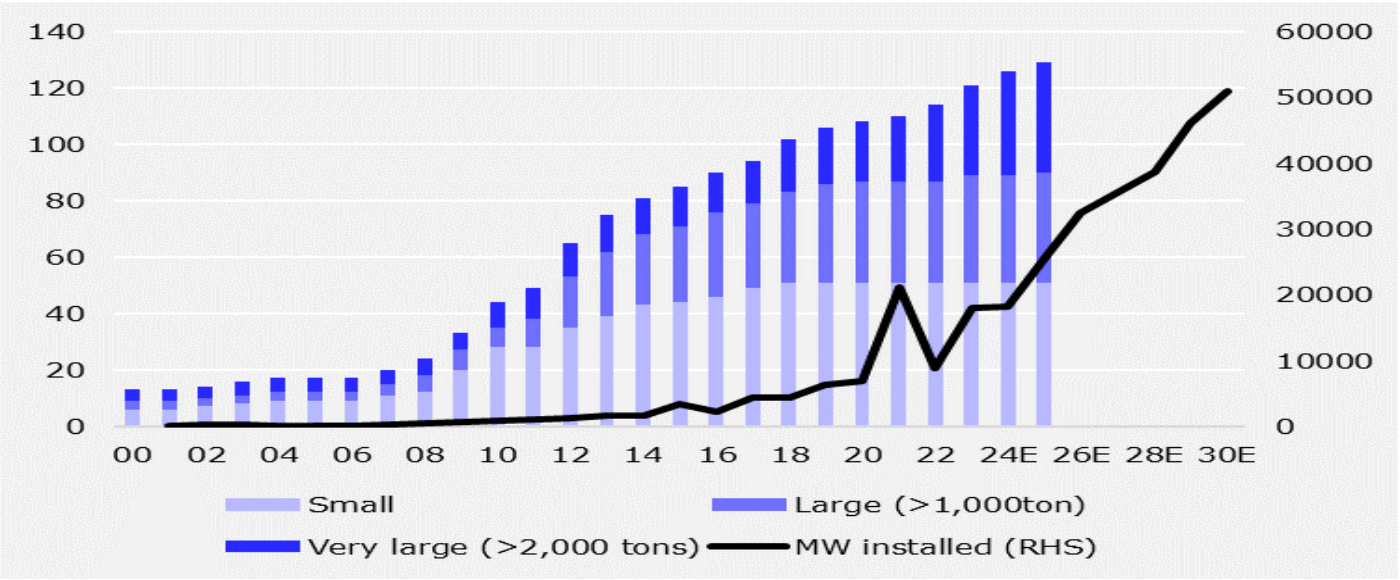


Source: IRENA, GWEC, R.Brakenhoff

Number of installation vessels could already become a bottleneck as of 2026

The graph below illustrates the growth in the number of installation vessels. It jumped from less than 20 vessels to more than 110 vessels in 2022. I distinguish vessels with crane capacity of <1,000 tons, vessels with cranes up to 2,000 tons, and ships with cranes that can lift more than 2,000 tons. Particularly the last group is important as offshore wind mills are becoming larger and larger. Therefore also the monopiles are getting heavier and heavier. In the coming years a number of new vessels will enter service, such as Van Oord's Boreas or the first Jones Act compliant vessel Charybdis from Dominion Energy. However, the graph clearly shows that the growth in the number of vessels is clearly unsufficient in comparison with the amount of MWs that have to be installed. Of course, the number of wind mills is not growing as fast as the line as the size of the wind mills will continue to increase. In addition, efficiency of new vessels will improve as well. However, I believe there is still a gap as of 2026!

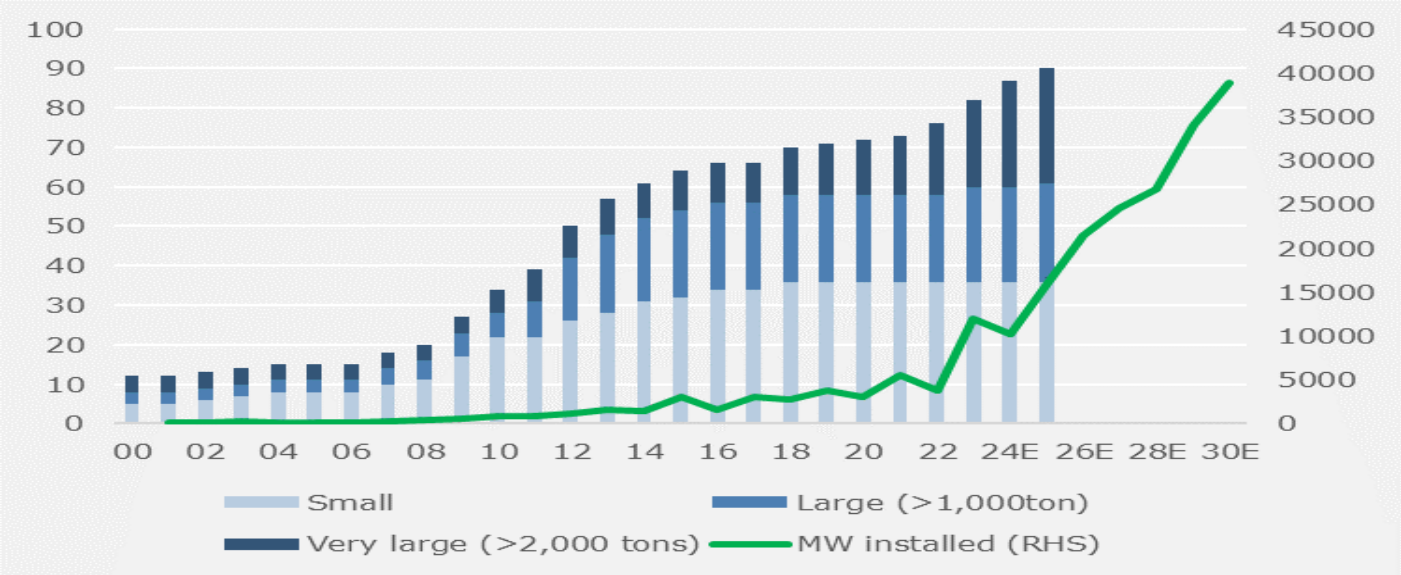
Graph 30: Number of installation vessels versus annual installation of offshore wind (MW)



Source: 4COffshore, GWEC, R.Brakenhoff

In my view, to illustrate the above shown picture in more details, I have excluded China. The Chinese offshore wind market is a Chinese 'party'. In addition, I believe that Western governments are not really eager to see Chinese installation vessels being active in their waters to install wind mills. The graph below shows the number of non-Chinese installation vessels versus the amount of installed offshore wind capacity excluding China. Again, I believe there will be a huge gap between available and needed vessel capacity as of 2026. In addition, the installation market will develop more geographically, i.e. it was mainly a European market, but in the coming years installation vessels will be needed in Europe, North America, and Asia (Taiwan, Japan, South Korea, Vietnam, India, etc.). The key question will be if ship owners have enough (financial) appetite to invest in new vessels in coming years. I will discuss that below.

Graph 31: Number of vessels versus offshore wind capacity (MW) to be installed excluding China



Source: 4COffshore, GWEC, R.Brakenhoff

Huge differences in financial ratios offshore wind installation companies

There are huge differences in companies active at the offshore wind installation. The Big4 dredging companies (Boskalis, DEME, Jan De Nul, Van Oord) have entered this market using their dredging/offshore knowledge. Other companies did make the switch from oil & gas into the renewables market, such as Saipem and GMS, or entered as newcomers the market. At the table below I have given some of the companies, but not all as some do not release financial data (Jumbo Shipping, HMC) or are part of large (construction) conglomerates (Penta Ocean, Toa Corporation). EBITDA margins of the companies below differ strongly, partly due to other overall company activities, but also several faced financial disappointments at the offshore wind market. Examples were Saipem, Van Oord, and Jan De Nul. Some of the companies are currently investing in new installation vessels, whereas others – such as Boskalis – do find the balance between risks/rewards not acceptable. We have to bear in mind that the global offshore wind market is still a relatively young market, i.e. risks are not always easy to calculate! To sum up, I believe that the group companies mentioned will not invest enough in new vessels in this decade to close the gap as shown at the graph above.

Table 7: Financial ratios offshore wind installation companies (2022 data)

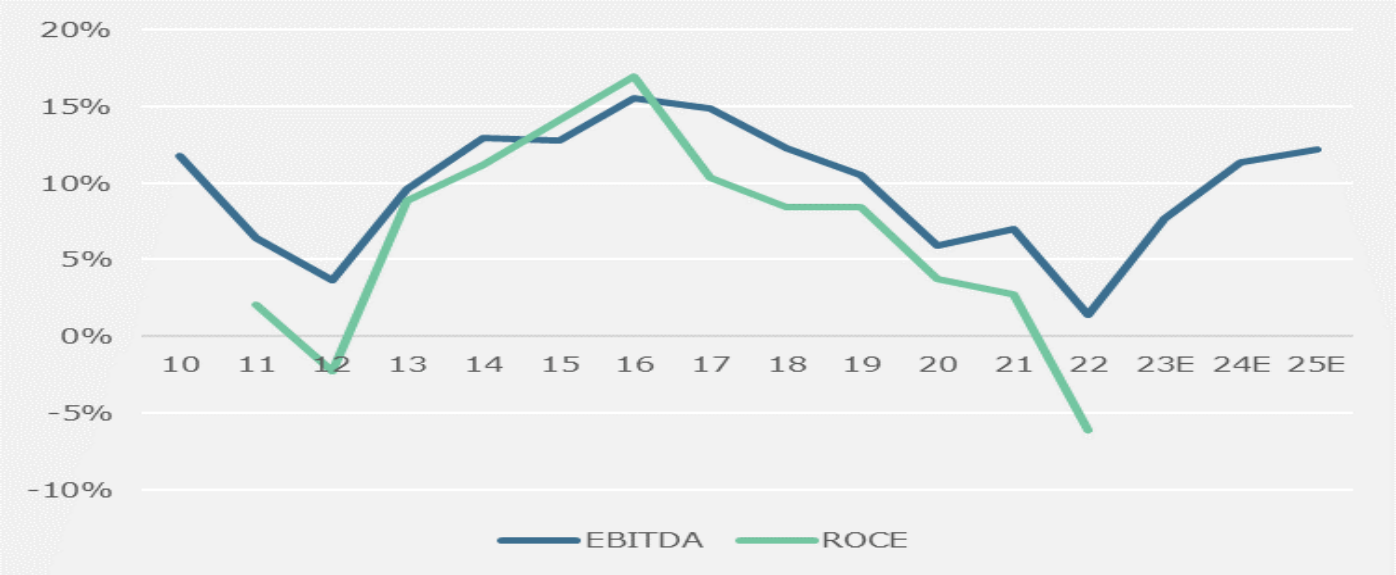
Company	EBITDA margin	ROCE	Net Debt/(Cash)
Boskalis	14.9%	+7.1%	EUR (237m)
Cadeler	60.1%	+8.0%	USD 96m
DEME	17.9%	+4.8%	EUR 521m
Eneti	42.5%	+7.3%	USD (63m)
GMS	53.7%	+6.2%	USD 319m
Jan De Nul *			
Saipem	6.0%	-0.1%	EUR 264m
Seaway 7	3.6%	-6.3%	USD 130m
Van Oord	12.0%	4.2%	EUR 178m

Source: Company Reports; Please note: * Jan De Nul are figures from 2021; ROCE = Return on Average Capital Employed

Can Wind Turbine Manufacturers keep up with the forecasted market growth?

In 2022 78GW of new onshore and offshore wind capacity was installed globally, which was less than the record level of 95GW in the year 2020. However, if the world wants to realise its climate goals, much more wind capacity should be installed per year in the coming decades. According to GWEC the amount of installed capacity should climb to 157GW in 2027. Currently the wind turbine manufacturers maximum capacity is only 163GW, i.e. they should raise their maximum capacity in the coming years. However, the financials of the turbine manfacturers has been disappointing in recent years. At the graph below, I have combined the figures of Vestas, SiemensGamesa, Nordex, and Goldwind. Although the group's combined sales climbed by a CAGR of 9.3% between 2010 and 2022, the EBITDA margin was hardly positive in 2022. The company's overall ROCE was even negative in 2022. The challenge for the manufacturers is to develop quickly bigger and bigger turbines, i.e. there is hardly time to earn back the investments made. For the period 2023-2025 Equity Analysts expect that the EBITDA margin should recover, assuming no more difficulties at newly developed turbines! Taking into account the disappointing financial performance of the turbine manufacturers, it is questionable how much financial room they will get from investors to increase their production capacity in the coming years.

Graph 32: Combined EBITDA margin and ROCE of wind turbine manufacturers (2010-2025E)

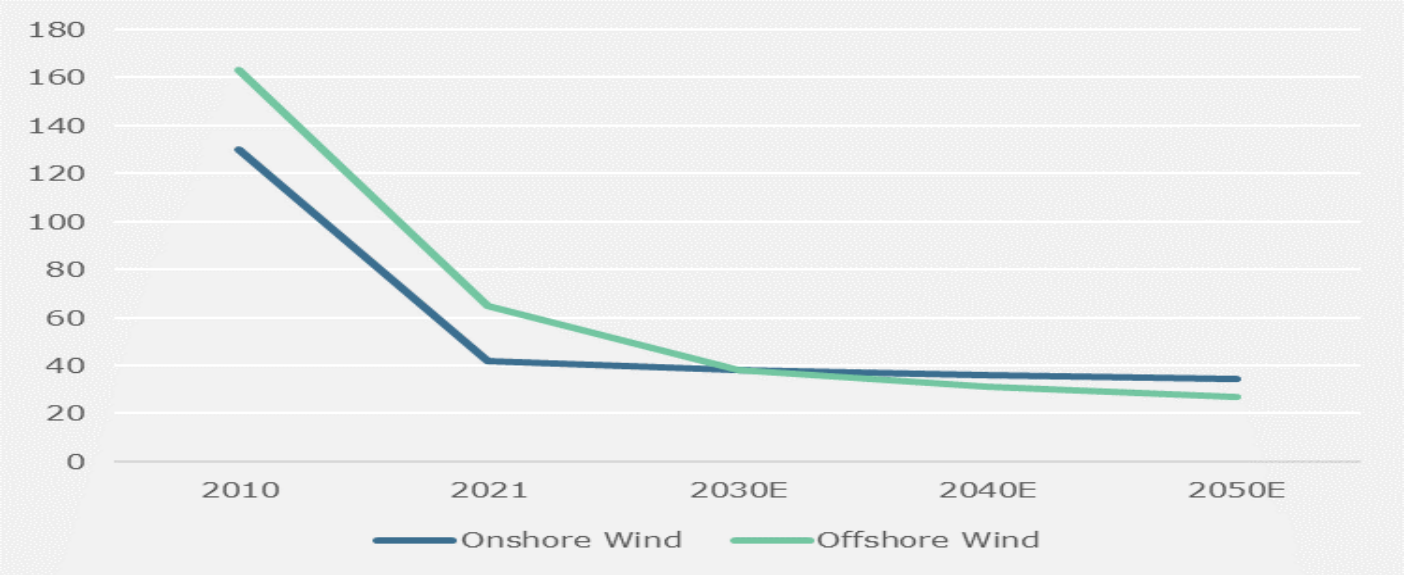


Source: Company reports, Marketscreener

LCOE of wind power in Europe has dropped strongly, but will this trend continue?

Thanks to economies of scale and a positive learning curve, the Levelised Cost of Electricity (LCOE) of wind power in Europe (and the rest of the world) has declined strongly. According to IRENA, the LCOE of onshore wind power in Euorpe plummeted by 68% between 2010 and 2021, whereas the drop amounted to 60% at offshore wind. Using IEA's NZE scenario, the LCOE of onshore and offshore wind power in Europe should decrease by another 18% and 58%, respectively, until 2050 compared to 2021 (see graph below). Taking into account the trends as described above in the previous paragraphs, I am afraid that these assumptions are too optimistic due to (i) higher inflation, (ii) scarcety of installation vessels and skilled staff, (iii) rising metal prices, (iv) declining governmental subsidies, and (v) investors becoming more demanding, i.e. asking for higher returns (pushing up cost of capital of projects).

Graph 33: Historical and expected Levelised Cost of Electricity in Europe (USD/MWh)

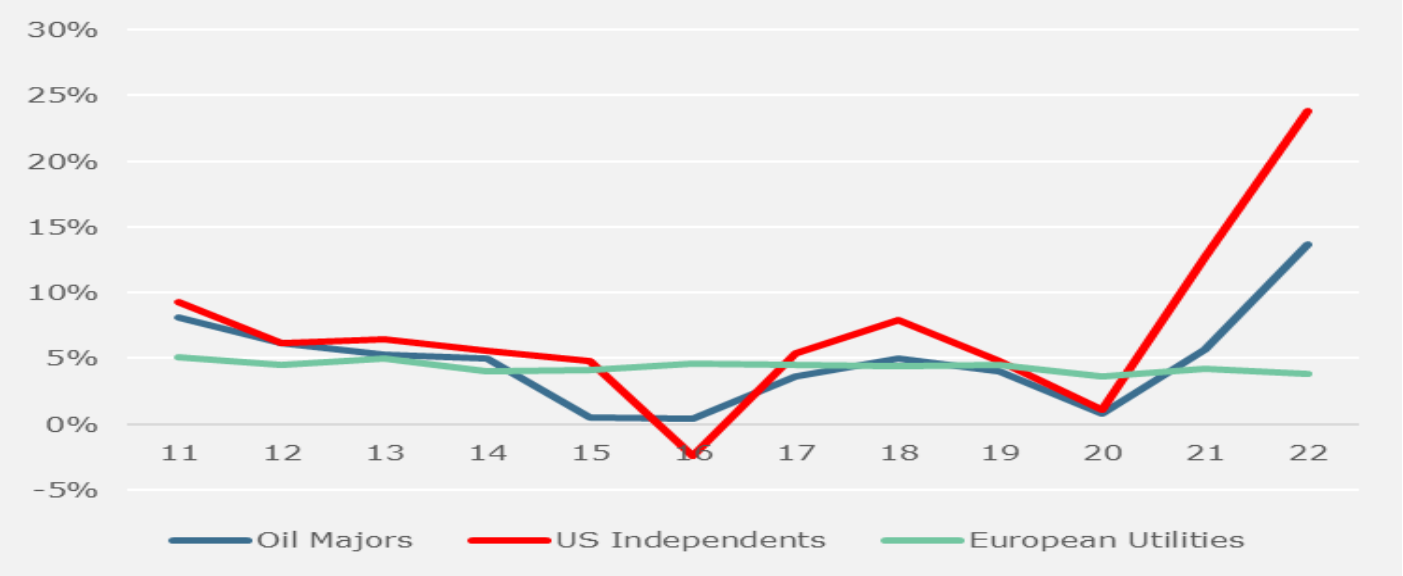


Source: IRENA Renewable Power Generation Costs 2021, IEA WEO 2022

ROCE Oil & Gas projects higher than Offshore Wind farms

Historically, companies realised more than double digit returns (Return on average capital employed) with their Upstream oil & gas activities. Because ROCE's on their Downstream activities were usually significantly lower, leading to an overall ROCE at the Oil Majors of 4.9% in the period 2011-2022 (see graph below). However, the US Independents realised higher returns, particularly as most of these companies are only active at Upstream. Finally, the European Utility companies realised – on average – a ROCE of 4.4%. However, these companies do have a mix of activities (nuclear, coal & gas power plants, renewable energy (wind and solar), whereby the renewable power's share of the company's total power generation is increasing. Taking into account those differences in returns, a lot of energy companies still would favor investments in oil & gas instead of renewable energy. To change this, governments should make investments in renewable energy more attractive by for instance lowering risks, keeping governmental policies stable for a long period, raising CO_2 prices, increasing taxes on fossil fuels and giving tax credits on renewable energy, etc. In addition, pressure from the public & investors should force fossil fuel companies to switch more quickly to renewables. Important for shareholders is that they will – temporary – achieve lower returns on their investments, but in the long run they will benefit from it.

Graph 34: Comparison ROCE Oil Majors, US Independents, and European Utility companies (2011-22)



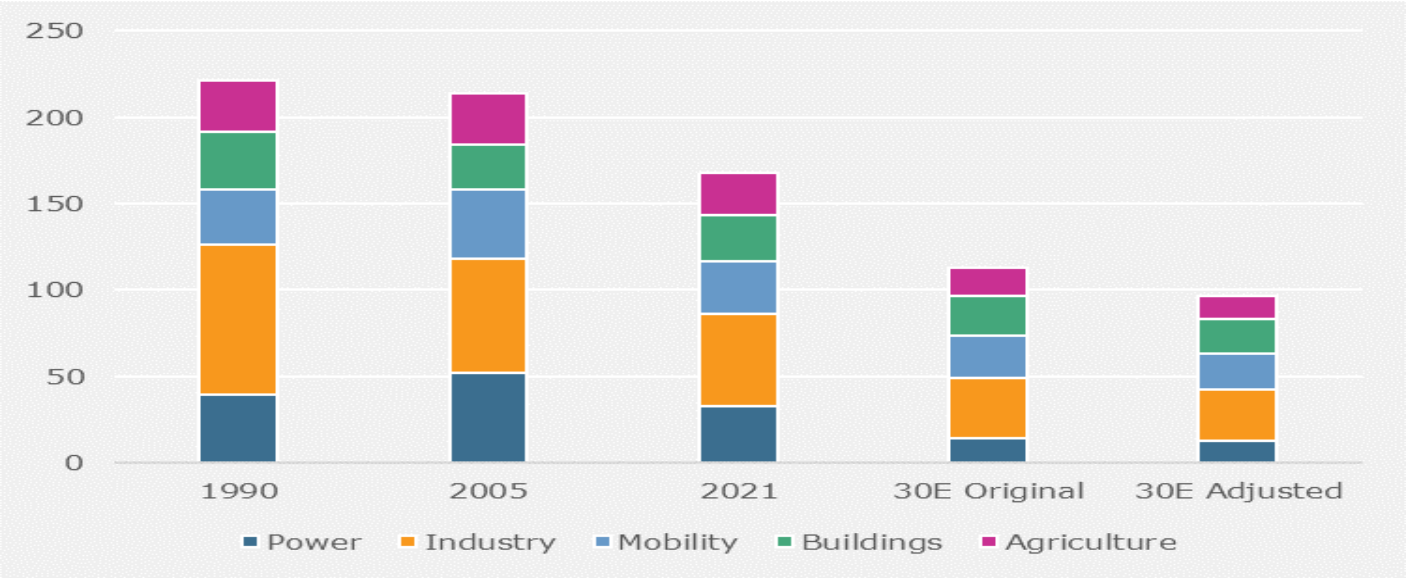
Source: Company reports, R.Brakenhoff

Additional GHG emission reduction measures in the Netherlands

Dutch government aiming for 60% GHG emission reduction in 2030

In 2021 total GHG emissions in the Netherlands amounted to 172m tons of CO_2 equivalent (see graph below). This means a 24% reduction compared to the year 1990 (227m tons). As such, this reduction is large as in the same period the Dutch population increased by 17% and the economy grew by 89%! However, EU's Fit for 55 program has set the reduction target for the EU at 55% compared to 1990. Originally, the Dutch government was aiming for total GHG emissions of 113m tons in 2030 (-50%). According to calculations made by the PBL already showed that taking into account all measures could lead to a reduction between 41-52% in 2030. To step up the reduction, recently the Dutch government announced an additional package of measures to lower emissions by 22m tons compared to the original plan (see graph). The graph does not take into account measures affecting all sectors, which should lead to additional GHG reductions and therefore arriving at the amount of 91m tons in 2030. Additional measures are for instance the construction of 3GW of solar power farms at sea. In addition, CO_2 pricing will be adjusted.

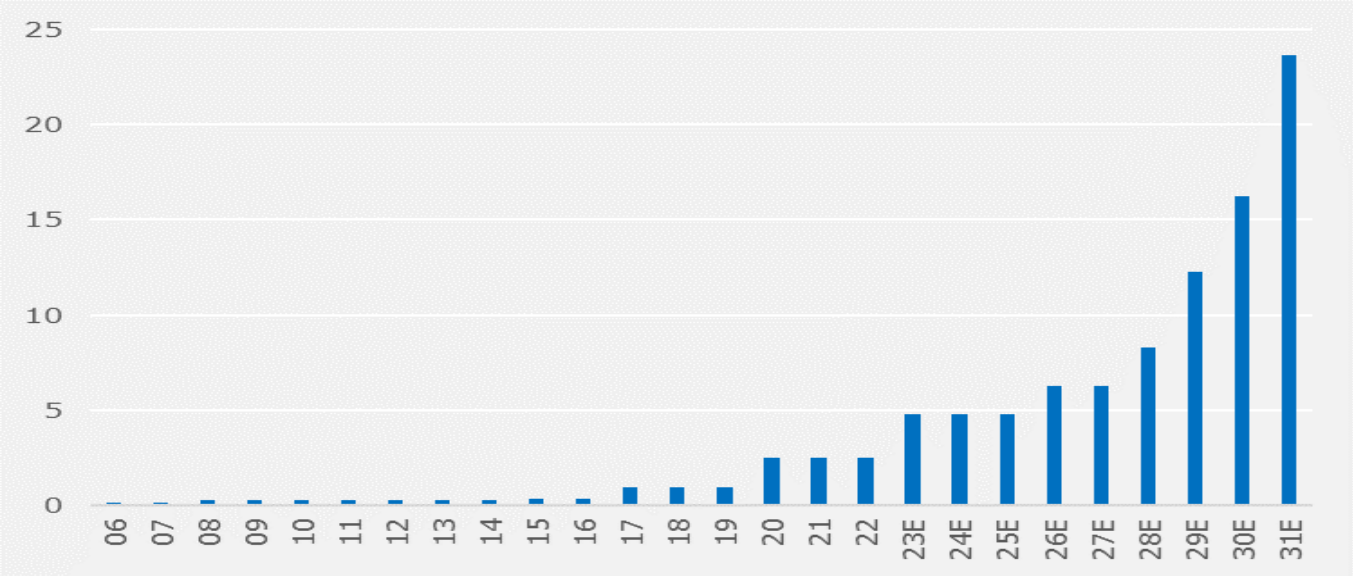
Graph 35: Dutch GHG emissions should drop 60% to 91 Mtons of CO_2 equivalent in 2030



Source: PBL, Ministerie van Economische Zaken en Klimaat

In 2022 the Dutch government raised its target of installed offshore wind capacity in 2030 from 11.5GW to 21GW. At the end of this year, around 4.7GW will be installed, i.e. a huge amount of capacity has to be installed in the coming years as shown at the graph below. The first new wind farms have been tendered and should be constructed by 2026, pushing up total capacity to 6.2GW. As a result, there is still a huge gap between actual and targeted capacity. In 2022 offshore wind accounted for 6.8% of total electricity generation in the Netherlands. Originally the Dutch government was aiming for 49TWh offshore wind generation in 2030, but 21GW should generate 97TWh. This means a huge contribution in the governments effort to make the power sector emission free by 2035. Total Dutch electricity demand is forecasted to be around 139TWh in 2030, i.e. offshore wind could account for 70%. Looking at my previous paragraphs, I believe that the risk is very high that the Dutch offshore wind target will not be met in 2030 due to lack of installation vessels, skilled staff, turbines, electricity infrastructure, financing, etc. As a result, the Dutch GHG emission reduction target of 60% in 2030 is in my opinion not really realistic as well.

Graph 36: Growth Dutch Offshore Wind capacity until 2031 (GW)

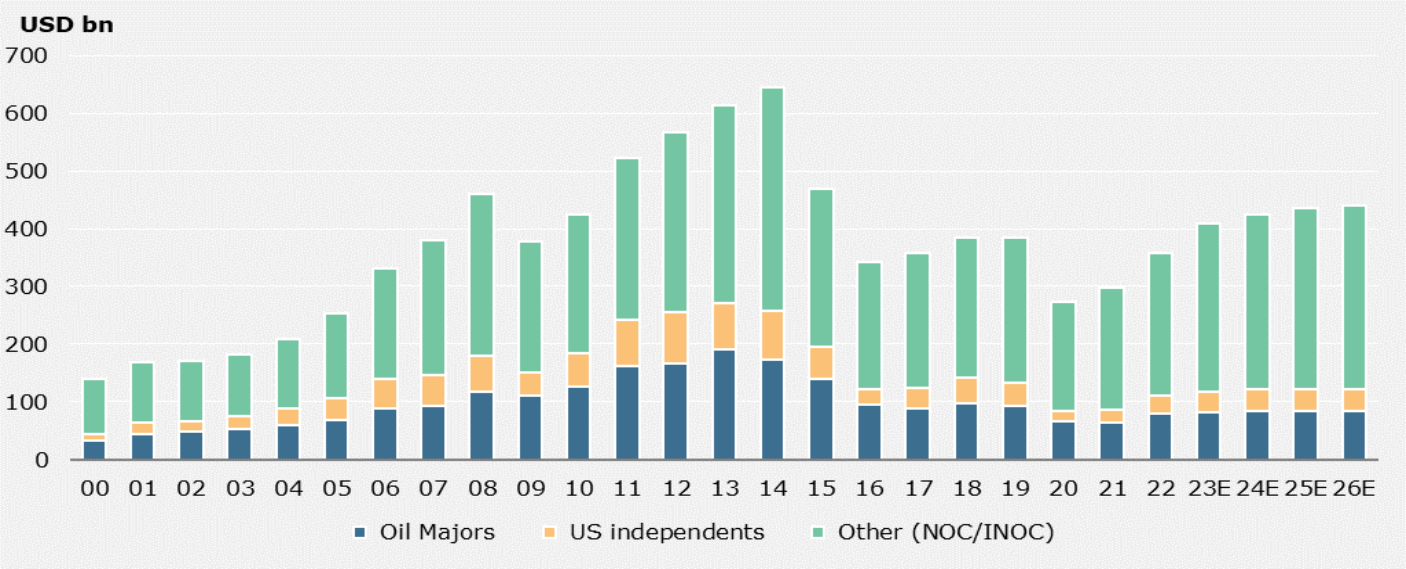


Source: RVO

Global Upstream E&P CAPEX expected to climb 12-14% in 2023

Regarding the outlook for 2023, global Upstream E&P CAPEX spending will likely to recover further by 12-14% compared to 2022. Partly due high inflation rates, the total amount to be invested in 2023 could be around 6% higher than the pre-COVID level seen in 2019. Combining the forecasted Upstream CAPEX budgets for the Oil Majors and US Independents for 2023, the Oil Majors will raise their spending by 3%, whereas the US Independents will step up their investments by 14%. Upstream E&P CAPEX spending in my view will continue to increase in the coming years, albeit the increase will be small.

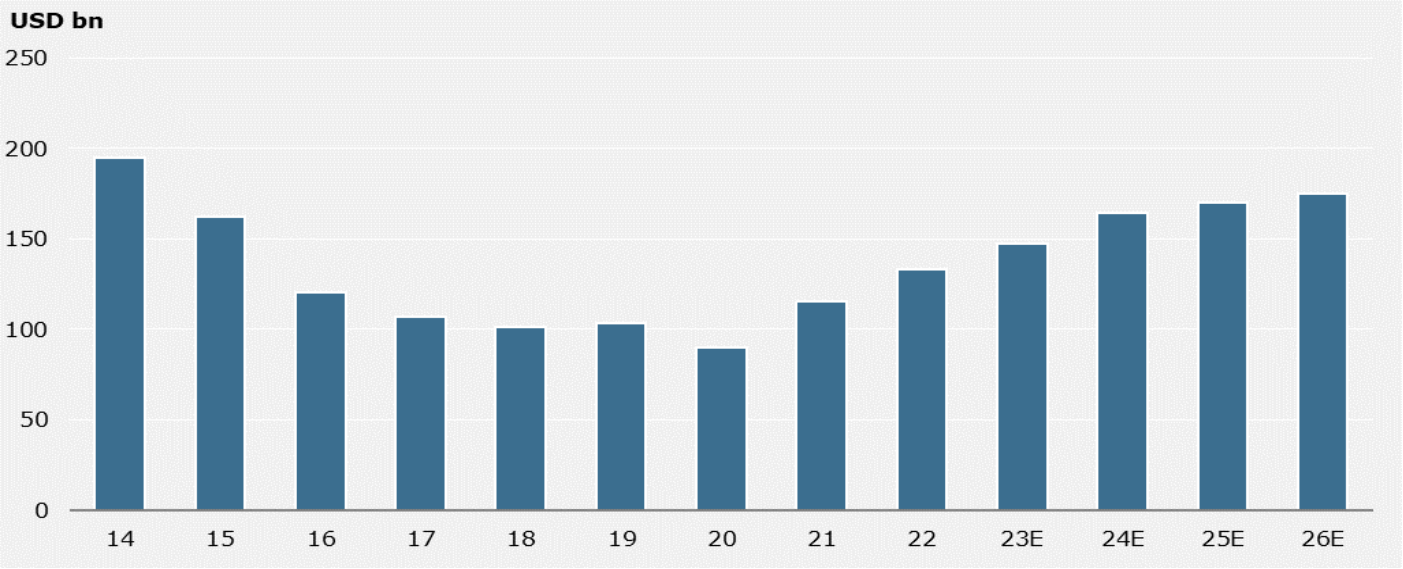
Graph 37: Global Upstream CAPEX spending forecast until 2026



Source: Company websites, IEA, International Energy Forum, R. Brakenhoff

Regarding Upstream E&P CAPEX spending at Offshore, I believed that the global market had bottomed out in 2018, which was approximately 50% lower compared to the level reported in 2014. However, COVID-19 resulted in the delay of several offshore projects, leading to a dip in offshore Upstream E&P CAPEX spending in 2020. However, CAPEX spending recovered strongly in both 2021 and 2022 (see graph below) and according to IHS Markit could increase by another 11% in 2023. Deepwater areas like Brazil, Guyana, Surinam, etc., are very promising thanks to relatively low break-even prices. All told, I expect Offshore CAPEX spending to rise to USD 170bn in 2025, which is comparable to the level seen in 2015.

Graph 38: Global Offshore Upstream CAPEX spending forecast until 2026



Source: COSL (IHS Markit), R. Brakenhoff

Earnings development of Oil Majors and US independents in 4Q22

The oil majors' total earnings before exceptional items (ExxonMobil, Shell, BP, Chevron, ConocoPhillips, Total, ENI) climbed YoY 37% to USD 50.5bn profit in 4Q22 (see table below) thanks to spectacularly higher oil and gas prices (Brent: +11%; WTI: +7% YoY; Henry Hub: +27%; European gas price: +15%), being slightly offset by lower oil and natural gas production (-2.6% YoY). Although the oil majors realized a strong result historically, it was 25% lower compared to 3Q22 due to lower oil prices and particularly sharply lower gas prices, resulting in 36% lower E&P earnings. The Oil Major's Downstream's earnings strongly climbed YoY in 4Q22, albeit being somewhat lower compared to the previous quarter. The oil majors' Upstream CAPEX spending rose by 17% YoY to USD 22.5bn. The oil majors' Cash Flow from Operations jumped by 28% to USD 83.0bn in 4Q22. Thanks to this high level of Cash Flow from Operations, being slightly offset by higher Upstream CAPEX spending and dividend payments, the oil majors' CF from Operations minus CAPEX and dividends remained at a very high level in 4Q22 (USD 33.1bn).

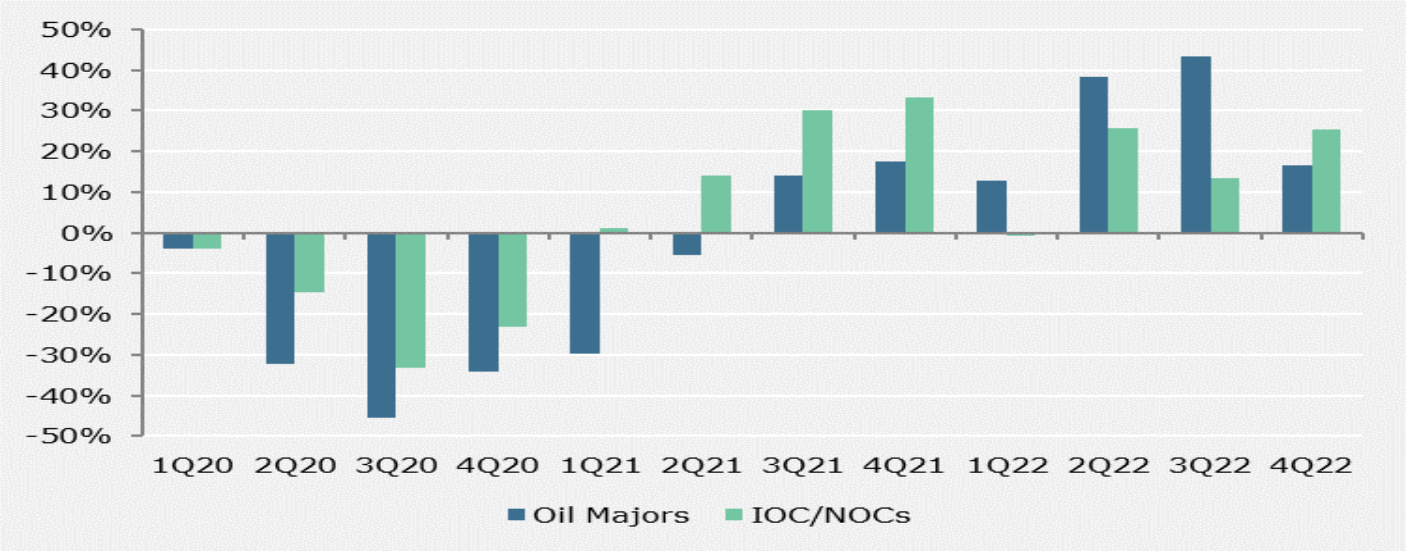
Table 8: Earnings development of Oil Majors in 1Q22, 2Q22, 3Q22, and 4Q22

USD m	1Q22	Change YoY	2Q22	Change YoY	3Q22	Change YoY	4Q22	Change YoY
E&P	38,643	211%	46,627	170%	49,067	125%	31,493	6%
Downstream	4,969	231%	17,455	437%	14,974	170%	11,161	183%
Total	48,280	230%	69,607	205%	67,258	130%	50,467	37%
Upstream CAPEX	17,234	13%	20,164	38%	20,178	43%	22,479	17%
Cash Flow from Operations	62,030	67%	91,915	85%	92,732	64%	82,997	28%
CF from Operations – CAPEX – Dividend	33,384	124%	51,926	120%	55,860	100%	33,142	-7%

Source: Company websites Please note: Results E&P, Downstream, and Total are adjusted for exceptional items

The Oil Majors raised their Upstream CAPEX spending by 17% YoY in 4Q22, which seems impressive but it was still less than halve the figure spent per quarter in 2014, it climbed by 25% YoY at the quoted NOCs (Chinese companies, Saudi Aramco, Petrobras, Pemex), see graph below.

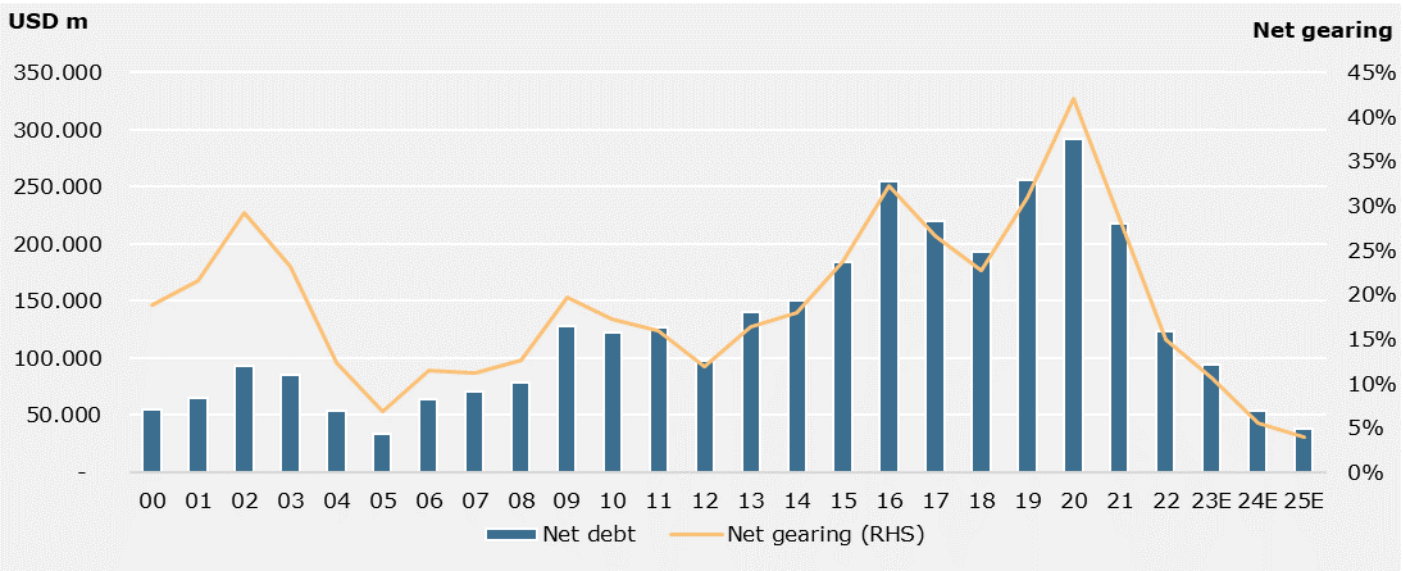
Graph 39: Change YoY Upstream CAPEX Oil Majors compared to other large quoted oil companies



Source: Company websites, R.Brakenhoff

Thanks to very high Cash Flow from Operations, the Oil Majors were able to reduce their net debt by nearly USD 95bn or 43% to USD 123.5bn at year-end 2022. The combined net gearing improved from 28.5% at year-end 2021 to 14.9% at year-end 2022 (see graph below). Looking ahead, equity analyst's expect that the Oil Major's net gearing will go down even further, giving them ample financial room to step up their ambitions to play a role at the energy transition.

Graph 40: Oil Major's net gearing ratio halved in 2022



Source: Company websites

Another group of oil & gas producing companies - the US independents – reported again strong earnings in 4Q22 thanks to the sharply higher oil & gas prices, and higher production (+8% YoY). Combining the figures of 14 quoted US oil & gas producing companies' net earnings climbed by 18% YoY to USD 10.4bn profit (adjusted for one-offs), which was well below earnings reported in the previous two quarters. Cash Flow from Operations jumped to USD 21.8bn in 4Q22. The US independents raised their Upstream CAPEX spending by 42% YoY in 4Q22. This increase looks huge, but bear in mind that Upstream CAPEX spending was low in 4Q21. In addition, Upstream CAPEX spending still stood below the levels seen in the pre-COVID year 2019. The US independents realized a USD 0.4bn improvement

to more than USD 8.1bn in 4Q22 in their Cash Flow from Operations minus Upstream CAPEX minus dividends despite higher CAPEX spending and dividend payments.

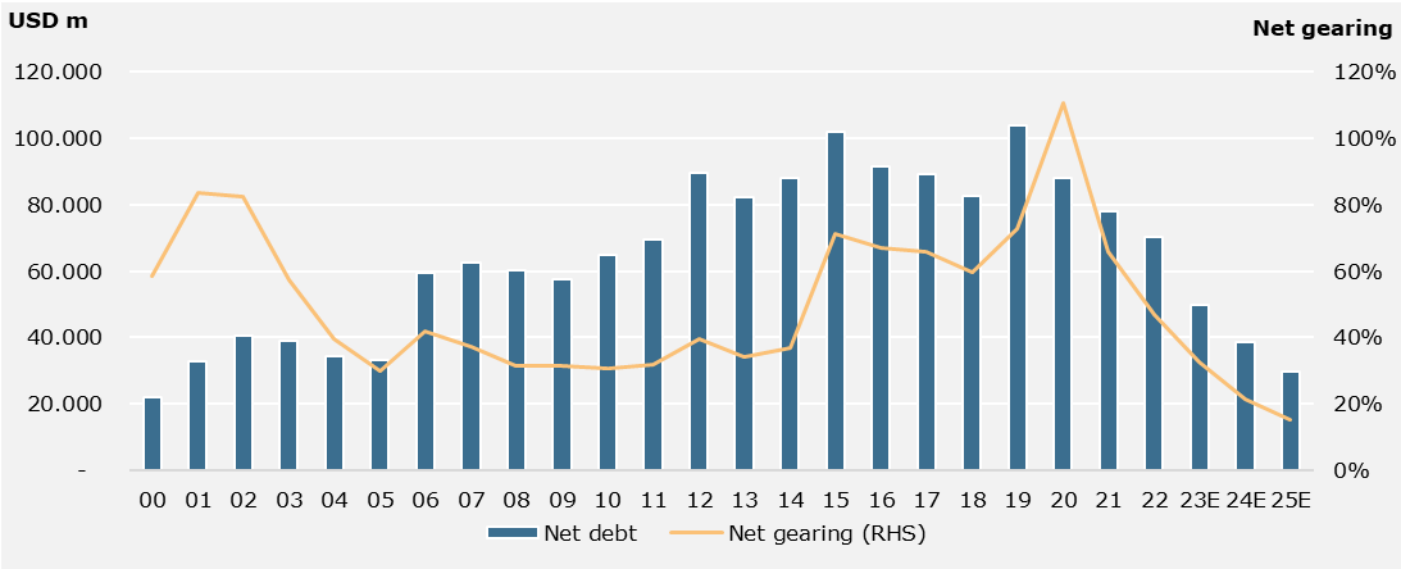
Table 9: Earnings development of US Independents in 1Q22, 2Q22, 3Q22, and 4Q22

USD m	1Q22	Change YoY	2Q22	Change YoY	3Q22	Change YoY	4Q22	Change YoY
EBIT	17,680	207%	21,650	232%	19,283	99%	14,775	18%
Net profit excluding one-offs	12,528	256%	15,110	271%	13,446	110%	10,387	18%
Oil & Gas production (m b/p/d)	7.1	12%	7.4	10%	7.6	12%	7.7	8%
Upstream CAPEX	6,778	45%	7,575	41%	8,324	53%	8,843	42%
Cash Flow from Operations	15,258	77%	23,758	86%	25,469	80%	21,771	26%

Source: Company websites

Also the US independents reduce their net debt level compared to the year 2021. At year-end 2022 net debt amounted to USD 70.1bn, down USD 8bn compared to year-end 2021. The combined net gearing improved from 66% at year-end 2021 to 47% at year-end 2022 (see graph below). Equity analyst's foresee a further improvement of the US Independent's net gearing ratio in the coming years, giving them ample financial room to raise CAPEX spending and/or dividend payments.

Graph 41: US independent's net debt decreased by USD 8bn in 2022

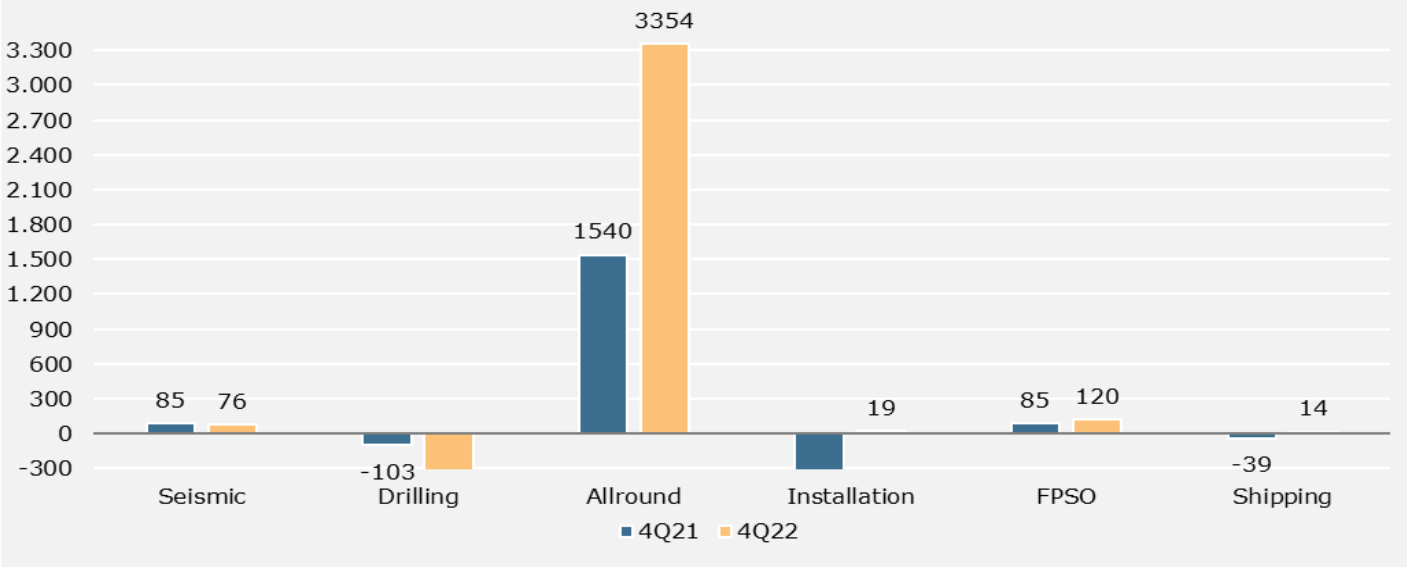


Source: Company websites

Oil Services industry's earnings were mixed in 4Q22

In 4Q22 the Oil Services companies reported mixed results. The Allround companies reported an earnings increase of more than 100%, whereas losses widened at Drilling due to disappointing results at Transocean. Thanks to sharply lower losses at Saipem, results at the Installation companies returned to a profit again. Also the shipping companies benefited from recovering market circumstances.

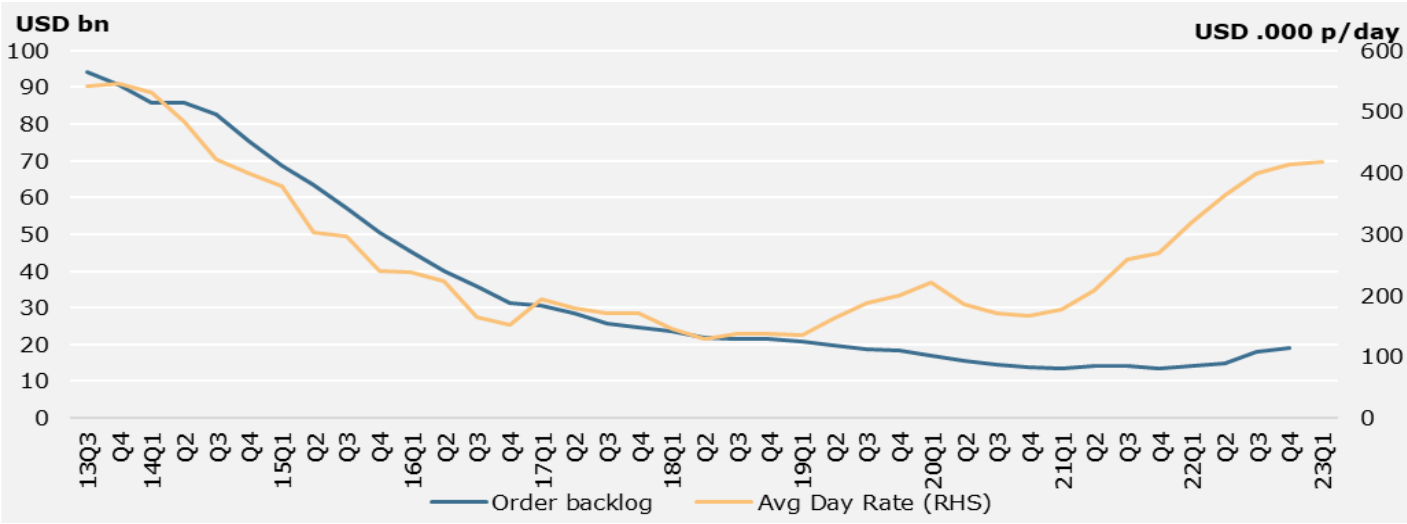
Graph 42: 4Q22 results showed huge improvement



Source: Company websites

Drilling rates of floaters (semi-submersibles and drillships) used at (ultra-) deepwater climbed further in 4Q22 and 1Q23, reaching levels seen for the last time in 2014 (see graph below). Also the order backlog rose by 35% YoY, but this was both thanks to impact of the merger between Noble and Maersk Drilling and improving market conditions.

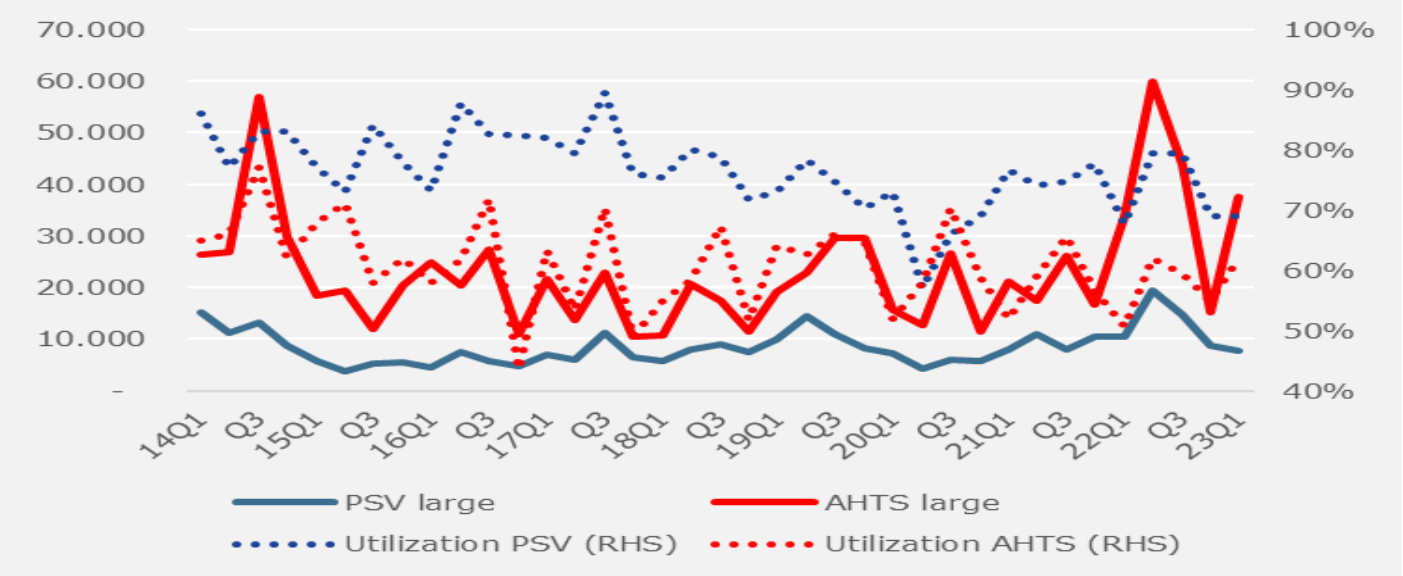
Graph 43: Drilling market slightly improved further in 4Q22



Source: Company websites, Clarkson Research

For the first time since many quarters, the shipping company's reported a small net profit in 4Q22. However, the recovery of the shipping rates on the spot market at the North Sea halted in 4Q22. In 1Q23 shipping rates for large PSVs decreased further YoY, but increased at large AHTSs. The shipping companies benefitted from mergers, cost cutting programs, and financial restructurings leading to improved earnings. Uncertain how long the earnings recovery will last, but one thing is certain that the sector's financial strength (net gearing) is now much better compared to several years ago!

Graph 44: Recovery shipping rates halted in 4Q22



Source: Seabrokers Please note: Shipping rates on the spot market in GBP per day at the North Sea

Table 10: Earnings development of Oil Services between 1Q21 and 4Q22

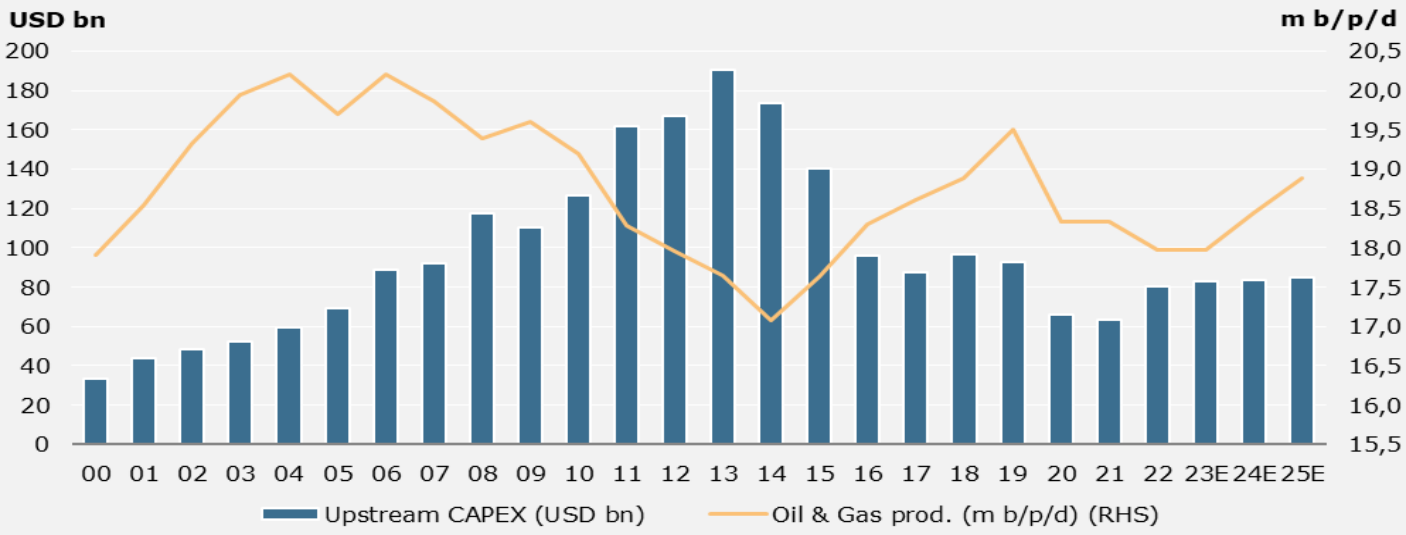
Change YoY	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22	4Q22
Sales	-23.0%	+9.3%	+12.6%	+15.3%	+13.9%	+18.8%	+19.7%	+18.2%
EBITDA	-21.8%	+7.2%	+21.0%	-0.6%	+27.5%	+71.7%	+47.3%	+75.1%
EBITDA margin	14.4%	13.2%	15.5%	13.2%	15.8%	18.5%	18.6%	19.4%
Net profit excluding one-offs	n/a	n/a	n/a	n/a	n/a	n/a	+423.9%	+932.7%
Equity (USD bn)		109.0		110.1		114.6		123.5
Net debt (USD bn)		66.9		53.1		55.4		44.0
Net gearing		61.4%		48.2%		48.3%		35.6%

Source: Company websites Please note: Not all companies have reported its 1Q21-4Q22 results due to delays as a result of financial difficulties/Chapter 11

Oil Majors' Upstream CAPEX spending will hardly recover due to energy transition

Thanks to a gradual recovery of global demand for oil & gas as well as oil & gas prices as of 2021, I expect that the Oil Majors will raise their Upstream CAPEX spending again in the coming years, albeit it will remain at a relatively low level compared to the period 2011-2014. Main reason is the structural change in the strategy of several Oil Majors (BP, Shell, Eni, Total), leading to a switch from investments in fossil fuels to renewables. All told, because of divestments and their low Upstream CAPEX spending on the one hand, but somewhat less impact of OPEC+ production cutbacks on the other, total oil & gas production by the Oil Majors is expected to recover by 5% to 18.9m b/p/d in 2025 compared to the year 2022.

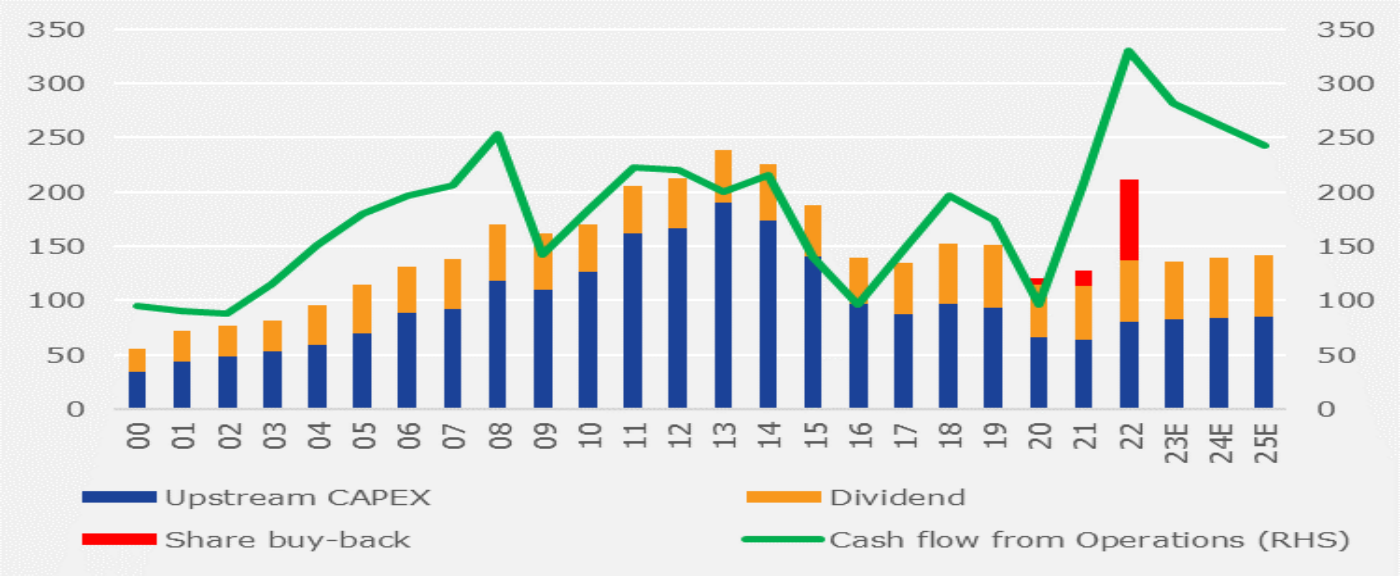
Graph 45: Upstream CAPEX spending Oil Majors could rise 24% in 2024 compared to 2021



Source: Company websites, R. Brakenhoff

For most of the Oil Majors, maintaining or even gradually raising their dividend payments to their shareholders is one of their top priorities. In 2020 Cash Flow from Operations was not sufficient to cover CAPEX and dividends, but this picture changed completely in 2021 and 2022. Record high Cash Flow from Operations gave the Oil Majors financial room to both raise dividends as well as buy back shares, i.e. returning excess cash to shareholders (2022: USD 74bn). Equity Analysts forecast slightly lower Cash Flow from Operations in the coming years, but as the graph below clearly shows, there will remain ample financial room to buy back shares again.

Graph 46: Oil Majors' Cash Flow peaked in 2022, but will remain relatively high in coming years

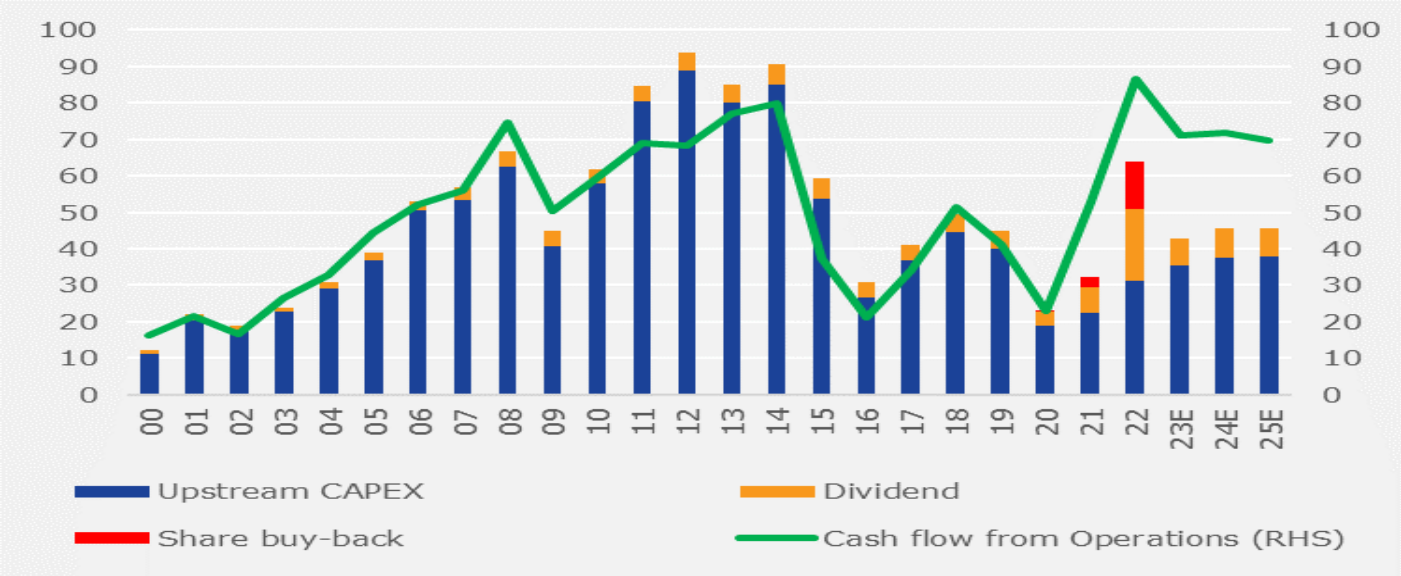


Source: Company websites; R. Brakenhoff Please note: Only share buy-backs taken into account for 2020, 2021, and 2022

US Independents CAPEX spending will go up, but not to previous heights

Thanks to the high US oil (WTI) and gas (Henry Hub) prices, the US Independents' generation of Cash flow from Operations peaked in 2022. Even after spending 40% more on Upstream CAPEX, there was ample financial room to raise dividends and to spend USD 13bn on share buy-backs in 2022. Although Equity Analysts expect somewhat lower Cash flow from Operations, it will still remain high in the period 2023-2025. After deducting higher Upstream CAPEX spending, the US Independents can still pay special dividends and/or perform share buy-backs again in the coming years.

Graph 47: US Independents' Upstream CAPEX spending remains low in coming years

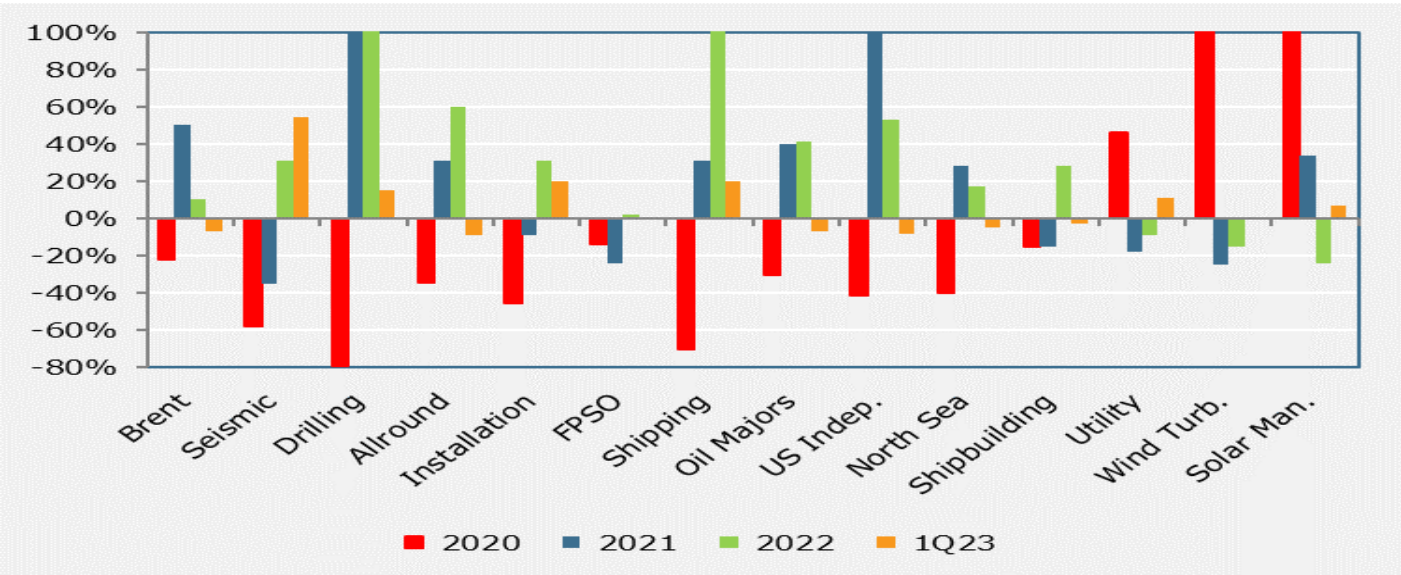


Source: Company websites; Marketscreener consensus estimates

Mixed picture share price development in 1Q23

In 1Q23 the Brent oil price decreased by 7%, whereas the Dow Jones Index stabilized compared to year-end 2022. Because of lower oil and particularly gas prices, the share prices of the Oil Majors, US Independents, and North Sea players declined. Share prices of Seismic, Drilling, and Shipping companies continued to outperform as investors believe that their market conditions will improve further in the coming years. After the turbulent year 2022 share prices of the European utility companies recovered in 1Q23 thanks to 'normalising' gas and electricity markets in Europe.

Graph 48: Development Brent oil prices and share prices in 2020, 2021, 2022, and 1Q23



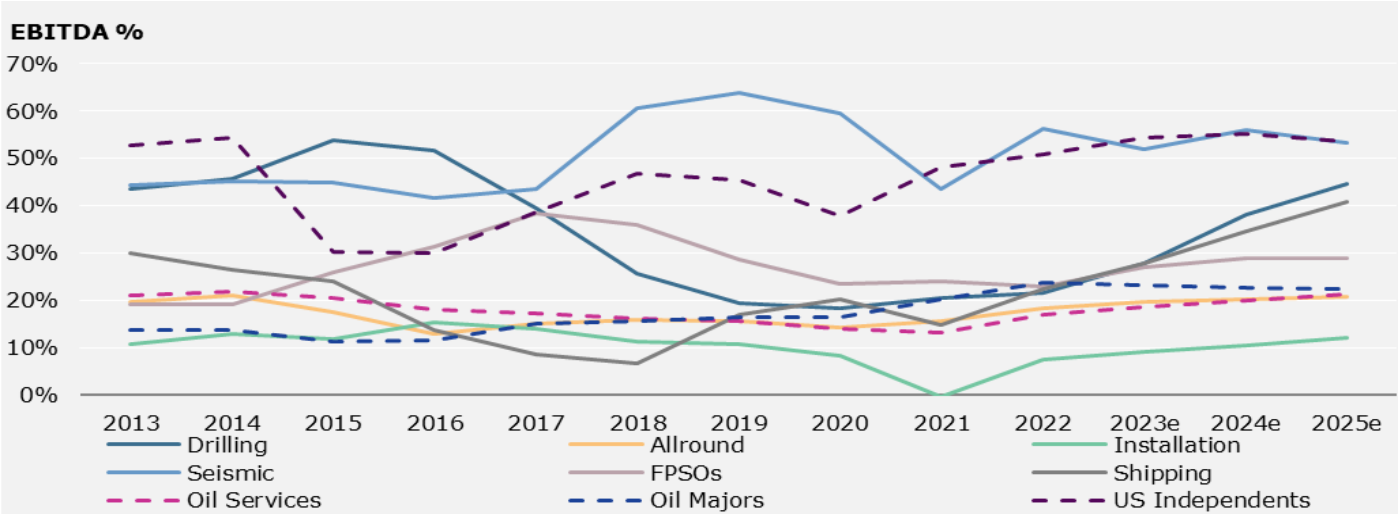
Source: Markets Businessinsider, Marketscreener, R.Brakenhoff Please note: Share prices drilling companies rose more than 100% in 2021 and 2022, but mainly as Valaris, Noble, Diamond Offshore, and Seadrill went out of Chapter 11

Oil Services market will improve further between 2023 and 2025

The graph below shows the historical and expected development of EBITDA margins of the Oil Services' sector and its segments as well as the Oil Majors and US Independents. After a 'dip' of many years, the Oil Services' EBITDA

margin is expected to reach its previous record level again (2014) in 2025. Except for Seismic, Equity Analysts expect margin improvements at all Oil Services' segments. Only margins at the Oil Majors and US Independents are expected to go down slightly due to somewhat lower oil and gas prices in the coming years.

Graph 49: EBITDA margins of nearly all Oil Services' sectors are expected to increase



Source: Markets Businessinsider