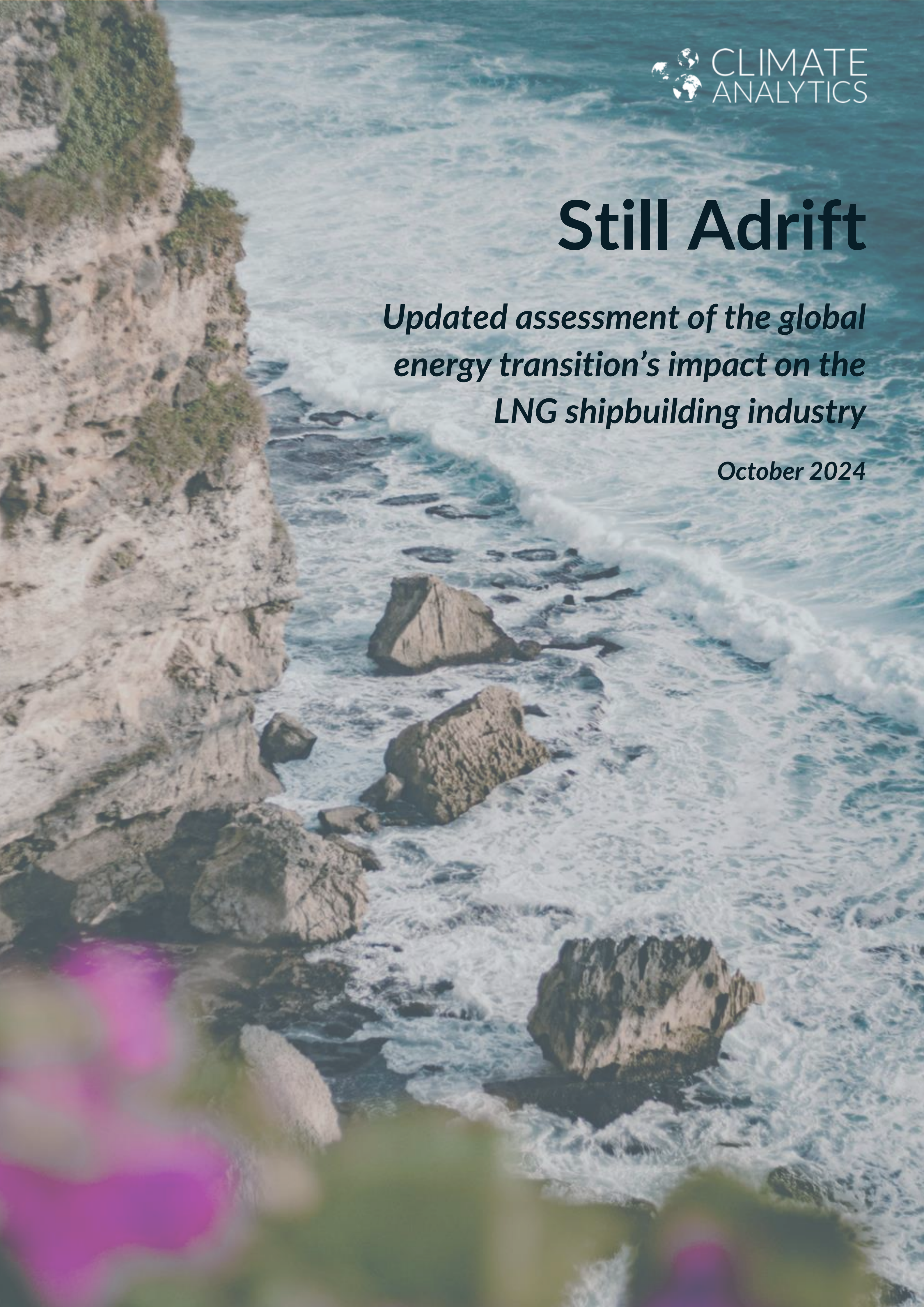

CLIMATE ANALYTICS

Still Adrift

Updated assessment of the global energy transition's impact on the LNG shipbuilding industry

October 2024

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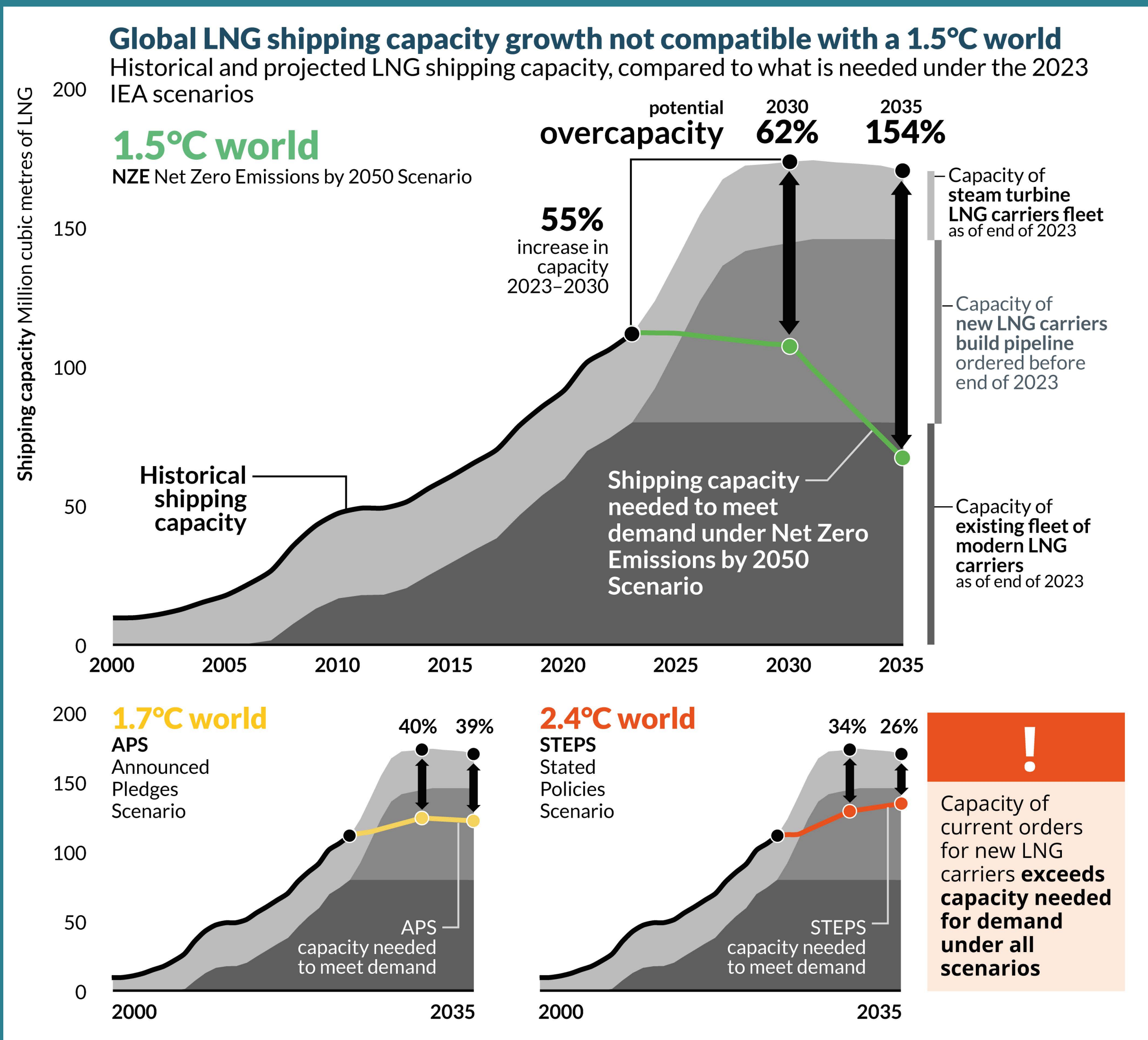
Executive Summary

This report updates our analysis of the liquefied natural gas (LNG) shipping capacity outlook. We look at the shipping capacity required for future LNG trade under the International Energy Agency's (IEA) latest scenarios, published in October 2023, along with recent order books for LNG carriers.

The shipbuilding industry contributed to enabling what the IEA nicknamed the gas "golden age": from 2010-2022, global liquefied natural gas (LNG) trade surged by 73%. The pace of new orders and construction is not slowing down. In 2024, 2025 and 2026, 251 carriers with a total of 43 million cubic metres (m^3) of shipping capacity are projected to be delivered – 38% of the capacity in operation as of 2023. While there were 64 orders for carriers in 2023, the first five months of 2024 alone saw 55 new orders placed.



We find a massive oversupply of LNG shipping capacity now and into the future under all IEA scenarios. Under the IEA's Net Zero Emissions (NZE) pathway that aligns with the goal of limiting global temperature increase to 1.5°C, no new LNG carriers are needed. With the orders on the books and deliveries scheduled in the next few years, the oversupply in 2030 in this scenario is projected to be equivalent to over 400 modern carriers.

Even under the IEA's more conservative, STEPS scenario, aligned with current private sector momentum and policies already adopted by governments around the world, an oversupply of LNG shipping capacity is evident. This surplus exists today and is projected to grow. By 2030, the excess LNG shipping capacity beyond what is required is projected to reach 40% of the operating capacity as of the end of 2023; the equivalent of 275 carriers.

The glut of new LNG carriers coming online in the near future following the recent intense influx of order will push the market into oversupply, risking stranded assets and locking in capital for purposes at odds with the global energy transition.

Two countries will build the overwhelming majority of LNG carriers to come online: China, and South Korea, with the latter taking up the vast majority of the industry. The discrepancy between the narrowing, yet still viable, path to limiting warming to 1.5°C and the surge in orders for LNG carriers creates multiple risks for the global energy transition and the stakeholders involved in the market. As the energy transition accelerates, investing in fossil fuel transport capacity represents a risky and shortsighted gamble for investors, shipbuilders, and shipowners.

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Introduction

The 2023 update to the International Energy Agency's (IEA) Net Zero Emissions roadmap shows an even narrower pathway to limiting global warming to 1.5°C compared to its previous iteration. The imperative to accelerate the energy transition has become increasingly compelling, driven by heightened energy security concerns, significant reductions in the costs of clean technologies, and the severe global impact of climate change (IEA, 2023a).

Aligning with this pathway requires phasing out fossil fuel extraction and combustion. The projected increase in fossil gas production, higher than coal and oil combined under current government policies and private sector momentum, is a major risk to this shift (SEI et al., 2023). With one-third of the global shipping capacity dedicated to transporting fossil fuels, trade plays a major role in global fossil fuel markets and hence in the energy transition (Kühne Foundation & UCL Energy Institute, 2024).

Fossil gas' 2010s "golden age" - a term coined by the IEA in 2011 - has been made possible, in part, by the shipbuilding industry. Over 2010-2022, global liquefied natural gas (LNG) trade surged by 73% (compared to 26% for aggregated gas trade, comprising both LNG and pipeline trade, over this timeframe), and by 10% - solely between 2021 and 2022 - as countries sought to diversify their supply sources away from Russian pipeline gas after its full-scale invasion of Ukraine (IEA, 2023d).

Reflecting this growth, LNG carrier shipbuilders have experienced an intense influx of orders for ships to be delivered later in the decade.

Contrary to recent industry projections suggesting a need for 100 additional LNG carriers, Solutions for Our Climate and Climate Analytics showed in 2023 that the pipeline of LNG carriers far exceeded what is required in IEA's Net Zero Emissions scenario (Climate Analytics, 2023; GTT, 2024; TradeWinds, 2024).

None of the IEA scenarios imply a need for this pipeline, including the Announced Pledge scenario and even the Stated Policies scenario, a pathway that can be seen as a snapshot of the world's energy future based on policies already implemented by governments and current private sector momentum, without accounting for additional measures or future increase in ambition.

This glut of new LNG carriers becoming operational in the coming years will push the market into oversupply territory, risking ending up as stranded assets, and locking in capital for purposes at odds with the global energy transition. In 2025 and 2026 only, 180 carriers with a total of 32 million m^3 of shipping capacity are projected to be delivered – 28% of the capacity in operation as of 2023.

This briefing provides an update of our 2023 work, informed by more recent data both on the demand side, thanks to the IEA scenario factoring in the latest policy settings, and global LNG trade projections, and on the supply side, with an updated LNG carriers orderbook.

Waning fossil gas demand amid global decarbonisation efforts

The 2023 IEA Net Zero Emissions (NZE) roadmap, published in September 2023 and used in the 2023 World Energy Outlook (WEO), shows a shift in gas trade dynamics, with higher LNG trade projections than in the previous WEO. Behind these revisions is the sharp decline in pipeline gas trade volumes 2022 compared to 2021, following Russia's illegal invasion of Ukraine in 2022, that prompted European countries dependent on imports to diversify their supply sources and increasingly turn to LNG (IEA, 2023b). In the NZE scenario, LNG trade still declines sharply in the medium-term, experiencing a 34% drop between 2022 and 2035.

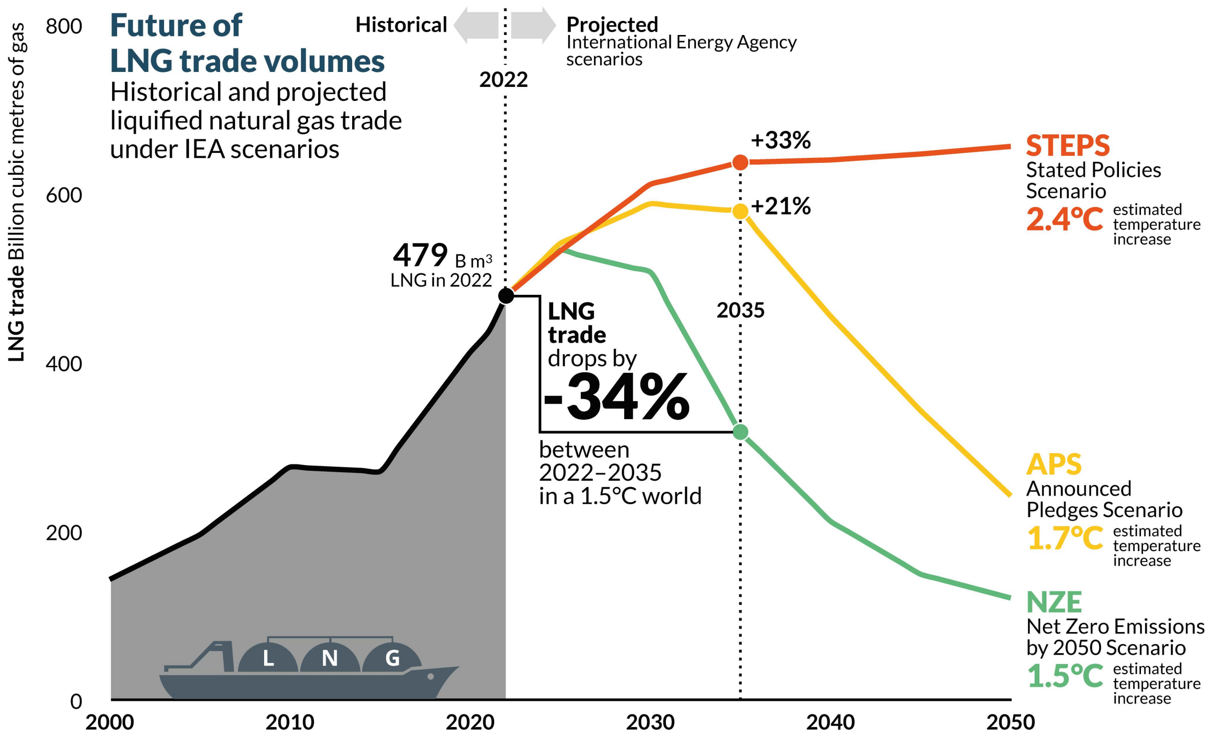

Figure 1: *Projected liquefied natural gas trade in the WEO 2023 scenarios. Source: IEA (2023).*

The upward revision of short-term LNG trade projections in the NZE scenario, driven partly by the rebalancing between liquefied and pipeline gas, should not overshadow the declining outlook for global gas demand. In the 2023 NZE scenario, total fossil gas demand decreases by 18% from 2022 to 2030 and by 78% from 2022 to 2050. Compared to the initial 2021 NZE scenario, the IEA has lowered its projections for fossil gas use by 10% for 2030 and 45% for 2050 in the latest iteration, citing the global energy crisis and reduced prospects for fossil gas-based fuels such as blue hydrogen (IEA, 2021, 2023a).

Under its scenarios aligned with current policies and announced pledges (STEPS and APS), the IEA has consistently, year after year, revised its global gas demand projections downwards, in spite of the global events, without any signs this trend might change. In all IEA scenarios, global gas demand peaks before 2030 (IEA, 2023d, 2023c).

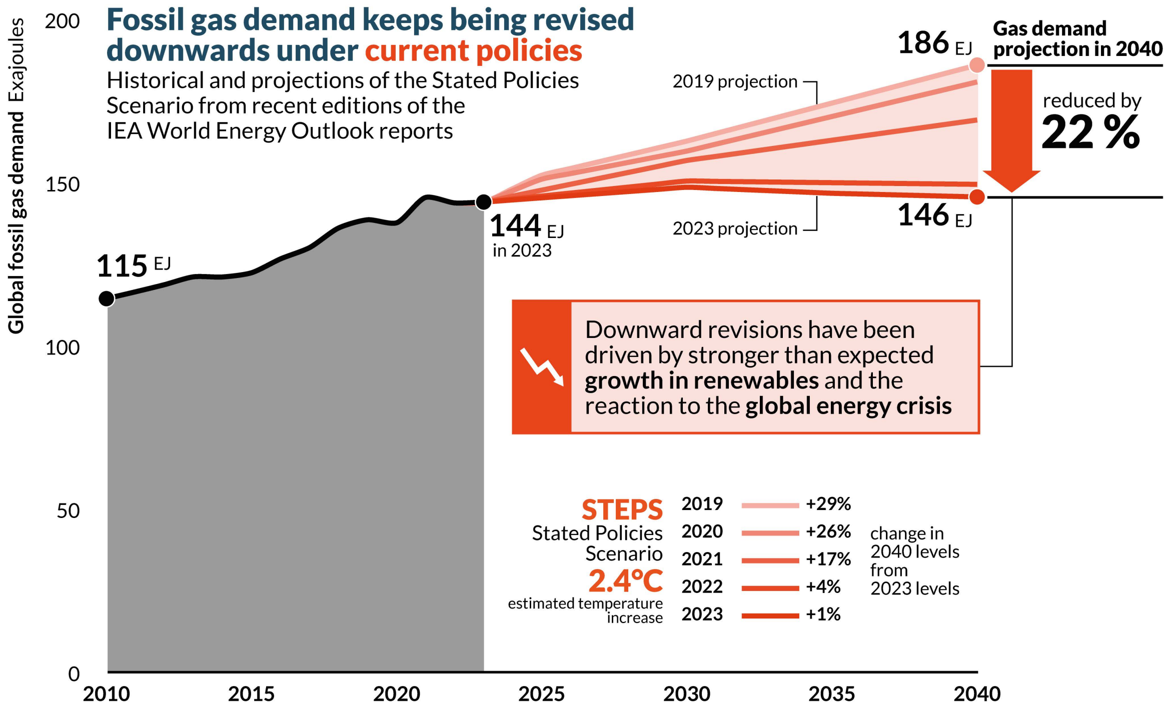

Figure 2: *Historical and projected global fossil gas demand under the IEA STEPS scenarios from the World Energy Outlook 2019 to 2023, aligned with current policies at the time of their publication. Source: (IEA, 2019, 2020, 2021, 2022, 2023d)*

These systematic revisions, driven by both the realisation that gas is not a remedy to energy security concerns and that its uses are not as competitive as clean technologies, might ultimately reflect on the LNG outlook (IEA, 2023d, 2023c). As noted by the IEA, achieving net zero emissions – and therefore reducing fossil fuel consumption and emissions by transitioning to clean energy sources – also brings energy security benefits that fossil gas was evidently not able to guarantee during the global energy crisis (IEA, 2023a).

Unprecedented volumes of LNG carriers soon to flood the market

The future need – or lack thereof – for additional shipping capacity is downstream of those global LNG trade dynamics. A flurry of orders placed in 2018 and 2019 resulted in a record year in 2021 for carrier deliveries. Updated historical data and orderbooks from Clarkson, with a cut-off date in May 2024, show that LNG carrier deliveries returned to 2012-2020 levels in 2022 and 2023. The available shipping capacity increased by 10 million m³ between 2022 and 2023, while 10 million m³ were delivered in 2021 alone.

Construction rates are expected to pick up again. Both 2021 and 2022 were record-breaking years for LNG orders, with 74 and 174 orders placed respectively - the highest numbers on record. While the whole year of 2023 saw 64 orders passed, the first five months of 2024 alone have already recorded 55. Even after the unprecedented number of orders in 2022, more orders continue to be placed (Riviera, 2024b, 2024a; TradeWinds, 2023b).

As a result of these recent orders, 12 million m³ of capacity are anticipated for delivery in 2024, 15 million m³ in 2025 and 16 million m³ in 2026. Combined, this represents 38% of the operating LNG shipping capacity as of the end of 2023.

The outlook for shipping capacity post-2028 has also been revised significantly upward. By 2030, 174 million m³ of LNG shipping capacity is expected to be available, marking a 55% increase from 2023. This is 14 million m³ more than estimated in May 2023, the equivalent of 5,600 Olympic swimming pools.

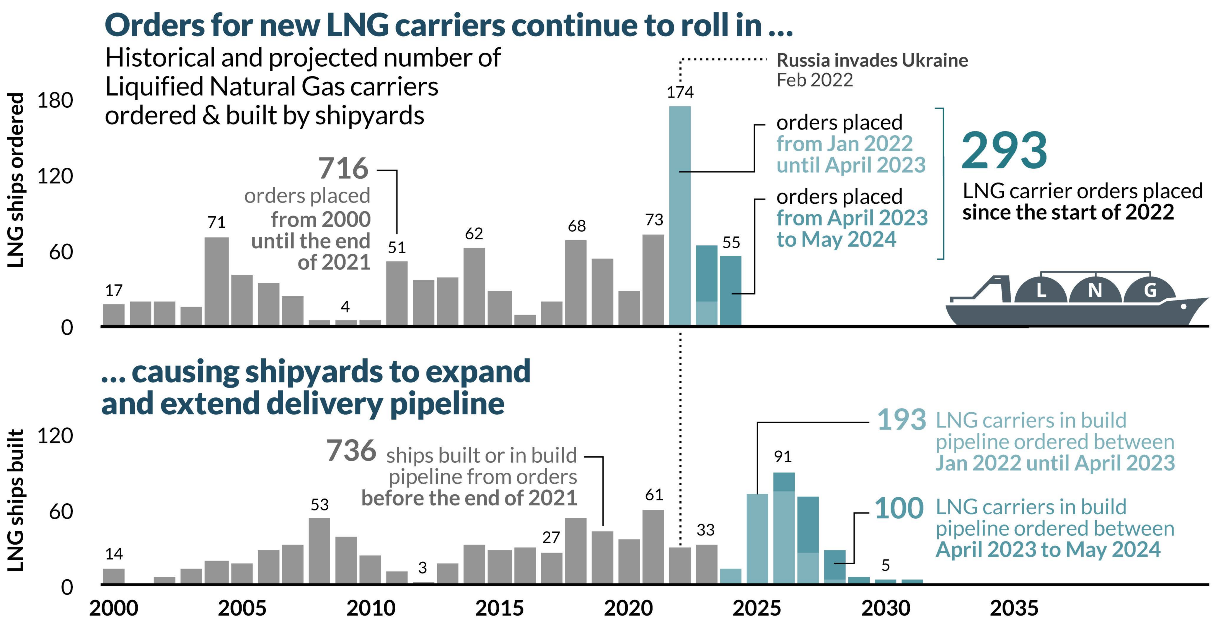

Figure 3: *LNG carriers orders and deliveries by timeframe: orders placed between 2000 and the end of 2021 are displayed in grey. Orders placed from January 2022 to April 2023 (the cut-off date for the data used in Climate Analytics' High and Dry report) are shown in light blue. More recent data, covering April 2023 to May 2024, is displayed in darker blue. The lower graph shows the deliveries of carriers based on their order dates presented in the upper graph. Source: Clarkson (2023, 2024).*

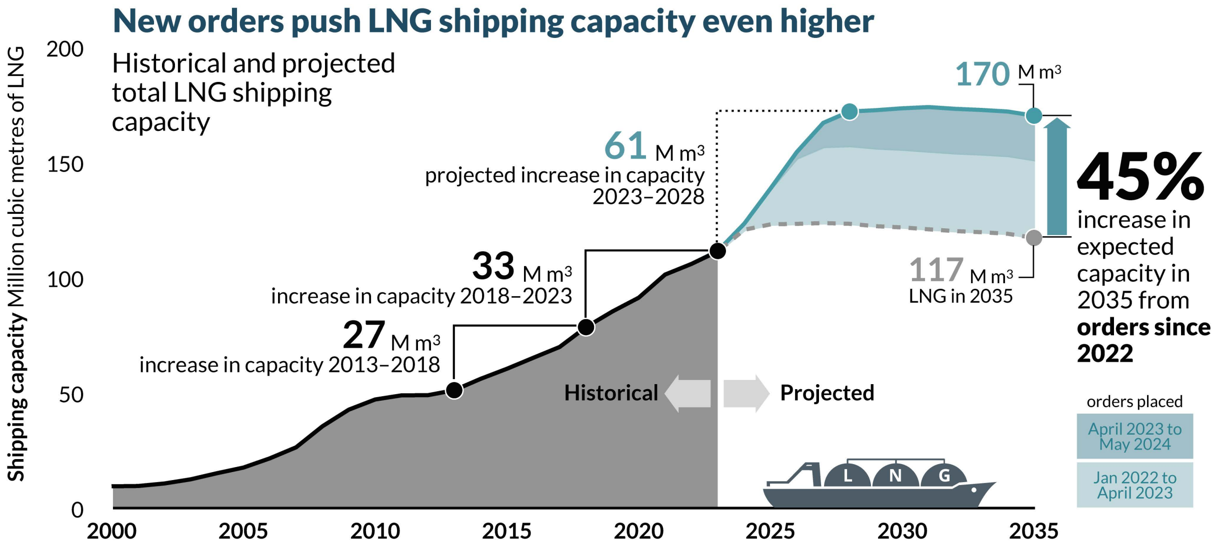

Figure 4: *Historical and projected LNG shipping capacity, highlighting the increase in projected capacity from orders passed 2022 onwards. Projections differentiate between orders passed before the end of 2021, orders passed between the start of 2022 and April 2023 (cut-off date of Climate Analytics' High and Dry report), and orders placed up until May 2024, the cut-off date of the dataset used in this report. Source: Clarkson (2023, 2024)*

Putting the pieces of the puzzle together

Comparing the global LNG trade outlook with the order book of LNG carriers allows for the identification of a shipping capacity oversupply. For this analysis, we build on the framework applied in (Climate Analytics, 2023). To determine the required shipping capacity in all scenarios, we used the median LNG shipping capacity utilisation since 2010, defined as the ratio between the operational ship capacity and the amount of LNG traded each year. Additionally, we assume, in line with industry standards, that the operational lifetime of a ship is 35 years (see Annex A for more details on the methodology).

By integrating both supply-side and demand-side data, we find that, compared to our previous report, the surge in LNG shipping capacity exceeds the increase in LNG shipping demand, even with the upward revision of LNG trade in the NZE scenario.

Under the IEA NZE scenario, the current fleet is sufficient to meet LNG shipping demand until 2050, meaning that no additional ships would be needed beyond those currently in operation. LNG shipping demand drops so rapidly in this scenario that post-2030, even if no ships on order were built, there would still be an oversupply of LNG shipping capacity, ultimately leading to a risk of stranded assets.

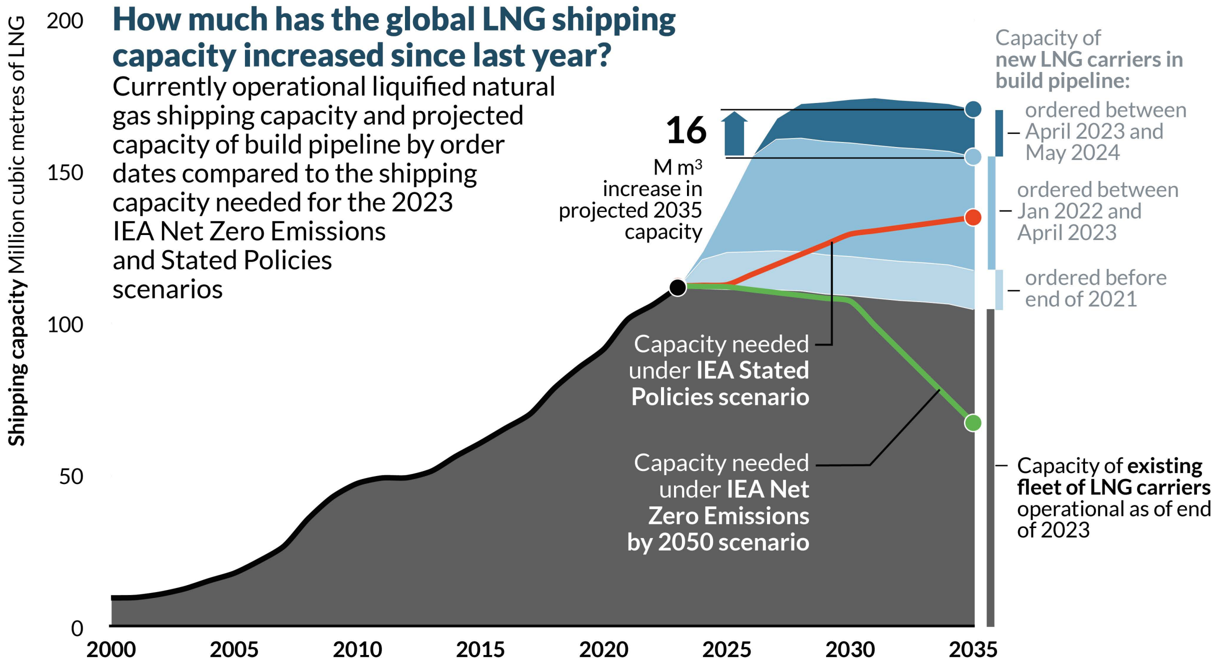

Figure 5: *Comparison of the projected needed liquefied natural gas shipping capacity in the STEPS and NZE scenarios with the historical and projected available shipping capacity. Source: Clarkson (2024), IEA (2023, 2022).*

Overall, across all the World Energy Outlook scenarios, including the STEPS scenario, there is a glut of LNG shipping capacity. Under this baseline scenario, based on current government plans and prevailing trends without considering new policies and further climate action, the excess LNG shipping capacity beyond what is required reaches 45 million m^3 by 2030. This is 40% of the operating capacity as of the end of 2023: the equivalent of 275 recent carriers.[1]

Older and less efficient steam turbine engines are more likely to be retired early than ships equipped with more recent technologies. Yet even after excluding them from the analysis, the glut remains with the ships on order.

[1] Using the average capacity of ships built between 2020 and 2023, of 165,000 m^3 (Clarkson, 2024).

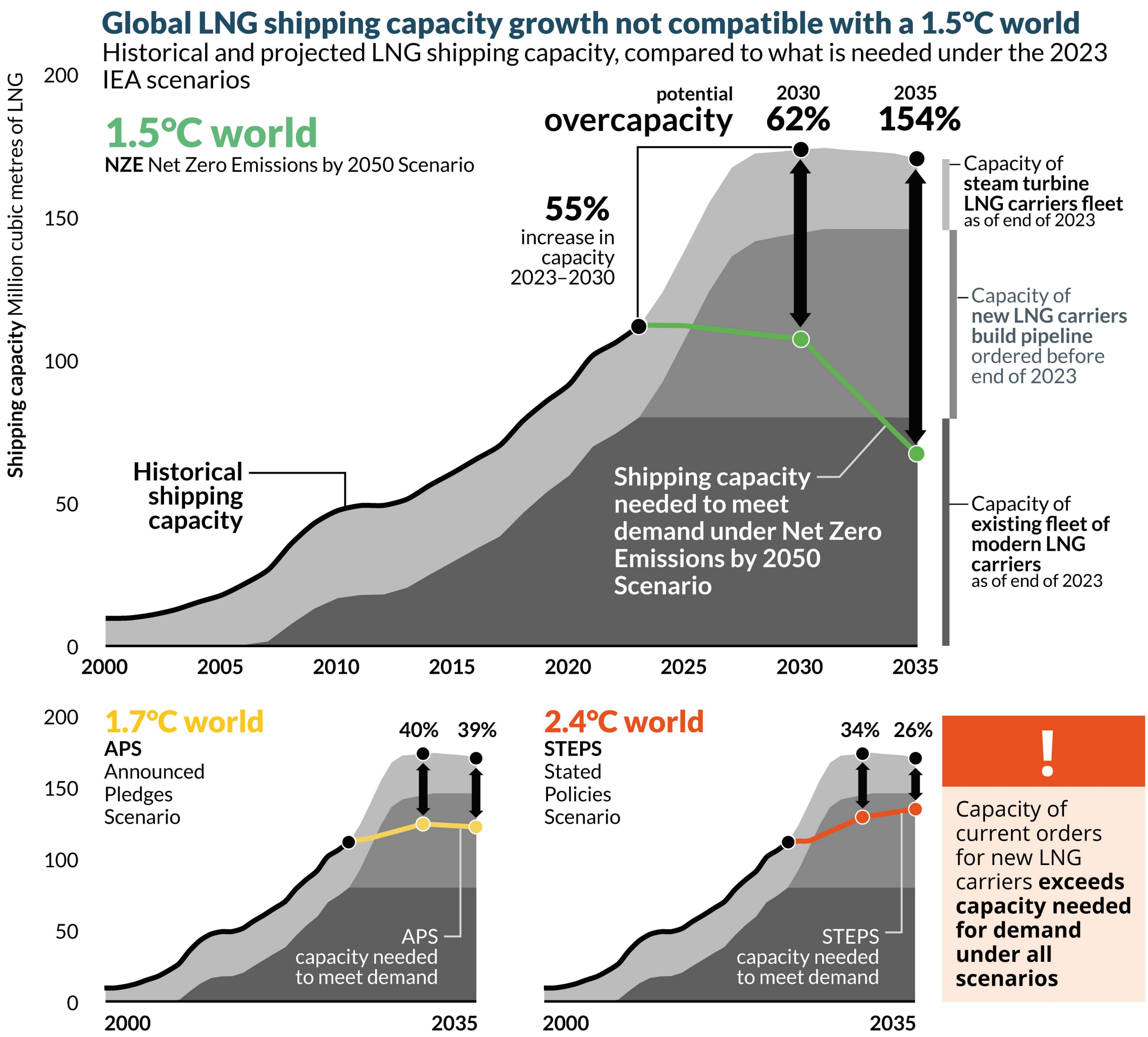

Figure 6: *Projected needed liquefied natural gas trade in the 2023 WEO scenarios, compared with the shipping capacity available. Source: Clarkson (2024), IEA (2023).*

Table 1*: Average annual oversupplied LNG shipping capacity and absolute value for 2030 and 2035 in million cubic meters, relative to the requirements under IEA scenarios. The full table is available in annex B. The oversupply in 2030 is projected to be equivalent to over 400 ships under the NZE scenario, 300 under the APS, and 270 under the STEPS scenario. By 2035, the oversupply would increase to 630, 290, and 220 ships, respectively.*

Scenario	Average oversupply 2025-2030	Average oversupply 2030-2035	Absolute oversupply in 2030	Absolute oversupply in 2035
NZE	50%	104%	67 million m^3	104 million m^3
APS	37%	41%	50 million m^3	49 million m^3
STEPS	35%	31%	45 million m^3	36 million m^3

Risks and policy implications

These findings show that the massive oversupply of LNG shipping capacity is unsustainable, even under a scenario capturing a snapshot of the global energy system's future based on current dynamics and government policies, without incorporating any new policies nor further progress in global climate action.

Under a pathway that aligns with the goal of limiting global temperature increases to 1.5°C, no new LNG carriers at all are needed. The discrepancy between the narrowing, yet still viable, path to limiting warming to 1.5°C and the surge in LNG shipping capacity poses a threat to both the global energy transition and the stakeholders involved in the market.

This glut mirrors the global LNG market dynamics, which is projected to enter oversupply within two years, according to the Institute for Energy Economics and Financial Analysis (IEEFA, 2024a). As more stakeholders, such as Japanese utilities, resell their LNG volumes and attempt to capture arbitrage opportunities, LNG demand and trade may appear artificially inflated. This risky speculative trading environment rests on unstable foundations and, more importantly, directly conflicts with the trends at play in the global energy transition (IEEFA, 2024b).

The additional LNG shipping capacity – and associated production lines in South Korea – risk becoming a stranded asset. LNG carriers, due to their highly specialised design and unique technical characteristics, are less adaptable for reconversion compared to, for instance, coal carriers, which can be repurposed for other dry commodities like iron ore. Among all fossil fuel carriers, LNG carriers pose the highest repurposing risks (Kühne Foundation & UCL Energy Institute, 2024).

The prospect of repurposing these assets for hydrogen shipping also appears limited in the short and medium-term. The product roadmap of Samsung Heavy Industries, one of the big three South Korean shipyards dominating the LNG shipbuilding market, does not anticipate large-scale hydrogen tanks for ships being ready before 2029 (Samsung Heavy Industries, 2024).

As the energy transition accelerates, investing in fossil gas transport capacities represents a risky and shortsighted gamble for investors, shipbuilders and shipowners. The oversupply of shipping capacity for an increasingly obsolete and climate-changing fossil fuel may lead to efforts to utilise this extra capacity at any cost, potentially leading to path dependency, economic rent-seeking, and regulatory capture to artificially sustain a sunset industry.

South Korea, a leader in LNG shipbuilding, is expected to construct 255 LNG carriers, over 70% of the LNG shipping capacity projected to become operational. It is also one of the largest global providers of international public finance for fossil fuels, with 84% of its fossil fuel finance directed towards gas projects between 2020 and 2022 (SFOC et al., 2024). The only other countries still engaged in LNG shipbuilding, China and Russia, are respectively projected to build 90 and seven carriers, with the latter designated for the Arctic LNG 2 project.

The skills and know-how of the well-established shipbuilding industry are assets that can be leveraged for other uses that would take this industry in the direction of the energy transition.

South Korea has an ambitious hydrogen strategy, with plans to become a net importer of the fuel. In the face of rising pressure to decarbonise, the domestic heavy industry sector - of which its shipbuilding is a pillar - is well-positioned to become a central node of the nascent clean hydrogen global supply chain in the long-term.

The country's offshore wind potential has also been identified as a major opportunity by the IEA (IEA, 2023d). More immediately, the national goal of South Korea reaching an installed capacity of 14.3 GW of offshore wind by 2030, projected to generate 770 thousand jobs, is an opportunity to scale up and *future-proof* an already competitive domestic industry (Global Wind Energy Council, 2024; Moneytoday, 2023).

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Annex A: Methodology

This briefing's methodology is based on the framework applied in (Climate Analytics, 2023).

Supply-side data

We used data from the Clarkson dataset, generated on 16 May 2024, for the LNG ship fleet in operation and on order. Two cases were considered: first, the capacity available if no new ships were built after the end of 2023 (compared to our previous report's estimate at the end of 2021); second, the capacity including vessels on order that are scheduled for delivery between 2023 and 2031. The delivery date assumed for carriers is the built date included in the Clarkson dataset, which represents a best estimate of the contracted delivery date for individual ships. The number of ships built in 2023 is lower than the projections from the April 2023 dataset used in our May 2023 report, following dramatic events in South Korean shipyards.[2]

LNG ships include the categories LNG carrier, and regasification vessels. While this represents a departure from the methodology applied in the previous report, (which, beyond the aforementioned categories, considered LNG & oil bunkering vessels, LNG bunkering vessels, LNG/Ethylene/LPG carriers, and CNG Carrier) to re-focus the analysis strictly on vessels used for LNG commodity trading, this affect minimally the comparability between the two publications as the shipping capacity timeseries vary by less than 0.5% following their exclusion. Power types are categorised into diesel electric, diesel 2-Stroke, diesel 4-Stroke, combined, and steam turbine. Steam turbine capacity was isolated by filtering for the latter category.

For both supply side forecasts, we assume full capacity availability. Individual ships were assumed to have a lifetime of 35 years, a value "consistent with LNG industry practice" and commonly used in the academic literature (Budiyanto et al., 2023; Flex LNG, 2024; TradeWinds, 2020).

As in our 2023 report, to determine the projected needed shipping capacity, we assume that ship capacity utilisation remains at median levels observed since 2010, at around 5.5 billion m^3 of gas traded per million m^3 of LNG shipping capacity (Climate Analytics, 2023). Ship utilisation has been trending down since the early 2000s, reaching a minimum of 5.1 billion m^3 of gas traded per million m^3 of LNG shipping capacity in 2021. While this decrease has not stopped until 2022, it has been relatively stable from in the past decade compared to its sharp decline in the early 2000s.

Deriving the required shipping capacity from the utilisation factor thus results in a more gradual change in LNG shipping capacity needs in the short term, compared to the projected spike in LNG trade under the NZE scenario. The already available capacity, along with new capacity coming online in the next few years, would be able to accommodate this additional trade under

[2] This includes the fire at Hankuk Carbon's factory, which has affected 25% of the plant's production of high-density cargo insulation panels crucial to LNG carriers (Korea JoongAng Daily, 2023; TradeWinds, 2023a).

this scenario. If we assume a higher utilization rate, such as the 75th percentile of historical observations - which still remains below the utilization rate of LNG carriers until 2013 - then the current LNG shipping capacity would be sufficient to meet the projected trade under the APS.

Demand-side data

The IEA 2023 World Energy Outlook scenarios inform the demand-side analysis. The WEO provides gas demand data in 5-year increments from 2030 to 2050, while projected LNG trade is only available for 2030 and 2050. We used linear interpolation to estimate LNG trade shares between 2022 and these two points. The 2025 gas demand in the NZE scenario, not provided explicitly, was extracted from the graph 3.23 of the WEO 2023 through curve fitting (IEA, 2023d).

Reader might notice that short-term LNG shipping demand is higher in the APS scenario than the STEPS scenario. The share of LNG in total gas demand by 2030 is slightly higher in the APS scenario than in STEPS (15% vs. 14% in 2030, and 17% vs. 15% by 2035, compared to 12% in 2022), while total gas demand in 2025 is relatively similar across scenarios, differing only by 1.5% between STEPS and APS. This translates, using the methodology presented above, in higher LNG trade under the APS scenario than in STEPS for this year (IEA, 2023d, 2023c).

Annex B: Oversupply per year

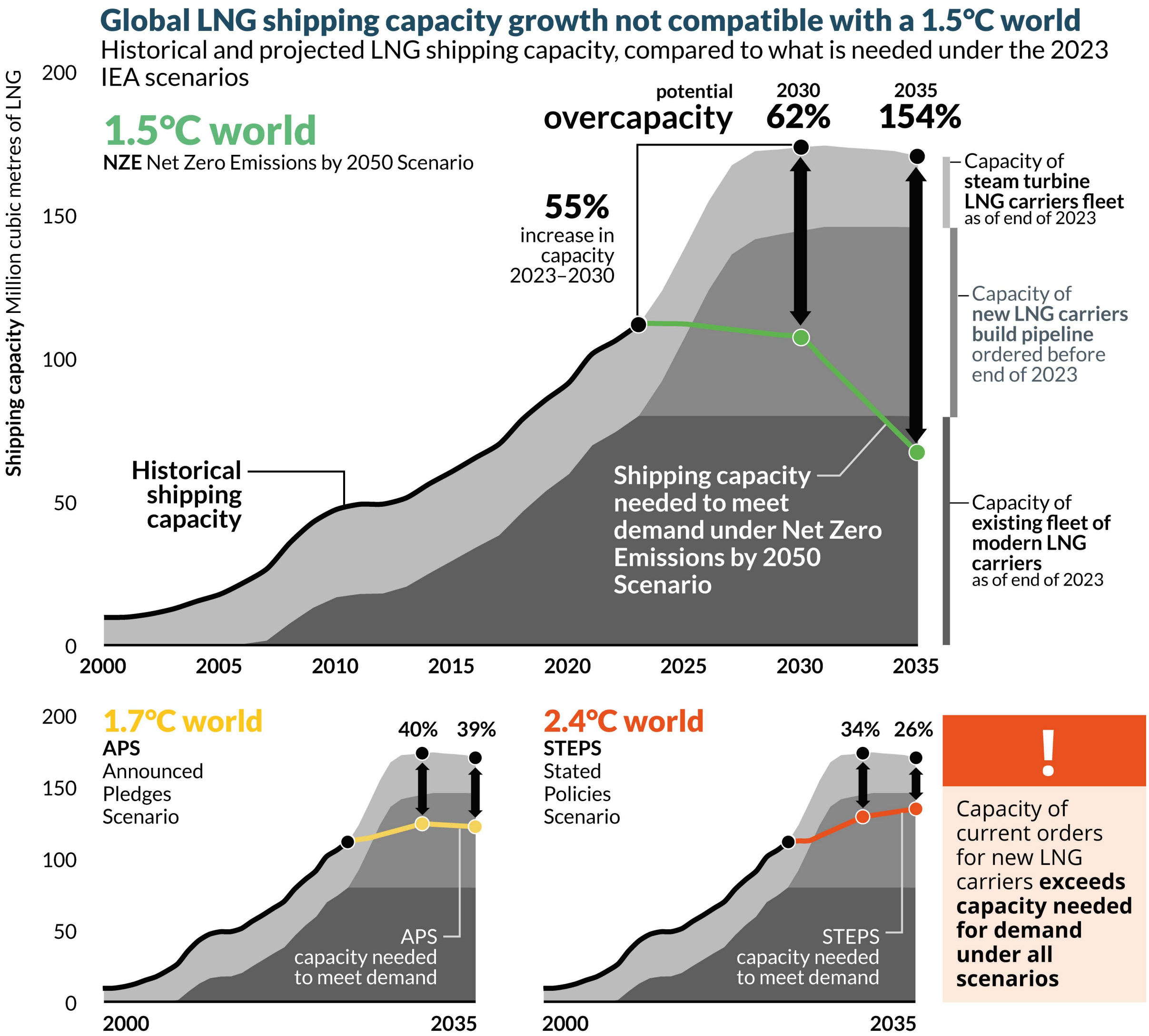

Figure 6: *Projected needed liquefied natural gas trade in the 2023 WEO scenarios, compared with the shipping capacity available. Source: Clarkson (2024), IEA (2023).*

Total capacity available

Table 2: Oversupply of LNG shipping capacity per year relative to the IEA WEO 2023 scenarios, in percentage and in absolute terms (million cubic meters).

	Percentage oversupply			Absolute oversupply (M m^3)		
Scenario	NZE	APS	STEPS	NZE	APS	STEPS
2024	11%	9%	10%	12	11	12
2025	25%	22%	24%	27	25	27
2026	40%	33%	34%	44	39	39
2027	53%	42%	41%	58	49	49
2028	59%	44%	41%	64	52	50
2029	60%	42%	38%	65	51	47
2030	62%	40%	34%	67	50	45
2031	76%	41%	34%	75	51	44
2032	91%	41%	32%	83	50	43
2033	109%	41%	31%	90	50	41
2034	130%	41%	29%	97	50	39
2035	154%	39%	26%	104	49	36
2036	173%	46%	27%	108	54	36
2037	192%	52%	26%	111	58	35
2038	213%	58%	24%	114	61	33
2039	236%	63%	22%	116	64	30
2040	264%	70%	20%	118	67	28

Total capacity available, excluding steam turbine ships

Table 3: Oversupply of LNG shipping capacity (excluding steam turbine carriers) per year relative to the IEA WEO 2023 scenarios, in percentage and in absolute terms (million cubic meters).

	Percentage oversupply			Absolute oversupply (M m^3)		
Scenario	NZE	APS	STEPS	NZE	APS	STEPS
2024	-17%	-18%	-18%	-32	-32	-32
2025	-3%	-6%	-4%	-20	-21	-20
2026	12%	7%	7%	-4	-6	-5
2027	24%	16%	15%	13	8	8
2028	30%	18%	16%	27	18	17
2029	33%	17%	14%	33	22	19
2030	35%	17%	12%	35	21	18
2031	48%	18%	12%	38	21	16
2032	61%	18%	11%	47	22	16
2033	76%	19%	10%	55	23	15
2034	95%	19%	10%	63	23	14
2035	118%	20%	9%	71	24	13
2036	133%	25%	8%	79	24	11
2037	151%	31%	8%	83	29	11
2038	172%	37%	8%	88	34	11
2039	197%	44%	8%	92	40	11
2040	226%	52%	8%	97	45	11

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