Global Energy Monitor

Europe Gas Tracker Report 2024

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ABOUT GLOBAL ENERGY MONITOR

Global Energy Monitor (GEM) develops and analyzes data on energy infrastructure, resources, and uses. We provide open access to information that is essential to building a sustainable energy future. Follow us at www.globalenergymonitor.org and on Twitter/X @GlobalEnergyMon.

ABOUT THE EUROPE GAS TRACKER

The Europe Gas Tracker is an online database that identifies, maps, describes, and categorizes gas infrastructure in the European Union and surrounding nations, including gas pipelines, liquified natural gas (LNG) terminals, gas-fired power plants, and gas fields. Developed by Global Energy Monitor, the tracker uses footnoted wiki pages to document each project and is updated annually.

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ON THE COVER

The cover photo shows the LNG Tanker Arctic Voyager in the Baltic Sea by Klaipeda, Lithuania. Image from Shutterstock with credit to Vytautas Kielaitis.

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FURTHER RESOURCES

To obtain data from the Europe Gas Tracker project, visit the Download Data page and the Summary Tables. All Global Energy Monitor data are freely available under a Creative Commons Attribution 4.0 International Public License unless otherwise noted.

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Europe Gas Tracker Report 2024

KEY POINTS

- With €84.1 billion in new liquefied natural gas (LNG) terminals and gas pipelines in planning, a gas infrastructure buildout is proceeding in Europe as if the region were still in crisis, even though it is in a far more secure position than it was two years ago. Compared to one year ago, there is 9% more LNG import capacity in development and 18% more pipeline projects by length in development. If built, these projects would increase Europe's total gas import capacity by 55%.
- New gas infrastructure in Europe is unnecessary. Europe already has two times as much LNG import capacity as LNG demand, and this gap could grow to a factor of four by 2030 if planned projects are built. Increasing Europe's gas import capacity also fails to address energy security risks inherent to the fuel: It is subject to price volatility and supply disruptions.
- LNG terminals and gas pipelines already under construction could, if used at full capacity, result in additional greenhouse gas emissions totaling 195 megatonnes CO_2 equivalent (CO_2e) per year, equivalent to that of 50 coal plants and at odds with the European Union's (EU) plan to reduce emissions by 55% by 2030. Including proposed projects, this figure grows six-fold. Meanwhile, renewables generation in Europe is on the rise, with generation from wind power surpassing that of gas for the first time in 2023. Doubling down on gas would be out of step with Europe's energy transition.
- An emerging hydrogen buildout with 35,000 kilometers (km) of hydrogen transmission pipelines planned threatens to justify building new gas infrastructure while offering false climate solutions, and recent EU policies offer major support to these plans.
- Although Europe's LNG plans have advanced quickly, several high-profile project setbacks in 2023 could indicate waning enthusiasm for LNG. Import projects in Ireland, Latvia, and Poland totaling 16.8 billion cubic meters per year (bcm/y) face uncertain futures due to environmental objections or low interest among their backers. Overall, GEM finds that 17.6 bcm/y of LNG import capacity in development is shelved and at least 60.6 bcm/y delayed.

EXECUTIVE SUMMARY

As Europe emerges from the second winter since Russia's invasion of Ukraine, the region appears to be in a far more secure position than it was at the start of its gas crisis. Nonetheless, data from Global Energy Monitor (GEM) show the push to build new LNG import terminals and gas pipelines, currently estimated to cost €84.1 billion, continues as if the region were on crisis footing.

According to GEM's Europe Gas Tracker, European countries are developing 248.7 bcm/y in new LNG import capacity and 16,491 km in new gas transmission pipelines, which includes cross-border pipelines capable of importing a further 46 bcm/y of gas into Europe. In the year since GEM's 2023 report on the Europe Gas Tracker, eight LNG terminals were brought online, boosting the region's import capacity by one-fifth, and the slate of new projects in development has grown by 9% for LNG import capacity and 18% for gas pipelines length. If built, this gas infrastructure could increase Europe's import capacity by as much as 55%.

Proposals to build new LNG terminals risk exacerbating the underutilization of existing gas infrastructure and saddling Europe's economies with expensive stranded assets, as the region plans to sharply reduce greenhouse gas emissions in the coming years. A wave of new gas projects would be inconsistent with the energy transition envisioned in European policy.

Meanwhile, industry and government support is coalescing behind a parallel 35,000 km buildout of new hydrogen and "hydrogen-ready" gas pipelines. This proposed hydrogen expansion would provide the gas industry an opportunity to further entrench methane gas in Europe's energy transition, since many projects would begin operating with gas or blended hydrogen. Because of the technical and economic challenges in transitioning gas infrastructure to hydrogen, a hydrogen network as currently envisioned by industry could offer implausible or even counterproductive climate solutions.

This report analyzes data from GEM's Europe Gas Tracker, updated through the end of January 2024, focusing on LNG terminals and gas transmission pipelines. The full Europe Gas Tracker data set is available for download on GEM's website and additionally includes data on oil- and gas-fired power plants and extraction sites.[1]

1. For more information on the scope of the Europe Gas Tracker, see the tracker's methodology page. For global data on gas pipelines and LNG terminals, see GEM's Global Gas Infrastructure Tracker.

THE STATE OF EUROPE'S GAS BUILDOUT

Europe has emerged from its gas crisis

After Russia's invasion of Ukraine in February 2022, the EU vowed to curtail Russian gas imports at the risk of facing gas shortages. The EU consumes gas predominantly for power and heat generation, industry, and household use, with about one-third of households relying on gas for heating. In 2021, the bloc was dependent on Russia for about 45% of its gas imports. The European Commission's REPowerEU plan, launched in May 2022, set out a roadmap for the EU to reduce its dependence on Russian gas by curbing gas demand, boosting renewable energy deployment, and filling the immediate shortfall in gas with U.S. LNG imports, among other actions. As Europe drew LNG cargoes away from Asia, LNG prices spiked, turning Europe's crisis into a global gas crisis. Wealthier importers like Japan paid exorbitant prices for LNG, and emerging economies such as Bangladesh and Pakistan were locked out of the market entirely.

Now, as Europe emerges from its second winter since the invasion, a case can be made that Europe's gas crisis is over. Gas storage levels have been higher than average the past two winters, with storage sites 99.6% full this November, and Europe is capable of importing enough gas from global markets (even if at great expense) to meet demand. As of January 2024, prices for gas deliveries were around €36 per megawatt-hour (MWh), which is above the average between 2015 and 2019 but not exceptionally high.

Meanwhile, the EU has made significant progress toward achieving its goals in the REPowerEU plan. According to Columbia University's REPowerEU Tracker, the region is on track to eliminate Russian gas imports by 2027, nearly on track to deploy 592 gigawatts (GW) of solar photovoltaic capacity by 2030, and on track to reduce its 2030 energy consumption 13% lower than an EU forecast made in 2020.

Perhaps most importantly, Europe's demand for gas is down and forecasted to decline this decade. The EU's total gas consumption fell by over 7% in 2023 compared to 2022. High gas prices have depressed industrial gas demand—which, as of June 2023, was at its lowest level in four years—and industrial demand may never fully recover to pre-crisis levels. Ember's European Electricity Review 2024 found that gas generation has fallen for four years in a row, and for the first time, total generation from gas was surpassed by that of wind power. Ember also found that wind and solar remained cheaper than gas in 2023 and that renewable costs will only continue to fall.

According to the Institute for Energy Economics and Financial Analysis (IEEFA) European LNG Tracker, gas demand is forecasted to continue to decline by 11% between 2023 and 2030. Importantly, if the EU is to meet the goal in its Fit for 55 plan to reduce emissions by 55% by 2030, gas consumption must fall by at least 33%, according to analysis by E3G.

As the threat of gas shortages passes and overall gas demand is on the decline, new gas import projects are out of step with Europe's energy transition.

Yet Europe's gas buildout could be far from over

Since Russia's invasion of Ukraine, Europe has brought online nine new LNG terminals and four new gas transmission pipelines, in addition to several expansion projects at existing facilities (Table 1). The eight LNG import terminals added in 2023 alone add a combined 46.5 bcm/y in import capacity, an increase of 17% to the region's existing capacity. The majority of these LNG terminals are floating storage and regasification units (FSRU), which have been favored because they can be deployed faster and more flexibly than land-based terminals.

Table 1. LNG import terminal and gas pipeline projects commissioned in Europe between January 2022 and January 2024

Project name	Country	Capacity (bcm/y)	Estimated cost (million €)	Month commissioned
Pipeline projects				
Beglej-Dermantsi-Batultsi-Kalugerovo Pipeline Rehabilitation and Partial Replacement	Bulgaria		67.48	January 2022
Medgaz Gas Pipeline Capacity Expansion	Spain	2.7	67	February 2022
Gas Interconnection Poland-Lithuania (508 km)	Poland, Lithuania	2.4	566	May 2022
Poland-Slovakia Gas Pipeline (165 km)	Poland, Slovakia	5.7	270	August 2022
Baltic Pipe Project	Norway, Denmark, Sweden, Poland	10.0	2,100	September 2022
Gas Interconnector Greece–Bulgaria (IGB)	Greece, Bulgaria	3.0	240	October 2022
Wilhelmshaven LNG Terminal Pipeline	Germany	10.0	26	December 2022
Bulgaria-Serbia Interconnector Gas Pipeline	Bulgaria, Serbia	1.8	170	December 2023
Trans-Anatolian Gas Pipeline Capacity Expansion	Georgia, Türkiye, Greece	8.0	–	2023
LNG terminal projects				
Świnoujście Polskie LNG Terminal Expansion	Poland	1.2	427	January 2022
Adriatic LNG Terminal Expansion	Italy	1.0	–	March 2022
Gate LNG Terminal Expansion	Netherlands	4.0	–	May 2022
Krk FSRU Expansion	Croatia	0.3	–	April 2022
Eemshaven FSRU	Netherlands	8.0	500	October 2022
Hamina LNG Terminal	Finland	0.1	100	October 2022
Revithoussa LNG Terminal FSU Capacity Expansion	Greece	0.8	91	November 2022
Wilhelmshaven FSRU	Germany	7.8	450	January 2023
Fos Cavaou LNG Terminal Expansion	France	1.75	–	2022
Inkoo FSRU	Finland	5.0	460	January 2023
Lubmin FSRU Phase 1	Germany	7.8	33.3	January 2023
Brunsbüttel FSRU	Germany	5.0	1,000	February 2023
Gulf of Saros FSRU	Türkiye	7.6	861	April 2023
Piombino FSRU	Italy	5.0	566	July 2023
El Musel LNG Terminal	Spain	8.0	2,440	August 2023
Le Havre FSRU	France	5.0	566	October 2023
Dunkirk LNG Terminal Expansion	France	2.0	–	2023

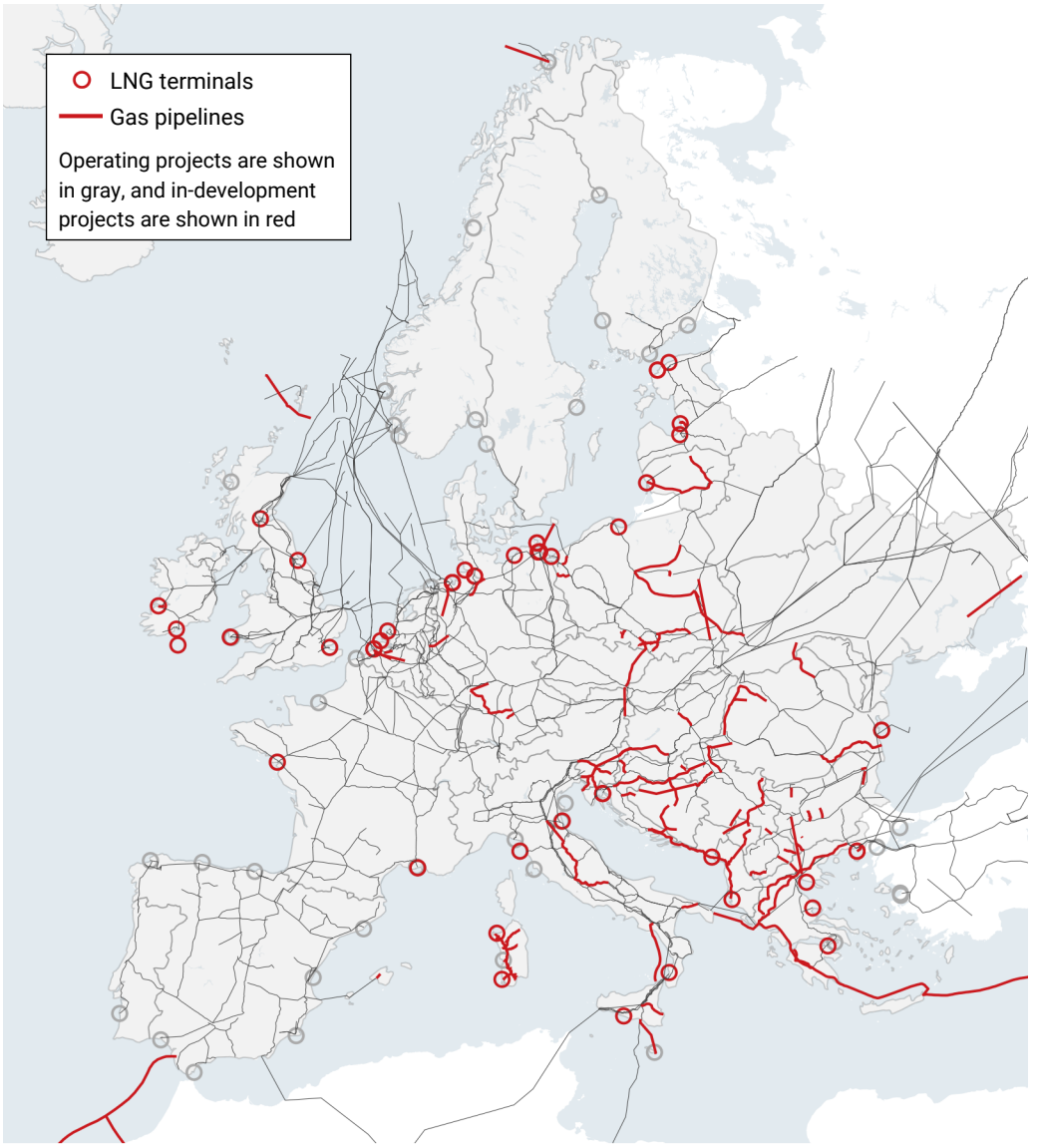
Source: Europe Gas Tracker, Global Energy Monitor

Note: Costs are not estimated for projects in which no new infrastructure was added (e.g., debottlenecking projects) and reported costs are not available. Average values to construct gas pipelines and LNG terminals were used for Europe based on regional calculations with GEM's cost data; for more information, see the Global Gas Infrastructure Tracker (GGIT) cost estimate methodology and Table A6.

A large buildout of new gas infrastructure is still in development. European countries are developing 248.7 bcm/y in new LNG import capacity and 16,491 km of new gas transmission pipelines, which includes cross-border pipelines capable of importing a further 46 bcm/y of gas into Europe (Figure 1).

GEM estimates the total cost of these projects to be €84.1 billion. About one-fifth of LNG import capacity in development is already in construction (46.7 bcm/y), and likewise for one-tenth of gas pipelines (1,878 km) (Table A1).

Figure 1: European buildout would serve regional import goals
Operating and in-development LNG terminals and gas pipelines in Europe



Source: Global Gas Infrastructure Tracker

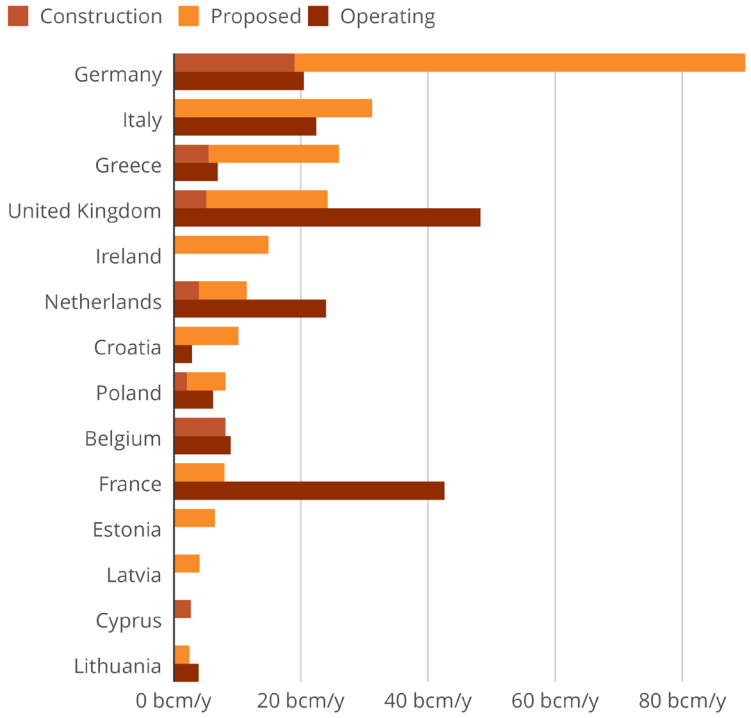
Within Europe, the countries with the most LNG import capacity in development are Germany (89.9 bcm/y), Italy (31.3 bcm/y), Greece (26 bcm/y), the United Kingdom (24.2 bcm/y), and Ireland (14.9 bcm/y) (Figure 2; Table 2). After China and India, Germany has the most LNG import capacity in development globally. Strong government and private sector support for LNG have launched the country to becoming one of Europe's top LNG importers, up from having no import terminals less than two years ago.

In terms of gas pipelines, the countries with the largest plans are Greece (2,795 km), Italy (1,923 km), Poland (1,516 km), Serbia (1,081 km), and Romania (1,052 km) (Table 2). There are just five pipelines in development that would import gas into Europe, including the proposed 5,660 km Nigeria-Morocco Gas Pipeline, which would bring gas into Spain from Nigeria, and proposed capacity expansions to the existing Trans-Anatolian Gas Pipeline (TANAP), which runs from Georgia through Türkiye to Greece.

Even though Europe's LNG plans have advanced quickly since early 2022, a few projects faced setbacks in 2023 that could indicate waning enthusiasm for LNG. Shannon FSRU (8.2 bcm/y) in Ireland was denied permission by a planning board due to its policy on fracked gas. Skulte LNG Terminal (4.1 bcm/y) lost support from the government of Latvia because it deemed the project no longer necessary. Poland's Gaz-System decided to shelve a second planned FSRU (4.5 bcm/y) at its Polish Baltic Sea Coast FSRU project because of low interest in booking its capacity. Overall, GEM finds that 17.6 bcm/y of LNG import capacity in development is shelved and at least 60.6 bcm/y delayed.

Figure 2: Europe's LNG import plans led by Germany, Italy, and Greece

LNG import capacity by status, billion cubic meters per year (bcm/y); countries ordered by capacity in development



Note: Includes countries with at least 1 bcm/y of import capacity in development
Source: Europe Gas Tracker, Global Energy Monitor

Table 2: Planned buildout and estimated cost for gas transmission pipelines and LNG import terminals in Europe, including all projects proposed or under construction

Country	Pipeline length (km)	Pipeline cost (million €)	LNG import capacity (bcm/y)	LNG terminal cost (million €)	Total cost (million €)
Albania	326	323			323
Andorra					
Austria	59	214			214
Belarus					
Belgium	148	533	8.2	116	649
Bosnia and Herzegovina	677	319			319
Bulgaria	547	1,489			1,489
Croatia	871	1,056	10.2	1,180	2,236
Cyprus	921	2,711	2.7	542	3,253
Czech Republic	232	487			487
Denmark	52	187			187
Estonia	1	4	6.5	1,150	1,154
Finland					
France			8.0	2,946	2,946
Germany	735	2,554	89.9	18,084	20,638
Gibraltar					
Greece	2,795	8,654	26.0	4,759	13,413
Hungary	189	496			496
Iceland					
Ireland	26	94	14.9	1,752	1,846
Israel	246	707			707
Italy	1,923	5,517	31.3	5,689	11,206
Kosovo					
Latvia	32	26	4.1	110	136
Liechtenstein					
Lithuania	432	1,559	2.5	412	1,971
Luxembourg					
Malta	70	181			181
Moldova					
Monaco					
Montenegro	141	252	0.5	89	341
Netherlands	61	220	11.5	1,587	1,807
North Macedonia	372	345			345
Norway	195	352			352
Poland	1,516	3,856	8.2	1,554	5,410
Portugal					
Romania	1,052	934			934
San Marino					
Serbia	1,081	1,377			1,377
Slovakia					
Slovenia	528	1,114			1,114
Spain	523	1,947			1,947
Sweden					
Switzerland					
Türkiye	156	269			269
Ukraine	350	1,164			1,164
United Kingdom	236	761	24.2	4,463	5,223
Total	**16,491**	**39,702**	**248.7**	**44,434**	**84,137**

THE COSTS OF NEW GAS INFRASTRUCTURE: €84.1 BILLION, 300 COAL PLANTS' EMISSIONS, AND MORE OVERCAPACITY

A continued gas buildout in Europe will be costly, in more ways than one. The capital expenditure and fuel costs associated with new projects could burden European governments and citizens; emissions from new projects risk pulling the region away from its own climate goals; and more LNG import terminals could exacerbate inefficiencies at existing facilities, where underutilization is the norm.

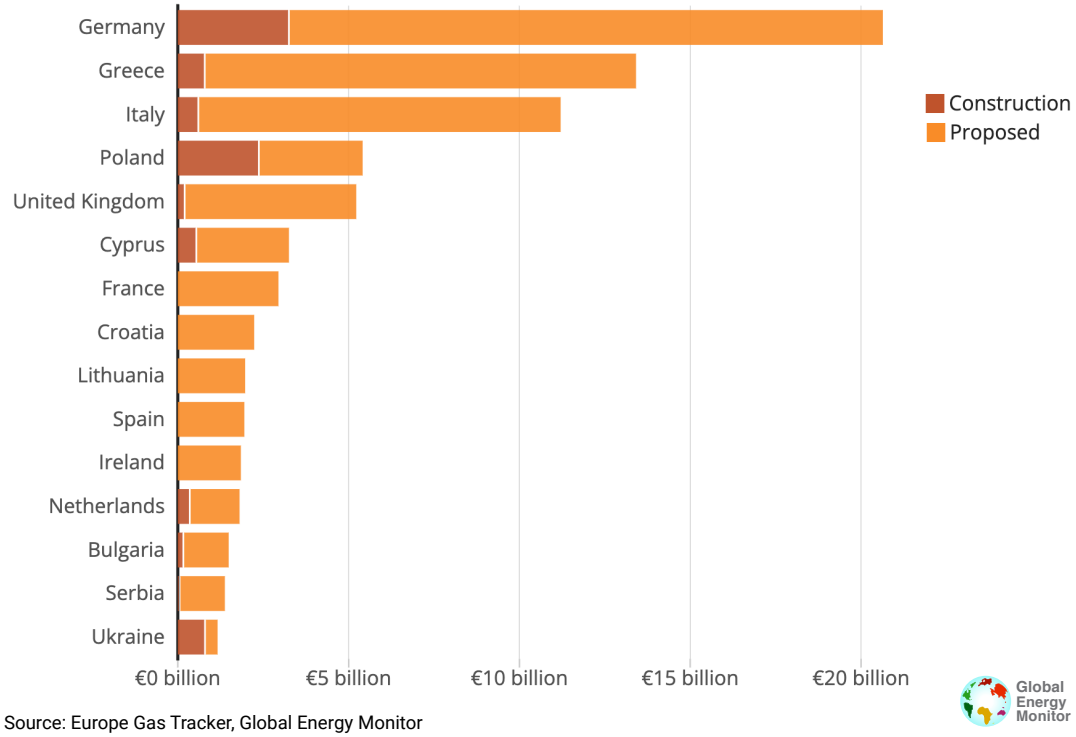
The price tag of Europe's planned gas buildout is €84.1 billion

GEM estimates that the total capital expenditure in new European gas infrastructure could be €44.4 billion for LNG terminals and €39.7 billion for gas pipelines, for a total of €84.1 billion (Table 2).[2] Projects already in construction amount to a total of €10 billion. Germany, Italy, and Greece, which are developing the most gas infrastructure in Europe, are together responsible for half of these plans (€45.3 billion) (Figure 3).

As Europe plans to decarbonize over the coming decades, continued investment in new gas infrastructure, built to last for decades, increases the risk that countries will be saddled with costly stranded assets. Furthermore, these steep costs represent only the upfront payment for an expanded gas economy. European gas consumers paid over €1 trillion for the fuel between 2021 and the summer of 2023.

Figure 3: Half the costs of Europe's gas buildout split among Germany, Greece, and Italy

Top fifteen European countries' estimated capital expenditures in prospective LNG import terminals and gas pipelines (billion €)



Source: Europe Gas Tracker, Global Energy Monitor

2. GEM's cost estimates use reported project costs, where available, and use these data to calculate regional averages applied to projects without reported cost data. For more information on this methodology, see the page for the GGIT cost estimates.

New gas pipelines and LNG terminals could boost Europe's emissions by up to one-quarter

The EU's emissions goals are incompatible with the planned gas buildout. The EU's Fit for 55 plan aims to reduce emissions by 55% by 2030, and in February, the European Commission called for an additional goal of reducing emissions by 90% by 2040. In December 2023, seven European economies responsible for almost half of the EU's power sector committed to be fossil-free by 2035 under the Pentalateral Energy Forum. France, Germany, and the Netherlands are among those making the pledge.

GEM estimates that the LNG terminals and gas pipelines already in construction in Europe, if fully used, could result in an additional 195 megatonnes CO_2 equivalent (CO_2e), on par with the annual emissions of 50 coal plants. Including proposed projects, the additional annual emissions could grow six-fold to 1.1 gigatonnes CO_2e, equivalent to that of nearly 300 coal plants, or a quarter of Europe's emissions in 2020 (Table 3).[3] It is unlikely all projects in development will be constructed, but over decades, when Europe plans to slash emissions, additional gas consumption will make it only more difficult to reach these goals.

As Europe's gas demand declines, new LNG import infrastructure will only worsen existing overcapacity

As gas demand falls across Europe and is set to keep falling due to climate policy goals, new infrastructure to import gas into Europe is not needed. Importantly, utilization rates for existing LNG import infrastructure show there is already ample spare capacity. According to IEEFA, between January and September 2023, the average utilization rate of Europe's LNG import terminals was merely 58%. An analysis from Food and Water Action Europe corroborates these findings and notes that the average utilization rate in Germany is just 50%. Germany is planning the world's third-largest buildout of LNG import terminals, yet its three operating terminals, all of which were proposed and built in response to the gas crisis, are operating at just half capacity. Greece has the third-most LNG capacity in development in Europe, after Germany and Italy, but the lowest terminal utilization rate in Europe at 36%.

GEM's data on infrastructure plans paired with demand forecasts reveal a widening gap between import capacity and demand. In terms of LNG

Table 3: Estimated emissions from LNG import terminals and gas import pipelines under development, for the top ten European countries

Country	LNG Import Terminals ($MtCO_2e$)	Gas Import Pipelines ($MtCO_2e$)	Total Emissions ($MtCO_2e$)
Germany	376		376
Greece	109	24*	132
Italy	131		131
United Kingdom	101		101
Ireland	62		62
Netherlands	48		48
Spain		45	45
Croatia	43		43
Poland	34		34
Belgium	34		34
Other	102		102
Total	**1,040**	**68**	**1,108**

*Greece's gas pipeline import emissions are shared with Türkiye, both of which would import gas through expansions to the Trans-Anatolian Gas Pipeline.

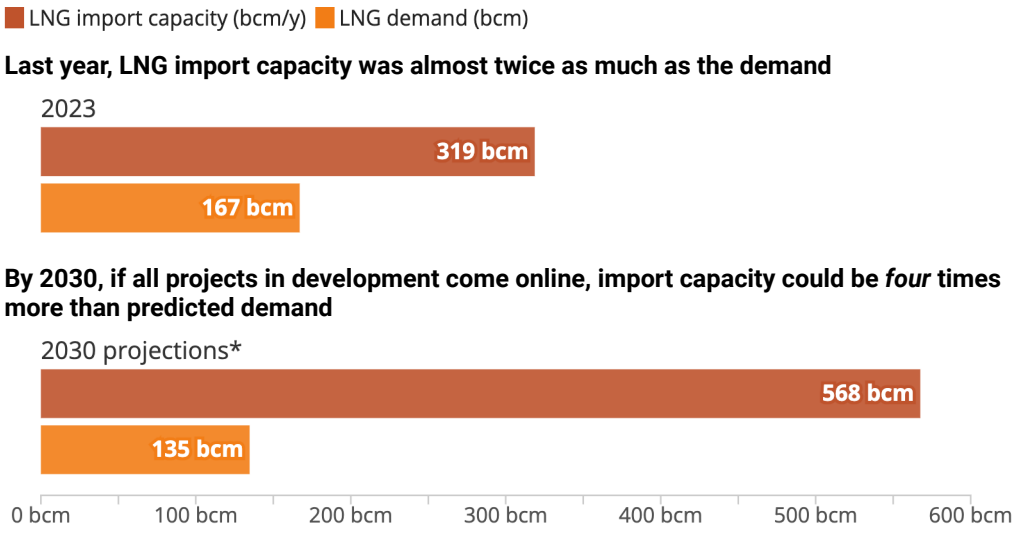
3. Emissions are estimated using import capacity values scaled by estimates presented in Kühne 2021. This methodology uses the global warming potential for methane over a 20–year time period.

capacity alone, Europe's import capacity in 2023 (318.7 bcm/y) exceeded its LNG demand (167 bcm) by nearly a factor of two. If all of the import capacity in development were built by 2030, Europe's LNG import capacity (567.5) would exceed IEEFA's forecast for LNG demand (134.7 bcm) by over a factor of four (Figure 4).

When combining import capacity for LNG with that of piped gas, the picture is similar. The IEA's 2023 World Energy Outlook finds that gas demand in Europe will fall by 28% by the end of the decade, from 544 bcm in 2022 to 390 bcm in 2030, if countries meet their climate targets (IEA's Announced Pledges Scenario). Including infrastructure under construction alone, Europe is on track to have an excess of 352 bcm/y import capacity via LNG terminals and gas pipelines by 2030, or enough spare capacity to import as much gas as China consumed in 2022. If everything proposed is developed as well, that gap almost doubles to 601 bcm/y.[4]

Europe already has sufficient import capacity, as evidenced by its successful pivot away from piped Russian gas imports. New import projects would only widen the gap between gas demand and capacity. The wave of new LNG terminals represents a strategic shift toward LNG imports for energy security, but Europe already has enough LNG import infrastructure to meet its needs, for now and for the future. Furthermore, increased import capacity fails to address energy security risks inherent to gas—that it is a global commodity subject to price volatility and supply disruptions.

Figure 4: Europe's LNG import capacity vs. demand gap is set to widen
LNG import capacity and demand in 2023 and projections for 2030



Source: Europe Gas Tracker, Global Energy Monitor & European LNG Tracker, IEEFA •
*2030 data: GEM's maximum LNG import capacity, assuming all projects in development are completed, and IEEFA's LNG demand forecast

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4. Data from the European Network of Transmission System Operators for Gas (ENTSOG) are used for Europe's existing gas pipeline import capacity. The calculations also factor in IEA's forecast for Europe's domestic gas production, as well as its total gas demand, to calculate its imported gas demand.

THE 35,000 KM HYDROGEN BUILDOUT: A RED HERRING

Alongside the EU's slate of LNG terminals and pipelines in development, a parallel expansion of gas infrastructure is being planned — for hydrogen. A massive network of hydrogen-based power infrastructure known as the European Hydrogen Backbone (EHB), promoted by 33 Transmission System Operators (TSOs), has been gaining momentum. Most recently, the European Commission adopted its 6th list of Projects of Common Interest (PCI) in November, which offers cross-border EU energy projects accelerated permitting and funding, and for the first time, as many as 65 of 166 projects are hydrogen-related. Much of the industry support around EU hydrogen infrastructure contends that the fuel offers a way to decarbonize the EU's power sector while retaining, and continuing to profit from, investments in existing gas (i.e., methane gas) infrastructure. However, methane gas infrastructure is largely unsuitable for hydrogen gas, and, as currently envisioned, the EHB could constitute a red herring for the bloc's decarbonization efforts.

According to GEM's Global Gas Infrastructure Tracker, about 35,000 km of hydrogen transmission pipelines are currently proposed across Europe with the intention of carrying 100% hydrogen, or close to that (Figure 5; Table A4).[5] Among these proposals, many of which form major national hydrogen networks or ambitious offshore routes weaving together European cities and production centers, nearly 12,700 km (36%) are proposed as repurposed methane gas pipelines, another 5,200 km (almost 15%) will involve some combination of new-build hydrogen infrastructure and repurposed methane infrastructure, and the remaining 17,500 km (50%) will be new-build hydrogen transmission pipelines. When considering all infrastructure that is proposed to be "hydrogen capable" — pipelines that can carry any amount of hydrogen — this collective length swells to over 63,000 km. Such proposals often hinge on the idea of "repurposed" methane pipelines — a term roundly touted as a misnomer, as methane gas pipelines are unsuitable for carrying hydrogen and will essentially need to be completely rebuilt. Just one hydrogen pipeline is under construction in the Netherlands, and only 2% of hydrogen pipelines by length have reached a final investment decision (FID) or are in another advanced stage of development, according to the European Network of Transmission System Operators for Gas (ENTSOG).

The European Commission's 6th PCI list adds substantial weight to these plans. Eligible for faster permitting and public funding are hydrogen projects costing in total over €50 billion, according to an estimate from Food and Water Action Europe. Large swaths of the EHB are among these latest PCI projects, including the Central European Hydrogen Corridor, the H2ercules Pipeline, the West Danish Hydrogen Network, the Belgian Hydrogen Backbone, the Nordic-Baltic Hydrogen Corridor, and the Nordic Hydrogen Route.

Of the 35,000 km of proposed hydrogen transmission pipelines tracked by GEM, about 22,400 km are included within projects on the 6th PCI list, led by massive proposed networks in Germany and Spain (Table A4). But details on these projects are scarce. Many of their developers claim that substantial portions of project routes will consist of repurposed methane gas pipelines but feature no technical details on what this repurposing entails, only illustrative rather than accurate maps of pipeline routes, and few details on exactly how much hydrogen will be carried in the pipelines.

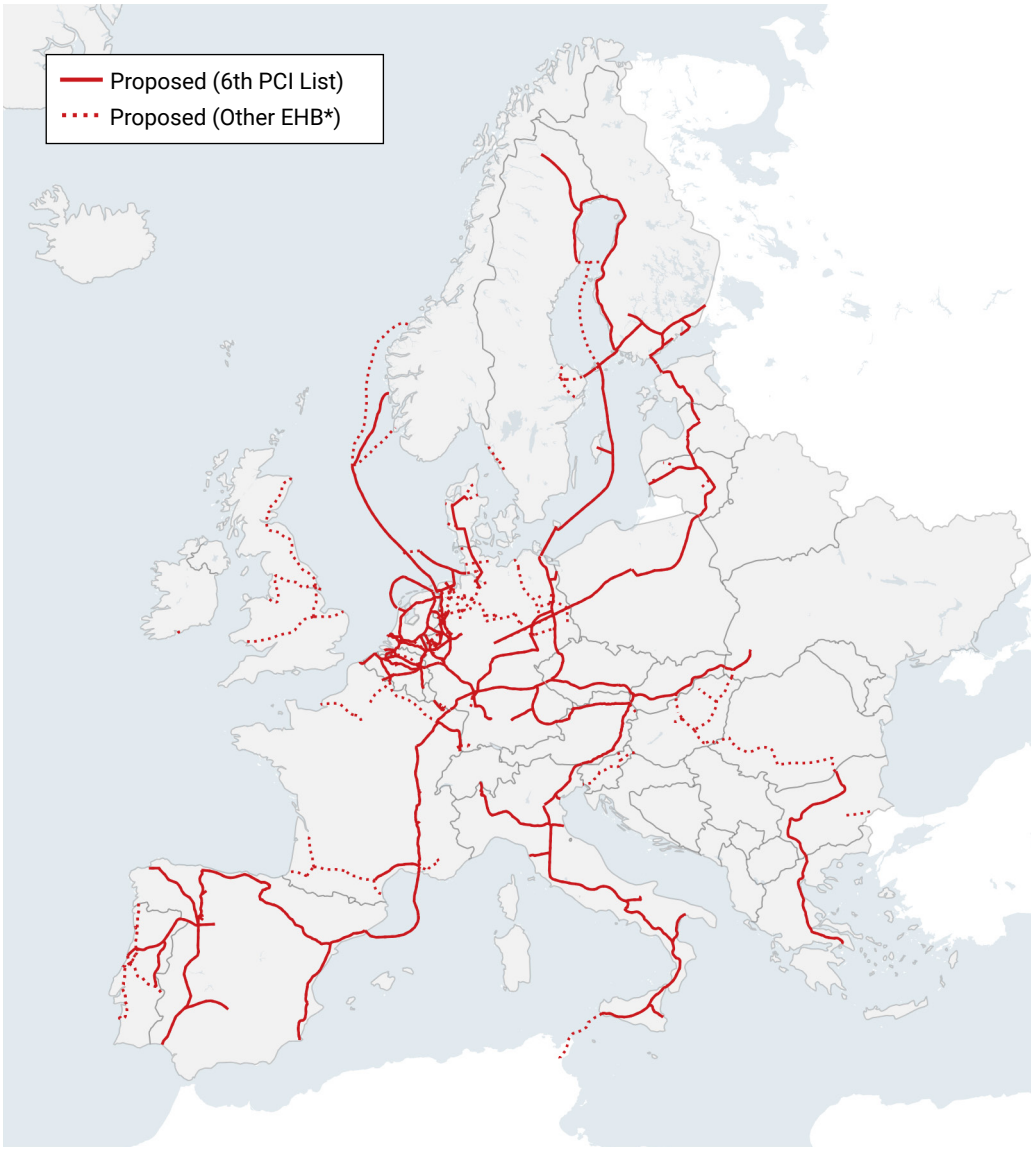
5. Some of the hydrogen pipeline classification data discussed here are not yet published along with GEM's gas pipeline data set, but are available upon request.

Furthermore, some hydrogen pipelines on the PCI list appear nearly identical to older methane gas pipeline projects that were proposed for PCI status or that made it onto previous PCI lists, begging the question as to whether "hydrogen-readiness" could be little more than a license to build gas projects. Some examples include massive, cross-border connections such as the H2Med Pipeline project (the newest iteration of the Midi-Catalonia Gas Pipeline) and the SoutH2 Pipeline (a slightly altered GALSI Pipeline), as well as a number of smaller, national projects.

While hydrogen produced with renewable energy could be a low-carbon solution for certain,

Figure 5: Europe pivots to hydrogen

H_2 transmission pipelines proposed in Europe by 2030



Source: Global Gas Infrastructure Tracker

*Other EHB = other pipelines in the European Hydrogen Backbone not on the 6th PCI list

hard-to-decarbonize sectors, the emerging vision of a methane gas system that will seamlessly switch to hydrogen for power and heating is a potentially dangerous distraction. There are multiple issues with substituting hydrogen into existing methane gas infrastructure, including:

- **Methane gas infrastructure cannot be easily repurposed for hydrogen.** Methane gas infrastructure is largely unsuitable for hydrogen gas, either pure or blended, because of the differences in the gases' physical properties. To accept hydrogen, pipelines, compressors, turbines, and other components would require major overhauls; most existing infrastructure can only carry miniscule amounts of hydrogen in its current state. Depending on the type of pipeline material used, cheaply repurposing methane pipelines on the scale envisioned by proponents of the EHB is virtually impossible.

- **Blending hydrogen into methane gas-fired generation offers little in the way of emissions reductions.** Most new gas turbines can only burn a maximum of 20–40% hydrogen within their fuel mix; expanding beyond that will require almost total overhauls of the turbines. While this may initially seem like a quick route to decreasing emissions from methane gas by 20–40%, burning a 20% mixture of hydrogen doesn't translate to an equivalent decrease in carbon emissions. This is because hydrogen has a much lower energy output by volume than methane gas, so the 20% blend of hydrogen only reduces methane usage by 7%. Even among these supposedly "hydrogen-capable" turbines, startlingly few have any realistic plans to source the hydrogen, or a plan for a real phase-out of gas. Projects such as the Crodux Slavonski Brod power station or the Ca's Tresorer power station, which have made progress toward building localized hydrogen infrastructure, will only burn between 2–10% hydrogen initially—hardly enough to make even the smallest dent in their total emissions.

- **Hydrogen for heating and power is inefficient.** The process of producing green hydrogen for power and heat is expensive and a less efficient use of renewable resources than simply using renewable power directly. As with any transfer of energy, converting power to hydrogen is an imperfect process. The efficiency of the best electrolysers stands at about 70%, with the other 30% being lost in the production of the hydrogen. Expert analysis also suggests that taking into consideration loss during production and transmission reduces the overall emissions reductions from blending 15% hydrogen into the system to less than 2%—a frustratingly low number considering the scale of the investments proposed.

- **There is a massive gap between current green hydrogen production and the requirements of the EHB.** As of 2022, the world consumed 95 million tons of hydrogen; 62% was produced with gas, 21% with coal, and 16% with oil (emitting more carbon into the atmosphere than the global aviation industry in 2021 in the process). Just 0.7% of global hydrogen production today is low-emissions electrolysis. The EU produced 8 million tonnes of hydrogen in 2021, of which 96% was from methane cracking. Accordingly, the European Commission estimates that some €24–40 billion is required to build the 65 GW of hydrogen electrolysis needed, in addition to the €3–400 billion required to develop the 150–200 GW of renewable energy required to power it—an amount almost equal to all of Europe's existing wind-powered energy capacity. While concrete plans for how such large-scale production can be achieved are not yet available, it is likely that if green hydrogen can't be found to fill these pipelines, the industry will turn to fossil-based hydrogen in order to meet the needs of the investments made, thereby destroying any possibility of emissions reductions. In its Renewables 2023 report, the IEA revised its hydrogen forecast downward, finding that just 7% of hydrogen projects planned to start by 2030 will start by then due to a lack of offtakers and other challenges.

Industry experts have highlighted that many projects, including those selected as PCI candidates, will require major changes to be feasible, under much changed market conditions for hydrogen. In January 2024, IEA head Fatih Birol said "Hydrogen will definitely become more important," but noted that "the current excessive expectations could distract from the fact that there are more important problems to solve."

CONCLUSION

Europe's energy landscape is different than it was a year or two ago. The region is no longer in an energy crisis and European countries have successfully procured enough gas two winters in a row, all while power sector trends point to an accelerating transition to clean energy. Still, the rush to build new gas infrastructure sparked by the gas crisis continues.

EU countries' policies send mixed messages of support to the gas industry. On one hand, the bloc has set strong climate targets: reducing emissions 55% by 2030 and achieving net zero emissions by 2050, potentially with an interim goal of reducing emissions 90% by 2040. Its new methane regulation and the expansion of its cap-and-trade emissions trading system could slash emissions from existing gas imports and disincentivize LNG consumption. At the same time, LNG projects continue to receive public support from the governments of Germany and Italy, among others. And the EU's 6th PCI list lends legitimacy and policy support to a massive expansion of what is nominally called hydrogen infrastructure, which could ultimately lock in more gas consumption, rather than usher in a new low-carbon sector.

The stakes of Europe's energy planning are high, and governments should consider how to better align a looming €84.1 billion gas buildout with the region's energy transition.

APPENDIX

Table A1: LNG import infrastructure under construction and proposed in Europe

Country	Terminal name	Capacity (bcm/y)	Cost (million €)
	Construction		
Greece	Alexandroupolis FSRU	5.5	360
Germany	Brunsbüttel LNG Terminal	8.0	1,300
Cyprus	Cyprus LNG Terminal	2.7	542
Netherlands	Gate LNG Terminal Expansion	4.0	350
United Kingdom	Grain LNG Terminal Expansion	5.2	200
Estonia	Paldiski FSRU		500
Germany	Stade FSRU	6.0	990
Germany	Wilhelmshaven TES FSRU	5.0	825
Belgium	Zeebrugge LNG Terminal 2024 Expansion	6.4	116
Belgium	Zeebrugge LNG Terminal 2026 Expansion	1.8	
Poland	Świnoujście Polskie LNG Terminal Expansion 2	2.1	934
Subtotal		**46.7**	**6,117**
	Proposed		
Greece	Argo FSRU	4.6	227
Montenegro	Bar LNG Terminal	0.5	89
Romania	Black Sea LNG Terminal Import Facility		
Greece	Dioriga FSRU	2.6	300
France	Fos Cavaou LNG Terminal Expansion 2	5.5	2,446
Italy	Gioia Tauro LNG Terminal	12.0	1,000
United Kingdom	Grangemouth FSRU	6.8	489
Lithuania	Klaipeda FSRU Expansion	2.5	412
Croatia	Krk FSRU Phase 1 Expansion	3.2	25
Croatia	Krk FSRU Phase 2 Expansion	7.0	1,155
Germany	Lubmin FSRU Phase 2 (Vessel 1)	2.0	12
Germany	Lubmin FSRU Phase 2 (Vessel 2)	7.0	42
Germany	Lubmin RWE FSRU	5.0	825
France	Montoir LNG Terminal Expansion	2.5	500
Germany	Mukran FSRU Phase 1		
Germany	Mukran FSRU Phase 2	13.5	2,227
Estonia	Paldiski LNG Terminal	2.5	400
Ireland	Pilot Cork FSRU	4.1	673
Poland	Polish Baltic Sea Coast FSRU	6.1	620
Albania	Port of Vlora FSRU		
Italy	Porto Empedocle LNG Terminal	8.0	1,000
Italy	Porto Torres FSRU	5.0	2,224
Italy	Portovesme FSRU		260
Ireland	Predator FSRU	2.6	429
Italy	Ravenna FSRU	5.0	1,000
Latvia	Riga FSRU Revived Project		
Germany	Rostock LNG Terminal	1.1	485
Ireland	Shannon FSRU	8.3	650
Latvia	Skulte LNG Terminal	4.1	110
United Kingdom	South Hook LNG Terminal Expansion	6.3	2,784
Germany	Stade LNG Terminal	13.3	1,000
Estonia	Tallinn LNG Terminal	4.0	250
United Kingdom	Teesside GasPort FSRU Recommissioned Project	6.0	990
Greece	Thessaloniki FSRU	7.3	1,204
Greece	Thrace FSRU	6.0	2,668
Italy	Toscana FSRU Expansion (Efficiency)	1.3	206
Germany	Wilhelmshaven NWO FSRU	9.0	1,485
Germany	Wilhelmshaven TES LNG Terminal	20.0	8,894
Netherlands	Zeeland Energy FSRU	7.5	1,237
Subtotal		**202**	**38,318**
Grand total		**248.7**	**44,434**

Table A2: Pipeline transmission infrastructure under construction and proposed for gas import into Europe

Country	Pipeline name	Status	Capacity (bcm/y)	Length in country (km)	Cost for country's segment (million €)
Türkiye	Arab Gas Pipeline Syria–Türkiye Extension (310 km total length)	Proposed		10	36
Spain	Nigeria-Morocco Gas Pipeline (5,660 km total length)	Proposed	30	138	559
Greece Türkiye	Trans-Anatolian Gas Pipeline Phase 3 Capacity Expansion	Proposed	7	0 new km	
Greece Türkiye	Trans-Anatolian Gas Pipeline TANAP X Capacity Expansion	Proposed	9	0 new km	
Ukraine	Taganrog-Melitopol-Berdyansk Gas Pipeline	Construction		221	796
Total			**46**	**148**	**594**

Table A3: All pipeline infrastructure (import, export, and within-Europe transmission) under construction and proposed within Europe's borders

Country	Pipeline name	Capacity (bcm/y)	Total pipeline length (km)	Estimated length in country (km)	Cost (million Euro)
	Construction				
Poland	Gustorzyn-Wronów Gas Pipeline		308	308	1,111
Italy	Methanization of Sardinia Project		573	573	600
Poland	Pogórska-Wola-Tworzen Gas Pipeline		168	168	301
Ukraine	Taganrog-Melitopol-Berdyansk Gas Pipeline		273	221	796
Pipelines with length < 150 km				609	1,111
Subtotal				**1,878**	**3,918**
	Proposed				
Italy	Adriatica Pipeline	8.8	170	170	554
Albania	Albania–Kosovo Gas Pipeline		212	107	109
Serbia				105	106
Lithuania	Amber Grid Gas Transmission System		287	287	1,035
Türkiye	Arab Gas Pipeline		310	10	36
Norway	Barents Sea Pipeline		195	195	352
Romania	Black Sea Shore–Podișor Gas Pipeline	15.0	308	308	360
Bosnia and Herzegovina	Bosnia and Herzegovina–Croatia South Interconnection Gas Pipeline	1.5	184	121	79
Croatia				63	41
Cyprus	Cyprus–Egypt Gas Pipeline	8.0	310	33	98
Czech Republic	Czech-Polish Interconnector Gas Pipeline (CPI)		207	155	211
Poland				52	70
Greece	EastMed Gas Pipeline	10	1,870	1,275	4,090
Cyprus				569	1,827
Türkiye				26	83
Slovenia	Hungary-Slovenia-Italy Interconnector Gas Pipeline	1.24	191	117	125
Hungary				74	79
Italy				1	1
Croatia	Interconnector Croatia-Serbia	7	182	109	93
Serbia				73	62
Croatia	Ionian Adriatic Gas Pipeline	5	540	262	284
Albania				176	191
Montenegro				102	111
Cyprus	Israel Cyprus Gas Pipeline	4	215	152	227
Israel				48	71
Israel	Israel–Egypt Offshore Gas Pipeline	10	593	137	493
Cyprus				43	157
Türkiye	Iğdır-Nakhchivan Gas Pipeline	0.5	160	79	6
Italy	Malta-Italy Gas Pipeline	2.03	159	89	229
Malta				70	181
Spain	Nigeria-Morocco Gas Pipeline	30.0	5,660	138	559
Romania	North–Vest Romania Pipeline		518	518	405
Croatia	Omišalj-Zlobin-Bosiljevo-Sisak-Kozarac-Slobodnica LNG main evacuation pipeline	10.0	180	180	198
Serbia	Paracin-Pancevo Gas Pipeline		239	239	65
Greece	Poseidon Gas Pipeline	15.0	976	914	3,183
Italy				62	217
United Kingdom	Rosebank Gas Pipeline		236	236	761
Italy	Sealine Tirrenica Gas Pipeline		255	255	920
Bosnia and Herzegovina	Serbia–Bosnia Interconnector Gas Pipeline	1.2	320	320	80
Bulgaria	Sofia-Sidirokastro Gas Pipeline		250	164	565
Greece				86	295
Germany	South German Gas Pipeline		250	250	902
Italy	Spain-Italy Offshore Interconnector	30.0	700	350	1,263
Spain				350	1,263
Poland	Wloclawek-Lomza Gas Pipeline		235	235	847
Pipelines with length < 150 km				5,310	12,903
Subtotal				**14,613**	**35,784**
Grand total				**16,491**	**39,702**

Table A4: Proposed hydrogen transmission pipeline infrastructure in Europe by member state, including blended hydrogen proposals

Country	6th PCI list (km)	Additional proposed (km)	Country total (km)
Germany	4,121	3,906	8,027
Spain	3,068	79	3,147
Finland	1,745	835	2,580
Italy	2,298	148	2,445
France	1,520	865	2,384
United Kingdom		2,000	2,000
Sweden	1,251	496	1,746
Netherlands	1,421	109	1,530
Norway	557	876	1,432
Portugal	515	797	1,312
Belgium	834	22	856
Austria	722	87	809
Denmark	575	222	798
Czech Republic	595	152	747
Poland	712	20	731
Hungary		675	675
Lithuania	518	138	655
Slovakia	585	46	631
Romania		599	599
Greece	465	12	476
Bulgaria	250	116	366
Ukraine	183	147	330
Slovenia		297	297
Latvia	235	6	241
Estonia	225	6	230
Ireland		12	12
Luxembourg		6	6
Total	**22,394**	**12,672**	**35,065**

Table A5: Top parent companies developing LNG terminals and gas pipelines, by total estimated cost of infrastructure

Parent	Pipeline costs (million €)	Terminal (million €)	Total costs (million €)
Snam	6,186	3,584	9,771
Tree Energy Solutions		9,169	9,169
Electricite de France	4,700		4,700
unknown	4,591		4,591
Gaz-System	4,018		4,018
Engie		3,221	3,221
Italgas	3,055		3,055
Deutsche ReGas		2,281	2,281
Hellenic Petroleum	1,645	602	2,247
QatarEnergy		1,879	1,879
Fluxys	932	564	1,496
Energie Baden-Württemberg AG	1,317		1,317
Gasunie	577	608	1,185
LNG Croatia LLC		1,180	1,180
Enel		1,000	1,000
Trafigura		990	990
Srbijagas	969		969
PGNiG		934	934
Plinacro	893		893
Transgaz	890		890
Israel Natural Gas Lines	792		792
Copelouzos Group	170	606	776
Vopak		733	733
Pilot LNG		673	673
ExxonMobil		672	672
Equinor	657		657
New Fortress Energy		650	650
other	573	71	644
PKN Orlen		620	620
Bulgartransgaz		606	606
GasLog Cyprus Investments		606	606
DEPA Commercial		606	606
DESFA		606	606
Edison		602	602
Bulgarian Energy Holding	595		595
SDH	574		574
MOL Group	545		545
Enagás	326	199	525
BP	138	381	519
Ruhr Oel GmbH		500	500

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Table A5: Top parent companies developing LNG terminals and gas pipelines, by total estimated cost of infrastructure *(continued)*

Parent	Pipeline costs (million €)	Terminal (million €)	Total costs (million €)
Government of Estonia		500	500
Sorgenia		500	500
Iren Group		500	500
Crown LNG Holdings Ltd		489	489
BarMalGas		485	485
Buss Group		448	448
Partners Group		448	448
Dow Chemical		448	448
Oiltanking		433	433
Predator Oil & Gas		429	429
RWE		412	412
Vitol		412	412
Stena AB		412	412
ADNOC		412	412
IFM Investors		412	412
InterConnect Malta Ltd	410		410
Alexela	2	400	402
Gazprom	393		393
DEFA		379	379
Shell	34	303	337
Delek Group	333		333
Albgaz Sha	323		323
Holburn Europa Raffinerie GmbH		301	301
Motor Oil		300	300
Lithuanian Ministry of Energy		299	299
Energean E&P Holdings Limited	299		299
Government of Greece	296		296
Moroccan National Board of Hydrocarbons and Mines	279		279
Nigerian National Petroleum Corporation	279		279
E.ON		275	275
Gasdotti Italia S.p.A.	270		270
BH-Gas d.o.o.	270		270
Samruk-Kazyna SWF JSC	237		237
TotalEnergies		232	232
Mediterranean Gas		227	227
National Grid		200	200
Gas Transmission System Operator of Ukraine	167		167
Electricity Authority of Cyprus		163	163
Suncor Energy	152		152
Montenegro Bonus	147		147

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Table A5: Top parent companies developing LNG terminals and gas pipelines, by total estimated cost of infrastructure *(continued)*

Parent	Pipeline costs (million €)	Terminal (million €)	Total costs (million €)
SOCAR	141		141
Allianz	130		130
Port of Tallinn		125	125
Nornickel PJSC	124		124
Mubadala Investment Company	115		115
OMV Group	115		115
Ministry of Economic Development of Kosovo Republic	107		107
Gas RES	103		103
Mitsubishi UFJ Financial Group		99	99
Ervia	94		94
Skulte LNG Terminal		88	88
Bayerngas GmbH	76		76
MER JSC Skopje	73		73
Verbund	59		59
ADIA	58		58
BCI	58		58
Macquarie Group Limited	58		58
MEAG	58		58
LNG Alliance		45	45
Government of Montenegro		45	45
UAB koncernas "Achemos grupė"		43	43
Stadtwerke München GmbH	41		41
JSC Mahistralni Gazoprovody Ukrainy (MGU)	40		40
Axpo	35		35
Chevron	34		34
Virši-A		22	22
Arbejdsmarkedets Tillægspension	18		18
CNIC Corporation Limited	18		18
Universities Superannuation Scheme	18		18
Guoxin Guotong Fund	18		18
CEMEX SAB de CV	18		18
Acciona S.A	18		18
Augstsprieguma Tikls	18		18
Stadtwerke Augsburg Holding GmbH	11		11
MM Capital Partners	8		8
Golar LNG		6	6
BOTAŞ	3		3
Infortar	2		2
Total	**39,702**	**44,434**	**84,137**

Table A6: Average costs for gas transmission pipelines and LNG import terminals, calculated by GEM to estimate unknown project costs

Infrastructure type	Cost estimate (€ million)	
Gas pipeline	3.6	to build 1 km of pipeline
Import terminal – onshore	561.9	to build 1 bcm/y of terminal capacity
Import terminal – floating	208.8	to build 1 bcm/y of terminal capacity

For more information, see the GGIT cost estimates wiki page.