Europe Gas Tracker Report

2021

Mason Inman, Greig Aitken, Scott Zimmerman

ABOUT GLOBAL ENERGY MONITOR

Global Energy Monitor (GEM) is a network of researchers developing collaborative informational resources on fossil fuels and alternatives. Current projects include:

- Global Coal Plant Tracker
- Global Fossil Infrastructure Tracker
- Europe Gas Tracker
- Global Gas Plant Tracker
- Global Coal Mine Tracker
- Global Steel Plant Tracker
- The Gas Index
- CoalWire newsletter
- GEM.wiki energy wiki

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.

AUTHORS

Mason Inman is Oil and Gas Program Director, Greig Aitken is Research Analyst, Scott Zimmerman is Researcher at Global Energy Monitor. Additional research by Lydia Plante, Research Analyst at Global Energy Monitor.

PRODUCTION

Design by Charlene Will and Mimi Heft. Additional design and page layout by David Van Ness.

PERMISSION FOR NONCOMMERCIAL USE

FURTHER RESOURCES

The Europe Gas Tracker includes project-level data in spreadsheets, methodology notes, and an interactive global map. To obtain primary data from the Europe Gas Tracker, please use our request form.

ABOUT THE COVER

Cover photo: Construction of the Krk LNG Terminal in Croatia. Courtesy of Balkan Investigative Reporting Network.

Europe Gas Tracker Report 2021

Mason Inman, Greig Aitken, Scott Zimmerman

EXECUTIVE SUMMARY

The outlook for expanding EU gas import capacity—an increase of 35% over the current capacity—is at odds with the EU's stated goal of net-zero greenhouse gas emissions by 2050, according to a new survey of gas infrastructure by Global Energy Monitor. Building all the gas infrastructure (pipelines and LNG terminals) currently in pre-construction or construction phases would add 222 billion cubic meters per year (bcm/y) of net gas import capacity into the EU (Figure ES-1). With EU members planning steep reductions in fossil fuel use as per the Paris Agreement, these expansion plans create an €87 billion stranded asset risk and threaten to lock-in emissions well beyond 2050.

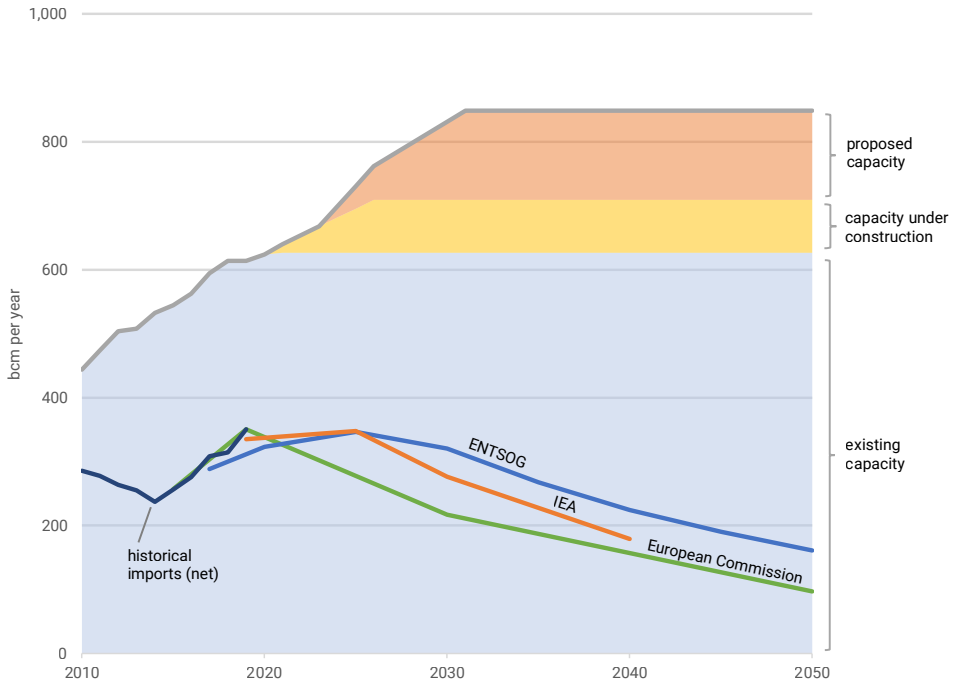
Key findings of this report:

- Gas pipelines under construction in the EU will cost an estimated €18 billion, raising EU gas import capacity 65 bcm/y. Gas pipelines in pre-construction would cost an additional €53 billion and raise EU import capacity by 85 bcm/y.
- LNG terminals under construction in the EU will add 20 bcm/yr of capacity at a cost of €2.6 billion. LNG terminals in pre-construction would add 81 bcm/yr at a cost of €13 billion.
- In 2020, €5.1 billion worth of gas projects were cancelled or shelved, and another €25 billion worth of projects were delayed.
- Despite these cancellations, the proposed gas infrastructure expansion in the EU threatens the bloc's medium-term goal of cutting emissions 55% by 2030.

- €10.1 billion from public and private sources has been identified for gas pipelines and LNG import terminals in the EU, covering financing for projects operating since 2015, and projects currently under construction or in pre-construction.
- EU public financing has played a vital investment catalyst role for new gas pipelines and import terminals over the last decade, but it is beginning to dry up. Policy changes, already underway at the European Investment Bank and expected to take effect with the revision of the EU's Regulation on Trans-European Networks for Energy (TEN-E), will end support for gas investments. Private finance may take up the slack in the short-term in spite of the climate, stranded asset and social license risks increasingly associated with fossil gas.

Figure ES1. EU fossil gas net import capacity and net imports.

The EU has had large overcapacity for gas imports, and projects under construction and proposed would raise the capacity further. In scenarios for net-zero emissions by 2050, fossil gas imports into the EU decrease significantly in the coming decades.



INTRODUCTION

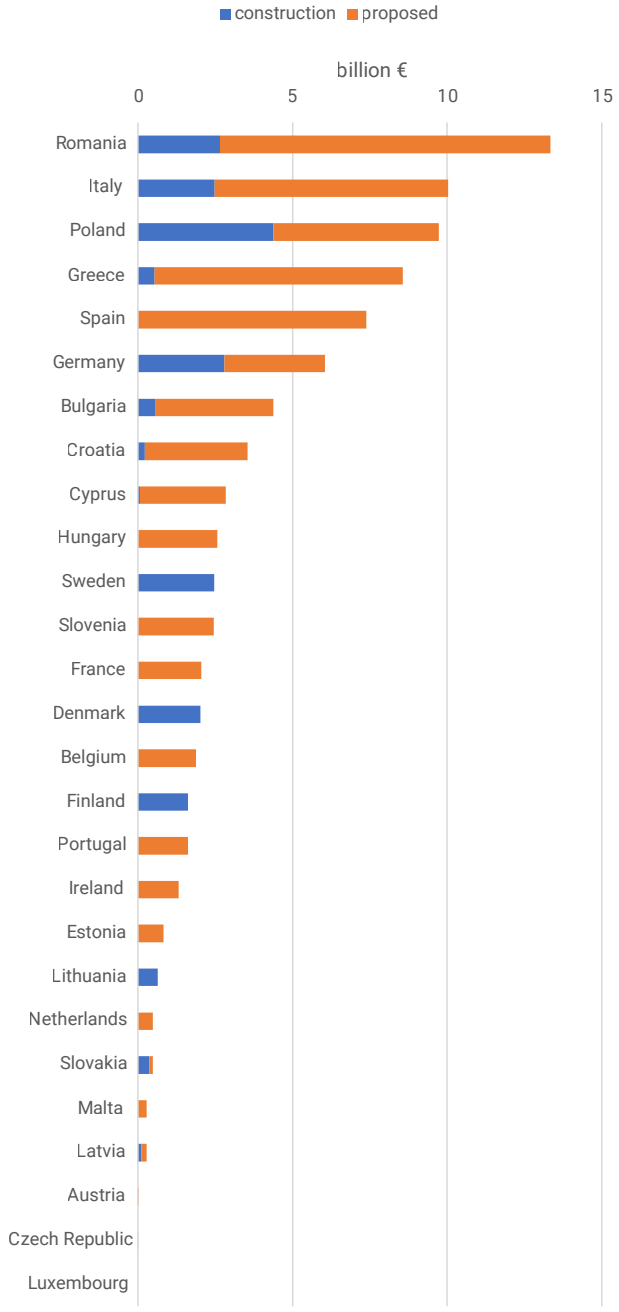
The European Union (EU) is in the process of adopting some of the most ambitious climate targets in the world, committing to reach net-zero greenhouse gas emissions by 2050, and to an ambitious interim target in 2030.[1] In European Commission outlooks, fossil gas consumption will decline rapidly by 2030 and beyond. Other low-emissions scenarios—from the International Energy Agency (IEA) and the European gas industry—agree that cutting emissions dramatically will involve drastically reducing fossil gas consumption.

Despite this expectation of rapidly declining fossil gas consumption in the EU, gas consumption in the region has increased in recent years, with CO_2 emissions from fossil gas nearly as high as those from coal (IEA 2021).

Meanwhile, there has been strong, ongoing expansion of the EU gas system, as shown by Global Energy Monitor's Global Fossil Infrastructure Tracker, a project-level database. In 2020, gas import capacity into the EU increased 10 billion cubic meters per year (bcm/y), and additions in Q1 of 2021 were the same annualized rate. These import capacity additions are below the average rate over the previous five years (16 bcm/y), but the Covid-19 pandemic has likely slowed project completions. Meanwhile, there are large projects in construction—in particular the Nord Stream 2 Gas Pipeline megaproject (55 bcm/y) that is nearly completed, and would bring gas from Russia to Germany. The build-out of EU gas import capacity shows no signs of stopping.

Projects in development would add substantially to the EU's gas import capacity. Building all the gas infrastructure currently in pre-construction or construction phases would add an estimated 222 bcm/y of net gas import capacity into the EU—an increase of 35%. Currently under construction in these countries are fossil gas pipelines and import terminals for liquefied natural gas (LNG) that will cost an estimated

Figure 1. Estimated cost of future EU gas infrastructure by country



Source: Global Energy Monitor, Europe Gas Tracker. For more details see subsequent tables in this report and the report methodology online.

1. In this report, the use of EU refers to the EU-27, so does not include the United Kingdom. When referring to the previous EU-28, that is stated explicitly.

€21 billion. Additional proposed gas pipelines and LNG terminals, if all built, would cost an additional €66 billion. This future gas infrastructure, if all built, would carry a total cost of €87 billion (Table 1).

EU gas infrastructure built now would allow for increased consumption of fossil gas for decades to come—beyond even 2050, when the EU is meant to have achieved net-zero emissions. This expansion of the gas system is at odds with this net-zero goal, as well as with medium-term goals in the EU for cutting emissions sharply by 2030.

Major expansions of EU gas import capacity are not needed for security of supply, either, according to a 2020 analysis by Artelys. That study concluded that "the existing EU gas infrastructure is sufficiently capable of meeting a variety of future gas demand

Table 1. Future gas infrastructure in EU countries (under construction or proposed)

Country	Pipeline Length (km)	Pipeline Cost (million €)	LNG import capacity (bcm/y)	LNG Terminal Cost (million €)	Total Cost (million €)
Austria	5	23			23
Belgium			11.2	1,885	1,885
Bulgaria	1,037	4,375			4,375
Croatia	757	3,195	4.4	346	3,542
Cyprus	657	2,775	0.8	65	2,840
Czech Republic	2	9			9
Denmark	481	2,029			2,029
Estonia			4.9	828	828
Finland	380	1,605	0.1	23	1,628
France	62	260	10.6	1,793	2,053
Germany	665	2,806	19.2	3,241	6,047
Greece	1,914	8,078	6.1	485	8,564
Hungary	609	2,572			2,572
Ireland	25	105	8.9	1,219	1,324
Italy	2,033	8,580	8.6	1,448	10,028
Latvia	38	160	1.5	119	279
Lithuania	152	641			641
Luxembourg					0
Malta	69	289	0.0	0	289
Netherlands			2.9	490	490
Poland	2,025	8,549	6.9	1,172	9,721
Portugal	384	1,623			1,623
Romania	2,833	11,960	8.2	1,379	13,339
Slovakia	114	482			482
Slovenia	582	2,457			2,457
Spain	1,496	6,316	6.3	1,068	7,384
Sweden	584	2,463			2,463
Total	**17,204**	**72,618**	**101**	**15,563**	**86,914**

Source: Global Energy Monitor, Europe Gas Tracker. For more details see subsequent tables in this report and the report methodology online.

scenarios in the EU28, even in the event of extreme supply disruption cases," which included shut-downs of major pipeline routes for as long as a year (Artelys 2020a). A follow-on study examining the potential for alternatives to fossil gas concluded: "There is no need for additional investments in methane infrastructure in the EU" (Artelys 2020b).

Meanwhile, the tide is turning against investment in gas infrastructure in the EU. Under proposed revisions that the European Parliament will vote on later in 2021, the Trans-European Networks for Energy (TEN-E) regulation would be changed to remove natural gas as a category of projects that are eligible for preferential treatment, including public funding.

In addition, the European Investment Bank (EIB) is phasing out investment in gas infrastructure. In November 2019, the EIB announced that it will end nearly all investment in gas projects by the end of 2021. In January this year, EIB president Werner Hoyer elaborated: "To put it mildly, gas is over. And this is a serious departure from the past. Without the end to the use of unabated fossil fuels we will not be able to reach the climate targets." Hoyer added that "the future does not lie in fossil fuels anymore" (Taylor 2021).

Some investors are starting to turn against gas. In January 2021, Aviva Investors, one of the United Kingdom's top asset managers, warned that it would divest from oil and gas companies within three years unless they make much stronger climate commitments, including setting net-zero emissions goals and integrating climate risks into their capital expenditure plans. Mirza Baig, Aviva's global head of ESG research and stewardship, told the *Financial Times*, "We have an obligation to clients and society to not fund something we believe is catastrophic to the world and capital markets" (Mooney 2021).

Given the need to transition away from the current system, directing major capital expenditures into that system creates two related problems:

- Lock-in, in which the current gas system becomes further entrenched
- Stranded assets, in which gas infrastructure becomes obsolete well before mid-century, as a system based on cleaner and cheaper renewables supplants it.

The EU does not need the major expansion of gas infrastructure that is under construction and planned, which would interfere with the EU's climate goals by locking in expensive infrastructure.

THE FUTURE OF EU GAS CONSUMPTION

To achieve net-zero greenhouse gas emissions by 2050, the EU will need to drastically reduce consumption of fossil gas (Figure 2). Any remaining use of fossil gas would have to be accompanied by carbon capture and storage (CCS), to prevent nearly all of the carbon dioxide (CO_2) emissions from entering the atmosphere (ENTSOG & ENTSOE 2020).

All credible scenarios for sharp emissions cuts in the EU agree on this general outlook. As shown in Figure 2, scenarios vary in the near-term pace of the necessary reductions, but all involve a sharp reduction in the use of fossil gas by 2030:

- European Commission scenarios for achieving net-zero emissions by 2050, with the interim target of reducing emissions 55% by 2030
- The International Energy Agency's (IEA) Sustainable Development Scenario
- The industry group European Network of Transmission System Operators for Gas (ENTSOG), in the Ten Year Network Development Plan (TYNDP) 2020.

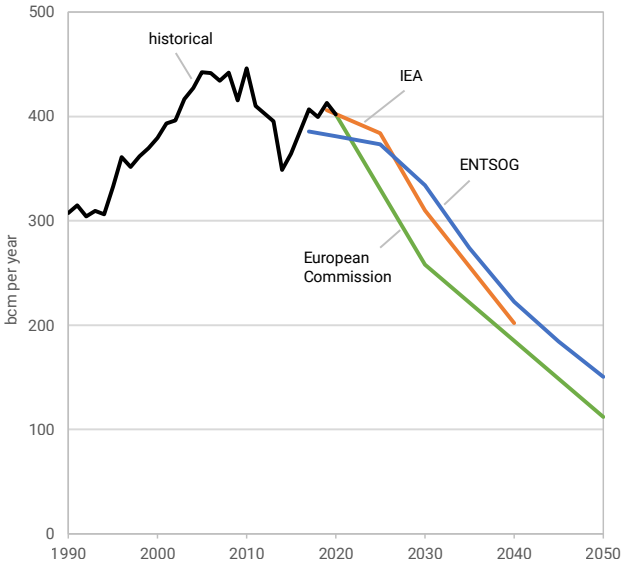
A review of additional scenarios by the European Commission's Joint Research Centre found agreement among low-carbon scenarios would involve "a reduction of oil and natural gas use by at least three-quarters compared to today" (Tsiropoulos 2020).

In 2020, the European Parliament adopted a proposal for the European Climate Law that includes a stricter target for 2030 emissions than had been in place. Under the European Climate Law, the EU would be required to cut emissions by 55% by 2030 (relative to the 1990 baseline). In 2020, the European Commission published an analysis of what would be required to achieve that new, stricter target for 2030; fossil gas consumption would need to decline 36% from 2020 to 2030 (European Commission 2020). Low-emissions scenarios from the IEA and ENTSOG agree closely with the European Commission about the need for a sharp decline in fossil gas consumption (Figure 2).

In comparison, fossil gas consumption in the EU-27 has been roughly flat over the past four years (2017–2020), at about 400 billion cubic meters per year (bcm/y) (European Commission 2021, Eurostat 2021). To achieve the reductions in gas consumption expected in the European Commission outlook for 2030, gas consumption will need to immediately start declining at a rate of more than 4% per year.

These targets require a rapid pace of decarbonization, including sharp emissions reductions from all sectors. Switching from coal to gas is inconsistent with this, as the infrastructure—gas pipelines, LNG terminals, and power plants—have long lifetimes, whereas the time for using gas is running out. Reducing emissions in line with these goals will also require decarbonization of the buildings sector, which is heavily reliant on gas for heating (see page 24).

Figure 2. Scenarios for EU-27 fossil gas consumption



Sources: Historical data: European Commission 2021. Projections: European Commission, the average of three net-zero scenarios that achieve 55% reductions by 2030 (European Commission 2020); IEA: Sustainable Development Scenario (IEA 2020); ENTSOG: Average of two low-emissions scenarios in the Ten Year Network Development Plan 2020 (ENTSOG and ENTSO-E 2020), adjusted to represent EU-27 (excluding the United Kingdom). More details in the report methodology online.

FUTURE EU GAS IMPORTS

The EU has large excess gas import capacity, and the bloc's import capacity is set to increase dramatically if projects under construction and proposed are all completed. Meanwhile, there is clear agreement that the EU will import less gas in the future as it rapidly cuts emissions in line with its goals of a 55% reduction in emissions by 2030 and net-zero emissions by 2050.[2]

Figure 3 shows historical net imports of fossil gas, and outlooks for gas imports from the European Commission, IEA, and ENTSOG, for scenarios consistent with net-zero emissions by 2050. All of these bodies expect the region's fossil gas imports to decline significantly, driven by dramatic reductions in fossil gas consumption (as shown in the previous section).

Figure 3. EU-27 fossil gas net imports and net import capacity

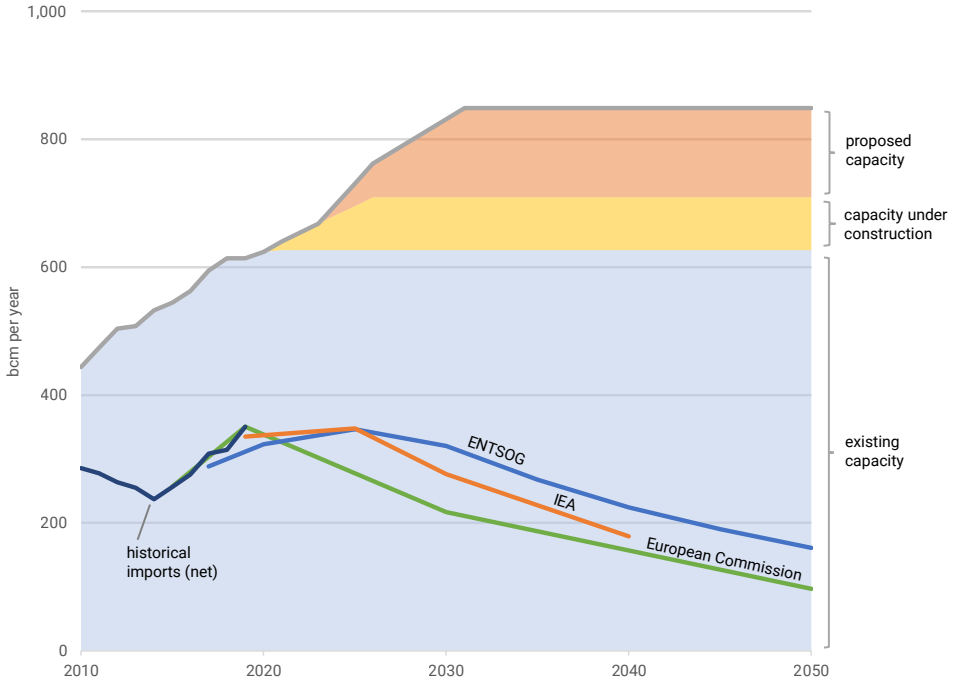


Figure 3 assumptions: Linear implementation of projects currently under construction over 5 years (2021 to 2026). Linear implementation of projects currently in pre-construction starting 3 years in the future, and extending over 7 years (2024–2031). No retirement of currently operating infrastructure. No further projects entering development. The ENTSOG scenario for EU-27 is estimated as 88% of the original ENTSOG scenario for the EU-28, based on historical gas imports in the EU-27 and EU-28 over 2010–2019.

Sources: Historical pipeline capacity from ENTSOG 2010, ENTSOG 2019, and Global Energy Monitor, Europe Gas Tracker, March 2021. Future pipeline capacity, and LNG capacity (both historical and future), from Global Energy Monitor, Europe Gas Tracker, March 2021.

2. The additional capacity from proposed projects may be higher than shown; not all proposed projects had data available for the proposed capacity.

Tables 2 and 3 provide additional detail on the EU's future gas import capacity from pipelines and LNG terminals that are under construction or proposed.

Table 2. Planned pipelines to import gas into the EU.

Only portions in EU countries are listed.
Projects on the candidate 5th Projects of Common Interest list are marked by ‡ (European Commission 2021).

Name	Capacity (bcm/y)	Country	Length (km)	Est. Cost (million €)
Under construction				
Baltic Pipe Project ‡	10.0	Denmark	424	1,790
		Poland	102	431
		Sweden	86	365
Nord Stream 2 Gas Pipeline	55.0	Denmark	57	239
		Finland	380	1,605
		Germany	88	370
		Poland	95	401
		Sweden	497	2,099
Under construction subtotal	65.0		1,729	7,300
Proposed				
East Med Gas Pipeline (with capacity expansion) ‡	20.0	Cyprus	531	2,241
		Greece	1,201	5,071
GALSI Pipeline	8.0	France	62	260
		Italy	564	2,382
Ionian Adriatic Pipeline (IAP)	5.0	Croatia	230	971
Israel Cyprus Gas Pipeline	1.0	Cyprus	127	534
Macedonia-Bulgaria Interconnector Gas Pipeline		Bulgaria	21	88
Medgaz Gas Pipeline capacity expansion	2.5	Spain	n/a	n/a
Nigeria-Morocco Gas Pipeline		Portugal	244	1,030
		Spain	948	4,003
Serbian-Hungarian Gas Pipeline	6.0	Hungary	79	332
Trans-Adriatic Pipeline (TAP) capacity expansion	10.0	Greece, Italy	n/a	n/a
Ukraine-Romania Gas Pipeline		Romania	25	105
White Stream Gas Pipeline ‡	32.0	Bulgaria	147	620
		Romania	109	460
Proposed subtotal	84.5		4,287	18,097
Total (under construction and proposed)			**6,017**	**25,397**

Source: Global Energy Monitor, Europe Gas Tracker. Assumed costs for pipelines: €4.2 million per km (Oil and Gas Journal 2020).
More details in the report methodology online.

Table 3. Planned EU LNG import terminals.

Projects on the candidate 5th Projects of Common Interest list are marked by ‡ (European Commission 2021).

Country	Name	Capacity (bcm/y)	Est. Cost (million €)
Under construction			
Cyprus	Cyprus LNG Terminal (Import) ‡	0.8	65
Finland	Hamina LNG Terminal	0.1	23
Greece	Alexandroupolis LNG Terminal ‡	6.1	485
Italy	HIGAS LNG Terminal	0.4	69
	Porto Empedocle LNG Terminal	8.2	1,379
Latvia	Skulte LNG Terminal ‡	1.5	119
Poland	Świnoujście Polskie LNG Terminal (expansion)	2.4	414
Under construction subtotal		19.6	2,555
Proposed			
Belgium	Zeebrugge LNG Terminal (2024 Expansion)	8.7	1,471
	Zeebrugge LNG Terminal (2026 Expansion)	2.4	414
Croatia	Krk LNG Terminal (Phase 2 expansion) ‡	4.4	346
Estonia	Paldiski LNG Terminal	1.2	207
	Tallinn LNG Terminal	3.7	621
Finland	Rauma LNG Terminal		
France	Fos Cavaou LNG Terminal Expansion 1	2.7	460
	Fos Cavaou LNG Terminal Expansion 2	5.4	920
	Montoir LNG Terminal Expansion	2.4	414
Germany	Brunsbüttel LNG Terminal	6.9	1,172
	Rostock LNG Terminal	0.4	69
	Stade LNG Terminal	11.8	2,000
Ireland	Predator FSRU Terminal	3.3	260
	Shannon LNG Terminal, Phase I	0.3	46
	Shannon LNG Terminal, Phase II	2.1	355
	Shannon LNG Terminal, Phase III	3.3	558
Malta	Delimara Onshore LNG Terminal		
Netherlands	Gate LNG Terminal Expansion	2.9	490
Poland	Polish Baltic Sea Coast Terminal ‡	4.5	759
Romania	Constanta LNG Terminal	8.2	1,379
Spain	Gran Canaria LNG Terminal	1.4	230
	Mugardos LNG Terminal Expansion 3	3.6	609
	Puerto de la Luz LNG Terminal		
	Tenerife LNG Terminal	1.4	230
Proposed subtotal		81.0	13,008
Total (under construction and proposed)		**100.6**	**15,563**

Source: Global Energy Monitor, Europe Gas Tracker. Assumed costs for LNG terminals: Floating terminals, €79 million per bcm/y capacity; on-shore terminals, €169 million per bcm/y capacity (IGU 2018). More details in the report methodology online.

MOVING GAS WITHIN THE EU

Additional pipelines are planned that are entirely within the EU, which can transport gas within countries, or from importing countries to others that have little or no direct access to import gas from outside the EU.

Table 4. Future gas pipelines within the EU.

Only pipeline segments of at least 150 km per country are named below.
Projects on the candidate 5th Projects of Common Interest (PCI) list are marked by ‡ (European Commission 2021).

Name	Capacity (bcm/y)	Country	Length (km)	Est. Cost (million €)
Under construction				
BRUA Gas Pipeline, Phase 1	1.8	Romania	462	1,952
European Gas Pipeline Link (EUGAL)	55.0	Germany	413	1,745
Gas Interconnection Poland-Lithuania (GIPL) ‡	2.4	Lithuania	152	641
		Poland	281	1,188
Midia Gas Pipeline	1.0	Romania	166	700
Zeelink Gas Pipeline	9.6	Germany	164	691
pipeline segments shorter than 150 km per country		(various)	998	4,215
Under construction subtotal			2,637	11,130
Proposed				
BRUA Gas Pipeline, Phase 3 ‡		Romania	568	2,397
Black Sea Shore–Podișor Gas Pipeline ‡		Romania	212	895
Eastring Pipeline ‡	20.0	Bulgaria	222	936
		Hungary	285	1,204
		Romania	617	2,604
Goleniów-Lwówek Gas Pipeline		Poland	153	648
Guitiriz-Zamora-Adradas Gas Pipeline		Spain	548	2,312
Gustorzyn-Wronów Gas Pipeline		Poland	292	1,231
Hungary-Slovenia-Italy Interconnector Gas Pipeline ‡	1.2	Hungary	159	672
		Slovenia	239	1,008
Methanization of Sardinia Project		Italy	544	2,298
North–Vest Romania Pipeline		Romania	392	1,653
Onești-Gheraesti-Letcani Gas Pipeline		Romania	154	650
Poseidon Gas Pipeline ‡	15.0	Greece	680	2,871
Sealine Tirrenica gas pipeline		Italy	246	1,038
Szczecin - Lwówek to Dolna Odra Gas Pipeline		Poland	169	713
Varna-Oryahovo Gas Pipeline		Bulgaria	349	1,474
Vodice-Jarše-Novo mesto pipeline		Croatia	203	858
pipeline segments shorter than 150 km per country		(various)	2,218	9,361
Proposed subtotal			8,250	34,824
Total			**10,887**	**45,594**

Source: Global Energy Monitor, Europe Gas Tracker. Assumed costs for pipelines: €4.2 million per km (Oil and Gas Journal 2020). More details in the report methodology online.

PUBLIC AND PRIVATE FINANCE FOR EU GAS INFRASTRUCTURE

Global Energy Monitor has identified €9.1 billion from public and private financing sources that has been provided to 43 gas pipelines and 9 LNG import terminals in the EU which have started operating since 2015 or which are currently under construction. For 64 proposed gas pipelines and 25 proposed terminal projects (including expansions) slated to begin operations within the next eight years, GEM has identified €1 billion already committed from public and private financing sources. The financing—€10.1 billion in total—counted in this report does not include the often large equity investments made by private sector project promoters (see, for example, the Nord Stream 2 Gas Pipeline) but does cover the following:

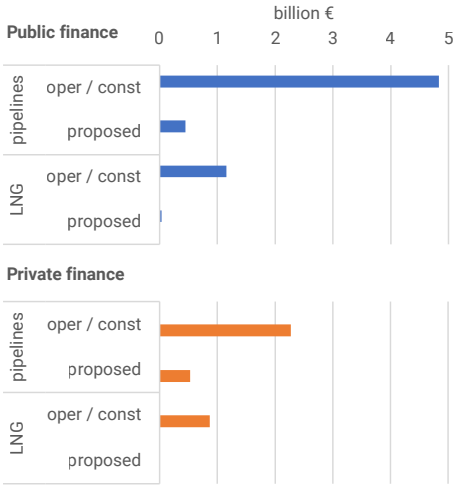
- Grants, debt financing, and equity financing from public sources, including the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), the EU's Connecting Europe Facility (CEF) and EU Regional Funds.
- Debt financing from commercial banks.
- Various financing from individual states.

As shown in Table 5 and Figure 4, identified public financing exceeds private financing by a ratio of approximately €2 public to €1 private. Funding via loans from the EIB and the EBRD, and via grants from EU budgetary sources such as the CEF, has traditionally been thought of as providing an initial catalyst to projects, which would then hope to attract additional funding from private sources such as commercial banks.

Most financial information from the EIB, the EBRD, and EU sources is now highly transparent, following more than two decades of calls for greater transparency and accountability from civil society finance campaigners. By contrast, publicly available information about private finance support for the 107 gas pipeline and 46 LNG terminal projects assessed in this financial research is marginal. Thus, the overall €10.1 billion amount from public and private sources stated above is a minimum figure. Equally, the 2:1 public to private ratio of *identified* finance, while instructive of the significant role which EU public finance has played to date, does not represent the full picture of a likely much higher volume of private finance which this research was not able to capture.

Figure 4. Public and private financing for EU gas pipelines and LNG terminals.

Projects operating since 2015 or currently under construction are listed as "oper / const."



Source: Global Energy Monitor, Europe Gas Tracker.

Table 5. Public and private financing for EU gas pipelines and LNG terminals (million €)

	Gas Pipelines		LNG Terminals	
	Operating since 2015 or under construction	Proposed	Operating since 2015 or under construction	Proposed
Public finance	4,833	445	1,159	31
Private finance	2,275	529	867	0
Total	7,108	974	2,026	31

Source: Global Energy Monitor, Europe Gas Tracker. More details in the report methodology online.

PRIVATE GAS FINANCE: THE TIP OF THE ICEBERG

One of the most controversial EU-backed fossil fuel investments of the last decade, the Trans-Adriatic Gas Pipeline (TAP), achieved its first delivery of gas from Azerbaijan into Italy at the end of 2020. Following financial backing—combined lending of €1.2 billion—from the EBRD and the EIB, 17 international commercial banks joined the project with a collective €2.065 billion in loans, among them BNP Paribas, Crédit Agricole, ING, Mizuho, Standard Chartered and UniCredit. High-cost, geopolitically significant projects such as TAP which garner initial finance from multilateral development banks tend to follow the traditional project finance model, where financing from private lenders is usually clearcut and disclosed.

The Baltic Pipe Project, a smaller but still large and technically complex 600 km project to bring Norwegian fossil gas via Denmark to Poland, is currently under construction. Having initially received almost €250 million in several CEF grants, the pipeline's sponsors are now pursuing an alternate funding model. One of its promoters, Poland's Gaz-System which has a 50% stake, secured a substantial US$1.4 billion corporate loan from ten commercial banks in June 2020. The proceeds of this loan—extended by subsidiaries of Bank of China, BNP Paribas, CaixaBank, China Construction Bank, Crédit Agricole and various Polish banks—are to be used by Gaz-System for various infrastructure projects which comprise its 2020–2025 investment strategy of fossil gas expansion, including the Baltic Pipe. As such, this US$1.4 billion loan cannot be disaggregated and is not counted in this research. Private financing, when it can be identified, is supporting many more environmentally damaging, climate-busting fossil gas infrastructure projects than "sustainable" financiers care to readily disclose.

The public finance breakdown

European Union funding for infrastructure not only provides capital resources but also plays a leveraging role by legitimizing projects, thereby reducing the risks for private funders. EU funding includes grants from the CEF, the European Regional Development Fund (ERDF), the European Energy Programme for Recovery (EEPR) and other EU funding lines. As shown in Table 6 on the next page, the EU's financing instruments contributed over €2.6 billion in public subsidies to the gas industry out of total commitments of €6.9 billion made by a range of public sources. The importance of EU funding is also evidenced by the number of gas projects supported: 51 projects received EU grant money out of the total number of 153 projects researched, making EU support by far and away the most visible funding source.

Since its November 2019 unveiling of a landmark Energy Policy ending any further financing of fossil gas infrastructure after 2021, the EIB has nonetheless provided €142 million in loans for three pipelines (the Poland-Lithuania Gas Interconnector, the Bulgaria-Serbia Gas Interconnector, and the North Macedonia-Greece Interconnector) as well as a €150 million loan for the under construction Cyprus LNG Terminal. However, the historic legacy of the EU's bank will be that it was the prime mover amongst globally significant financial institutions to end fossil fuel financing.

Table 6. €6.9 billion in public financing for EU gas pipelines and LNG terminals (million €)

	Gas Pipelines		LNG Terminals	
	Operating since 2015 or under construction	Proposed	Operating since 2015 or under construction	Proposed
EU funding				
CEF	1,128	137	208	20
ERDF	568	–	130	–
EEPR	130	5	–	–
Other EU	40	50	187	–
EU funding subtotal	1,868	192	525	20
EIB	1,656	231	283	–
EBRD ‡	1,099	8	155	–
State-backed funding				
Azerbaijan	125	–	–	–
Croatia	–	–	100	–
Finland	31	–	96	8
Nordic Investment Bank	32	–	–	–
Slovakia	21	–	–	–
U.S. Agency for International Development	–	0.4	–	–
Western Balkan Investment Framework	–	14	–	–
State-backed funding subtotal	209	14.4	196	8
Total	**4,833**	**445**	**1,159**	**28**

Source: Global Energy Monitor, Europe Gas Tracker. More details in the report methodology online.

‡ The value for EBRD includes €27 million in grants for four pipelines in Bulgaria provided by the Kozloduy International Decommissioning Support Fund, which is administered by the EBRD.

While the draft TEN-E regulation presented by the European Commission last December and the programming for the next €1 trillion EU Budget for 2021–2027 are expected to heavily restrict funding support for gas, the possibility remains that the €200 billion pot for ERDF—which falls under the overall EU Budget—will still include wide loopholes for gas-hungry eastern European member states in particular to exploit. For example, while gas transportation projects are now off the ERDF table, financial support avenues for smaller scale gas distribution projects are likely to remain. Similarly, the EU's COVID response package, the €672.5 billion Recovery and Resilience Facility (RRF) to be shared among member states, excludes in principle any fossil fuel project, yet the Commission has stated that it will still allow financial support for gas-based power and/or heat generation projects on a case-by-case basis (Bellona 2021).

As Table 6 shows, a relatively marginal €212 million in EU funding has gone to proposed fossil gas transportation projects. One of these, the controversial East Med Gas Pipeline, has already received CEF grant money for pre-construction studies (ongoing) to assess its feasibility. This 1,900 km megaproject is ambitiously penciled in to be ready by 2025, with a final investment decision currently targeted for 2022. It is hard to see how the EU could reconcile further public money support for East Med on this timeline given both the proposed European Climate Law and the trajectory of the draft TEN-E regulation which seeks to remove gas from future EU financial support.

Finance threats for the EU's climate goals

The European Climate Law's policy commitment to climate neutrality by 2050, combined with the EIB's new Energy Policy, amounts to a tectonic shift that has fundamentally changed the landscape for future infrastructure expansion. Nevertheless, some major public finance institutions, along with most private ones, remain out of step with the emerging new standard.

Most notable among these is the EBRD, which this research has found to have provided €1.2 billion in financing for EU gas pipelines and LNG terminals. The EBRD is regarded as a sister institution to the EIB, though with shareholders including Australia, Canada, Japan, Russia, and the UK, it is different. The U.S. is also a major shareholder, and with the new Biden administration looking into ending its funding of overseas fossil fuel projects via agencies such as the EBRD, the London-based development bank may now be incentivized to sever ties with the fossil fuel industry (Chen 2021). The EBRD is about to consult publicly on its "Paris Alignment" approach, which is scheduled to take effect in 2022 (EBRD 2019). This is an opportunity for the bank to make good on its claims to be a leader in environmental and sustainable finance by ending its support for all fossil fuels (EBRD 2020).

While public financing policy is rapidly moving to meet the new standard embodied in the European Climate Law, private finance policies continue to lag. For example, a recent *LNG Industry* article by energy sector legal specialists on the future of gas in Europe notes: "Private capital is expected to play a growing role in LNG projects given the image of natural gas as the cleanest of the fossil fuels and increasing environmental, social, and governance pressure on investors, which will cause a retreat from investment in more carbon-intensive projects" (Howell and Quigley 2021). For LNG projects, read also gas pipelines.

To date across the commercial banking sector, only four major banks—BNP Paribas, Rabobank, UniCredit and US Bancorp—prohibit financing for pipelines transporting shale oil and gas, and only BNP Paribas and UniCredit have additionally introduced marginal measures to restrict their financing of LNG projects and companies (Global Energy Monitor 2021). So far, those measures remain the exception, with restrictions on financing by international commercial banks limited to tar sands and Arctic gas extraction and transport, but not most gas-related infrastructure. But with European public policy now abandoning infrastructure, the key role of public funders in underwriting project risk is rapidly being removed, leaving private lenders more exposed to risk. Overall, environmental, social, and governance pressure on banks and investors is increasing rapidly, and the social license needed for private lending to fossil gas is disappearing.

A final factor for EU gas infrastructure finance comes in the shape of the Three Seas Initiative (3SI), a fledgling public-private investment vehicle primarily focused on supporting transport and energy projects. 3SI received a US$1 billion funding pledge from the Trump administration in October 2020. The 12 participating 3SI nations, which are also expected to contribute state funding, comprise all of the EU's central and eastern European member states, located between the Adriatic, the Baltic and the Black Seas (Three Seas Initiative 2020).

It has been noted that the 3SI founding declaration "mentions renewables, but lists several European gas infrastructure projects and it is clear gas is at its heart" (Popov 2020). While no 3SI financing for gas projects has yet come to fruition, the initiative clearly presents another potential means for high methane content, U.S. fracked gas exports to find a destination in central and eastern Europe. If the Biden administration is concerned with reducing, if not eliminating, U.S. financing for fossil fuels overseas, it should work to reconfigure existing 3SI energy planning away from gas investments to instead solely help renewable energy development in the region.

EU REGIONAL BREAKDOWN

Most of the EU has significant gas import infrastructure under construction or proposed, the exception being Northern EU, as shown in Table 7.

The data can also be explored in GEM's interactive Europe Gas Tracker map, which includes gas pipelines, LNG terminals, gas-fired power plants, and gas extraction sites.

Table 7. Future gas infrastructure (pipelines and LNG terminals) by EU region.[3]

Pipeline costs are attributed to the regions in which the pipelines have been or would be laid.
Import capacities are for imports into each region.[4]

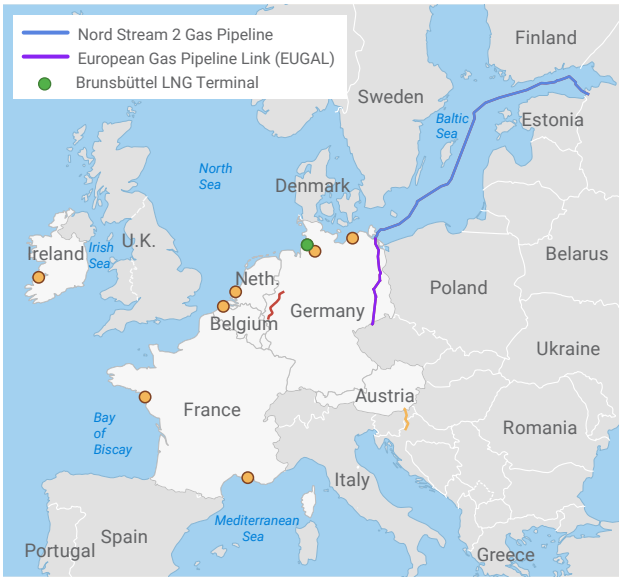
	Under construction		Proposed	
	Est. Cost (million €)	Import capacity (bcm/y)	Est. Cost (million €)	Import capacity (bcm/y)
Western EU	2,806	55.0	9,016	57.8
Eastern EU	8,963	17.0	29,281	64.9
Southern EU	3,095	18.0	27,632	46.6
Northern EU	6,121	0.1	0	0.0

Western EU

Western EU (Figure 5) has the largest future gas import capacity expansion, with 112 bcm/y of capacity under construction or proposed. Half of this import capacity is from the Nord Stream 2 Gas Pipeline, a mega-project under construction to bring Russian gas to Germany, with capacity of 55 bcm/y. The European Gas Pipeline Link (EUGAL), also under construction with 55 bcm/y capacity, would carry gas from Nord Stream 2 across Germany to the Czech border. Nord Stream 2 is nearly complete, but US sanctions have targeted companies working on the pipeline, causing work to halt. Recent news reports state that Germany plans to press for completion of the pipeline despite the sanctions (Rinke et al 2021), but the US has reiterated that it intends to apply sanctions (Reuters Staff 2021a). With national elections scheduled for September, the Green Party has vowed to block the pipeline if they win sufficient power (Reuters Staff 2021b).

Figure 5. Western EU

Pipelines are shown as lines and LNG import terminals as circles. Other than the projects named in the legend, those under construction are shown in red and those proposed are in orange.



3. **Western EU:** Ireland, France, Belgium, Netherlands, Luxembourg, Germany, Austria. **Eastern EU:** Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Slovenia, Croatia, Hungary, Romania, Bulgaria. **Southern EU:** Portugal, Spain, Italy, Malta, Greece, Cyprus. **Northern EU:** Sweden, Finland, Denmark.

4. The import capacities for each EU region do not sum to the total of the import capacity for the EU as a whole. This is because gas can be imported into one EU region, and then carried by pipeline to another region within the EU.

Most of the other potential gas import capacity for the Western EU is from proposed LNG terminals or proposed expansions of existing LNG terminals in a variety of countries (Germany, Belgium, France, Ireland, and Netherlands), as detailed in Table 3 on page 11. However, some LNG terminals in the region have faced opposition and/or questionable economics; two have been cancelled (Ireland's Cork LNG Terminal and Germany's Wilhelmshaven LNG Terminal), and questions hang over the economics of Germany's proposed Brunsbüttel LNG Terminal (6.9 bcm/y).

Eastern EU

Eastern EU (Figure 6) has the next highest gas import capacity expansion with 90 bcm/y of capacity under construction or proposed. This includes 64 bcm/y of pipelines that would bring gas into Romania, Poland, Bulgaria, Hungary, and Croatia, as well as 26 bcm/y of LNG terminals in Romania, Poland, Estonia, Croatia, and Latvia.

One of the major projects underway is the Baltic Pipe Project (10 bcm/y capacity), to carry gas from Norway to Poland. The project is intended to diversify Poland's gas supply, since the country is largely dependent on Russian gas, and the EU has provided the pipeline €267 million in grants through CEF. (For more on the Baltic Pipe Project, see the box "Private gas finance: The tip of the iceberg," on page 14.)

A major proposed project into the region is the White Stream Gas Pipeline (32 bcm/y capacity), which would cross the Black Sea from Georgia to Romania, carrying gas from Turkmenistan to the EU. The project has received €1.8 million in EU funding through CEF for preliminary work. The Constanta LNG Terminal (8.2 bcm/y capacity) is proposed for the Black Sea shore in Romania, where it would receive gas from Azerbaijan.

Figure 6. Eastern EU

Pipelines are shown as lines and LNG import terminals as circles. Other than the projects named in the legend, those under construction are shown in red and those proposed are in orange.

Southern EU

Southern EU (Figure 7) has 60 bcm/y of gas import capacity under construction or proposed. Two major LNG terminals are currently under construction, Greece's Alexandroupolis LNG Terminal (6.1 bcm/y) and Porto Empedocle LNG Terminal (8.2 bcm/y) on the Italian island of Sicily.

Proposed pipelines include the 1,900-km East Med Gas Pipeline (up to 20 bcm/y), which would be the world's longest and deepest offshore pipeline, running from Israel and Cyprus, via the island of Crete, to mainland Greece. From there it would connect with the proposed Poseidon Gas Pipeline to transport gas across the Adriatic Sea to southern Italy. European environmental groups have called on the European Commission to remove East Med and Poseidon from the Projects of Common Interest (PCI) program and further European public funding support as they are incompatible with EU climate targets and risk becoming stranded assets due to projected declines in gas demand and already existing excess import capacity.

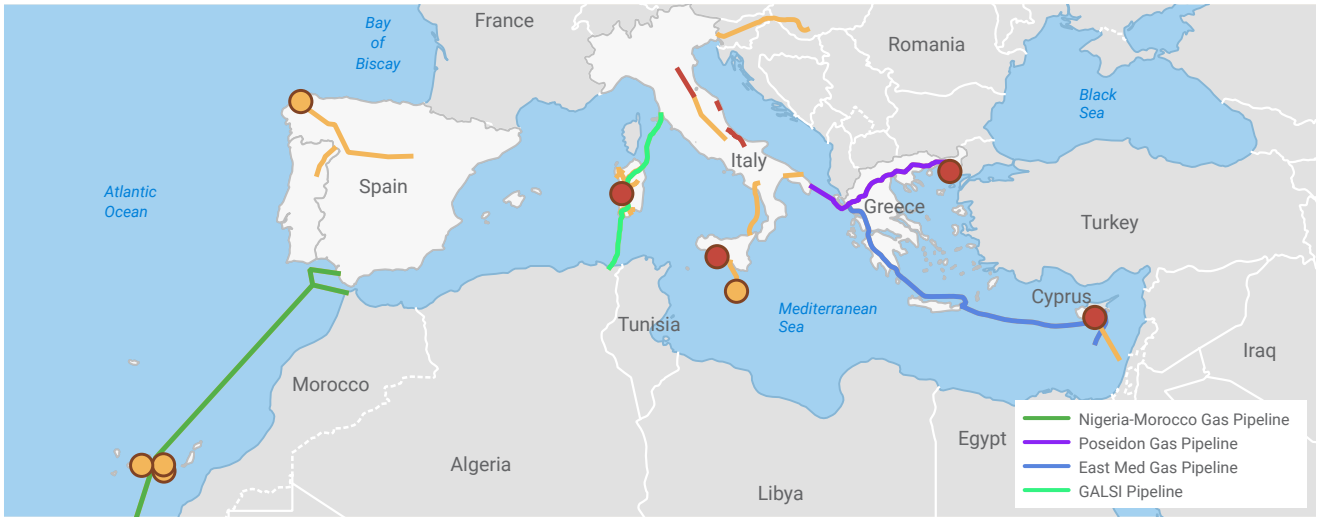
Additional proposals include the GALSI Pipeline from Algeria to Italy (8 bcm/y) and an expansion of the recently opened Trans-Adriatic Gas Pipeline ending in Italy (adding 10 bcm/y, to carry a total of 20 bcm/y). An additional proposed megaproject is the Nigeria-Morocco Gas Pipeline, which would run offshore from Nigeria to Spain, with spurs running onshore to countries in West Africa and North Africa. It is unclear what the capacity of the Nigeria-Morocco Gas Pipeline would be, so it is not counted toward totals in this report; if built, it would raise EU gas import capacity still further.

Northern EU

Northern EU has negligible future gas import capacity planned, with the small capacity Hamina LNG Terminal in Finland (0.1 bcm/y) under construction, and two other small LNG terminals in the proposal stage. Most of the cost assigned to Northern EU is for the Nord Stream 2 gas pipeline and Baltic Pipe Project, which passes through waters of Denmark and Sweden, but which will carry gas to Germany in Western EU. (No map is included for the Northern EU.)

Figure 7. Southern EU

Pipelines are shown as lines and LNG import terminals as circles. Other than the projects named in the legend, those under construction are shown in red and those proposed are in orange.



CANCELLED, SHELVED AND DELAYED PROJECTS

Cancelled and Shelved Projects

Since early 2020, several proposed gas infrastructure projects in the EU have been cancelled or shelved, as shown in Table 8. These projects would have cost €5.1 billion to build.[5]

Since early 2020, five proposed gas pipelines for carrying gas within the EU have been cancelled or shelved; these projects would have cost an estimated €4.0 billion if built. The cancelled pipelines were a proposed 473-km pipeline in Greece; a 46-km pipeline in Romania; and interconnectors between Portugal and Spain, and between Austria and the Czech Republic. Also, an interconnector between the Czech Republic and Poland was shelved. Three of these projects received over €2.5 million in grants from the EU's Connecting Europe Facility.

Two large LNG terminals proposals have also been cancelled. Uniper announced the cancellation of the Wilhelmshaven LNG terminal in Germany (9.9 bcm/y capacity), citing insufficient demand and economic uncertainties. Following pressure from local politicians, the Cork LNG Terminal in Ireland (4.0 bcm/y capacity) was also cancelled when the project's memorandum of understanding expired in December 2020. Together these LNG terminals would have cost €1.1 billion if built.

Table 8. EU gas infrastructure cancelled or shelved since early 2020

Pipelines

Status	Name	Countries	Length (km)	Est. Cost (million €)
Cancelled	Bidirectional Austrian-Czech Interconnector Gas Pipeline (BACI)	Austria, Czech Rep.	116	491
	BRUA Gas Pipeline, Phase 2	Romania	46	192
	Komotini-Thesprotia Gas Pipeline	Greece	473	1,998
	Spain-Portugal Interconnector Gas Pipeline	Spain	73	307
Shelved	Czech-Polish Interconnector Gas Pipeline (CPI)	Czech Rep., Poland	233	984

LNG Terminals

Status	Name	Country	Capacity (bcm/y)	Est. Cost (million €)
Cancelled	Wilhelmshaven LNG terminal	Germany	9.9	790
	Cork FSRU Terminal	Ireland	4.0	318
Total (pipelines and LNG terminals)				**5,081**

Source: Global Energy Monitor, Europe Gas Tracker. Assumed costs for pipelines: €4.2 million per km (Oil and Gas Journal 2020). Costs for LNG terminals: Floating terminals, €79 million per bcm/y capacity; on-shore terminals, €169 million per bcm/y capacity (IGU 2018). More details in the report methodology online.

5. Global Energy Monitor defines projects as cancelled if they are explicitly cancelled by the project promoters, or if there has not been any tangible progress on the proposal for four years; projects are defined as shelved if they have not had any tangible progress for two years.

Delayed Projects

Out of the gas infrastructure projects that are under construction or proposed, €24.8 billion worth of projects have been delayed for a variety of reasons:

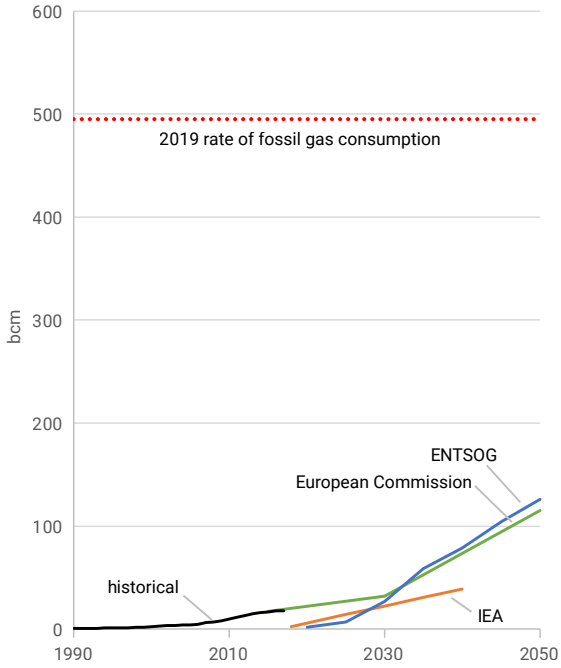
- The Black Sea Shore-Podisor Gas Pipeline in Romania was delayed in August 2020, with the estimated date of completion pushed from 2021 to 2022.
- The Celorico-Spanish Border Gas Pipeline in Portugal faces a three-year delay in start-up, as estimated in November 2020, due to the rejection in 2018 of the project's environmental impact assessment by the Portuguese national environmental authority, requiring restarting route planning, engineering, and environmental assessment.
- The GALSI Pipeline from Algeria to Italy was originally expected to start operation in 2018, but there has not been any reported construction work. In November 2020, the timeline was updated for starting operation in 2022.
- The Ionian Adriatic Gas Pipeline (IAP) from Albania to Croatia, via Montenegro and Bosnia and Herzegovina to Croatia, was acknowledged in June 2020 to have been delayed due to the COVID-19 pandemic. S&P Global reported in December 2020 that the project remains on the drawing board.
- The Methanization of Sardinia Project in Italy had been expected to start operation in 2021, but ENTSOG expects the project to commence operation in 2025.
- The Nord Stream 2 Gas Pipeline, running through the Baltic Sea from Russia to Germany, was hit with new U.S. sanctions in January 2021, which appear to be aimed at further hampering and delaying the project by widening the number of business entities which would face penalties should they assist the completion of the pipeline portion in Danish waters.
- The Onești-Gheraesti-Letcani Gas Pipeline in Romania is delayed due to "obtaining the necessary endorsements, agreements and permits, extension of the procurement procedure durations," according to ENTSOG's TYNDP 2020.
- The Shannon LNG Terminal in Ireland (5.7 bcm/y capacity) faces strong headwinds. Although the project has been proposed since 2008, the Irish coalition government that formed in 2020 announced that it opposed the project and would withdraw it from the EU's Projects of Common Interest (PCI) process, which can help fast-track projects and secure public funding. Since the terminal's planning approval has been withdrawn, it can not move forward until the proponents complete a new environmental impact assessment and reapply for planning approval.
- The White Stream Gas Pipeline that would cross the Black Sea from Georgia to Romania, was originally scheduled to start in 2018, but as of October 2020, ENTSOG reported an expected start-up in 2024.

POTENTIAL FOR CARBON-NEUTRAL GASES

Although net-zero scenarios from the European Commission (2018, 2020) and ENTSOG agree that fossil gas use has to be sharply reduced, these scenarios have different expectations for the potential of other sources of methane (the main component of fossil gas). Other sources of methane could be scaled up to some degree, but each faces limits and/or cost issues. Together, these sources are expected to replace at most one-quarter of current fossil gas use (Figure 8).

Also, it is important to note that two of the gases that are expected to scale up in net-zero scenarios—synthetic methane and hydrogen—are not energy sources. They are only energy carriers, meaning they must be created through the consumption of other energy sources. They could be created through the use of clean electricity (e.g., "green hydrogen") and result in zero emissions. Or they could be created through the use of fossil fuels together with CCS (e.g., "blue hydrogen"), which would result in some residual emissions not captured and stored, and so would be low-carbon but not carbon-neutral.

Figure 8. Scenarios for non-fossil sources of methane (EU-28)[6]



Sources: Historical: Eurostat 2021; European Commission 2018, average of 1.5 °C scenarios; ENTSOG and ENTSO-E 2020, average of low-emissions scenarios; IEA 2019.

Biogas and biomethane: Biogas can be created from crops, manure, and waste materials. Biogas typically has a large fraction of carbon dioxide (CO_2) mixed in, which can be separated out to create biomethane. Biogas accounted for 4% of EU gas consumption in 2019 (Eurostat 2021). According to analysis by the IEA, biogas has limited additional potential in the EU and is relatively expensive, with "only modest scope for costs to fall because the technology is generally mature" (IEA 2019).

Synthetic methane (also known as "e-gas" or "power-to-methane"): Methane can also be synthesized using electricity. If synthesized in a specific way—using clean electricity, such as from wind turbines, and using CO_2 captured from fossil fuels or from the air—and used in an ideal way, then using e-gas would not add any greenhouse gas emissions. However, in practice some of the methane would inevitably leak from pipelines during transportation—and methane is a powerful greenhouse gas (Grubert 2020). Also, this power-to-methane process would be expensive; it involves significant losses in converting energy from electricity into synthesized methane, and capturing CO_2 to use in the process also consumes significant energy. Projections from the European Commission see some potential for e-gas, but it is limited, even in an aggressive climate policy scenario (European Commission 2018).

Due to these limitations, no credible scenario foresees other sources of methane serving as a complete replacement for current fossil gas. The European Commission (2018) scenarios for reaching net-zero

6. Scenarios shown were created for the EU-28, prior to the United Kingdom leaving the EU; other data in this report is for EU-27 (excluding the United Kingdom).

emissions involve consumption of biogas and synthetic methane totaling about 126 bcm per year in 2050 (Figure 8), only about one-quarter the rate of EU fossil gas consumption in 2018. Scenarios from the IEA (2019) and ENTSOG (ENTSOG and ENTSO-E 2020) foresee lower rates of use of alternative methane.

Hydrogen: Renewable electricity can be used to create carbon-neutral hydrogen, which could replace some uses of fossil gas. ENTSOG expects that hydrogen would scale up by 2050 to supply the energy equivalent of about one-fifth of current fossil gas use (ENTSOG and ENTSO-E 2020). Hydrogen would most likely be used predominantly for certain purposes, such as industry, shipping, and aviation, with only a small portion blended into the gas grid (IEA 2020).

Some proposed new fossil gas pipelines are being recast as "hydrogen-ready," such as the Malta-Italy Gas Pipeline. After Malta failed to receive EU funding for the pipeline in the latest round of CEF disbursements, in January 2021 Minister for Energy Miriam Dalli said that, in order to try again for EU funding, under more stringent requirements for gas projects, Malta will advance the project as a "hydrogen-ready" pipeline (Calleja 2021).

Existing pipelines for methane (fossil gas) could be retrofitted in the future to carry hydrogen, carrying a large fraction of the hydrogen that would be used in a net-zero emissions future, the consultancy Artelys concluded in modeling the combined electricity-gas-hydrogen system through 2050 (Artelys 2020b). But few if any additional methane pipelines would be needed. "A smart allocation of renewables results in no additional [methane] infrastructure being required in the EU," the Artelys study concluded.

Most hydrogen would not be mixed into the existing gas grid, according to the IEA's Sustainable Development Scenario. This low-emissions scenario involves a vast scale-up of hydrogen generation, but only a small fraction (7%) of the hydrogen in 2040 would be blended into the gas grid. Most hydrogen would be devoted to the chemical industry or to sectors that are difficult to electrify, such as steel, aviation, and shipping (IEA 2020).

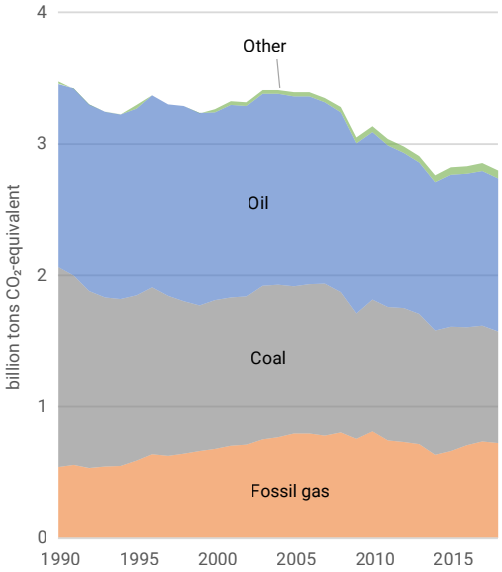
HISTORICAL EU FOSSIL GAS CONSUMPTION

Burning fossil gas was responsible for over one-quarter of EU CO_2 emissions from fuel combustion in 2018. In recent years, emissions from coal have been decreasing, but meanwhile emissions from gas have been increasing (Figure 9).

Emissions from all these fossil fuels—coal, fossil gas, and oil—have to be reduced to near-zero for the EU to achieve net-zero emissions by 2050 (European Commission 2018, 2020). That means most uses of these fossil fuels will have to be avoided through higher efficiency or replaced by clean energy. When fossil fuels are still used, their greenhouse gas emissions will have to be avoided using carbon capture and storage (CCS) (ENTSOG and ENTSO-E 2020).

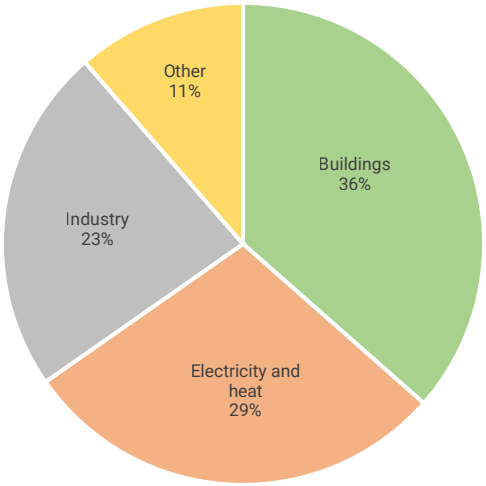
In the EU, fossil gas is burned primarily for heat in buildings (both residential and commercial), accounting for 36% of use in 2017 (IEA 2021). Burning fossil gas in power plants, many of which also generate heat used in buildings or industrial processes, accounts for 29% of fossil gas use, and industry accounts for 23% (Figure 10).

Figure 9. EU-27 CO_2 emissions from fuel combustion 1990–2019



Source: IEA 2021

Figure 10. EU-27 uses of fossil gas in 2018



Source: IEA 2021

REFERENCES

Artelys. 2020a. An updated analysis on gas supply security in the EU energy transition. Published January 20, 2020.

Artelys. 2020b. What energy infrastructure to support 1.5°C scenarios?. Published November 13, 2020.

Bellona. EU RRF "Do No Harm" criteria fail to safeguard the resilience of the recovery. Published February 18, 2021.

Calleja, L. Malta to push ahead on hydrogen-ready pipeline after losing out on EU funds. Malta Today. Published January 5, 2021.

Chen, H. Biden Executive Order Can Help U.S. End Fossil Fuel Finance. Natural Resources Defense Council. Published January 28, 2021.

European Bank for Reconstruction and Development. Multinational development banks present their Paris Alignment approach. Published December 10, 2019.

_____. Five years on from Paris 2015, the next climate challenge. Published December 7, 2020.

European Commission. In-depth analysis in support of the Commission Communication COM(2018) 773: A Clean Planet for all. Published December 2018.

_____. Stepping up Europe's 2030 climate ambition. COM/2020/562. September 17, 2020.

_____. List of candidate 5th PCIs in gas for public consultation. Published January 2021.

_____. EU energy statistical pocketbook and country datasheets. Accessed March 2021.

Eurostat. Energy Statistics. Accessed March 2021.

ENTSOG and ENTSO-E. TYNDP 2020 Scenario Report. Published February 2020.

Global Energy Monitor. Pipeline Bubble 2021: Tracking Global Oil and Gas Pipelines. Published February 2021.

Grubert, E. At scale, renewable natural gas systems could be climate intensive: the influence of methane feedstock and leakage rates. Environmental Research Letters. 2020. DOI: 10.1088/1748-9326/ab9335

Howell, N. and Quigley, A. Europe's pivotal role in the global LNG market. LNG Industry. Published February 11, 2021.

International Energy Agency (IEA). World Energy Outlook 2019.

_____. World Energy Outlook 2020.

_____. Data and statistics: CO_2 emissions by energy source. Accessed March 2021.

International Gas Union (IGU). World Gas LNG Report – 2018 Edition. Published June 23, 2018.

Mooney, A. Aviva will use its "ultimate sanction" to force action on global warming. Financial Times. Published January 31, 2021.

Patricolo, C. The US leading role at the Three Seas Initiative Summit. CEE Energy News. Published October 22, 2020.

Popov, J. US–Russia gas battle is building stranded assets in Europe. Energy Monitor. Published November 30, 2020.

Reuters staff (2021a). Blinken warns entities involved in Nord Stream 2 pipeline to immediately quit. Reuters. Published March 18, 2021.

_____ (2021b). Germany's Greens vow to scrap Russian gas pipeline after election. Reuters. Published March 19, 2021.

Rinke, A et al. Analysis: Germany bets U.S. will make the best of "bad deal" Nord Stream gas link. Published March 16, 2021.

Smith CE. Liquids pipeline operators' net incomes increase 23.5%. Oil and Gas Journal. Published October 5, 2020.

Three Seas Initiative. Undersecretary Keith Krach: U.S. will invest up to $1 billion in 3SI. Published October 19, 2020.

Tsiropoulos, I et al. Towards net-zero emissions in the EU energy system by 2050. European Commission Joint Research Centre. 2020.