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New LNG Regasification Terminals in Europe

Planned and Announced Projects for Supply Security

FTI CONSULTING

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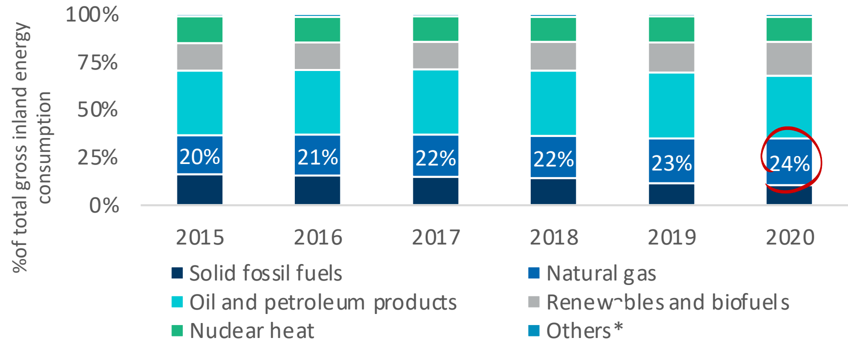
Natural gas accounts for ~25% of energy consumption in the EU and Russia is the largest supplier, creating a major security of supply concern

Executive Summary (1/2)

Role of natural gas in European Energy mix – LNG import infrastructure

- Natural gas is the second largest source of energy in the EU-27, representing 24% of total energy consumption.



- In 2021, total consumption of natural gas in the EU amounted to 412 bcm, up by 4% (17 bcm) compared to 2020.
- LNG accounted for 24% of total natural gas imports in the EU in 2021 – the rest is supplied through pipelines, mainly from Russia, Norway, the UK and Algeria.
    - 11 LNG importing countries in the EU: Greece, Italy, Spain, Portugal, France, Belgium, the Netherlands, Poland, Lithuania, Croatia, Malta.
    - 21 terminals operational as of mid-February 2022 in Europe, for a total regasification capacity of 160 bcm/year and a total storage capacity of 7.65 millions of m3 LNG.
    - 5 additional projects (including expansion at existing terminals) under construction in the EU as of mid-February 2022, for a total additional regasification capacity of at least 19.5 bcm/year.

Reliance on Russian gas – Geopolitical context and possible impacts

- EU's reliance on natural gas imports increased in recent years – Russia is the largest source of imports (155 bcm, or 41% of total imports in 2021).
- European dependency on Russian gas varies according to country, with the western nations less dependent and the central and eastern countries almost 100% dependent.
- The conflict and invasion of Ukraine by Russia at the end of February 2022 significantly impacted the natural gas markets in Europe. With the development of the conflict, EU countries have adopted measures and sanctions against Russia and plan to reduce or cut reliance on Russian gas imports in the short to medium-term.
- In particular, the NordStream 2 project, a pipeline connecting Russia to Germany with a planned capacity of 55 bcm/year has been suspended. European countries are now exploring other supply options, and in particular the development of LNG terminals.

Sources: Eurostat; GIE LNG database; ICIS; FTI Consulting analysis.

EU governments are planning to reduce reliance on Russian gas through increased LNG imports: 21 new or accelerated LNG projects identified

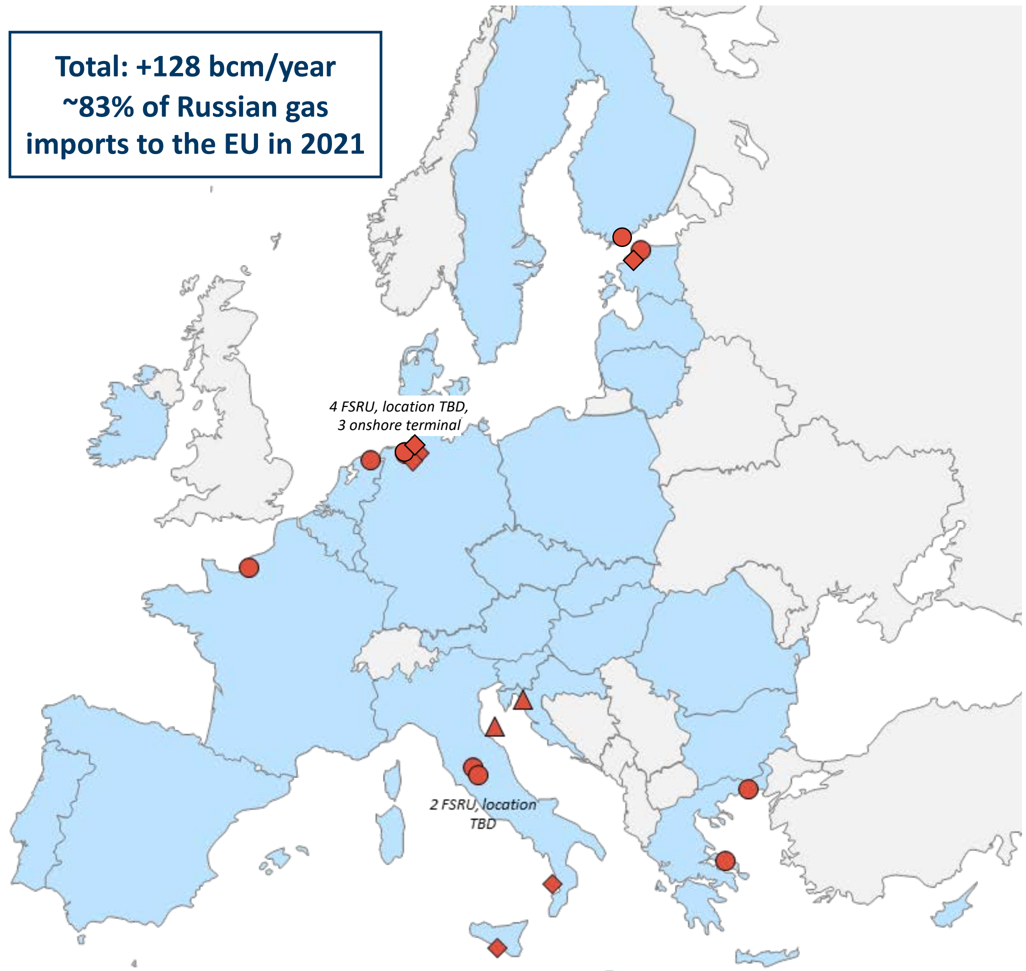
Executive Summary (2/2)

European countries[1)] strategies to reduce or cut reliance on Russian gas imports

- Governments in countries with the highest share of Russian gas in total imports announced new plans to cut reliance in the short/medium-term, in particular:
  - Germany (50+% of Russian gas in 2021): 3 onshore LNG terminal projects, and 4 FSRUs projects accelerated
  - Italy (~40% of Russian gas in 2021): 2 FSRU projects currently under development by Snam, in addition to other potential new onshore terminals and expansion of capacity at existing terminals
  - Finland & Estonia (~100% of Russian gas in 2021): Joint project between the two Governments to develop rapidly an FSRU project and potential development of the Paldiski LNG terminal project in Estonia

- Other countries in the EU are also developing strategies to cut reliance on Russian gas imports, including[2)]:
  - France: 1 FSRU project
  - The Netherlands: 1 FSRU project
  - Greece: 2 FSRU projects

LNG terminal projects announced or re-launched/accelerated in the EU-27 after the start of the war in Ukraine



Announced/re-launched (after start of war in Ukraine) | LNG terminal (onshore) | LNG terminal (FSRU) | Expansion | EU Member State

Sources: ICIS; Reuters; FTI Consulting analysis.
Notes: 1) Selection of countries. 2) Not exhaustive.

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B. Current LNG import infrastructure and announced projects (until mid-February 2022)

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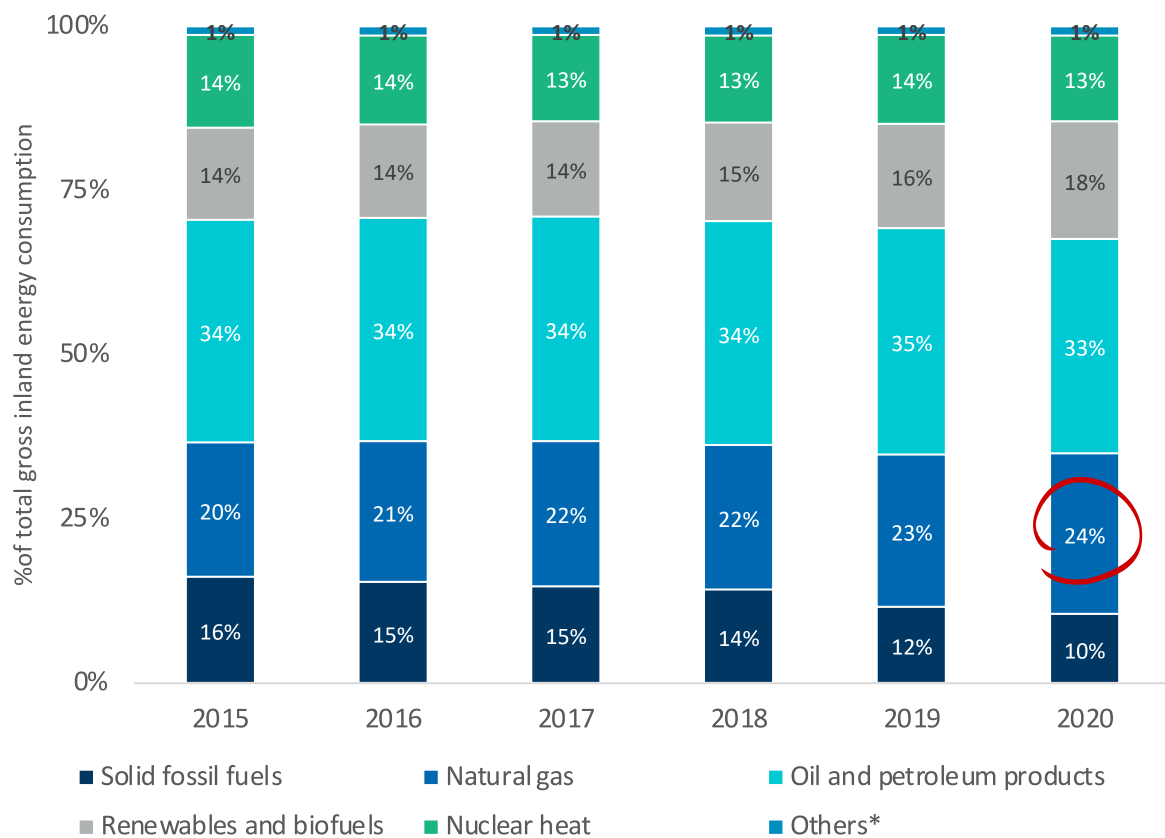
D. Focus on European Countries Strategies and Plans

Gas accounted for 24% of total energy consumption in the EU, compared to 20% in 2015

Natural gas in the European (EU) Energy System – Natural gas demand

Natural gas consumption/demand, share in gross inland energy consumption, EU-27 (%)



FTI Consulting comments

- Natural gas is the second largest source of energy in the EU-27, representing 24% of total energy consumption.
- Gas consumption in the EU-27 experienced a 2% annual increase between 2015 and 2020.
- Prior to the war, the gas demand in Europe was forecasted to remain stable up to 2025 (compared to 2019 levels).
- In 2021, total consumption of natural gas in the EU amounted to 412 bcm, up by 4% (17 bcm) compared to 2020.

Sources: Eurostat; European Commission Quarterly Report on European Gas Markets Q4 2021; FTI Consulting analysis.
Note: *Others include : Peat and peat products, non-renewable waste, oil shale and oil sands, electricity and heat.

Russia is the largest source of gas imports in the EU, with 41% of total imports in 2021 – Reliance on Russian gas varies between countries

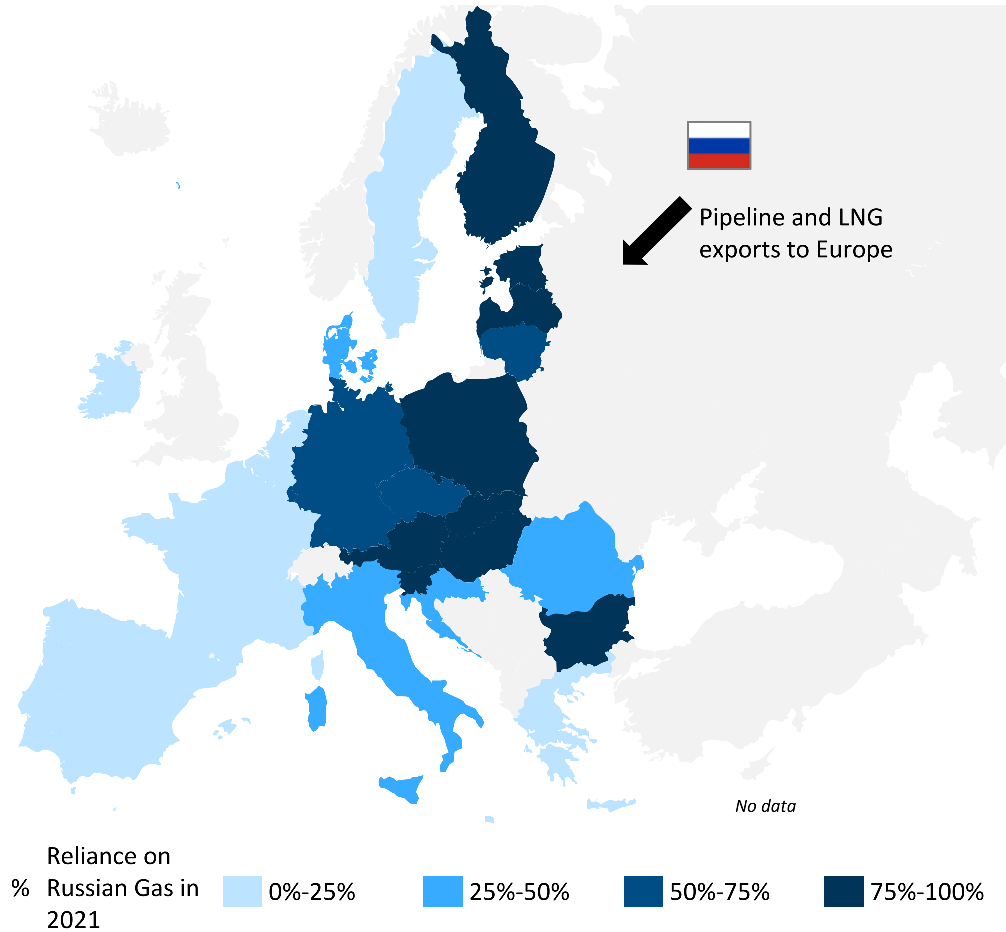
Natural gas in the European Energy System – Sources of imports

Key figures on imports of natural gas in the EU-27

Total gas import dependency in 2021	87% *Imports from outside EU-27/Total supply*
Imports from Russia in 2021	155 bcm (including 16 bcm of LNG)
Imports from Russia in % of total imports in 2021	41%

Reliance on Russian gas by EU Member State (% range)

European dependency on Russian gas varies, with the western nations less dependent and the central and eastern countries almost 100% dependent



Sources: : Eurostat; European Commission Quarterly Report on European Gas Markets Q4 2021; European Commission Joint European action for more affordable, secure and sustainable energy; FTI Consulting analysis.
Notes: Total supply = Imports + Production - Exports

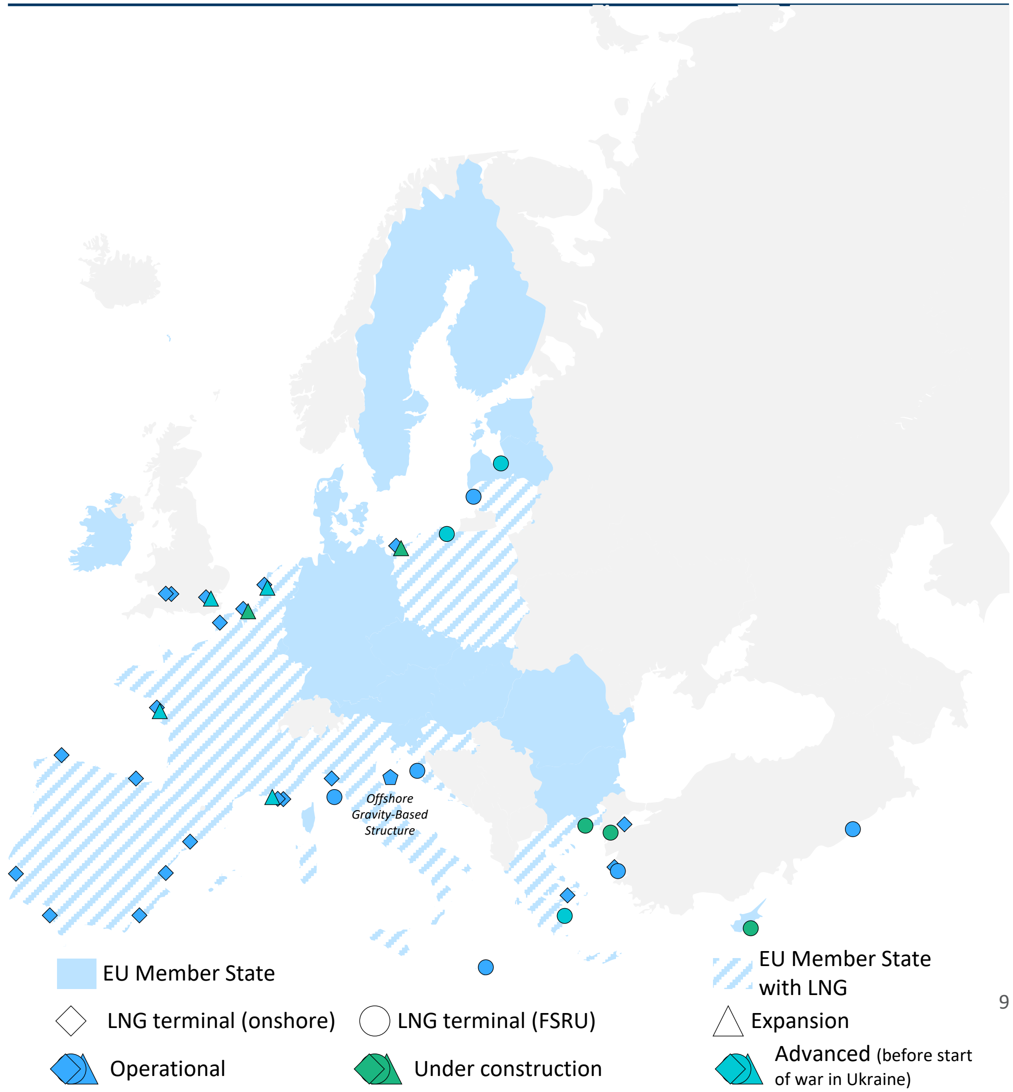
LNG accounted for 24% of gas imports in the EU in 2021 – There are currently 21 operating LNG terminals, and 5 projects under constuction[1]

European LNG infrastructure, operating and under construction (as of mid-February 2022)

Key figures

- In 2021 **the EU imported 338 bcm natural gas** of the 412 bcm it consumed (82%).
- **LNG accounted for 24% of total natural gas imports in the EU in 2021** – the rest is supplied through pipelines, mainly from Russia, Norway, the UK and Algeria. While total net gas import increased by 2.8% in Q4 2021[2)] in the EU, the LNG imports grew by 33% with an increase of 53% for December. LNG imports for January and February 2022 have more than doubled year-on-year.
- **11 LNG importing countries** in the EU: Greece, Italy, Spain, Portugal, France, Belgium, the Netherlands, Poland, Lithuania, Croatia, Malta.
- **21 terminals operational** as of mid-February 2022 in the EU, for a total regasification capacity of 160 bcm/year and a total storage capacity of 7.65 millions of m3 LNG[3)].
- The existing LNG regasification capacities could amount for **49.2% of the gas imports** (40.3% of consumption) if used fully.
- **5 additional projects under construction in the EU** as of mid-February 2022, for a total additional regasification capacity of (at least) 19.5 bcm/year.
- 1 additional project in Turkey, for an additional 9.7 bcm/year.

Infrastructure map (including non-EU terminals)



Sources: European Commission Quarterly Report on European Gas Markets Q4 2021; Gas Infrastructure Europe; FTI Consulting analysis.
Notes: **Excluding small and mid-scale LNG terminals, and LNG storage terminals.**
1) Including expansion projects at existing / operating LNG terminals.
2) Year-on-year comparison.
3) Source Gas Infrastructure Europe.

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Following the start of the war in Ukraine in February 2022, at least 21 projects have been announced (new projects or relaunched/accelerated)

European LNG infrastructure, other projects, including projects re-launched/accelerated after mid-February 2022

Context and Key figures

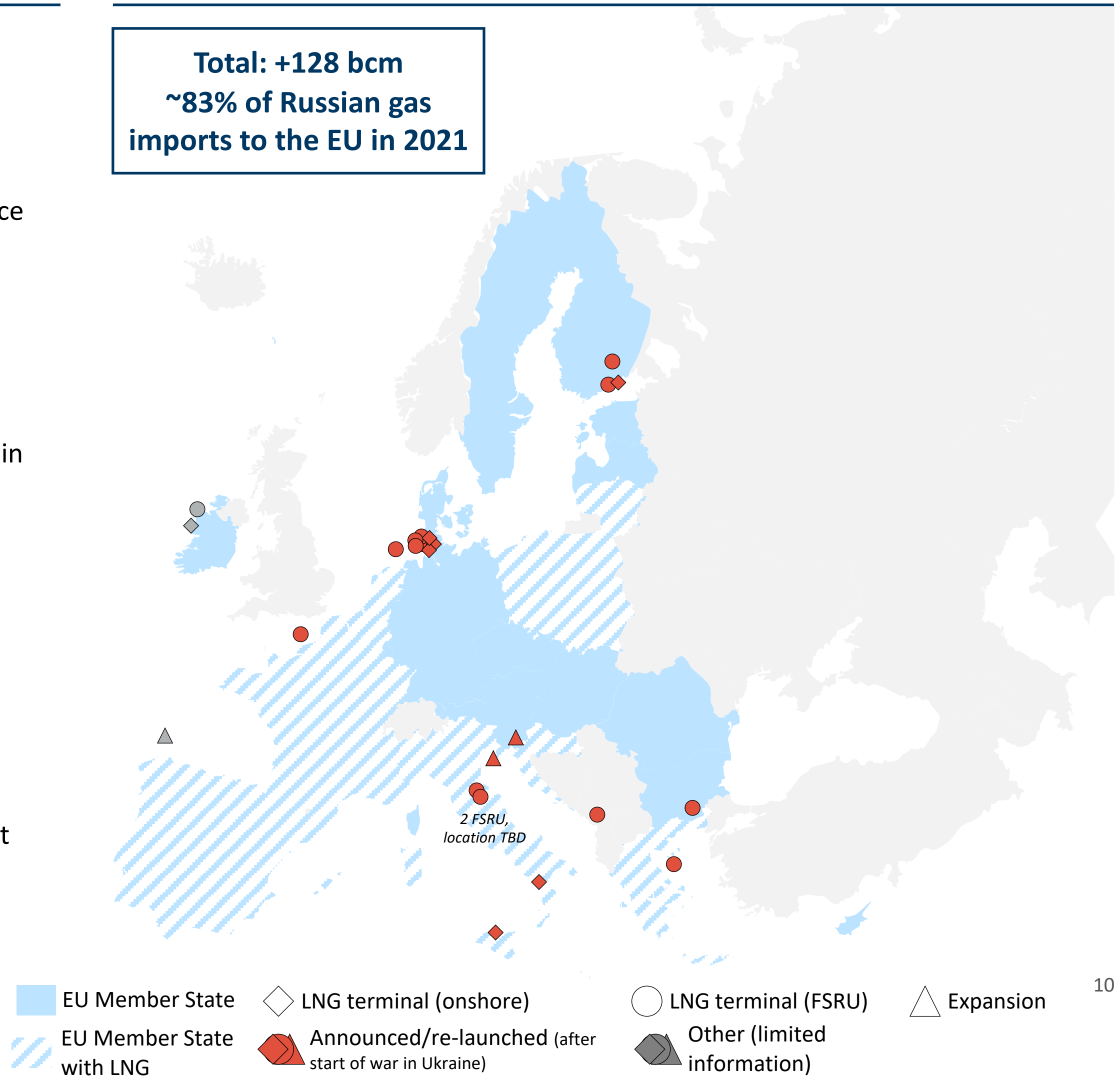
Geopolitical context

- The conflict and invasion of Ukraine by Russia at the end of February 2022 significantly impacted the natural gas markets in Europe. With the development of the conflict, EU countries have adopted measures and sanctions against Russia and plan to reduce or cut reliance on Russian gas imports in the short to medium-term.
- In particular, the NordStream 2 project, a pipeline connecting Russia to Germany with a planned capacity of 55 bcm/year has been suspended.
- European countries are now exploring other supply options, and in particular the development of LNG terminals.
- LNG presents two main challenges: first to secure its supply, and second to make sure that once regasified that it could flow "anywhere" in the EU.

Impacts on LNG infrastructure projects in the EU

- This context led to the start of new LNG import terminal projects in many countries across Europe, and the acceleration of previously announced projects.
- In particular, we have identified 16 active projects, in 10 different countries and for a total regasification capacity of at least +97.4 bcm/year.

Infrastructure map (including non-EU terminals)



Sources: FTI Consulting analysis.
Notes: Excluding small and mid-scale LNG terminals, and LNG storage terminals.

In particular, countries with the highest share of Russian gas in total imports announced new plans to cut reliance in the short/medium-term

Announced strategies and plans – Selected countries

Germany (50+% of Russian gas in 2021)

- Germany is the only major gas consuming country with sea access which has no LNG terminal yet.
- In April 2022, the German Finance Ministry has approved the spending of up to EUR 3bn to finance floating terminals for liquified natural gas (LNG) in German ports, with the signing of the first charter contracts scheduled in April.
- Development of LNG import terminals has been accelerated with fours FSRUs already booked on behalf of the German Government, and the accelerated development of two onshore terminals
    - Uniper: letter of intent signed for the chartering of two FSRUs – 7.5bcm/year each
    - RWE: chartering of two FSRUs – 10 to 14 bcm/year in total.
- Other onshore LNG terminal projects under development.
- An LNG Acceleration Act is planned so that these LNG projects can be developed at a high pace.

Italy (~40% of Russian gas in 2021)

- In March 2022, the Italian Ecological Transition Minister has mandated Snam to discuss plans for two floating storage regasification units (FSRUs) with the acquisition of one FSRU and the leasing of a second.
- Future projects also include the resuming of the Porto Empedocle LNG plant project in Sicily, with a yearly 8 bcm regasification capacity.
- There are also plans under discussion for increase of capacity at currently existing terminal.

Finland & Estonia (~100% of Russian gas in 2021)

- In April 2022, Finland's Ministry of Economic Affairs and Estonia's Government announced that they planned to jointly charter an FSRU so that both countries can completely end their reliance on Russian gas this winter.
- The two countries are also working on the development of a new terminal.

Other countries in the Eu are also developing strategies to cut reliance on Russian gas imports, including:

France	The Netherlands	Poland
Greece	Cyprus	Croatia

Sources: Clean Energy Wire; Reuters; ICIS; German Federal Ministry for Economic Affairs and Climate Action – Second Energy Security Progress Report; FTI Consulting analysis.

2. Details of Projects

A. Methodology – Comments on sources and limitations

B. LNG terminals under construction

C. LNG terminals announced before mid-February 2022, advanced projects

D. LNG terminals announced/re-launched and projects accelerated after mid-February 2022

E. Other LNG terminal projects (with limited information)

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We have collected public information available on LNG terminal projects in Europe – The projects are described in a summary table

Methodology and sources

- We have collected data on CAPEX, capacity, project sponsors on other project characteristics of new LNG terminal projects (including expansion projects) under construction or announced in Europe. We have relied on publicly available data.
- Sources include:
  - ICIS LNG infrastructure database, as of 08/04/2022
  - ICIS News
  - ENTSGO TYNDP 2022 Project Tables
  - Gas Infrastructure Europe (GIE) LNG database 2022
  - GIIGNL Annual Report 2021
  - Global Energy Monitor
- There are some **limitations** to this approach:
  - Data collected is based on diverse sources, from official communications from project developers and authorities, to news releases.
  - The quality of information available varies significantly between projects. In particular, CAPEX data may be based on estimates or budgets, and may not be accurate.
  - The scope covered by the amount of CAPEX is not always described in details.
  - **The distinction between "Advanced" and "New /Re-launched / Accelerated" is based on categories in the ENTSOG TYNDP 2022 Project Tables, and additional research on each project.**

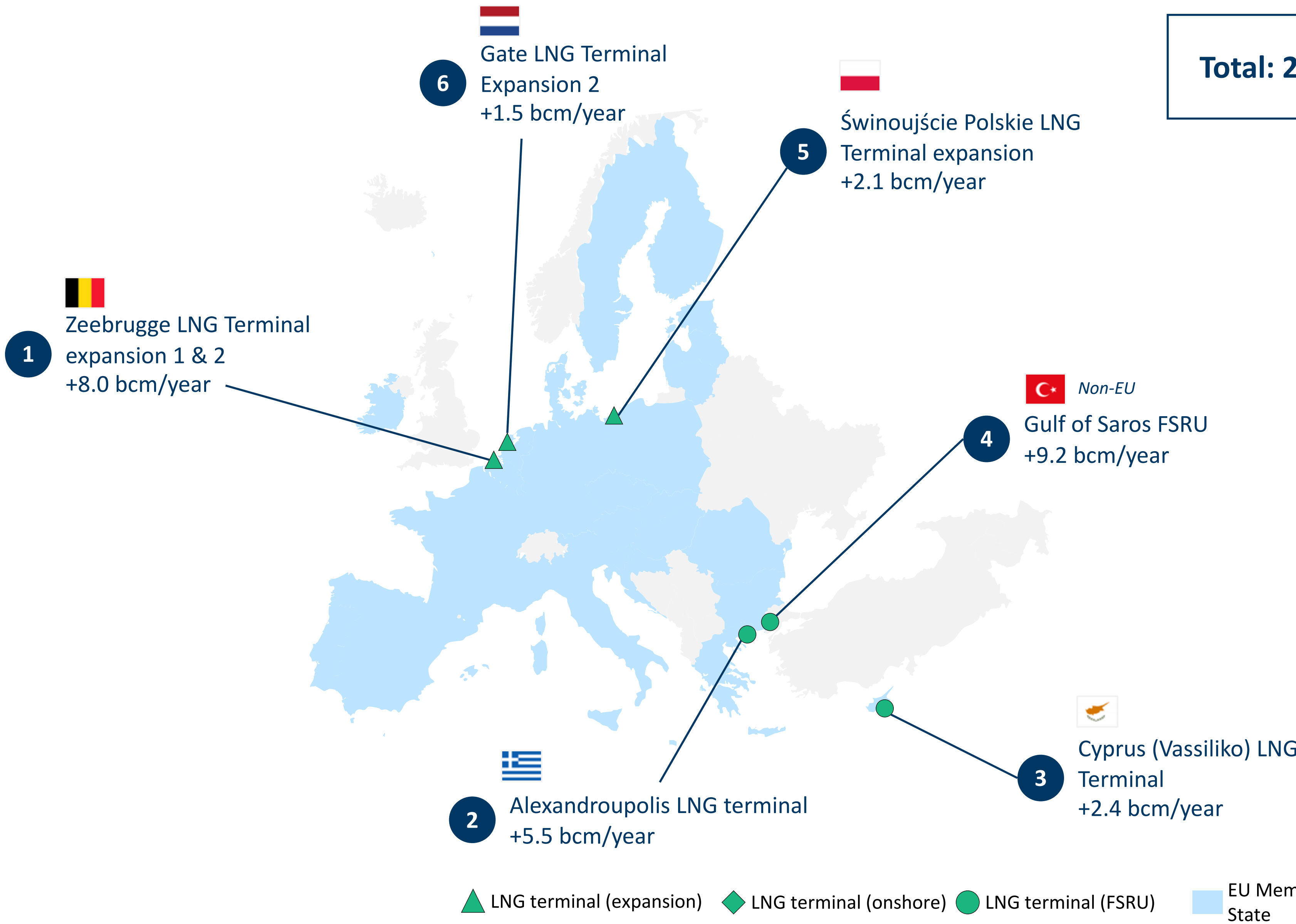
Project Description – Template

Location	Country, Region
Type of project	▪ New / Expansion at existing LNG terminal ▪ Onshore / FSRU / Other
Status	Under construction (FID taken) / Announced
Expected start of operations	Year of commissioning or start of operations (expected)
Main project sponsors	List of project sponsors / Shareholders / Capital structure when available
CAPEX	CAPEX budget announced
Regasification capacity	▪ Planned additional annual LNG regasification, in bcm per year ▪ Current annual LNG regasification (for expansion projects), in bcm per year
Storage capacity	▪ Planned additional LNG storage, in m3 LNG ▪ Current LNG storage (for expansion projects), in bcm per year
Other project characteristics	Including other services (in addition to regasification and storage)
Other comments	Including information on capacity reservation

There are 6 LNG terminal projects under construction in Europe, for a total of 29.2 bcm/year of regasification capacity

Overview of projects under construction – Europe

Total: 29.2 bcm/y



Sources: FTI Consulting.

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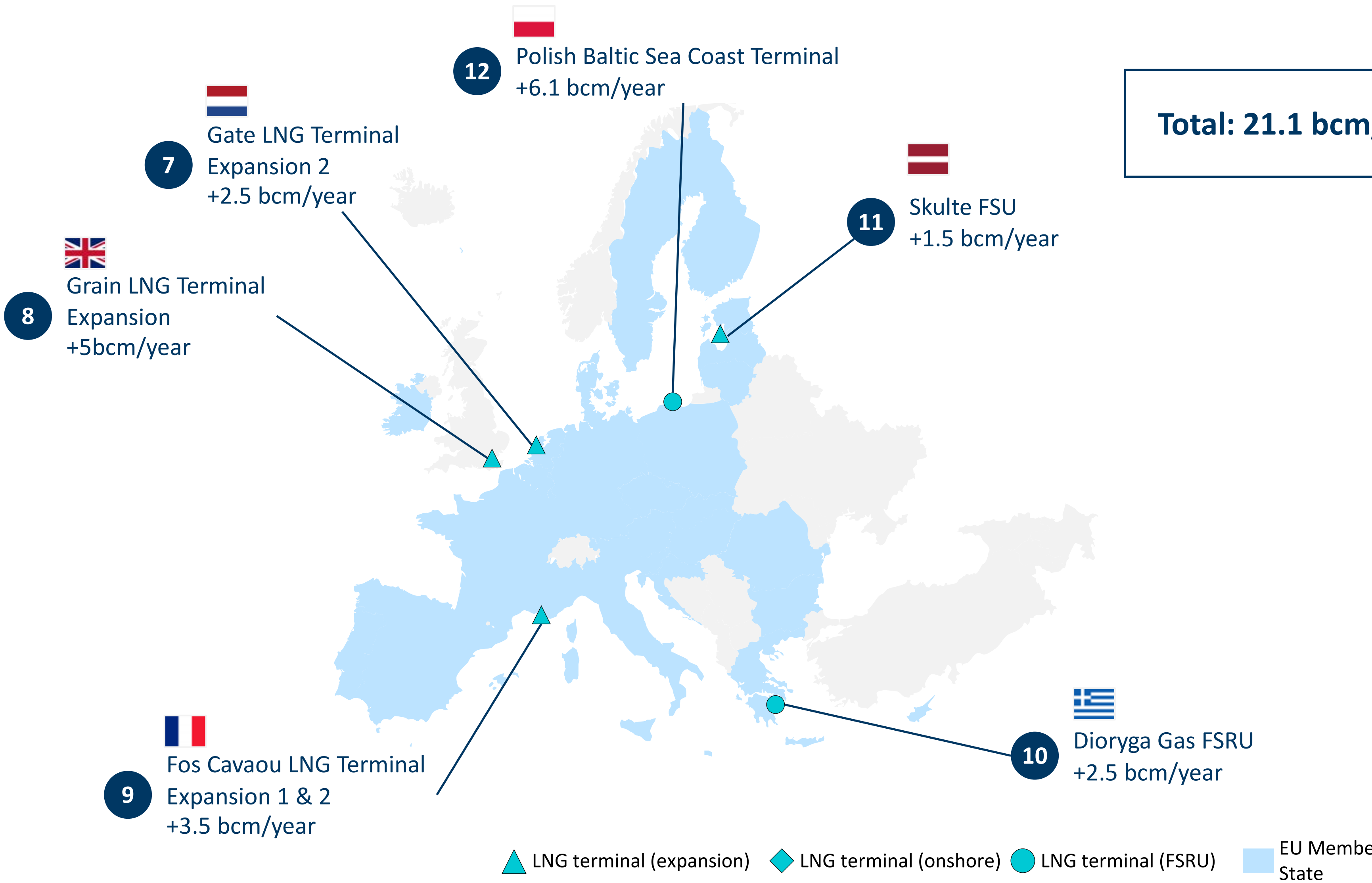
We have identified 6 LNG terminal projects that could be considered as already advanced before the war in Ukraine, for a total of 21 bcm/y

Overview of potential projects – Europe



Total: 21.1 bcm/y

Sources: FTI Consulting.

D LNG terminals announced/re-launched after mid-February 2022

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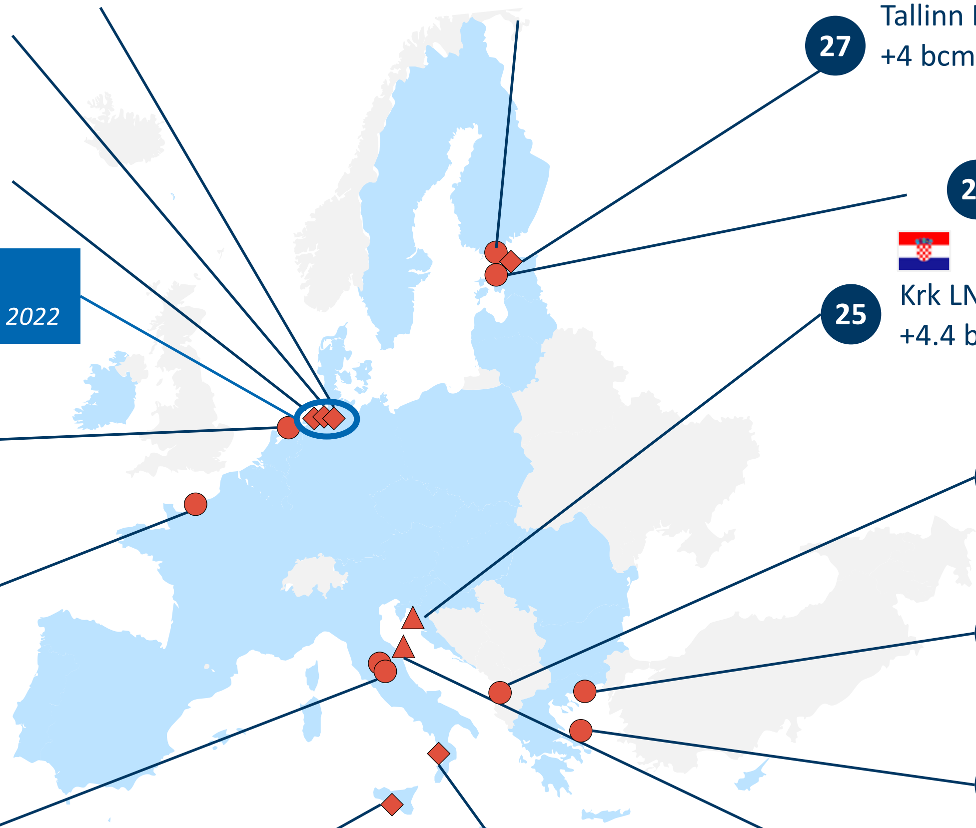
Since the beginning of the war, there are at least 21 projects that either appeared or were re-launched / accelerated, for a total of 128 bcm

Total: +128 bcm/y

Overview of potential projects – Europe



13 Brunsbüttel LNG terminal
+8 bcm/year

14 Stade (HEH) LNG Terminal
+12 bcm/year

15 Wilhelmshaven Terminal
+16-20 bcm/year

+ 4 FSRUs, ~25 bcm/year
New projects, announced in March 2022

16 Eemshaven FSRU Terminal
+8 bcm/year

17 Le Havre FSRU Terminal
+4.2 bcm/year

18 2 additional FSRU Terminals
Location to be defined
+10 bcm/year

19 Porto Empedocle LNG Terminal
+8 bcm/year

20 Gioia Tauro LNG Terminal
+12 bcm/year

21 Adriatic LNG Expansion
+0.5 bcm/year

22 Argo (Volos) FSRU Terminal
+5.2 bcm/year

23 Thrace FSRU Terminal
+5.5 bcm/year

Non-EU
24 Vlora LNG-to-Power
No information on capacity

25 Krk LNG Terminal expansion
+4.4 bcm/year

26 Paldiski FSRU
+2.5 bcm/year

27 Tallinn LNG terminal
+4 bcm/year

28 Finland and Estonia FSRU
+3.1 bcm/year

Sources: FTI Consulting.

LNG terminal (expansion) LNG terminal (onshore) LNG terminal (FSRU) EU Member State

Development of LNG import terminals has been accelerated with 4 FSRUs already booked, and the accelerated development of 2 onshore terminals

Focus on Germany

German Government

Uniper

- **On 05/05/2022**, an agreement was signed between the Federal Government and the state of Lower Saxony on the **expansion of Wilhelmshaven into a green energy hub for Germany**.
- Uniper is supporting this project with its on-site projects - **in the short term in the form of the LNG terminal**, and in the medium and long term in the form of the Green Wilhelmshaven project.

1 onshore terminal – 10 bcm

Uniper

- **On 05/05/2020, a letter of intent (LOI) was signed for the chartering of two floating storage and regasification units (FSRU).**
- Uniper **had optioned both FSRUs on the market for the Federal Government**.
- **Each FSRU will have a capacity of up to 7.5 bcm per year**.
- Uniper, as builder and operator of the terminal, will invest around €65 million.

2 FSRU – ~15 bcm

RWE

- **On 05/05/2022, on behalf of and in the name of the German government, RWE has chartered two so-called Floating Storage and Regasification Units (FSRU).** FSRUs are special ships that offer a **rapid interim solution** for landing liquefied natural gas (LNG) until the first LNG terminals on the German mainland are completed. RWE will also manage the operation of the vessels.
- Both vessels are owned by Höegh LNG.
- Each of the ships is capable of receiving up to 170,000 cubic metres of LNG. **Total regasification capacity is expected to reach between 10 and 14 bcm per year**.
- The plan is for the FSRU platforms to **start operating as early as next winter**.
- The next step is to **determine which unloading sites are suitable**. Wilhelmshaven, Brunsbüttel, Rostock or Stade came into question. A first decision has been announced on 05/05/2022 for **Wilhelmshaven to become an FSRU location**.

2 FSRU – ~10 to 14 bcm

RWE / Gasunie

- **On 05/03/2022, KfW (on behalf of the German Federal Government), Gasunie and RWE signed MoU to build an LNG terminal at Brunsbüttel.**
- The KfW will acquire 50% of the shares in the LNG terminal for the Federal Government. Gasunie will operate the facility.
- **The terminal will have an annual regasification capacity of 8 bcm** and provide a possibility to import gas directly to the German market from regions which cannot be reached by gas pipelines.
- The partners in the project are working to realise the venture as quickly as possible whilst complying with all the rules governing authorisations and State aid.
- The terminal **could be operational from 2026**.

1 onshore terminal – 8 bcm

According to LNG brokers, charter rates for these FSRUs could be around USD 150k-200k/day, for 10 year contracts

Sources: Uniper; RWE; German Federal Ministry for Economic Affairs and Climate Action – Press Release (05/03/2022); FTI Consulting analysis.
Note: **One additional onshore terminal project** in Stade, developed by a consortium of private companies (Fluxys / Parterns Group / Dow / Buss Group) – Set to be completed in 2026.

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We have identified 3 additional projects (total of 13.8 bcm/y) with very limited information available

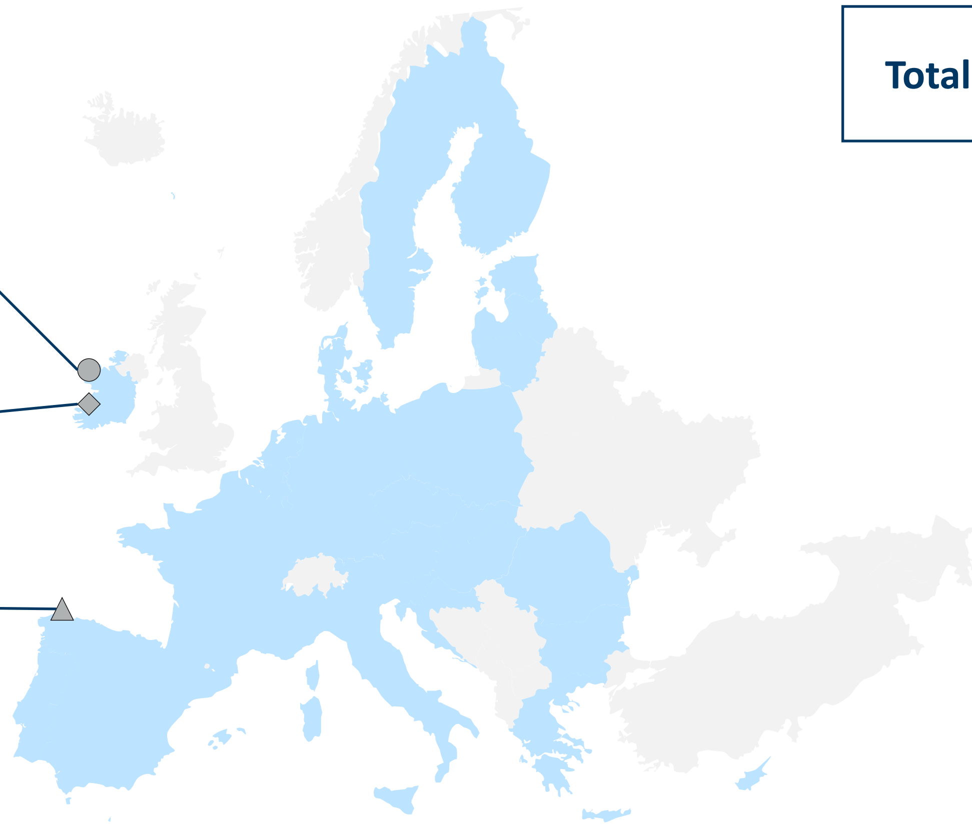
Overview of potential projects – Europe

Total: + 14 bcm/y

29 Mag Mell FSRU Terminal
Location to be defined
+2.6 bcm/year

30 Shannon FSRU
+7.8 bcm/year

31 Murgardos LNG Terminal Expansion
+3.6 bcm/year



LNG terminal (expansion) LNG terminal (onshore) LNG terminal (FSRU) EU Member State

Sources: FTI Consulting; GIE database.

Experts with Impact™

Emmanuel Grand

Senior Managing Director, FTI Consulting, Paris

emmanuel.grand@fticonsulting.com | +33 1 40 08 12 43

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