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# Natural gas: what supply risks for the European Union?





with the support of BRGM and RTE

## Executive summary and conclusions

The European Union (EU) is at risk of enduring a situation of permanent and severe competition between natural gas importing countries, or even a chronic shortage of liquefied natural liquid (LNG) gas on the global market at short, mid and long term.

This results from the highly unpredictable **future of Russian import contracts**. It is also a by-product of **two decades of a declining gas production in Western Europe**, as well as **the equally long-standing delay in implementing climate targets** aiming at fossil fuel substitution.

Europe currently faces a dilemma: it may either transform its economic system to make it more energy- and material-efficient, or remain highly vulnerable to the geopolitical and environmental evolution of the continent. Such is the conclusion of our risk analysis report, conducted by the Shift Project, under the supervision of the Ministry of Armed Forces, with the support of the French Electricity Transmission Network company (RTE, *Réseau de transport d'électricité*) and the French Geological Survey (BRGM, *Bureau de recherches géologiques et minières*).

#### Assessment of the vulnerability of future gas supplies to the EU

The analysis of gas supply risks for the EU, conducted by the Shift Project, a French think-tank working on energy transition, is based on November 2022 data provided by Rystad Energy, a leading business intelligence company.

We compared various **assumptions regarding the evolution of EU demand** with the share of this demand **that might be covered by domestic production** or by ongoing or very likely **medium- and long-term** (> 1 to 2 years) supply **contracts**.

We attempted to assess the degree of vulnerability of this EU supply pattern.

Nota bene: <u>It is normal that a significant part of future demand is not covered by existing</u> <u>contracts</u>. In a normal situation, at any given moment, **about one third of the current demand is covered by spot contracts or short-term contracts (< 1 to 2 years)**. In such contracts, **prices are very sensitive to fluctuations in the immediate balance between supply and demand**. By definition, Rystad Energy's prospective data reveals very few existing short-term contracts. But they provide assumptions of future production volumes likely to be contracted, for short or long term delivery.

**Should the volumes contracted with Russia fail to be delivered**, the proportion of unidentified supplies would reach 40% of the EU demand by 2025 as expected by Rystad.

**If Russian supply volumes were to be quickly restored to the level expected by existing contracts**, and if EU demand were to decline significantly, albeit at a slower pace than set by its climate targets, 12% of EU supply by 2025 would remain unidentified, 25% by 2030 and 50% by 2035. Should EU's demand remain at its 2021 level, the proportion of unidentified supplies would rise to a quarter of that demand by 2025 and then to almost a third by 2030.

If the EU members successfully meet their climate commitments pledged under the "Fit for 55" plan, they may significantly reduce their exposure to a partial or total default of Russian supply.



**Figure 1. Comparison of EU demand and supply over the 2010-2040 period.** (Source: The Shift Project, based on November 2022 Rystad Energy data.)<sup>1</sup>

In order to assess the unidentified future supply volumes, we added up the projected future EU production, its ongoing import contracts, and volumes potentially available for contracting from Norway and Algeria, via pipeline. The gap between this sum of identified sources and the projected evolution of EU demand provides the estimate of unidentified sources of supply.

**The EU imports a very large share of its natural gas consumption**, with about 70% of imported volumes currently coming via pipeline primarily from three countries: by decreasing order of importance, Russia, Norway and Algeria.

<sup>&</sup>lt;sup>1</sup> Unless otherwise noted, all graphs in this report were constructed by The Shift Project based on November 2022 data provided by the Norwegian business intelligence firm Rystad Energy. Gas volumes are given in billion cubic meters (bcm). For a given quantity of gas, this unit corresponds to the volume that it would occupy at 15°C and at atmospheric pressure.

Therefore, **the unidentified volumes of supply** we have estimated **might be provided through future contracts on the global LNG market** delivered by tanker, or through a hypothetical normalisation of relations with Russia.

We then compared the unidentified supply volumes for the EU and the rest of the world with an estimate of **LNG export volumes available for contracting**: <u>see Figure 2 below</u>. This comparison reflects the **potential level of tension on the global LNG market**, barring any normalisation of relationships with Russia.

#### Better contractual coverage of Chinese demand A threat of economic wars over supply

Asia and Europe (outside of Russia) are currently on a par as the two largest global natural gas importers. With a significant growth in the past two decades, China's demand is expected to increase strongly in the near future.

The plausible development of massive new needs in other parts of Asia (India, Pakistan, Thailand, Bangladesh, Indonesia, etc.) during this decade would greatly increase global LNG demand.

The coverage by ongoing long-term contracts of expected future demand appears to be significantly better for China than for the EU.

	2025	2030	2035	2040
EU with Russian contracts (with potential new pipeline contracts with Norway and Algeria)	87 %	75 %	53 %	57%
EU without Russian contracts (with potential new pipeline contracts with Norway and Algeria)	61 %	58 %	48 %	54 %
China	100 %	85 %	70 %	63 %
East Asia	95 %	80 %	63 %	52 %

Table 1. Rates of coverage by existing supply contracts of gas demand, as expected by Rystad Energy.

In a tight supply market, the more an importer has to resort to short-term contracts, the more it is exposed to high and volatile prices.

It is a source of concern that fierce supply competition in the LNG market will develop between Western Europe and East Asia, between these two regions and importing developing countries, and finally within the European Union itself. Competition for supplies between importing countries is already very sharp, hurting some vulnerable economies in South Asia and Europe.

In this respect, we should emphasize that the surge in gas prices that marks the beginning of the current energy crisis is not concomitant with the February-March 2022 invasion of Ukraine by Russia, but dates back to the early autumn of 2021, when global demand resumed once the peak of the COVID crisis was over. Moscow managed to seize the opportunity of these structural tensions to impose its pressure upon Europe.

**Supply tensions are likely to grow**, given the expected growth in Asian import needs on the one hand, and the slow implementation of European fossil fuel phasing-out targets on the other. Such prospect confirms the coming of a **geostrategic system systematically operating under energy and material availability constraints.** This is a highly problematic situation for the importing countries.

#### Potential structural deficit on the global LNG market

A comparison between our estimate of unidentified global supply volumes (EU and non-EU) and future LNG export volumes available for contracting reveals a highly uncertain situation on the global LNG market by 2025, followed by a potential significant mismatch between available supply and currently anticipated demand.

In the event of a sustained shutdown of Russian supplies, global LNG demand is likely to experience endemic and severe supply shortfalls.

Assuming that Russia's exports to the EU would be limited to the volume of existing contracts, the overall balance on the global LNG market, which might barely be achieved by 2025, could easily turn into chronic deficits, for example in the event of harsh winters in both Western Europe and Asia, or dry summers in Brazil. Besides, with the indefinite shutdown of the Nord Stream 1 & 2 pipelines, this assumption of compliance with the volume of existing contracts is probably already partially out of reach by 2025.

Figure 2. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystad demand scenario.



(Source: The Shift Project, based on Rystad Energy data from November 2022.)

#### Fog of war & related uncertainties – Achieving decarbonisation: planning a step towards peace

This report merely aims to outline a risk, and doesn't claim to predict the future. Obviously, the evolution of the situation in Ukraine and the development of relations between Russia and the EU generate major uncertainties: this report is a snapshot of the situation, with grey areas, and is just as valuable for its "off-camera" part.

The first area of uncertainty lies in **the future of overall Russian gas supplies**, with the crucial unknown being the **fulfilment of current contracts**. The situation as of early December 2022 clearly backs the assumption that a significant portion of the volumes contracted between Russia and the EU will not be delivered over the next few years.

This consideration immediately brings up the second source of uncertainty: the **extent to which natural gas demand in European economies might be destroyed – whether involuntarily or deliberately**. So far, a large part of EU's industrial and economic model was based on Russia's significant natural gas export capacities at reasonable price. This model collapsed, presumably beyond recovery, with the February 2022 invasion of Ukraine.

**The evolution of gas prices**, itself highly uncertain, will be a decisive parameter in this respect. Taking into account the current trends in futures contracts, Rystad Energy, like other sources, expects prices in Western Europe to remain at the current non-standard levels until 2024, before reverting to normal levels around 2025. Beyond that date, these price assumptions include a perpetuation, in long-term contracts, of the strong disadvantage that gas prices in Europe represent vis-à-vis the United States<sup>2</sup>.

The evolution of prices on spot and short-term contracts, erratic by nature, promises to be dependent on the extent to which Western European and Asian demand levels are not covered by long-term contracts, and on their absolute and relative solvency.

The **nature and the extent of the potential destruction of demand** affecting Europe are equally uncertain. The **negative signals** as reported by the daily news happen to be no less numerous nor less significant than the positive ones. Whole sectors of the European industry as well as numerous craft activities are under threat. Peaks are observed in – often unsatisfied – demand for insulation work or heat pumps, while the use of fuel oil and coal is increasing. Unfortunately, in such context, the issue of **greenhouse gas emissions** "**imported**" **by LNG** appears to be pushed to the background (LNG transport often generates more emissions than pipeline transport, provided that the pipes do not leak; the opposite is often the case in Russia).

To this date, **the development of natural gas supply in the short, medium and long term** represents another major source of uncertainty. Rystad Energy has significantly raised some of its production forecasts since the beginning of the gas price boom. New discoveries and projects will undoubtedly come on stream, perhaps beyond the assumptions already factored into Rystad Energy's projections taken into account in the current report.

Half of the world's conventional natural gas production appears to be "mature" today, and is therefore by definition destined to decline. This conventional production seems to be on an undulating plateau since 2010, barely growing.

Therefore, shale gas producers and large producers of non-mature conventional gas reserves will play a decisive role in meeting growing global demand. Therefore, **the US and Qatar could occupy increasingly dominant positions in the global LNG market.** 

**2023** \$5 ; **2024** \$3,5 ; **2025** \$3,5 ; **2026** \$4 ; **2027** \$4,5 ; **2028** \$5 ; **2029** \$5,5 ; **2030** \$6 ; **2035** \$7 ; **2040** \$7,5

East Asia LNG prices, reference prices, East Asia

<sup>&</sup>lt;sup>2</sup> Overview of price assumptions underlying the projections provided by Rystad Energy (long-term contracts, US\$ / MMBtu) :

TTF, reference prices Continental Europe

**<sup>2023</sup>** \$51 ; **2024** \$26 ; **2025** \$12 ; **2026** \$9 ; **2027** \$9 ; **2028** \$9 ; **2029** \$10 ; **2030** \$11 ; **2035** \$12 ; **2040** \$14 Henry Hub, reference prices, <u>United States</u>

**<sup>2023</sup>** \$25 ; **2024** \$16 ; **2025** \$13 ; **2026** \$11 ; **2027** \$10 ; **2028** \$10 ; **2029** \$10 ; **2030** \$10 ; **2035** \$12 ; **2040** \$14

Regarding the **identified risk of a supply deficit on the LNG market**, the development of production capacity appears to be the first-order variable governing the future volumes available for export, while the development of **liquefaction infrastructure** appears to be a second-order variable.

Whether an adequate **regasification infrastructure** can be developed to meet the EU's LNG import needs, will likely remain a factor of uncertainty until at least 2025. Problems with the availability of **LNG tankers**, **storage capacity and transportation capacity after regasification** can lead to numerous bottlenecks, the identification of which is beyond the scope of this report.

Finally, **the future of Russia's gas production capacity** could itself be a source of uncertainty, as Western investor and technology companies pull out. This issue is equally beyond the report's scope of this report.

In a closely related area, the security of the EU's oil supply<sup>3</sup>, the EU's readiness to consistently implement the announced boycott of Russian oil remains in doubt at this time. On the other hand, according to Rystad Energy, there is concern that Russia's aging oil production capacity is to experience a sharp decline, also due to the ongoing withdrawal of Western companies and investors.







Source: Rystad Energy research and analysis; Rystad Energy UCube

Considering the combination of major risks and uncertainties that mark our current hazardous situation a shift towards an energy- and material-efficient economy, along with the systematic though inevitably constrained development of competitive low-carbon energy sources, represents a crucial challenge for the European Union.

<sup>&</sup>lt;sup>3</sup> See also on this subject the two previous reports authored by the Shift Project under the supervision of the DGRIS of the French Ministry of the Army : <u>« The Future of oil supply in the European Union »</u>, May 2021;

<sup>«</sup> The European Union can expect to suffer oil depletion by 2030 », June 2020.

## **Editorial Committee**

## **Authors**

Matthieu AUZANNEAU, executive director, The Shift Project Guillaume SCHNEIDER, analyst, The Shift Project Emma STOKKING, project leader, The Shift Project

Translation : Jean-Louis CLAUZIER

#### **Reviewers**

Marc BLAIZOT Maxence CORDIEZ Maxime GERARDIN **Olivier RECH** 

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The content, conclusions and views expressed in this report are only those of The Shift Project.



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and

RTE, the French Electricity Transmission Network company (Réseau de transport d'électricité)

#### List of abbreviations

E&P	Exploration et production	LNG	Liquified natural gas
FID	Final investment decision	BCM	Billion cubic meters
GHG	Greenhouse gas	EU	European union

gas

## **Table of contents**

EXECUTIVE SUMMARY AND CONCLUSIONS1
Editorial Committee
1. OVERVIEW OF GAS SUPPLY IN THE EUROPEAN UNION
I. European Union Demand10
II. The decline of non-Russian European production12
III. Uncertainties regarding Russian production15
IV. European Union supply contracts17
A. Contracted Imports via pipeline, Russia excepted18
B. Contracted imports over LNG20
C. Focus on regasification capacity21
2. ASIA, THE WORLD'S NEW LARGEST IMPORTER
I. China's supplies are more secured25
II. Chinese production boosted by shale gas26
III. Supply contracts are mainly LNG- based27
3. POTENTIAL STRUCTURAL SHORTAGE ON THE GLOBAL LNG MARKET 29
I. Estimated Global Uncontracted LNG Volumes29
II. Assessment of potential medium- and long-term shortages, according to Rystad Energy's demand scenario31
A. Assuming that Russian exports to the EU will be restricted to volumes already contracted
B. Assuming that Russian volumes contracted with the EU will be cancelled33
4. PROSPECTS FOR SHALE GAS, AS A SUBSTITUTE FOR THE PLATEAUING CONVENTIONAL GAS PRODUCTION
APPENDICES

## **Table of figures**

Figure 2. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystad demand scenario	Figure 2. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystal demand scenario	Figure 1. Comparison of EU demand and supply over the 2010-2040 period2
LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystad demand scenario	LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystad demand scenario	Figure 2. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted
Rystad demand scenario       4         Figure 3. Scenario of Russia's crude oil production before and after the war: graph published by Rystad       6         Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period       10         Figure 5. Gas production in Norway by degree of maturity over the 1990-2040 period       12         Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 7. Gas production in Norway by degree of maturity over the 1990-2040 period       14         Figure 8. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Comparison between EU demand and supply over the 2010-2040 period       15         Figure 11. Comparison between EU demand and supply over the 1990-2040 period       16         Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040.       20         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040.       20         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040.       20         Figure 16. Gas imports by continents over the 2010-2040 period       22         Figure 17. Gas demand from Asia and EU over the 2010-2040 period       23         Figure 20. Gas production in China by gas type over the 2010-2040 peri	Rystad demand scenario.       4         Figure 3. Scenario of Russia's crude oil production before and after the war: graph published by Rystad         Energy in May 2022.       6         Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period       10         Figure 5. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 8. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040       18         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040       21         Figure 16. Gas imports by continents over the 2010-2040 period       23         Figure 17. Gas demand from Asia and EU over the 2010-2040 period       23         Figure 20. Gas production in China by gas type over the 2010-2040 period       23         Figure 21. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2010-2040 period       26<	LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following
Figure 3. Scenario of Russia's crude oil production before and after the war: graph published by Rystad Energy in May 2022	Figure 3. Scenario of Russia's crude oil production before and after the war: graph published by Rystad Energy in May 2022	Rystad demand scenario4
Energy in May 2022	Energy in May 2022.       6         Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period       10         Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period       12         Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 7. Gas production in Norway by exploitation zone over the 1990-2040 period       13         Figure 8. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040.       18         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040.       20         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040 period       23         Figure 16. Gas imports from Asia and EU over the 2010-2040 period       23         Figure 19. Comparison between East Asia demand and supplies, over the 2010-2040 period       25         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2040 period       26         Figure 22. Contracted vo	Figure 3. Scenario of Russia's crude oil production before and after the war: graph published by Rystad
Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period       10         Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period       12         Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 7. Gas production in Norway by exploitation zone over the 1990-2040 period       13         Figure 8. Gas production in Cyprus by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040       200         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040       204         Figure 16. Gas imports by continents over the 2010-2040 period       23         Figure 17. Gas demand from Asia and EU over the 2000-2040 period       23         Figure 19. Comparison between East Asia demand and supples, over the 2010-2040 period       26         Figure 19. Comparison between EU and non-EU unidentified future supplies, and the global uncontracts over the 2010-2040 period       26         Figure 21. East Asian gas import contracts between Russia and the EU are fulfilled, and following Rystad demand scenario.	Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period       10         Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period       12         Figure 7. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 8. Gas production in Norway by degree of maturity over the 1990-2040 period       14         Figure 9. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       15         Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040.       18         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040.       20         Prigure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040 period       22         Figure 18. LNG imports from Asia and EU over the 2010-2040 period       23         Figure 18. LNG imports from Asia and EU over the 2010-2040 period       25         Figure 21. East Asian gas import contracts over the 2010-2040 period       25         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period       28	Energy in May 2022
Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period       12         Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 8. Gas production in Norway by degree of maturity over the 1990-2040 period       14         Figure 9. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040       18         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040.       20         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040 period       21         Figure 16. Gas imports by continents over the 2010-2040 period       23         Figure 17. Gas demand from Asia and EU over the 2010-2040 period       23         Figure 21. Comparison between East Asia demand and supplies, over the 2010-2040 period       25         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period       27         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-	Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period       12         Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 7. Gas production in Norway by degree of maturity over the 1990-2040 period       14         Figure 8. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040       18         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040       2010-2040         period       21         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040       21         Figure 16. Gas imports by continents over the 2010-2040 period       22         Figure 17. Gas demand from Asia and EU over the 2010-2040 period       23         Figure 20. Gas production in China by gas type over the 2010-2040 period       25         Figure 21. East Asian gas import contracts over the 2010-2040 period       27         Figure 23. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted UNG volume	Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period
Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 7. Gas production in Norway by exploitation zone over the 1990-2040 period       13         Figure 8. Gas production in Russia by degree of maturity over the 1990-2040 period       14         Figure 9. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes ontracted by the European Union, 2010-2040.       20         Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040 period       21         Figure 16. Gas imports by continents over the 2010-2040 period       22         Figure 17. Gas demand from Asia and EU over the 2010-2040 period       23         Figure 18. LNG imports from Asia and EU over the 2010-2040 period       25         Figure 21. Comparison between East Asia demand and supplies, over the 2010-2040 period       26         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period       27         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period       33<	Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period       13         Figure 7. Gas production in Norway by exploitation zone over the 1990-2040 period       13         Figure 8. Gas production in Cyprus by degree of maturity over the 1990-2040 period       14         Figure 9. Gas production in Russia by degree of maturity over the 1990-2040 period       15         Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period       15         Figure 11. Comparison between EU demand and supply over the 2010-2040 period       17         Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040       18         Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period       18         Figure 14. LNG Volumes contracted by the European Union, 2010-2040       200         Period       21         Figure 16. Gas imports by continents over the 2010-2040 period       22         Figure 17. Gas demand from Asia and EU over the 2010-2040 period       23         Figure 20. Gas production in China by gas type over the 2010-2040 period       23         Figure 21. East Asian gas import contracts over the 2010-2040 period       26         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period       28         Figure 23. Comparison between EU and non-EU unidentified future supplies, and the global uncontrac	Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period
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Figure 20. Gas production in China by gas type over the 2010-2040 period	Figure 20. Gas production in China by gas type over the 2010-2040 period       26         Figure 21. East Asian gas import contracts over the 2010-2040 period       27         Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period       28         Figure 23. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystad demand scenario.       32         Figure 24. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are NOT fulfilled, and following Rystad demand scenario.       33         Figure 25. Global gas production by gas type over the 1990-2050 period       34         Figure 26. Global conventional gas production over the 1990-2050 period       35         Figure 28. Natural gas production in the United States by gas type over the 1990-2050 period       36         Figure 30. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are NOT fulfilled, and following Rystad demand scenario.         33       Figure 26. Global conventional gas production over the 1990-2050 period       35         Figure 28. Natural gas production in the United States by maturity level over the 1990-2050 period       36         Figure 30. Comparison between EU and non-EU unidentified future supplies, and the glob	Figure 19. Comparison between East Asia demand and supplies, over the 2010-2040 period
Figure 21. East Asian gas import contracts over the 2010-2040 period	Figure 21. East Asian gas import contracts over the 2010-2040 period	Figure 20. Gas production in China by gas type over the 2010-2040 period
Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period	Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period	Figure 21. East Asian gas import contracts over the 2010-2040 period
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Rystad demand scenario.       32         Figure 24. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are NOT fulfilled, and following Rystad demand scenario.       33         Figure 25. Global gas production by gas type over the 1990-2050 period.       34         Figure 26. Global conventional gas production over the 1990-2050 period.       35         Figure 27. Natural gas production in the United States by gas type over the 1990-2050 period.       35         Figure 28. Natural gas production in the United States by maturity level over the 1990-2050 period.       36         Figure 30. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following a constant 2021 EU demand scenario.       38	Rystad demand scenario. 32 Figure 24. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are NOT fulfilled, and following Rystad demand scenario. 33 Figure 25. Global gas production by gas type over the 1990-2050 period. 34 Figure 26. Global conventional gas production over the 1990-2050 period. 35 Figure 27. Natural gas production in the United States by gas type over the 1990-2050 period	LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following
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Figure 26. Global conventional gas production over the 1990-2050 period	Figure 26. Global conventional gas production over the 1990-2050 period	Figure 25. Global gas production by gas type over the 1990-2050 period
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		a constant 2021 EU demand scenario

## 1. Overview of Gas Supply in the European Union

## I. European Union Demand



Figure 4. European Union Gas Demand, by sector, over the 2010-2040 period

Gas consumption in the EU for 2022 lies around **366 billion cubic meters** (bcm). It can be broken down into four main categories: industry, power generation, residential, and non-residential building.

Since 2010, gas consumption in the EU has remained mostly stable (the decrease recorded in 2022 reflects Russian gas restrictions related to Ukraine invasion).

Regarding EU gas demand over the 2023-2050 period, several trends emerge, involving reduction forecasts that may vary by a factor of two:

• The "Fit for 55" Plan: this package of 13 legally binding measures (Directives and Regulations), initially presented by the European Commission in July 2021, plans to curb the EU's greenhouse gas (GHG) emissions by 55% by 2030 from its 1990 level. Regarding gas consumption, this set of policies forecasts a 30% reduction in 2030 as compared to 2020, i.e., a reduction of 116 bcm and a consumption of 274 bcm in 2030.

• The "REPowerEU" Plan: this scheme, presented by the European Commission in May 2022, boosts the ambition level of the "Fit for 55" package, in order to enable the EU to rapidly move away from Russian gas and crude resources. Regarding gas consumption, this scheme suggests a set of non-binding levers that would allow a 250 bcm reduction, to reach a 140 bcm consumption level by 2030.

Table 2. Breakdown of additional gas consumption reductions by 2030 under the REPowerEU Plan (in addition to the "Fit for 55" reductions)<sup>4</sup>

	(in bcm)
Fit for 55 measures (30 % reduction from the 2020 consumption level)	116
Coal as a substitute	24
Nuclear energy as a substitute	7
Shifting to other energy sources in the residential and tertiary sectors	9
Biomass as a substitute	1
Energy efficiency and heat pump technology	37
Bio-methane as a substitute	17
Gas consumption reduction in EU's industry	12
Hydrogen as a substitute	27

Rystad Energy's EU demand scenario takes into account uncertainties in the evolution of the energy mix for power and heat generation, as well as in industry, despite European decarbonization targets. Gas remains the main or one of the main sources for residential heating in several European countries, such as Germany, the Netherlands and France.

Rystad Energy notes that few European countries have set clear targets for residential electrification, especially since the publication of REPowerEU.

**Rystad Energy believes that the EU is not likely to meet the Fit for 55 and REPowerEU targets** especially for heat pump and renewable energy deployment, possibly for hydrogen demand substitution, etc.

Rystad Energy also believes that many countries are actually expected to increase their demand for gas for electricity in the medium term, and will need a lot of gas in the future. Germany's demand is expected to increase in the medium term, due to the switch from coal to gas.

As a result, Rystad Energy expects the **consumption level to approximate 340 bcm by 2030, with a later decrease to 240 bcm by 2040.** 

<sup>&</sup>lt;sup>4</sup> <u>« Commission staff working document - Implementing the REPowerEU action plan: investment needs, hydrogen</u> <u>accelerator and achieving the bio-methane targets »</u>, European Commission, May18, 2022.

## II. The decline of non-Russian European production



Figure 5. Gas production in Europe, excluding Russia, over the 1990-2040 period (Source: Rystad Energy.)

Gas production in Europe, excluding Russia, has been declining since the mid-2000s, despite a significant growth in Norwegian production over the last 30 years.

The EU's domestic production accounts for 12% of its 2022 consumption level.

This domestic production in the EU-27 (UK excluded) appears to be in terminal decline, considering the current state of reserves and the degree of production maturity<sup>5</sup>. The main cause for this decline relates to the depletion of a great number of North Sea fields, with a similar trend being observed in the United Kingdom, where extractions started to decline in 2000.

<sup>&</sup>lt;sup>5</sup> A field is said to be "mature" when more than half of its estimated recoverable reserves have been extracted. The production of this field is then destined to be exhausted more or less quickly.



*Figure 6. Gas production in Norway by degree of maturity over the 1990-2040 period* (*Source: Rystad Energy.*)

Figure 7. Gas production in Norway by exploitation zone over the 1990-2040 period



The possibility of slowing the decline of (non-Russia) European gas production by 2030 appears to be highly dependent on the success of current or potential developments of reserves located in Norwegian territorial waters. However, these new developments are not expected to be large enough to prevent a sharp decline in Norway's production during the 2030s, given the maturity level of the remaining Norwegian sources.



Figure 8. Gas production in Cyprus by degree of maturity over the 1990-2040 period (Source: Rustad Energy)

## A development of reserves recently identified in the territorial waters of the independent part of the island of Cyprus could help mitigate the decline of (non-Russia) European production during the 2030s.

However, Turkey challenges control over these waters. Moreover, the proximity of major importing countries at the East and South of Cyprus raises doubts as to whether the development of Cypriot reserves would significantly contribute to easing EU's import needs.

## III. Uncertainties regarding Russian production



Figure 9. Gas production in Russia by degree of maturity over the 1990-2040 period

*Figure 10. Gas production in Russia by exploitation zone over the 1990-2040 period* (*Source: Rystad Energy.*)



**Almost half of Russian gas production is mature.** Overall, it has followed a plateau fluctuating around 600 bcm since the 1990s. The decline in mature production has so far been compensated for, in particular through the development of Arctic reserves.

The future production capacity from recently discovered but yet undeveloped reserves **looks uncertain**, as Western expertise and capital play a major role in the development of recent, highly technical projects (typically in the Yamal Peninsula).

## **IV. European Union supply contracts**

Until early 2022, Russian gas covered about 40% of total EU imports. Russia supplied 154 bcm in 2021, or 37.2% of total EU consumption.



Figure 11. Comparison between EU demand and supply over the 2010-2040 period (Source: The Shift Project, from Rystad Energy November 2022 data).

In the event of a sustained cessation of Russian supplies, the share of unidentified supplies would reach as early as 2025 no less than 40% of the EU demand forecast by Rystad Energy at that time.

If Russian supply volumes are quickly restored to the level foreseen by existing contracts, and if on the other hand EU demand decreases sharply, albeit at a slower pace than according to its climate targets, 12% of EU's supply sources for 2025 remain unidentified, reaching 25% in 2030 and 50% in 2035.

Should EU demand remain at its 2021 level, the share of unidentified supplies would account to one quarter of the demand in 2025, and more than a third of the demand in 2030.

As of today, the future trends in the actual level of natural gas consumption in the EU are highly unpredictable. They will depend on both volume availability and price trends.

Will this evolution be imposed or intentional?

Again, our ambition here is merely to outline a risk. Such risk can result in a sudden, involuntary destruction of demand in Europe or elsewhere, in harmful supply competition within Europe and between Europe and the rest of the world, or in persisting supply shortages on the global market.

## A. Contracted Imports via pipeline, Russia excepted



*Figure 12. Volumes of EU gas pipeline contracts by exporting country, Russia excepted, 2010-2040* (*Source: Rystad Energy.*)

Until early 2022, Russia supplied over 50% of EU gas imports by pipeline. The combined volumes delivered via pipeline to the European Union by the **other suppliers**, Norway, Algeria, Libya and Azerbaijan, totalled 97 bcm of gas in 2021, as compared to 118 bcm for Russia.



Figure 13. Gas production in Algeria by degree of maturity over the 1990-2040 period

Whether Algeria can maintain its export capacity depends on the success of ongoing or potential development projects of previously identified reserves. Such developments are not expected to be significant enough to prevent a sharp production decline during the 2030s.

Algeria's gas consumption has increased sharply over the past two decades, undermining its export capacity.

**Both Azerbaijan and Libya** are likely to remain second rank suppliers, given their limited extraction capacity (despite a – politically controversial – sharp rise of imports from Azerbaijan in 2022).

## **B. Contracted imports over LNG**



Figure 14. LNG Volumes contracted by the European Union, 2010-2040. (Source: Rystad Energy.)

Nota bene: The contracts listed in the Rystad Energy database are those that are publicly announced. It covers all long-term (> 1 or 2 years) LNG contracts. In Figure 1, we have chosen to display actual imports in the "contracts" category until 2022. This is why there is a peak in 2022 in this figure that is not visible in the graph dedicated to LNG contracts in Figure 13. above: a significant share of LNG gas was imported this year from the spot market.

Both the United States and Qatar seem likely to play a major role as referees of Europe's natural gas supply security for a long time to come, due in both cases to their capacity to develop extractions over the 2020 decade.

In the case of shale gas in the United States, however, this development capacity should remain highly dependent on the movement of hydrocarbon prices.

**Greenhouse gas emissions induced by LNG flows are a major issue:** the purification and liquefaction of natural gas, as well as its transport and regasification, appear to **consume twice as much energy and emit twice as much GHG** as transport by pipeline<sup>6</sup>.

It should be noted that, as of today, a significant share of long-term LNG demand is already covered by American shale gas contracts (a feature that is also to be noted for East Asia, see below).



<sup>&</sup>lt;sup>6</sup> See for example : Importations de gaz naturel : tous les crus ne se valent pas, Carbone 4, October 2021 (in French)

## C. Focus on regasification capacity



Figure 15. EU Regasification capacity and import needs (demand minus production) over the 2010-2040 period (Source: The Shift Project, based on November 2022 Rystad Energy data.)

The ability of EU countries to develop adequate regasification infrastructure to meet LNG import requirements is likely to remain a factor of uncertainty until at least 2025.

In addition, problems with the availability of **LNG tankers**, **storage capacity** and **transportation capacity after regasification** may lead to numerous bottlenecks, which are outside the scope of this study.

## 2. Asia, the world's new largest importer

Asia and Europe are expected to remain the two largest importers of natural gas, with Asia seemingly on its way to overtake Europe as the world's largest importer.



Figure 16. Gas imports by continents over the 2010-2040 period (Source: Rystad Energy.)

Gas demand from East Asian countries (China, Japan, the two Koreas, Taiwan, Mongolia) is expected to continue its strong growth, according to Rystad Energy. This demand has increased sixfold since 2000, while EU demand has remained fairly stable.

Strongly growing demand is expected from the rest of Asia (especially India).



Figure 17. Gas demand from Asia and EU over the 2010-2040 period





The continued development of China's LNG import needs, and a possible strong growth by the end of the decade of new needs elsewhere in Asia (India, Pakistan, Thailand, Bangladesh, Indonesia), may have fateful structural implications for the world economy and its geopolitical balances. In this respect, it should be noted that the current energy crisis actually started with the recess of the COVID pandemic, dating back to the fall of 2021, when global gas imports resumed, not with the February 2022 invasion of Ukraine. Incidentally, this created a window of opportunity that Moscow was able to seize, whether deliberately or not, as part of its strategy to pressure the EU.

## I. China's supplies are more secured



*Figure 19. Comparison between East Asia demand and supplies, over the 2010-2040 period* (Source: The Shift Project, based on November 2022 Rystad Energy data.)

East Asia will also experience supply risks in the coming years: following Rystad's assumptions for consumption growth, **unidentified sources for East Asian supplies are expected to account for 4% of demand in 2025, 20% in 2030 and 37% in 2035.** 

The share of demand covered by existing contracts is seemingly higher in China than in Europe.

	2025	2030	2035	2040
EU with Russian contracts (with potential new pipeline contracts with Norway and Algeria)	87 %	75 %	53 %	57%
EU without Russian contracts (with potential new pipeline contracts with Norway and Algeria)	61 %	58 %	48 %	54 %
China	100 %	85 %	70 %	63 %
East Asia	95 %	80 %	63 %	52 %

Table 3. Rates of coverage by existing supply contracts of gas demand (LNG and pipeline), as expected by Rystad Energy.

## II. Chinese production boosted by shale gas



*Figure 20. Gas production in China by gas type over the 2010-2040 period* (Source: Rystad Energy.)

China, virtually the only East-Asian gas producer, relies on a significant development of its shale gas production, to replace its nearly stagnant conventional gas production.

## III. Supply contracts are mainly LNGbased



Figure 21. East Asian gas import contracts over the 2010-2040 period (Source: Rystad Energy.)

Asian demand for LNG today is mainly from East Asia (primarily China, Japan, South Korea and Taiwan).

LNG accounts for three-quarters of East Asia's natural gas imports.

As in Europe, the United States and Qatar are expected to play a key role in East Asia's security of supply, this time alongside Australia and, to a lesser degree, Malaysia.

Since 2021, China has imported more LNG than any other country in the world.

As with the EU, there is already a significant level of long-term coverage of East Asian demand by US shale gas LNG contracts.

**China is the only East Asian importer by pipeline**. Russia has made a strong entry in 2020 in its import contracts. If it sees the light of the day, **the "Power of Siberia 2"** pipeline project, championed by Russia, could double Russia's export capacity to China as early as 2030. This pipeline would allow the delivery to China of up to 50 bcm per year from gas fields that currently meet European demand.

According to Rystad Energy, for technical reasons, the volumes exported from China to Russia are expected to remain below contractual levels until 2025:



Figure 22. Contracted volumes vs. forecasted export volumes from Russia to China by pipeline over the 2018-2030 period

## **3. Potential structural shortage on the global LNG market**

## I. Estimated Global Uncontracted LNG Volumes

We assessed the risk of a medium to long-term deficit in the global LNG market by comparing an estimate of future uncontracted LNG volumes with the volume of unidentified global supply sources (EU and non-EU).

The estimates of LNG volumes available for contracting are constructed as follows.

- **3 future production levels** are taken into account based on assumptions provided by Rystad Energy:
  - o probable (fields in production and under development)
  - o possible (identified fields to be developed),
  - uncertain (fields to be discovered);
- **3 corresponding net export potentials**<sup>7</sup> are derived, under Rystad Energy demand assumption;
- **3 degrees of liquefaction capacity development perspective** are taken into account (operational, planned and speculative capacities<sup>8</sup>);
- LNG export contracts known to date are taken into account;
- a calculation formula is applied according to which a country can only deliver what it produces, minus what it consumes, minus what it has already committed to deliver, provided it has adequate liquefaction capacity.

<sup>&</sup>lt;sup>7</sup> For the few countries exporting by both pipeline and LNG, an arbitrage is made on the basis of contracted volumes and Rystad estimates.

<sup>&</sup>lt;sup>8</sup> World liquefaction capacity defined as:

<sup>•</sup> operational (operational + under construction + Final investment decision, FID)

<sup>•</sup> forecast (planned but with no FID)

<sup>•</sup> speculative (possible but not planned)

## Table 3. Estimate of global LNG volumes not yet contracted, but potentially available for export in 2025, 2030, 2035 and 2040, in bcm

Estimated global uncontracted LNG volumes – 2025		Potential global gas exports		
		Likely	Possible	Uncertain
Liquefaction capacity World	Operational	97	113	114
	Forecast	97	113	114
	Speculative	97	113	114

Estimated global uncontracted LNG volumes – 2030		Potential global gas exports		
		Likely	Possible	Uncertain
Liquefaction capacity World	Operational	65	210	214
	Forecast	65	246	267
	Speculative	69	259	280

Estimated global uncontracted LNG volumes – 2035		Potential global gas exports		
		Likely	Possible	Uncertain
Liquefaction capacity World	Operational	136	311	320
	Forecast	136	381	433
	Speculative	136	422	475

Estimated global uncontracted LNG volumes – 2040		Potential global gas exports		
		Likely	Possible	Uncertain
Liquefaction capacity World	Operational	155	349	412
	Forecast	155	435	664
	Speculative	155	503	746

The first-order variable defining the volumes of global LNG that are available for contracting is the development of gas production capacity (investment in exploration and production, "E&P"). The second-order variable is the development of liquefaction capacity.

## Until 2025, the global LNG volumes available for contracting can be forecast with a fairly high level of certainty (about 115 bcm in 2025).

From 2030 onwards, the span of possible scenarios gets wider:

- until 2030, by combining the potential development of gas production capacity with the expected liquefaction capacity, we obtain global LNG volumes available for contracting range from 250 to 300 bcm;
- by 2035, global LNG volumes available for contracting range from 375 to 475 bcm;
- by 2040, global LNG volumes available for contracting range from 450 to 750 bcm.

## II. Assessment of potential medium- and long-term shortages, according to Rystad Energy's demand scenario

Based on Rystad Energy's demand scenario, the estimated uncontracted non-EU LNG volumes needed are **36 bcm in 2025, 290 bcm in 2030, 580 bcm in 2035 and 710 bcm in 2040.** 

These volumes are essentially intended to meet demand in China and the rest of Asia, with a significant increase expected in India and the rest of South Asia in the coming years. They correspond to expected import needs, less volumes already contracted.

Our conclusions remain conditional on the following points, which are yet to be addressed:

- estimation of the adequacy of international LNG transport capacity (number and types of LNG carriers needed to expand and modify international flows);
- the redirection of Russian export flows to non-EU importing countries, which would reduce the order of magnitude of the estimated supply shortages at successive time horizons.

Nota bene: the estimated shortages are maximal insofar as the capacity for redirecting Russian export flows to other, non-EU destinations, which would in turn release volumes that could be shipped to the EU, is not quantified in this study. In any case, such redirection is unlikely to be completed before 2025 or 2030.

## A. Assuming that Russian exports to the EU will be restricted to volumes already contracted

Figure 23. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are fulfilled, and following Rystad demand scenario.



## Nota Bene: More detailed deficit estimates assuming EU demand remains at 2021 levels are provided in the appendices.

Assuming that the contracts between the EU and Russia are fulfilled, the balance between the foreseeable volumes of LNG exports on the one hand, and an estimate of future world liquefaction capacity on the other, reveals a tension on the LNG market by 2025, with a likely sharp deficit by 2030.

A potential overall balance in the LNG market, which might barely be achieved by 2025, could easily turn into chronic deficits, for example in the event of harsh winters in both Western Europe and Asia, or dry summers in Brazil.

Given the sine die shutdown of the Nord Stream 1 & 2 pipelines, this assumption of respecting the planned volumes may already be partially out of reach by 2025.

By 2030, the deficit to be feared if gas trade between the EU and Russia does not return to normal is close to 100 bcm, which amounts to Qatar's retreating from the LNG market. At best, the deficit would still reach the order of magnitude of 100 bcm by 2035.

EU countries can significantly reduce their exposure to a partial or total default of Russian supplies, provided they successfully fulfil their climate commitments pledged under the "Fit for 55" plan.

## **B.** Assuming that Russian volumes contracted with the EU will be cancelled

Figure 24. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are NOT fulfilled, and following Rystad demand scenario.



Assuming that gas trade between Russia and the EU is cancelled,

- by 2025, a deficit in the order of 85 bcm can be expected on the global market,
- by 2030, a deficit in the order of 120 to 175 bcm can be expected on the global market;
- by 2035, a deficit in the order of 120 to 400 bcm can be expected on the global market;
- by **2040**, the global market can be expected to be either **in balance** or with a deficit exceeding **450 bcm**, this very wide range of possible scenarios being mainly contingent on the extent of future development of "shale" gas resources (see below).

Considering that it is impossible to rely safely on volumes contracted from Russia, the redirection of import needs towards other supplier countries involves:

- a predictable supply shortage for the EU as well as other importing areas;
- extreme and growing tensions on the global gas market as a whole, and in particular on the LNG market;
- unprecedentedly high gas price levels, reflecting a market in short supply.

# 4. Prospects for shale gas, as a substitute for the plateauing conventional gas production



Figure 25. Global gas production by gas type over the 1990-2050 period (Source: Rystad Energy)

The supply and competition risks analysed above are now dependent on the development of shale gas.

Since 2010, global conventional gas production has been **plateauing around 2,900 bcm** per year. This level could **near 3,000 bcm per year by the beginning of the next decade**.

Global production of so-called "shale gas" is growing rapidly and **is expected to peak in the mid-2030s with an annual production exceeding 1,500 bcm**.



Figure 26. Global conventional gas production over the 1990-2050 period (Source: Rvstad Energy)

Conventional production might rise above the plateau reached during the previous decade, provided that potential new developments can do more than compensate the decline of the existing production, which happens to be currently over 50% mature.



Figure 27. Natural gas production in the United States by gas type over the 1990-2050 period



Figure 28. Natural gas production in the United States by maturity level over the 1990-2050 period

The further pursuit of the tremendous development of "shale" gas in the United States is contingent on a persistent intense drilling activity, as the extraction by hydraulic fracturing results in the rapid decline of the existing production.



Figure 29. Non-conventional gas production by producing country over the 1990-2050 period (Source: Rustad Energy)

The United States currently provides the **overwhelming majority of shale gas extraction**. Its production is expected to **peak in the early 2030s**, according to Rystad Energy.

Once this peak has been reached, we should expect a **decline of the entire global shale gas and natural gas production** (see Figure 25).

## **Appendices**

## I. Shortage with a constant 2021 EU demand scenario

Figure 30. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that <u>existing contracts between Russia and the EU are fulfilled</u>, and <u>following a constant 2021</u> <u>EU demand scenario</u>.



(Source: The Shift Project, based on Rystad Energy data from November 2022.)



Figure 31. Comparison between EU and non-EU unidentified future supplies, and the global uncontracted LNG volumes, assuming that existing contracts between Russia and the EU are NOT fulfilled, and following a constant 2021 EU demand scenario.

## **II. EU country profiles**

For each of the EU country (excluding Luxembourg, Malta and Cyprus), the following 4 graphs are drawn (from Rystad Energy's data of November 2022):

- 1- **History of gas supply sources**: the domestic production, broken down by field maturity, and imports, broken down by origin (intra-EU, Russia, rest of the world).
- 2- Past and future contracted volumes, compared with past imports. Nota bene: The contracts listed in the Rystad Energy database are those that are publicly announced. It covers all long-term (> 1 or 2 years) LNG contracts. For pipelines, there is less visibility and some contracts may not be displayed.

There can be differences between displayed imports and contracts:

- Imports may be higher than contracts for two reasons: spot and short-term contracts or non-public pipeline contracts
- They can also be lower: LNG contracts usually include flexibility clauses, allowing to import less than initially contracted volumes

(In Figure 1, we have chosen to display actual imports in the "contracts" category until 2022.)

- 3- **Past and future estimation of regasification capacities**, broken down by infrastructure construction progress, compared with past LNG imports.
- 4- Past and future estimation of gas production, broken down by field maturity

1: Austria	
2: Belgium	
3: Bulgaria	
4: Croatia	
5: Czech Republic	
6: Denmark	
7: Estonia	
8: Finland	
9: France	
10: Germany	
11: Greece	51
12: Hungary	
13: Ireland	
14: Italy	
15: Latvia	
16: Lithuania	
17: Netherlands	
18: Poland	
19: Portugal	
20: Romania	
21: Slovakia	61
22: Slovenia	
23: Spain	63
24: Sweden	

## 1: Austria – 2021 consumption: 9 bcm (source: Rystad); 22 % of primary energy (source: BP)



## 2: Belgium – 2021 consumption: 19 bcm (source: Rystad); 23 % of primary energy (source: BP)



## 3: Bulgaria – 2021 consumption: 4 bcm (source: Rystad); 16 % of primary energy (source: BP)



## 4: Croatia – 2021 consumption: 2 bcm (source: Rystad); 29 % of primary energy (source: BP)



## 5: Czech Republic – 2021 consumption: 9 bcm (source: Rystad); 20 % of primary energy (source: BP)



### 6: Denmark – 2021 consumption: 3 bcm (source: Rystad); 14 % of primary energy (source: BP)



## 7: Estonia – 2021 consumption: 1 bcm (source: Rystad); 8 % of primary energy (source: BP)



### 8: Finland – 2021 consumption: 2 bcm (source: Rystad); 7 % of primary energy (source: BP)



#### 9: France – 2021 consumption: 47 bcm (source: Rystad); 17 % of primary energy (source: BP)



#### 10: Germany – 2021 consumption: 94 bcm (source: Rystad); 27 % of primary energy (source: BP)



### 11: Greece – 2021 consumption: 7 bcm (source: Rystad); 24 % of primary energy (source: BP)



## 12: Hungary – 2021 consumption: 11 bcm (source: Rystad); 39 % of primary energy (source: BP)



#### 13: Ireland – 2021 consumption: 4 bcm (source: Rystad); 30 % of primary energy (source: BP)



## 14: Italy – 2021 consumption: 77 bcm (source: Rystad); 42 % of primary energy (source: BP)



### 15: Latvia – 2021 consumption: 1 bcm (source: Rystad); 29 % of primary energy (source: BP)



#### 16: Lithuania – 2021 consumption: 2 bcm (source: Rystad); 33 % of primary energy (source: BP)



#### 17: Netherlands – 2021 consumption: 34 bcm (source: Rystad); 37 % of primary energy (source: BP)



#### 18: Poland – 2021 consumption: 23 bcm (source: Rystad); 19 % of primary energy (source: BP)



## **19:** Portugal – 2021 consumption: 6 bcm (source: Rystad); 23 % of primary energy (source: BP)



### 20: Romania – 2021 consumption: 10 bcm (source: Rystad); 30 % of primary energy (source: BP)



## 21: Slovakia – 2021 consumption: 5 bcm (source: Rystad); 28 % of primary energy (source: BP)



### 22: Slovenia – 2021 consumption: 1 bcm (source: Rystad); 12 % of primary energy (source: BP)



#### 23: Spain – 2021 consumption: 35 bcm (source: Rystad); 22 % of primary energy (source: BP)



## 24: Sweden – 2021 consumption: 1 bcm (source: Rystad); 2 % of primary energy (source: BP)



**The Shift Project** is a French think tank advocating the shift to a post-carbon economy. As a non-profit organisation committed to serving the general interest through scientific objectivity, we are dedicated to informing and influencing the debate on energy transition in Europe. The exponential development of digital technology, and its potential interactions with the decarbonization targets of our societies, is one of the key issues of the carbon transition.

Our members are large companies that want to make the energy transition their priority.

#### **Contact:**

Emma Stokking +33 (0) 7 86 53 39 84 emma.stokking@theshiftproject.org



16 rue de Budapest, 75009 Paris www.theshiftproject.org