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No Russian gas to Europe: a scenario analysis

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29 June 2022

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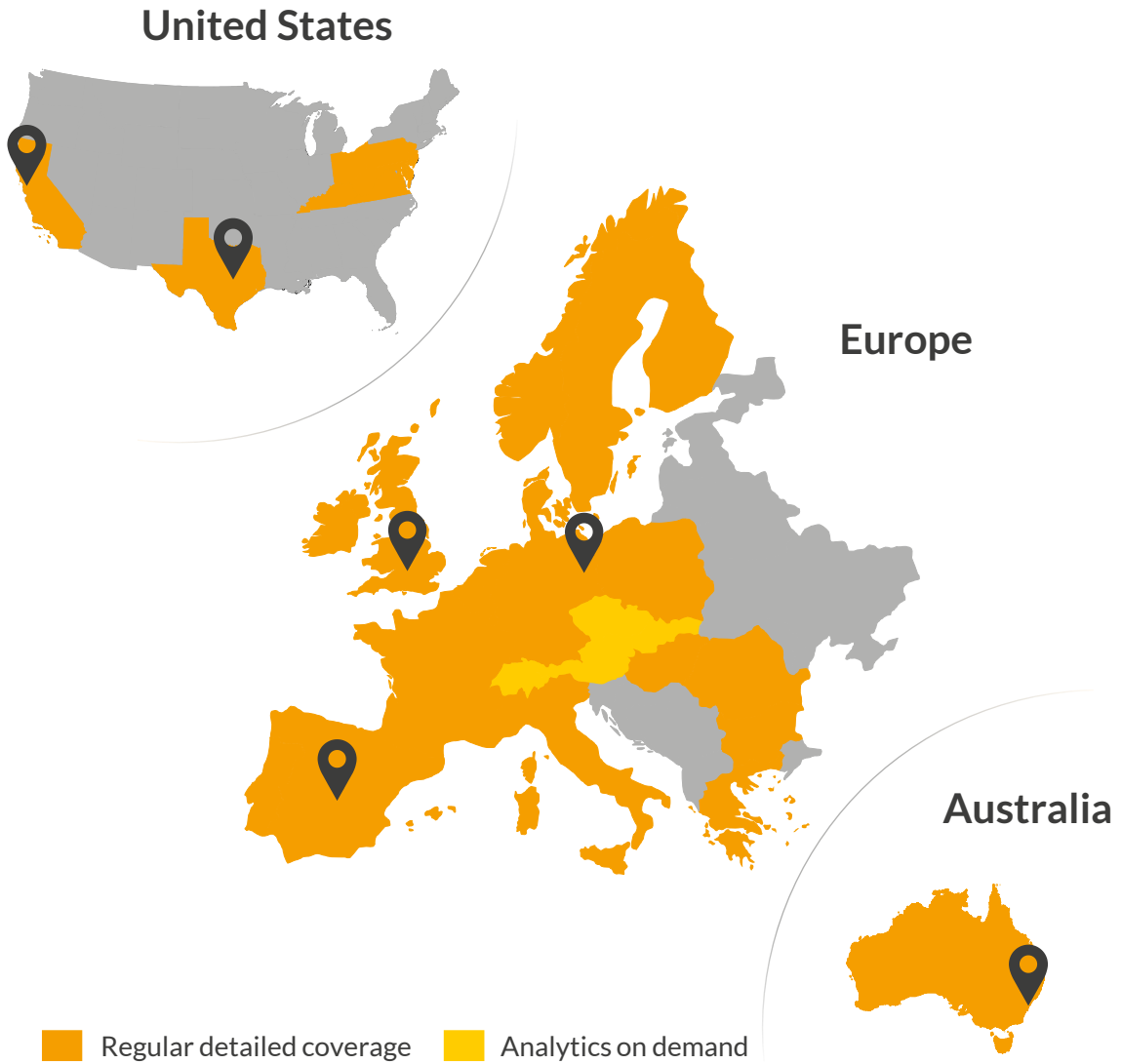

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Source: Aurora Energy Research

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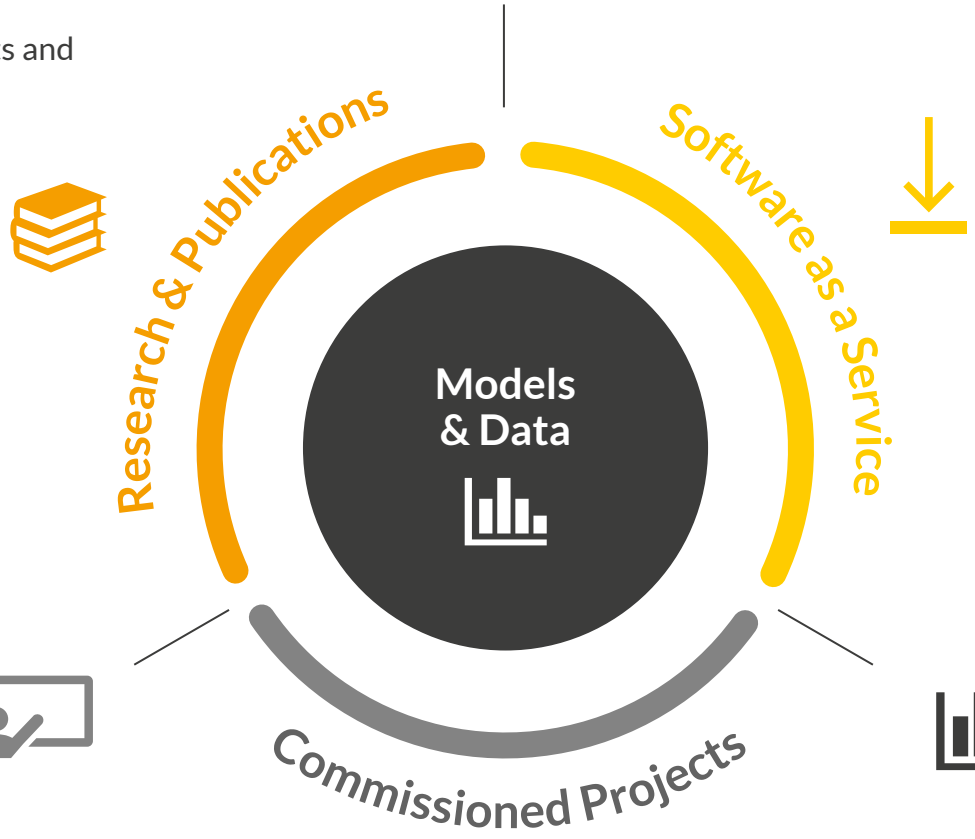

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- Out-of-the-box SaaS solutions, combining cutting-edge sophistication with unparalleled ease of use
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- *Amun* automates asset-specific wind farm valuations for over 30 leading funds, developers and utilities

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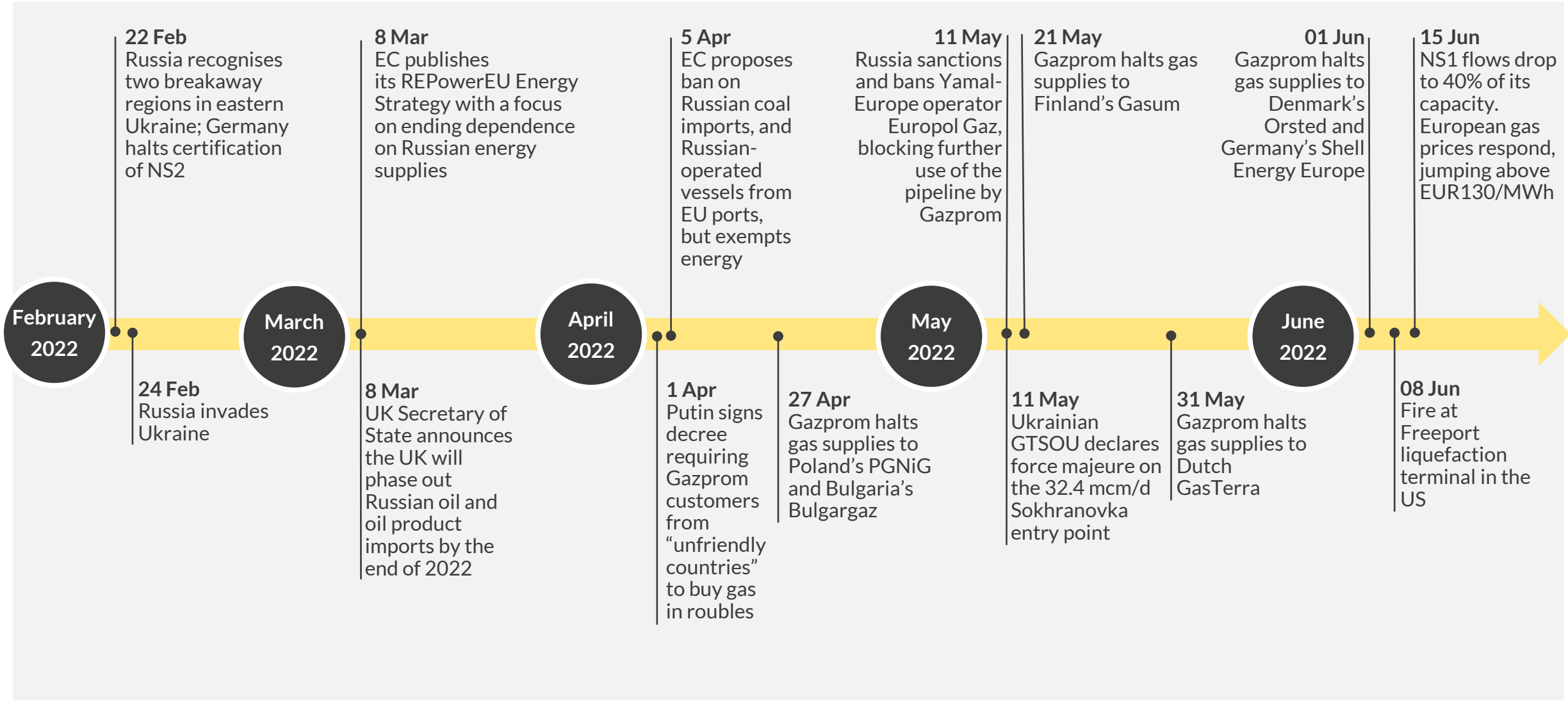
Source: Aurora Energy Research

Timeline of key developments from the start of the war



The timeline is not exhaustive

Source: Aurora Energy Research

The European Commission has responded to the Ukraine war with an updated decarbonisation strategy to reduce reliance on Russian gas

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Part of over-arching EU Green Deal framework

2021 'Fit for 55' — 2022 REPowerEU

Key objectives	Proposed package reflecting a ratcheting up of climate ambition and energy-related targets by 2030	A plan to reduce EU's reliance on Russian fossil fuels and fast forward the green transition	Aurora's assessment of REPowerEU Achieving all the targets set in REPowerEU will be difficult due to possible supply chain bottlenecks and the magnitude of required investments
1 Emissions reduction	▪ 55% reduction in GHG emissions by 2030 relative to 1990 levels	▪ Heightened ambition to electrify industry and buildings by doubling heat pump deployment and by requiring rooftop solar installations	▪ Supply chain disruptions/limitations could hinder such heightened ambitions
2 Renewables deployment	▪ 40% share of renewable energy in EU's overall energy mix by 2030	▪ Raise the 2030 target for renewables under Fit-for-55 from 40% to 45%[1], speeding up permitting to achieve 20% faster[2] buildout in 2020s ▪ Target of 10 mt of domestic green hydrogen production by 2030	▪ Permitting often slowed down by NIMBYism and public acceptance ▪ Supply chain disruptions/limitations could hinder such heightened ambitions
3 Increase energy efficiency	▪ 36% and 39% energy efficiency improvements in final and primary energy consumption, respectively	▪ Increase from 9% to 13% of the binding energy efficiency target ▪ Measures to encourage energy savings and promotion of behavioural changes	▪ Promotion of behavioural changes requires consumer and political acceptance; important to assess the effect that suggested measures could have on standard of living
4 Ensure security of supply	▪ Increase share of sustainable fuels in aviation and shipping to decarbonise and reduce reliance on fossil fuel imports	▪ Diversify supply to reduce EU dependence on Russian gas ▪ Investment in LNG infrastructure ▪ Domestic biomethane production of 35 bcm by 2030	▪ The LNG market is set to be tight up to mid-2020s ▪ The European Biogas Association estimates that the capital investments needed to reach this target could be some EUR80 billion

1) Total wind and solar capacity would reach 1069GW, 644GW more than in 2022. 2) Versus "Fit for 55" baseline buildout rate

Source: Aurora Energy Research

Two scenarios are considered and compared with our Continued Flows[1] forecast: the Immediate Halt and the Managed Phaseout of Russian gas supply

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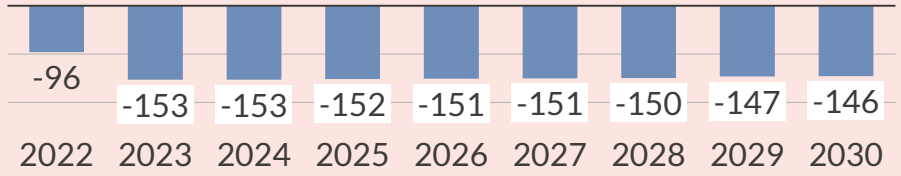
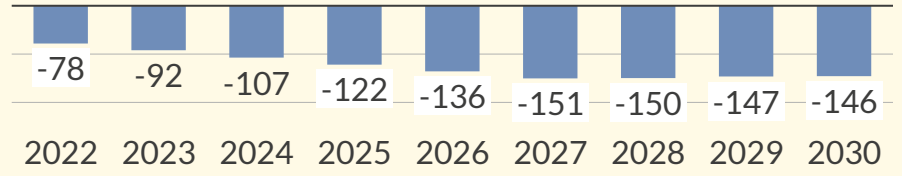
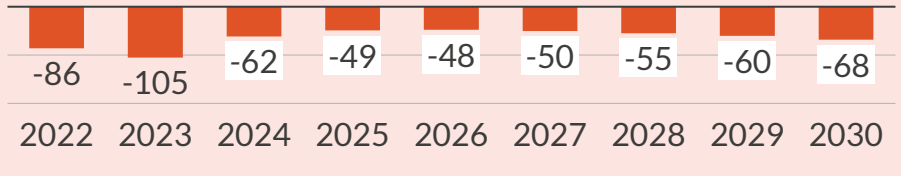
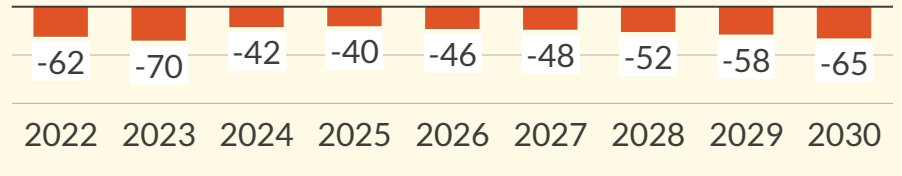
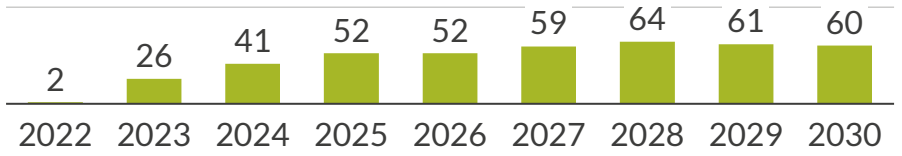
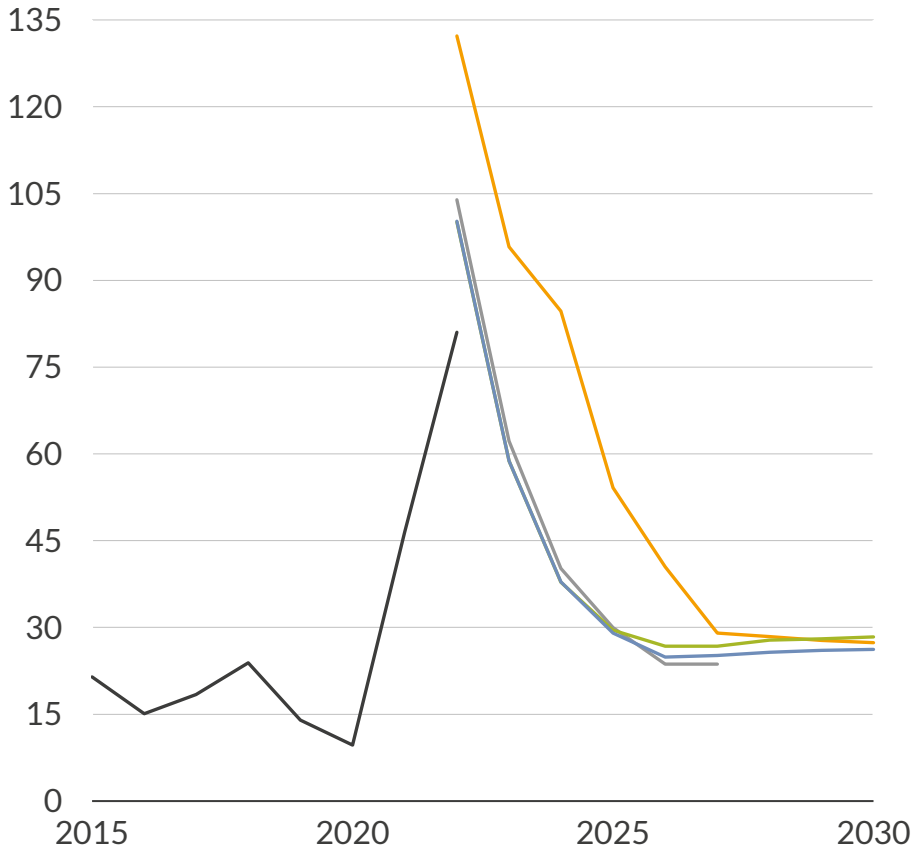
	Immediate Halt scenario Russia completely halts supply to Europe as soon as Jul-22	Managed Phaseout scenario Europe strives to fully phase out Russian gas by the end of 2026
1 Loss of Russian gas supply vs Continued Flows forecast (bcm)		
2 Price and policy driven demand reduction vs Continued Flows forecast (bcm)		
3 Biomethane production	▪ REPowerEU target of 35 bcm/a by 2030 is achieved. In 2021, biomethane production totalled 3bcm	
4 Accelerated renewables buildout	▪ 950GW of solar and wind capacity in EU-27 are achieved by 2030, 119GW short of the REPowerEU target	
5 LNG import capacity buildout – additional vs Continued Flows forecast (bcm)		

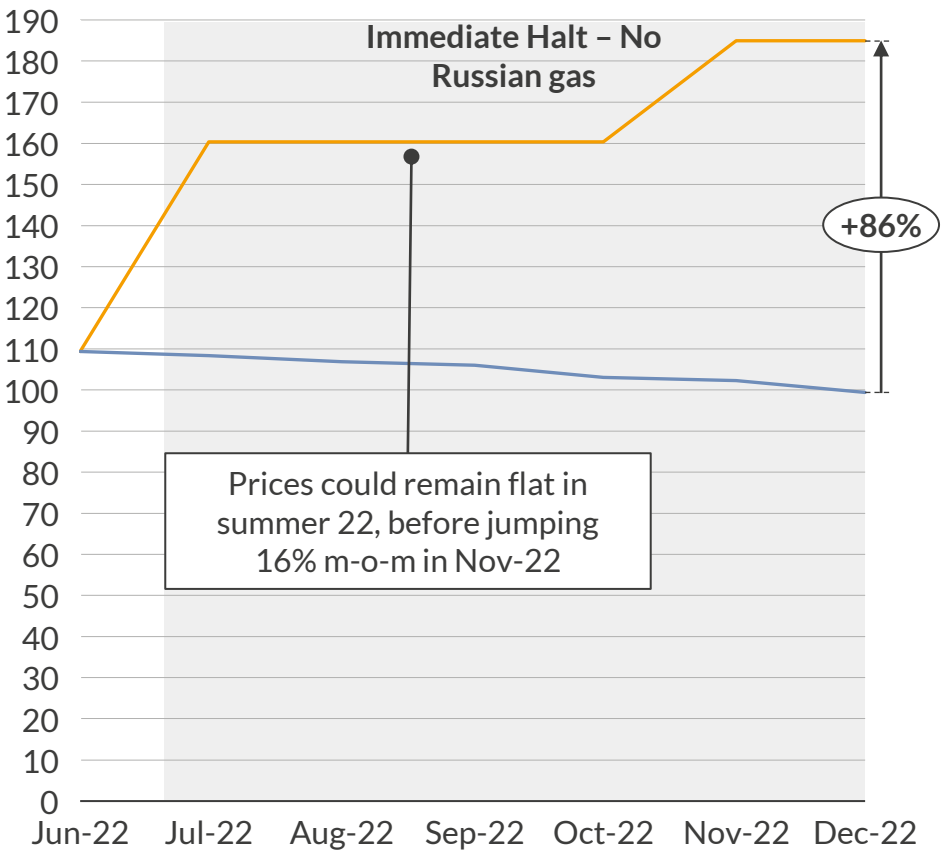
1) Aurora's forecast released in April 2022, which included the indefinite suspension of Nord Stream 2, but assumed no severe discontinuation of flows through the other Russian gas routes to Europe

In the Immediate Halt scenario, TTF hub prices could increase by 86% vs Continued Flows, trading at EUR185/MWh by the end of 2022

Average annual TTF natural gas prices
EUR/MWh (real 2021)



TTF natural gas prices – focus on 2022 prices in Immediate Halt
EUR/MWh (real 2021)



Historical — Futures[1] — Immediate Halt — Managed Phaseout — Continued Flows

1) Futures as of 14/03/2022, aligned with Continued Flows scenario published in April by Aurora

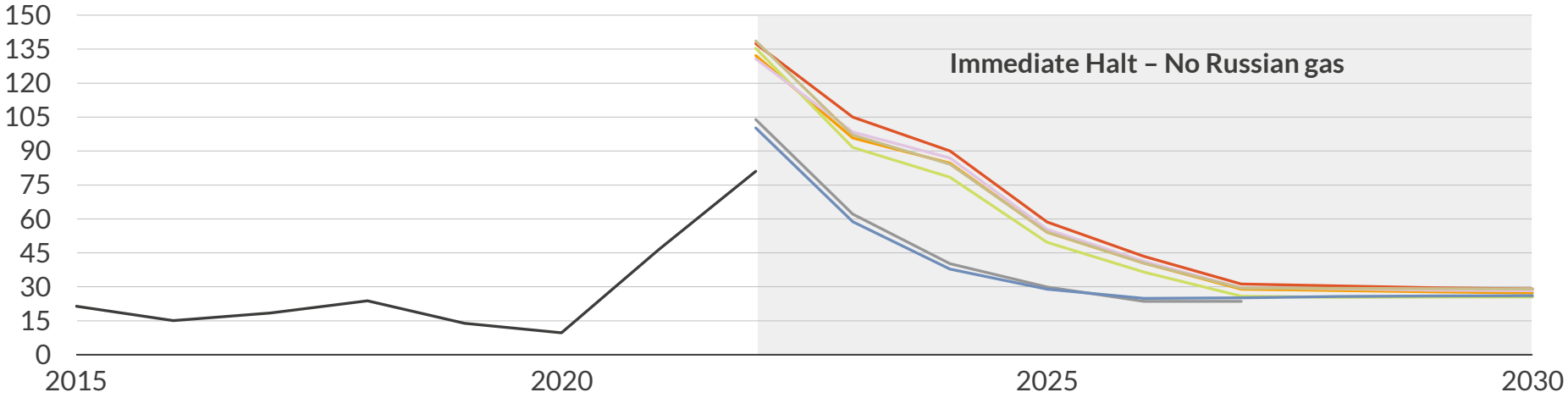
Sources: Aurora Energy Research EOS, EIKON

- In Immediate Halt, gas prices reach EUR160/MWh in Jul-22, and EUR185/MWh in Nov-22, 48% and 86% above Continued Flows, respectively
- As a result of the ambitious policy driven demand measures and additional supply from biomethane and LNG, Managed Phaseout prices are well aligned with Continued Flows up to 2024
- After 2026, TTF prices in both scenarios average only EUR2/MWh more than Continued Flows due to:
  1. Permanent demand reduction compared to Continued Flows because of policy measures
  2. Increasing LNG regasification buildout (more than 95% of the new capacity available by 2026)
  3. Expanding global LNG liquefaction capacity, particularly in the US

In the Immediate Halt scenario, price spreads would change, creating new opportunities for arbitrage within Europe

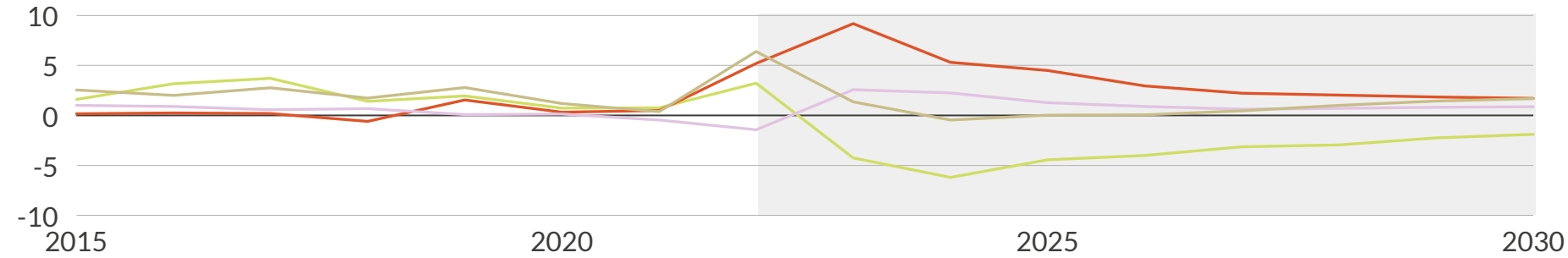
Selected European gas hub prices – Immediate Halt scenario

EUR/MWh (real 2021)



Price spread to TTF

EUR/MWh (real 2021)



Historical - TTF
Netherlands - TTF
Germany - THE
Italy - PSV
Futures[1]
Spain - MIBGAS
UK - NBP
Continued Flows - TTF

1) Futures as of 14/03/2022, aligned with Continued Flows scenario published in April by Aurora

Sources: Aurora Energy Research EOS, EIKON

- Price spreads between European hubs have been modest for the past few years, particularly in northwest Europe
- In the Immediate Halt scenario, price spreads widen, in some cases in unusual directions. For instance, Italian gas has historically traded at a premium to German gas. In the Immediate Halt scenario, Italian gas could trade at an average discount to the German THE of 4.2EUR/MWh between 2022 and 2025, as Italy becomes a more important import route to Europe
- In this period, the main drivers for the spreads are:
  1. Availability of LNG import capacity
  2. Access to additional indigenous production
  3. Access to additional sources of pipeline supply

In both scenarios, lower Russian imports requires substantial demand reduction as well as a rapid increase in LNG imports and biomethane

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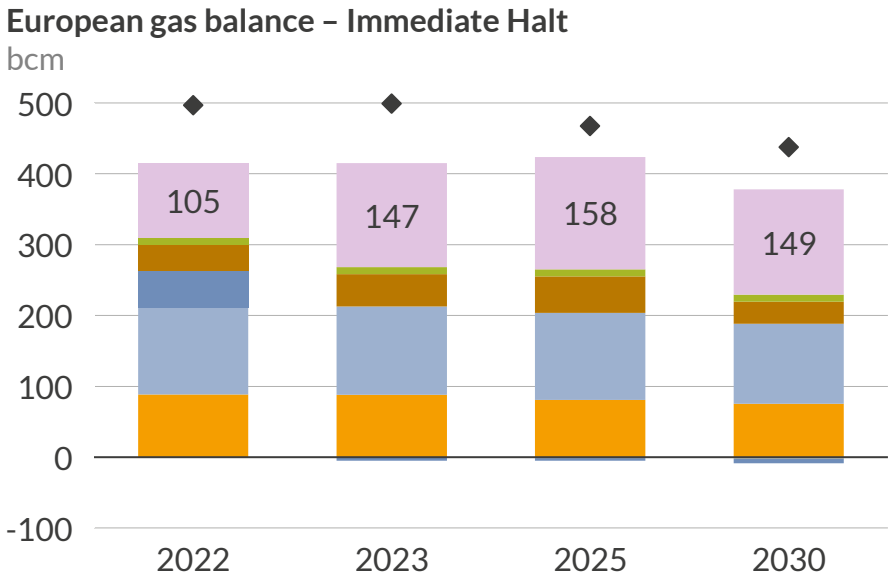
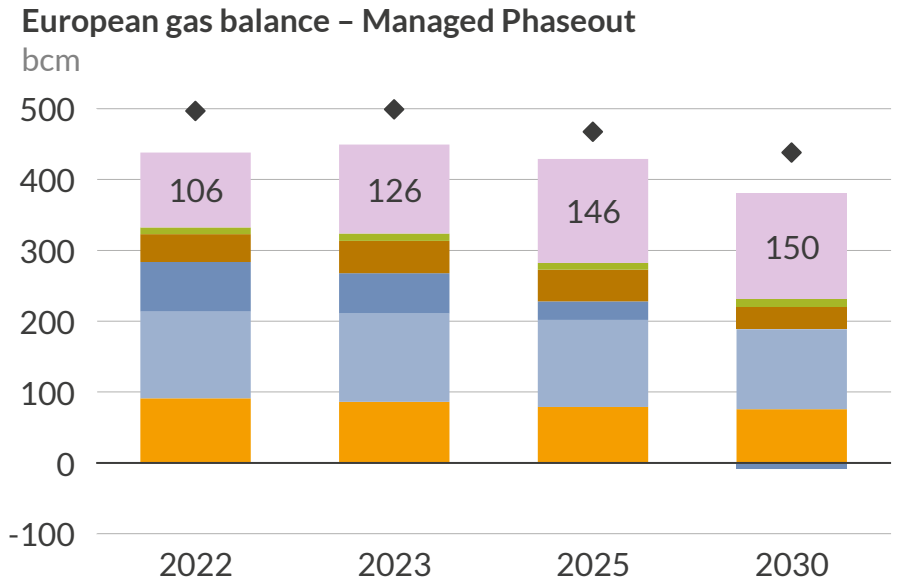
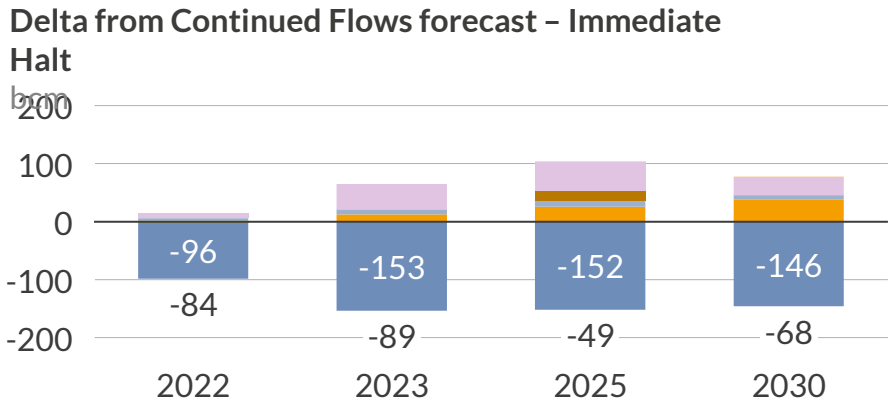
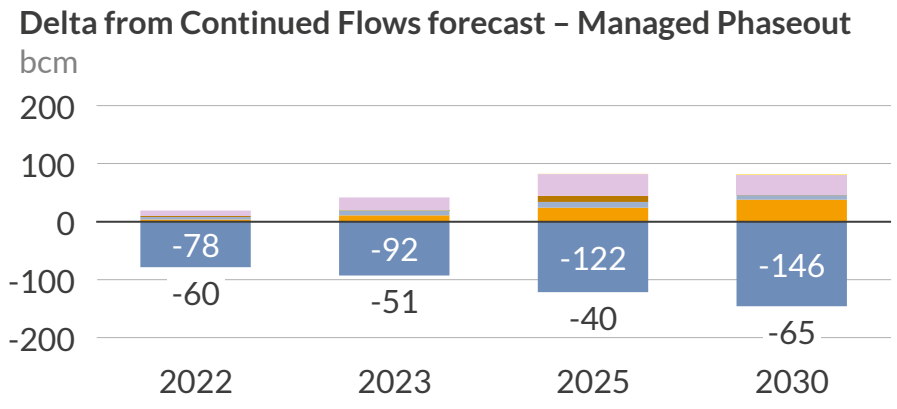








Non-EU Balkans
Azerbaijan
Russian gas routes
Indigenous Production[1]
LNG
North Africa
Norway
Continued Flows forecast

1) Includes biomethane production

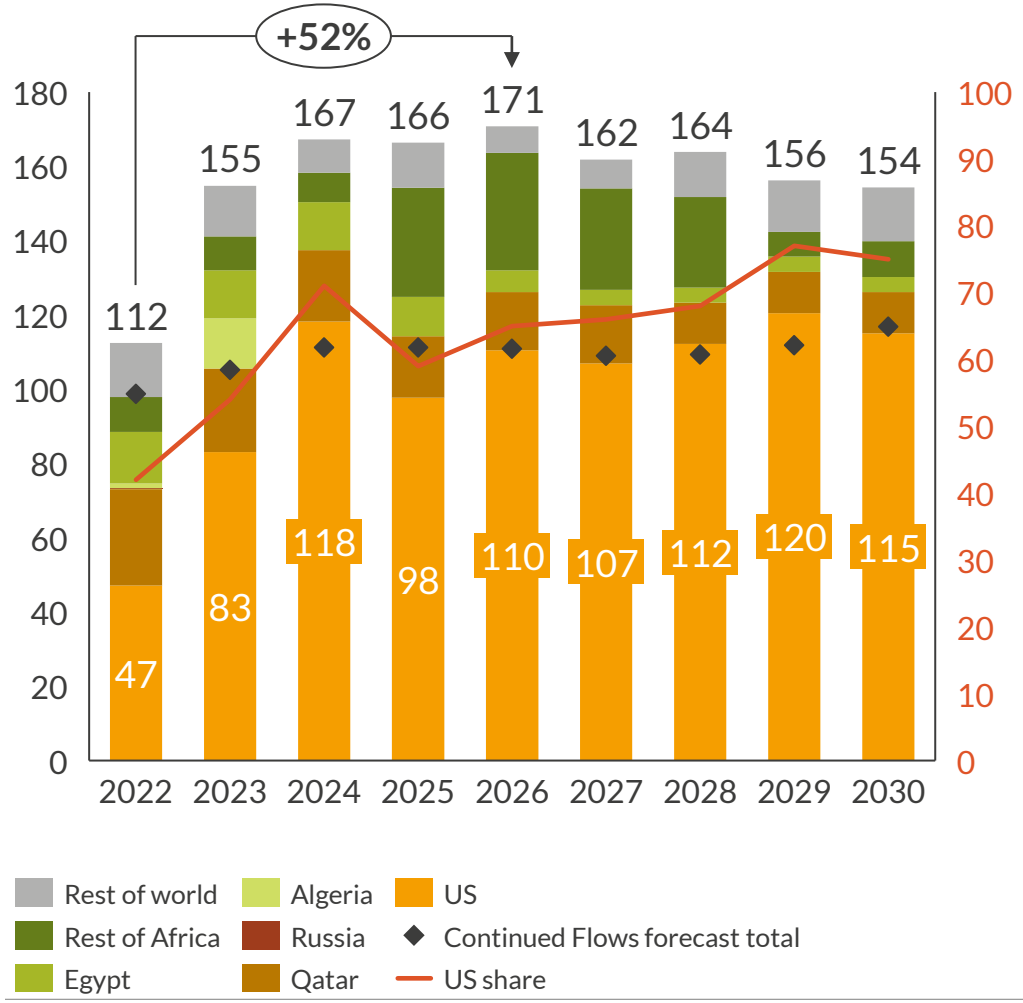
Source: Aurora Energy Research

- Driven by high prices and additional policies, demand decreases substantially compared to Continued Flows forecast between 2023 and 2030, by 65 bcm/a and 54 bcm/a on average in Immediate Halt and Managed Phaseout, respectively
- In the short-term, demand reduction is largely price driven, while after the mid-2020s the largest contribution is provided by accelerated RES buildout, electrification, efficiency gains, and renewable gas supply
- In both scenarios:
  1. LNG imports increase rapidly, accounting for around 40% of the European gas balance by 2030
  2. North African and Norwegian piped supply also increase vs Continued Flows forecast
  3. Biomethane production totals 35bcm in 2030, or 32bcm higher than in 2021

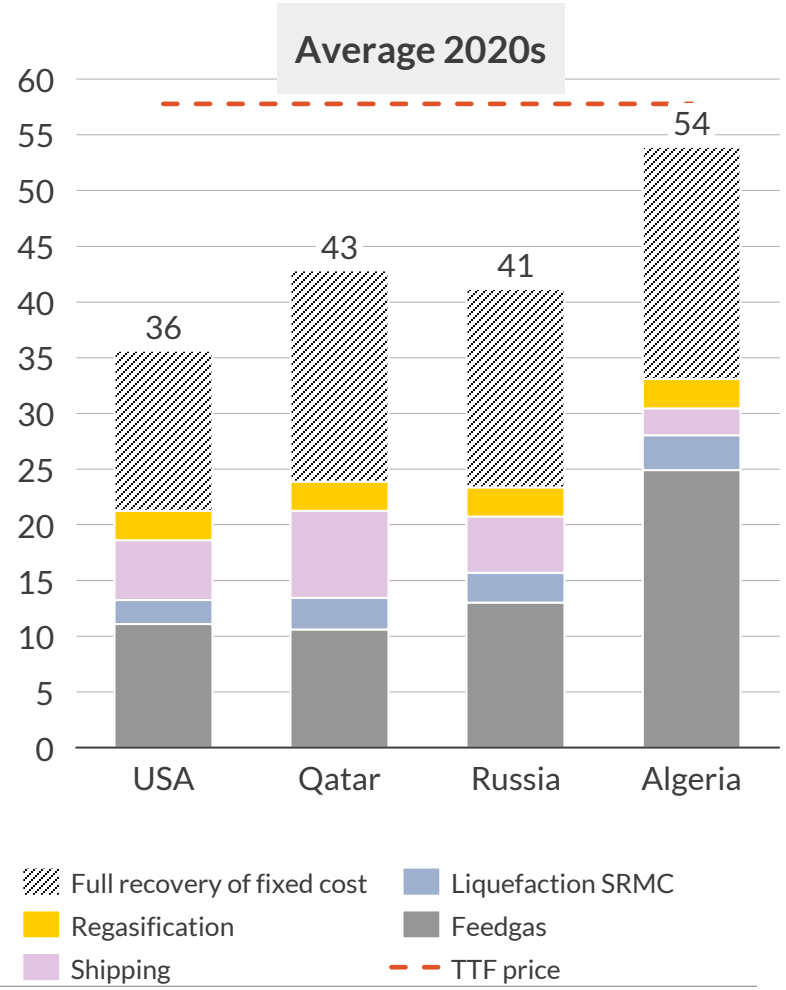
European LNG imports from the US grow by 56 bcm/a (+145%) by 2030, accounting for 75% of total LNG imports

European LNG imports by source[1] – Immediate Halt
bcm

US' share
%



LNG costs to TTF – Immediate Halt
EUR/MWh (real 2021)



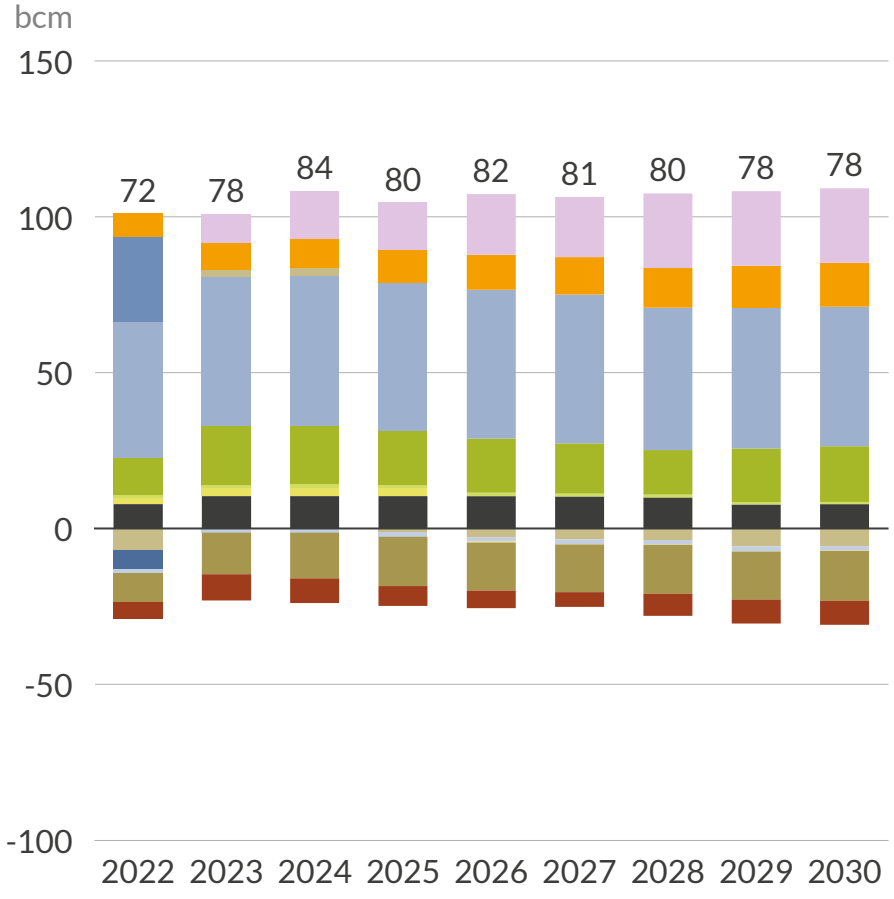
- In the Immediate Halt scenario, European appetite for LNG rises faster than in Continued Flows forecast, growing by 53% between 2022 and 2026, when imports peak at 171bcm
- As the cost of LNG from the US to Europe is the lowest, LNG imports from the US increase by 68bcm (+145%) by 2030. US LNG accounts for 64% of European LNG imports on average in 2022-2030
- Qatari LNG production costs can compete with the US, but higher shipping costs (45% above the US) limit the growth of imports from Qatar
- In spite of the high price of African LNG, imports increase in the early part of the forecast, driven by very high gas prices and the need to make up for the loss of Russian gas in a very tight LNG market. As the LNG market loosens up, imports from Africa start to decrease from 2025

1) Europe includes EU-27, UK, Norway and Switzerland (not the Balkans). Numbers defer from LNG numbers in EU Balance because the numbers here are gross LNG flows (before factoring in boiloff due to travel distance), while the numbers in the EU Balance are net LNG flows (after factoring in boiloff due to travel distance)

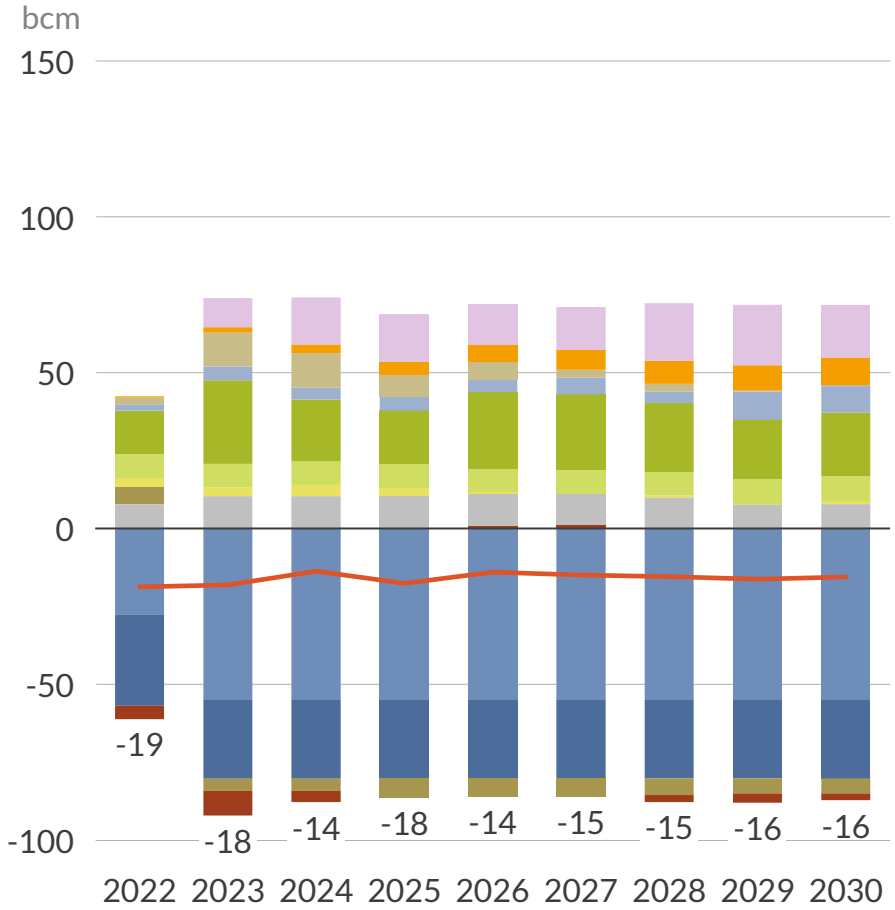
Sources: Aurora Energy Research Gas Model (AER-GAS), Reuters

In the Immediate Halt case, German gas demand would drop by 16 bcm/a on average in 2022-2030, relative to Continued Flows

Germany gas balance – Immediate Halt



Germany gas balance – Delta from Continued Flows



1) Includes biomethane production

Source: Aurora Energy Research

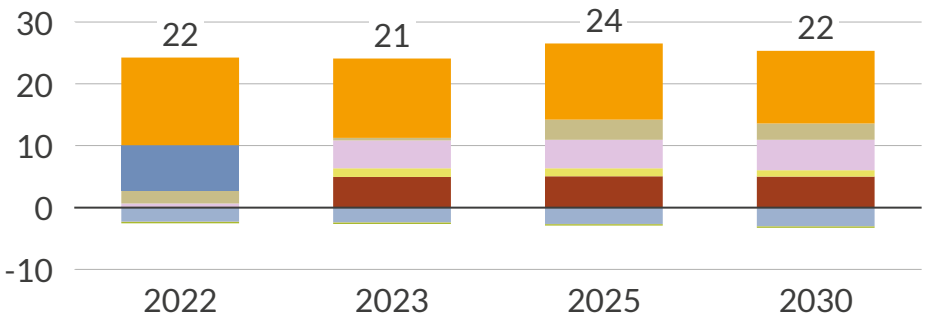
- In the Immediate Halt scenario, Germany loses around 47 bcm of gas supply from Russia in 2022 and 80 bcm/a from 2023 onwards
- In order to make up for the loss, demand side measures are required. In Immediate Halt, demand reduces by 16 bcm/a throughout this decade
- Germany is pursuing an ambitious plan to expand its LNG import capacity. LNG imports grow as more capacity becomes available thanks to three FSRUs targeted for the end of 2023 and the larger projects in Wilhelmshaven, Brunsbuttel, and Stade. By 2030, LNG imports account for 31% of overall gas demand
- Due to its LNG regasification capacity, the Netherlands will become a net exporter of gas to Germany, with exports averaging 16.6 bcm/a from 2022 to 2030

Bulgarian and Hungarian security of supply could be at risk if European imports from Russia were to stop completely

Romania does not face any security of supply risk due to their abundant indigenous production. On the other hand, Bulgarian and Hungarian energy security could be endangered, as in Continued Flows, Russian gas fulfils more than 60% of Bulgaria's and 98% of Hungary's gas demand

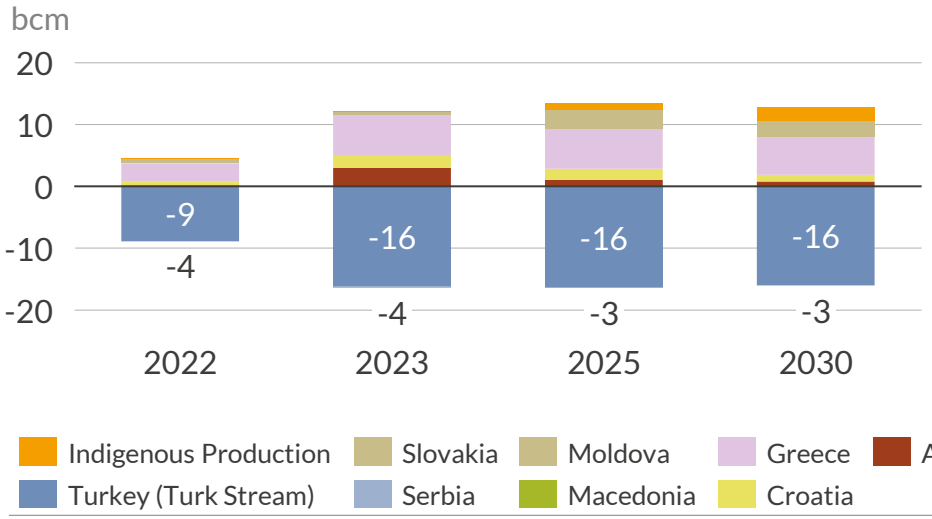
Bulgaria-Hungary-Romania combined gas balance – Immediate Halt

bcm



Delta from Continued Flows

bcm



	Risks for security of supply	Severity of possible shortage of supply	Mitigation factors
Bulgaria	▪ More than 60% of gas supply in Continued Flows forecast is of Russian origin ▪ Little opportunities for LNG import capacity development ▪ Very limited storage infrastructure	◑	▪ Pipeline import capacity from Greece has expanded since 2021 ▪ Possible implementation of measures to reduce demand
Hungary	▪ Almost 100% of gas supply in Continued Flows is of Russian origin ▪ Landlocked	◕	▪ Well developed pipeline infrastructure connecting to all neighbouring countries ▪ Possible implementation of measures to reduce demand
Romania	▪ Romanian gas may be needed to support Hungary and Bulgaria	○	▪ Annual indigenous production is larger than expected gas demand in Immediate Halt scenario

Takeaways

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Since Russia's invasion of Ukraine, gas prices across Europe have increased, and spreads within Europe have widened. High prices drove a drop in gas demand, particularly in Germany

Record high LNG imports and lower gas demand left European gas prices near pre-war levels by May. In June, prices rose again in response to sharp drops in Russian gas flows and an outage at a US LNG export terminal

Reducing natural gas demand will be essential to manage any further drops in Russian gas imports. In the short term this will come from industry and the power sector. In the long term this comes via more renewables buildout, renewable gases production, and reductions in the residential and commercial sector

1

In the event of an Immediate Halt to Russian gas imports, gas prices could nearly double by the end of 2022. Germany would trade at a premium to other western hubs due to its high Russian gas share. Industrial demand turns down even further, and LNG imports rise by 40 bcm/a from 2022 to 2023

In the power sector, wholesale prices and solar and wind capture prices rise by around 40% in response to the higher gas prices

2

In a Managed Phaseout scenario, gas prices are closer to our Continued Flows scenario mainly due to strong policy measures. This comes in the form of long-term demand side measures, and higher LNG and other imports, similar to the Immediate Halt scenario

By 2030, the European gas balance is similar to the Immediate Halt scenario. In both scenarios demand is nearly 70 bcm/a lower and LNG imports are 30 bcm/a higher than in our Continued Flows forecast

Source: Aurora Energy Research

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