Nikolai Tupikin: How Many Crises Can Europe's Energy System Withstand?

"But I just don't understand what you'll use to heat your homes. You don't want gas, you're not developing nuclear power… Are you going to burn wood? You'd have to go to Siberia to get it… You don't even have any wood." – ***Vladimir Putin****, speaking at an economic forum in Berlin, 26 November 2010.*

Sixteen years ago, the remark sounded like a political quip. What, in fact, has happened to Europe's energy system since then?

Russian President Vladimir Putin (right) with Gazprom Chairman of the Management Committee Alexey Miller. Photo: kremlin.ru

I set out to assess how well prepared Europe was for winter 2026–2027. I began with the figures for underground gas storage and quickly realised that, on their own, they told me very little. The key questions were not just how much gas was in storage, but how quickly it could be withdrawn and delivered to consumers, and what could replace it if supplies were disrupted.

One answer led to several more questions: how do cross-border interconnectors work? What happens during a prolonged lull in wind generation? Who pays for emergency purchases, and can public finances absorb the extra cost?

I decided to focus on what could be checked against published data, research and forecasts: the physical limits of the infrastructure, market conditions, fiscal constraints and official climate outlooks. A fresh escalation in the Middle East, a crisis around Taiwan, a sharp shift in US policy or a major natural disaster could change the picture. I make no attempt to predict such events.

That inquiry led me to a broader conclusion: the central question is not simply whether Europe will have enough gas this winter. It is how many shocks the energy system, industry, the financial system and public finances can absorb at the same time.

This is not an industry expert's verdict or a think-tank report. It is one person's attempt to make sense of a subject that initially seemed straightforward. I invite you to follow the investigation with me.

I'll begin with the question that prompted this review: **How much gas has Europe stored underground ahead of winter?**

Where Europe stands ahead of winter

Compared with 2010, Europe is far less dependent on Russian pipeline gas and far more reliant on the global liquefied natural gas (LNG) market. Supply routes are more diversified, but storage levels are well below those of a year ago: on 1 October, EU storage was 72% full, compared with 83% on the same date in 2025. By 21 October, the figure had risen to 74.6%, or about 845 TWh. The gap is particularly striking in Germany, where storage was only about 61% full.

ENTSOG's October assessment suggests that Europe's gas infrastructure can meet demand under a wide range of conditions. In a cold winter with limited LNG availability, however, the combined volume of required demand cuts and potentially unmet demand could reach 437 TWh, or roughly 40 billion cubic metres (bcm). That is more than half the gas held in EU storage on 21 October. The gap would have to be covered by additional supplies, lower consumption, or both.

If severe cold, weak wind generation and supply disruptions coincide, Europe could face a stark choice: protect household heating by cutting industrial gas use, accept higher household bills, or shift more of the cost onto public budgets.

The analysis that follows shows how one shock can magnify another. What if the "perfect storm" materialises? Can Europe buy the gas it needs, or will demand have to be cut? The answer depends not only on storage levels, but also on weather across several continents, conditions in the global LNG market and the resilience of four interlinked systems: energy supply, industry, financial markets and public finances.

1. Gas in storage is not the same as a safety margin

The EU-wide figures mask wide differences between countries. According to Gas Infrastructure Europe (GIE), on 21 October 2026 German storage was just 61.1% full and Dutch storage 64.7%. France was in a much stronger position at 87.4%, and Italy at 90%. Germany has the EU's largest underground storage capacity, yet it held less gas than Italy: 151 TWh against 183 TWh. France held 108 TWh and the Netherlands 93 TWh.

EU rules set a 90% storage target to be reached between 1 October and 1 December, although exemptions and additional flexibility apply in 2025–2027. There is, however, an economic catch. As Russia's Institute of Energy and Finance (IEF) has noted, the old strategy of buying gas cheaply in summer and selling it at a premium in winter no longer reliably makes economic sense. High summer prices increased the risk that traders would lose money on storage, weakening their incentive to inject gas into underground facilities.

Meeting the target still does not guarantee that enough gas will be available at the peak of winter demand.

The amount of gas in storage and the rate at which it can be delivered are not the same thing. As a storage site empties, pressure falls and the maximum daily withdrawal rate declines. Gas may still remain underground, but extracting it at the same rate becomes harder.

In one ENTSOG stress scenario, European storage ends the winter at around 11% full. At that level, a late cold snap or an unexpected supply disruption becomes especially dangerous because there is less room to meet a sudden rise in demand. The real safety margin is not simply the percentage of capacity filled; it is the ability to sustain sufficient daily withdrawals throughout the cold season.

2. Germany's gas equation: storage at 61%, prices above €90/MWh

Germany is particularly exposed to gas-market shocks. Gas is needed for heating and heavy industry, and the country's transmission network also carries supplies to neighbouring countries. Even without a physical shortage, a sharp price rise can impose a heavy cost on the German economy.

According to Germany's Federal Network Agency, during the week of 13–19 October, the country received 17.4 TWh of pipeline gas and 1.6 TWh through its LNG terminals. The terminals were running at an average utilisation rate of just 37.2%. The regulator assessed supplies as stable and the risk of a supply squeeze as low. It also warned that storage levels were well below last year's and could be left at very low levels by the end of winter.

At first glance, LNG terminals running at less than half capacity look like a useful reserve. But spare capacity only means that more gas can be received; it does not mean that additional cargoes can be bought on the world market and delivered in time.

There is another constraint: German storage operators are required to keep their facilities at least 30% full by 1 February 2027. Even if that benchmark is met, it does not guarantee that gas can be withdrawn fast enough during a late cold spell.

For Germany, the immediate problem is less the amount of gas available than its price. In the chemical industry, gas is both a fuel and a feedstock. Ammonia and fertiliser production, along with glass and ceramics, are especially gas-intensive. In metals and engineering, high gas and electricity prices push up costs all along the production chain.

On 20 October, the TTF benchmark price rose above €90/MWh for the first time since late 2022. The effects are already showing up in industry. Fertiliser maker Yara reported that high gas prices and deferred demand had weighed on margins and shipments in the third quarter. It adjusted operating rates at its European plants in response to energy costs and production conditions. Adjusted EBITDA, a key measure of operating performance, fell to $675 million from $804 million a year earlier.

From the standpoint of the gas balance, lower industrial output looks like good news: consumption falls, leaving more gas for other users. For the wider economy, the effect runs in the opposite direction: less output, fewer hours worked, lower incomes and reduced tax receipts. The energy system buys itself breathing room at the expense of industry, workers' earnings and public revenue.

Germany's vulnerability, then, lies less in a lack of gas sources than in the cost of keeping an energy-intensive economy supplied.

3. Fifty-seven reactors: can France stabilise Europe's energy market?

Unlike Germany, France generates most of its electricity from nuclear power, which is less directly exposed to gas prices. The IAEA lists 57 operating reactors with a combined capacity of about 63 GW. In 2025, nuclear power supplied roughly 68% of French

electricity. EDF expects annual output of 350–370 TWh in both 2026 and 2027. By comparison, Russia's entire fleet operated by Rosenergoatom, part of Rosatom, generated 218.3 TWh in 2025. The French fleet is expected to generate roughly 1.6–1.7 times as much electricity as Russia's entire nuclear fleet.

France's gas storage was also relatively high, at about 87% on 21 October. Together, its gas reserves and nuclear fleet make France an important stabilising force in Europe's energy market: it can draw on stored gas and export electricity to neighbours, reducing their need for gas-fired generation. But that support has limits.

Reactors are taken offline for scheduled maintenance, and unplanned outages also occur. Some plants are also sensitive to river levels and water temperatures. In summer 2026, low river levels and unusually warm water forced temporary operating restrictions at several nuclear plants.

France also relies heavily on electric heating. During a severe cold spell, domestic electricity demand rises sharply and exports may have to be cut to meet demand at home. If a cold snap coincides with outages at several reactors, France could switch from net exporter to net importer of electricity.

France can therefore cushion an energy crisis in neighbouring countries, but only when spare generation capacity is available and cross-border interconnectors have room to carry the power. That reserve is especially important for Germany, yet it may not be available when the system is under the greatest strain.

4. One market, different vulnerabilities

Italy enters winter with about 183 TWh of gas in storage and storage sites 90% full. That is a strong starting point. But Italy relies heavily on gas-fired power generation, so a fall in hydropower output or a rise in electricity demand would push up gas consumption.

Spain has large LNG terminals and is well placed to receive gas by sea. Getting that gas to Central Europe is harder: pipeline capacity across the Pyrenees is limited. Even if Spanish terminals have spare capacity, the extra gas may not be able to reach consumers in Germany.

The Netherlands remains one of Europe's main gas hubs, with its terminals, storage facilities and trading infrastructure. Yet on 21 October, Dutch storage was only 64.7% full, well below the EU average.

Landlocked countries in Central, Eastern and South-Eastern Europe depend on supplies routed through neighbouring states. Gas at an EU terminal is not enough: it still has to pass through several national transmission networks, each with its own bottlenecks. ENTSOG highlights these regional constraints in its assessment.

The United Kingdom occupies a distinctive position. It is outside the EU but remains an important part of the European gas market. It draws on its own North Sea fields, pipeline

imports from Norway and continental Europe, and LNG terminals. Its storage capacity, however, is small. According to figures supplied by the UK government in response to a parliamentary question on 14 July 2026, it totals about 1.7 bcm, equivalent to just seven days of average winter demand. The UK therefore relies heavily on uninterrupted flows from current suppliers and, when demand rises, competes with continental Europe for additional LNG cargoes.

Europe's total gas stocks do not guarantee that every consumer can get the gas they need. One country may have ample supplies but little capacity to send them across the border. Another may have LNG terminals but too little gas in storage. In a third, demand may be more sensitive to the weather.

National markets are linked by trade and contracts, but each still depends on specific delivery routes. That brings us to the next question: how can gas physically reach the places where it is needed most?

5. Pipelines, pressure and bottlenecks: gas still has to reach the places that need it

Imagine a six-lane motorway at rush hour. Queues build at narrow exits onto local roads, backing up into the through lanes and slowing drivers who are not turning off. The motorway's width is no help if the exits cannot handle the volume of traffic.

Europe's gas network works in much the same way. It comprises main pipelines, compressor stations, LNG terminals, storage sites and connections between national systems. Each link has its own capacity limits.

Between countries. The Pyrenean corridor is the clearest example: Spain's LNG terminals can receive far more gas than the pipelines can carry onwards into France. On other routes, including those across the Alps, capacity also depends on the direction of flow and the spare capacity of the neighbouring network.

Within a country. The biggest storage sites and industrial consumers are not always close to one another. Much of Germany's gas infrastructure is concentrated in the north, while many large consumers are in the south. Under normal conditions, the network can cope. At peak times, everything depends on the spare capacity of the specific corridor.

Pressure and compressors. Compressor stations keep gas moving at the required pressure, but their capacity is finite. The maximum daily withdrawal rate from some storage sites also falls as they empty. During a cold snap, the system is constrained by its weakest link, not by its average capacity.

Changing flow directions. Before 2022, Gazprom supplied Europe with around 150 bcm of pipeline gas a year. By 2025, deliveries had fallen to 18 bcm, leaving TurkStream as the only operating route. The sharp decline increased the importance of western LNG terminals and northern routes for supplies to Central and Eastern Europe.

The transmission system has been reconfigured to allow gas to flow from west to east, but not every pipeline can carry the same volumes in both directions.

Europe may have enough gas in aggregate and still face a local shortage. If the shortfall affects not just one region but the continent as a whole, the bottleneck shifts from pipelines to the global LNG market.

6. Why the US cannot quickly send more LNG to Europe

The United States has become the EU's largest LNG supplier from outside the bloc. US export capacity is expanding, and cargoes can be redirected between markets. According to the US Energy Information Administration (EIA), US LNG exports averaged 493 million cubic metres a day in the first half of 2026. Its October forecast puts the figure at 530 million cubic metres a day in the first half of 2027, as new capacity comes online.

Another factor is likely to increase European demand for US LNG: from 1 January 2027, the EU will stop importing Russian LNG under long-term contracts. According to the Institute of Energy and Finance, Russian LNG accounted for 10.4% of EU LNG imports in the third quarter of 2026, much of it from NOVATEK's Yamal LNG project. European buyers will need to find alternative supplies just as the heating season is in full swing.

But the scope for a rapid increase in transatlantic deliveries is limited by production capacity, infrastructure and conditions in the US domestic market.

Production. Before gas reaches a European terminal, it must be extracted, piped to a liquefaction plant, turned into LNG, loaded onto a tanker and shipped across the Atlantic. If export plants are already running close to full capacity, output cannot rise sharply. Spare capacity at European terminals is useless if there is no additional LNG to load.

Infrastructure. Most major US export plants are concentrated along the Gulf Coast. Cold weather, power cuts, equipment failures and pipeline problems can all disrupt operations. During Winter Storm Uri in 2021, the US gas system suffered widespread disruption; an accident at Freeport LNG in June 2022 then shut a major export plant for an extended period. Such incidents can sharply reduce supplies to the global market.

The domestic market and politics. US exporters buy gas on the same market that heats American homes and supplies US industry. The logic in Washington is straightforward, regardless of which party is in power: no president wants Americans to freeze in winter, and every extra dollar on a heating bill is another vote against the incumbent. If exports threaten domestic supply or drive up prices at home, calls to restrict overseas shipments will follow quickly.

But such a move cannot happen overnight. Existing export authorisations and contracts are governed by law and binding agreements. Markets move faster than politicians: if US domestic prices rise, exporters pay more for their feed gas, and overseas buyers may face higher prices for US LNG as well.

There is a precedent for government intervention in the US gas market. In January 2024, the White House paused reviews of applications for new LNG export authorisations to countries without a free-trade agreement with the United States. Existing exports were unaffected. The pause was lifted in 2025, but the precedent for political intervention in LNG export policy had been set.

For Europe, the conclusion is simple: US LNG gives buyers more options, but it does not guarantee extra supplies in the volumes they need, when they need them. If Asian demand rises at the same time as European demand, prices could jump far faster than the US can expand exports.

7. Asia and Europe: who gets the next LNG cargo?

Europe competes for available LNG cargoes primarily with Asia. A cargo will go to whichever buyer offers the best price once shipping costs are factored in. The key price benchmarks are Europe's TTF and Asia's JKM. Even a high price cannot guarantee extra supply: there may simply be no uncommitted gas left on the global market.

Competition was already intensifying in October. According to Kpler estimates cited by Reuters on 22 October, Asian LNG imports could reach 23.31 million tonnes for the month, the highest monthly total in three months. In the week to 16 October, the JKM spot price for Northeast Asia rose to $29.30 per million British thermal units, almost three times its level at the end of February. Even at those prices, buyers kept purchasing.

China has domestic production, pipeline gas from Russia and Central Asia, storage facilities and the option of switching to coal. In 2025, Gazprom supplied China with 38.8 bcm through the Power of Siberia pipeline. Those pipeline deliveries reduce Beijing's exposure to the global LNG market. When LNG is expensive, China can cut spot purchases and even resell some contracted cargoes. That happened in 2022, when some cargoes originally intended for China became available to Europe. A cold winter changes the equation: China needs the extra gas itself. Kpler expected Chinese imports to rise to 5.47 million tonnes in October 2026, up from 5.20 million tonnes in September.

Japan and South Korea are more reliant than most economies on seaborne gas imports. Much of their supply is secured under long-term contracts. Japan, for example, continues to receive Russian LNG from the Sakhalin-2 project. Japanese buyers accounted for 58% of the project's shipments in 2025. When the weather is mild and inventories are ample, the need for extra purchases is limited: Japan's LNG imports were forecast to fall to 4.47 million tonnes in October, while stocks held by its energy companies were above year-earlier levels. In 2022, both countries helped Europe secure additional cargoes. In a severe cold spell, however, they will need those volumes themselves.

India and Southeast Asia are more sensitive to high prices. When LNG becomes expensive, some buyers cut imports, switch fuels or curb industrial output. That can free up cargoes for Europe, but at a high price. When prices fall, India and Southeast Asian buyers return to the market and compete for supplies again.

Asian demand depends above all on weather, gas stocks and the availability of alternative fuels. In a mild winter, Asia may free up cargoes for Europe. In a cold winter, competition intensifies and prices rise.

A high price does not, by itself, mean a physical shortage. The market first prices out buyers who can switch fuels or cut consumption. But if severe cold coincides with supply disruptions, even record prices may not secure additional LNG cargoes for Europe, especially if shipping routes are also disrupted.

8. The Strait of Hormuz: how a shortage elsewhere becomes Europe's problem

A 2025 review by HSE University projected that new LNG capacity in North America and the Middle East would help meet peak European demand. The crisis in the Persian Gulf in 2026, however, changed the outlook.

Before the conflict in the Middle East, almost one-fifth of global seaborne LNG trade passed through the Strait of Hormuz, primarily from Qatar. Most of that gas went to Asia, but Europe felt the effects too. With their usual supplies disrupted, Asian buyers began competing more aggressively for US LNG, which the EU also relies on.

By October 2026, shipments through the strait had partially resumed but remained well below pre-crisis levels. Qatar extended supply restrictions affecting some European and Asian customers. Global gas prices rose, while other producers had limited capacity to replace the missing volumes.

ACER assessed the scale of the risk in May. Its analysis found that a complete halt to LNG shipments through Hormuz for all of 2026 would leave global LNG supply 27 bcm below the 2025 level. This is not a forecast of actual losses, but an estimate of how sharply a prolonged crisis could reduce supply.

Disruptions in the Strait of Hormuz have already intensified competition between Europe and Asia for LNG. But geopolitics is not the only force shaping the global gas market. This winter, weather could simultaneously affect gas demand, power generation and shipping across several continents.

9. El Niño: how weather on three continents can move the gas market

The winter of 2026–2027 could bring one of the strongest El Niño events on record. In its 8 October assessment, the US National Oceanic and Atmospheric Administration (NOAA) put the probability of El Niño remaining strong or very strong during January–March at more than 83%. Warming in the central and eastern equatorial Pacific alters atmospheric pressure, circulation patterns and jet streams. Through planetary Rossby waves, these changes can propagate thousands of kilometres, affecting North America, the Atlantic, the Arctic and Eurasia.

For the energy system, the sequence of weather anomalies matters more than the seasonal average. A prolonged thaw can be followed by a sharp cold snap; the usual

westerly flow can give way to a blocking high. These shifts affect gas demand, wind and hydropower output, fuel production and maritime transport.

The polar vortex: a link between the Arctic and China. The stratospheric polar vortex plays an important role in these processes. Atmospheric waves can weaken or displace it, altering circulation over Eurasia. In September 2026, Chinese climate researchers published a study in Atmospheric Research based on data from 1961–2021. They found a link between a shift of the vortex into the Asian sector and colder-than-average conditions across much of China, particularly in central and eastern regions. The study also identified the North Atlantic Oscillation and Eurasian wave activity as contributing factors. This does not mean the vortex will necessarily shift towards China this winter. A strong El Niño can intensify atmospheric disturbances, while the westerly phase of the quasi-biennial oscillation (QBO), according to NOAA's October assessment, generally favours a more stable vortex. The key indicators to watch are the vortex's position and strength, the Siberian High and the development of blocking highs. These patterns could create conditions for major outbreaks of Arctic air into Asia.

Northeast Asia: a short cold spell, a sharp rise in demand. The winter of 2023–2024 offers a useful example. During a strong El Niño, eastern China experienced several cold-air outbreaks, culminating in snow and freezing rain in February 2024. Researchers linked these events to changes in the jet stream over the North Atlantic, Rossby waves and a stronger Siberian High. A few weeks of severe cold can be enough to move prices on the global LNG market. If a cold spell hits China, Japan and South Korea at the same time, gas demand will surge and fewer cargoes will be available to Europe.

Europe: caught between wind and high pressure. Seasonal forecasts suggest that north-western Europe may see milder, windier conditions early in the winter. That would reduce heating demand and could boost wind generation. But atmospheric circulation could shift in January or February under El Niño's influence. Blocking highs can bring cold weather and prolonged lulls in wind, known as Dunkelflaute, when wind and solar output fall at the same time. The resulting power shortfall would have to be covered, potentially by burning more gas. Timing matters: such conditions could emerge late in the winter, when storage sites are partly depleted and their maximum withdrawal rates have fallen. Each additional cold week would accelerate the drawdown of the remaining stocks.

The United States: winter storms and LNG exports. NOAA's October outlook points to a wetter, stormier winter in the southern United States, where gas production, pipeline infrastructure and Gulf Coast LNG export terminals are concentrated. Freezing rain, ice and power outages could temporarily disrupt the system. Some climate models also indicate an increased chance of colder conditions in the south-eastern United States in January–April, although NOAA's official outlook is more cautious and does not predict specific cold spells. In a tight global market, even a brief shutdown of US exports in the second half of winter could matter.

Water and logistics: from Panama to Southeast Asia. El Niño has already affected shipping. Because of low rainfall, the Panama Canal Authority cut the number of daily vessel transits in September 2026 from 38 to 34 and then to 32. For LNG carriers travelling from the United States to Asia, this means queues, delays and potentially longer routes. Ships spend more time at sea, freight costs rise and fewer tankers are available. Lower rainfall in Southeast Asia could also reduce hydropower output and increase demand for gas and coal, adding to LNG demand. Southern Europe is similarly sensitive to rainfall and water reserves, although El Niño's influence on its weather is less direct.

Even a very strong El Niño in 2026 does not necessarily mean an energy crisis. Warmer weather in the northern United States and East Asia could reduce gas consumption, while a mild, windy winter in Europe could ease pressure on the energy system.

The risk lies not in seasonal averages but in extremes. Even if the winter as a whole is mild, separate weather anomalies can coincide. Two weeks of severe cold in Asia, a prolonged lull in European wind generation and a disruption to US exports could increase demand for LNG just as supply tightens. The combination becomes particularly dangerous when available supplies, storage withdrawal capacity and shipping options are already stretched.

10. One reserve, multiple threats

El Niño can affect several parts of the global energy system at once, but weather is only one of the risks. Most of these threats are well known to analysts, energy companies and regulators, and there are protocols, reserves and contingency plans to deal with them. The real problem begins when several events occur at the same time.

Dunkelflaute. A prolonged spell of low wind and solar output forces power systems to call on backup capacity, import electricity or cut consumption. If gas-fired plants make up the shortfall, gas demand rises.

Lower hydropower output. Drought and low reservoir levels constrain hydropower generation in Italy, Spain and elsewhere. Other sources must make up the shortfall, including gas-fired generation.

Norwegian supply disruption. Norway remains the EU's largest gas supplier. A prolonged outage at a major production or transport hub would cut pipeline deliveries, increasing the need for LNG and withdrawals from storage.

French nuclear outages. Unplanned repairs, or scheduled maintenance coinciding with a cold spell, could force France to reduce electricity exports. Neighbouring countries would have to find alternatives, including gas-fired power.

Infrastructure damage. Accidents, cyberattacks or sabotage could disable pipelines, compressor stations, LNG terminals or cross-border power links. The impact would depend on which asset was damaged and how long repairs took.

A fall in global LNG supply. Disruptions in the Strait of Hormuz, outages at export plants and stronger demand in Asia would reduce the number of LNG cargoes available to buyers. Europe would have to pay more and draw down its own storage faster.

Government crisis measures. Freezes on retail tariffs, price caps, subsidies and administrative rationing can protect consumers, but they can also raise public spending and weaken suppliers' incentives to bring in extra volumes when wholesale prices are tightly capped. State compensation for high gas prices and strict price caps can have different effects on the market.

Europe's energy system can absorb each of these risks, at least in part, when they occur on their own. But what happens when several hit at once?

Imagine a factory with a trained standby worker. If one employee calls in sick, the replacement can take their place and the production line keeps moving. But if three employees are off sick at the same time, one person cannot cover all three jobs. There is a reserve, but it cannot absorb every shock at once.

The same principle applies to energy. Extra gas supplies, backup power stations and storage stocks can help offset individual disruptions. But if temperatures fall, wind generation drops and gas imports decline at the same time, all three problems call on the same limited pool of fuel.

Worse, one disruption can magnify another. Low wind means gas-fired power stations burn more fuel, accelerating withdrawals from storage and pushing up demand. A shortage of available LNG cargoes drives prices higher. Expensive energy then forces industry to cut production, and the downturn spreads to jobs, banks and public finances.

Even if extra gas can be found and delivered, one question remains: who pays for it? Emergency purchases, support for energy companies and aid to industry all cost money. European governments, too, have limited fiscal room.

11. Public finances: what does it cost to get through a crisis?

In 2022–2023, European governments spent enormous sums shielding households and businesses from soaring energy prices. But deciding to provide support and finding the money to pay for it are two different things, especially when the sums run into hundreds of billions of euros.

Germany: the money is there, but spending it is not straightforward

Germany's public debt is relatively low, at around 63% of GDP according to Eurostat data for the second quarter of 2026. But Germany's Basic Law (Grundgesetz) limits the federal government's ability to borrow. The so-called debt brake (Schuldenbremse) caps structural borrowing in the ordinary federal budget at 0.35% of GDP, subject to statutory exceptions.

In March 2025, Germany eased these rules: defence and security spending above 1% of GDP was exempted from the usual limits, and a special fund of up to €500 billion was

created for infrastructure investment. The Basic Law also allows additional borrowing in an emergency, but this requires a separate Bundestag decision and a plan to repay the debt. Germany therefore has tools for emergency fiscal support, but deploying them requires political agreement and, above all, time.

The 2022 crisis shows how large the bill can become. Germany announced an energy stabilisation package capped at €200 billion and had to rescue Uniper, one of its largest gas importers. The €200 billion figure was the programme's ceiling, not the amount actually spent.

France: borrowing is easier, but more expensive

France has no debt brake like Germany's, but its public debt is much higher: 119.1% of GDP at the end of the second quarter of 2026. The budget deficit in 2025 was 5.1% of GDP, and France remains subject to the EU's excessive deficit procedure, which requires it to bring the deficit down.

For Paris, the main constraint is the cost of new borrowing. On 21 October, yields on French 10-year government bonds reached 5%, their highest level in more than two decades. Investors demanded a higher return amid the country's fiscal and political uncertainty.

France has used similar measures before. During the previous crisis, the government introduced a tariff shield (*bouclier tarifaire*) to limit increases in energy bills. It did not make gas any cheaper; the state simply absorbed part of the cost that households would otherwise have paid.

The government could introduce similar support again, but every additional billion euros would have to be weighed against high debt, expensive borrowing and existing budget commitments.

Different constraints, the same problem

Germany has more fiscal room, but stricter rules on how it can be used. France has more freedom to make budget decisions, but carries more debt and faces higher borrowing costs.

Both countries can quickly support individual businesses and energy companies. Sustaining large-scale assistance to households and industry for months is much harder, particularly if high prices persist beyond the winter.

Businesses feel the impact of expensive energy immediately, without waiting for government decisions. Production can be restarted, but winning back lost orders, reopening closed facilities and reviving cancelled investment plans is much harder.

So the question is no longer simply whether there will be enough gas. It is who will pay, and how much, to keep energy flowing: consumers through their bills, businesses through lost profits, the state through subsidies, or future taxpayers through higher public debt.

Financial pressure can build even before governments have agreed on large-scale support for the economy. A sharp rise in energy prices, coupled with the threat of shortages, immediately strains businesses, banks and financial markets.

12. The margin call comes before the frost: how finance amplifies an energy shock

A sharp spike in gas prices can trigger a financial crisis before any physical shortage develops. Businesses need more cash to pay their energy bills, banks become more cautious about lending, and energy companies face larger margin calls on exchange-traded contracts. Financial stress can spread through the economy even while gas continues to flow.

Corporate lending

Consider a glass factory whose gas bill keeps rising. A glass furnace cannot simply be switched off for a few weeks and then restarted: shutting it down and cooling it require a carefully managed process, and a mishandled shutdown can damage the equipment. The factory keeps running even as its margins shrink, using up cash reserves to pay for energy.

After several months, the factory starts running short of cash for day-to-day costs and asks its bank for an additional loan. But the bank sees a deteriorating financial position: profits are falling, debt is rising and the outlook for recovery is uncertain. Credit becomes more expensive and the bank asks for more collateral. The factory must now choose between buying raw materials, maintaining equipment and servicing its debt.

Lower output affects suppliers, transport companies and customers. Some lose orders, others receive less product than they need, and still others face late payments. The bank must set aside more provisions for potential loan losses. That weighs on its earnings and may limit its ability to lend to other businesses.

The government is hit from both sides: revenue falls as spending rises. When the factory cuts output, tax receipts decline. At the same time, supporting businesses and workers may require additional spending. If dozens of factories face the same squeeze, the energy crisis begins to affect banks and public finances.

And yet no household has been cut off from heating. Gas is still flowing, power stations are running and factories have not necessarily closed. But the economic crisis is already under way. All because energy has become too expensive.

Margin calls: profits tomorrow, cash today

European energy companies use futures and other derivatives to lock in prices for future gas and electricity deliveries. This protects them from sudden market swings, but it creates another problem.

When prices move sharply, an exchange may require traders to post additional cash collateral immediately against open positions. This is known as a *margin call*. The money

may be needed even if the company ultimately makes no loss on the trade. The profit may arrive when the contract is settled, but the collateral has to be posted today.

In September 2022, Norway's Equinor estimated that European energy companies might collectively need around €1.5 trillion to meet collateral requirements on their trading positions. This was an estimate of potential liquidity needs, not actual losses. The Bank for International Settlements later noted that the sharp rise in margin requirements put serious pressure on energy companies' finances.

Large energy companies may be able to secure bank loans or state guarantees. But when prices surge, many market participants need extra cash at the same time. Banks cannot expand lending indefinitely, and governments take on new liabilities before gas supplies have even been disrupted.

Trade credit insurance

There is another, less visible channel through which the crisis can spread. Allianz Trade, Atradius and Coface insure businesses against the risk that customers will not pay for goods delivered. When an industry's financial position deteriorates, insurers may reduce the amount of credit risk they are willing to cover.

That creates another problem for manufacturers. Gas is already more expensive, banks are more cautious about lending, and now the insurer may no longer cover the same volume of sales on deferred payment terms. Suppliers demand payment in advance, buyers have to find extra cash, and deals are delayed.

Currency and government bonds

Many international energy contracts are priced in US dollars. If the euro weakens, imported gas becomes even more expensive for European buyers. The size of the effect depends on the exchange rate, which is influenced by interest rates, investor behaviour and the state of the global economy.

Government borrowing can also become more expensive. If investors demand higher yields on sovereign bonds, governments have to borrow on less favourable terms, making it harder to fund energy subsidies and business support. Higher government bond yields can also feed through to bank lending rates, since banks' and companies' funding costs are often linked to conditions in the sovereign debt market.

Physical supplies may continue uninterrupted while a financial crisis is already taking shape. And the consequences extend beyond industry and finance. Even where governments keep gas flowing and homes heated, another question remains: will consumers be able to afford the energy they use?

13. Gas in the pipe, cold at home: the social cost of expensive energy

Gas is available, but can people afford it?

Under emergency gas-supply rules, households are priority consumers. But protection from disconnection does not protect them from high bills. How quickly wholesale price rises reach household budgets depends on tariffs, contracts and government compensation.

The energy system may remain technically sound while some people are forced to turn down the heating to levels that put their health at risk. Gas may still be in storage and pipelines, and power stations may continue operating, but that does not mean every European household can afford to keep warm.

Eurostat tracks the share of people who cannot afford to keep their homes adequately warm. The figure was 10.6% of the EU population in 2023, 9.2% in 2024 and 8.8% in 2025.

The situation has gradually improved since the 2022 energy crisis. But 8.8% still means that roughly one in eleven EU residents could not afford adequate heating.

For an older person living on a modest pension, an energy crisis looks very different from how it looks to a government or a gas company. Gas is flowing and the radiators are working, but the latest heating bill is too high. They may have to turn down the thermostat, close rooms they rarely use and spend most of the day in the warmest room.

The money saved goes towards food and medicines. As the flat cools, condensation can form on cold walls, creating conditions for damp and mould. For someone with a chronic condition, this kind of saving can have serious consequences.

In official statistics, everything can look fine: gas supplies have not been interrupted, there have been no accidents and consumption has fallen. But that reduction does not necessarily reflect greater energy efficiency. It may mean that someone can no longer afford the temperature they once took for granted in their own home.

Why cold homes are a health risk

The World Health Organization links low indoor temperatures to high blood pressure, respiratory and cardiovascular disease, and poorer mental health. Its guidance recommends a minimum indoor temperature of **18°C** for the general population during the cold season, while noting that older people, young children and those with chronic conditions may need warmer homes.

The problem goes beyond cold. High utility bills force households to cut back on food, medicines and other essentials. People living in poorly insulated homes are particularly vulnerable: they pay more for heating, yet their homes retain less of the heat.

The consequences are difficult to measure. Health is affected by age, chronic conditions, seasonal infections and many other factors. The social cost of an energy crisis cannot

therefore be assessed solely through illness or mortality statistics. It also matters how many people are forced to turn down the heating and cut back on everyday essentials.

In government offices, an energy crisis is measured in storage levels, gas prices and billions in public support. Officials decide on tariffs, subsidies and how much demand can be cut. Their offices will stay warm all winter. The question is how cold it will be in the homes of the people those decisions are meant to protect.

Conclusion: sixteen years on, the question has changed

Putin's 2010 remark in Berlin seemed to offer a simple answer: reject one source of energy and you risk running short of another. The reality in 2026 is more complicated. Europe has kept supplies flowing, built new terminals, rerouted energy flows and reduced consumption. Its dependence on pipeline routes has fallen, but it now relies more heavily on the global LNG market, maritime logistics and suppliers' ability to respond quickly when demand changes.

The next energy crisis could begin well beyond Europe's borders: with a cold snap in Asia, an outage at a US export terminal or a halt to shipping in the Middle East. A prolonged lull in wind generation in Europe could make matters worse. Prices rise first, forcing energy-intensive industries to cut output. The effects then spread to banks, public finances and households.

To protect household heating, gas use in industry can be cut. But every cubic metre saved this way comes at a cost: lost output, lower profits, closed plants and postponed investment. The longer the crisis lasts, the higher that cost becomes.

The central question for the winter of 2026–2027 is therefore not whether Europe will freeze. It is how many shocks it can absorb at once, and what economic and social price it will pay to keep energy flowing.

Europe has reduced its dependence on Russian pipeline gas, but it has not escaped dependence on external energy supplies. Its resilience now hinges on the global LNG market, maritime logistics and governments' ability to manage the consequences of a crisis.

For ordinary Europeans, the result of this complex equation will be measured in much simpler terms: the temperature in their homes and the size of their heating bills.

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Permanent link: https://sng.fm/36107-eu-energy-26-27.html

Sources and further reading

This section brings together the sources used in preparing the review. It is not an exhaustive bibliography or a formal reference list; it is a selection for readers who want to check the figures or explore particular questions in more detail.

Epigraph and historical context

1. **RBC**, 26 November 2010. “V. Putin suggested that Germans go to Siberia for firewood” (original Russian title: «В. Путин предложил немцам съездить за дровами в Сибирь»). Confirms the place, date and substance of the Berlin remark used in the epigraph. https://www.rbc.ru/economics/26/11/2010/5703e0c89a79473c0df176ae

2. **World Nuclear News**, 1 December 2010. Putin suggests Germans replace nuclear with firewood. An independent English-language account of the remark in the context of Germany’s energy policy. https://www.world-nuclear-news.org/Articles/Putin-suggests-Germans-replace-nuclear-with-firewo

Introduction and Section 1. Gas storage, the safety margin and the economics of injection

3. **Gas Infrastructure Europe (GIE)**: AGSI+ – Aggregated Gas Storage Inventory. Daily gas stocks, underground storage fill levels and country-level indicators for the EU. Basis for the figures as of 21 October 2026: EU, approximately 74.6% / 845 TWh; Germany, 61.1%; France, around 87%; Italy, around 90%; the Netherlands, around 65%. To reproduce the figures, select the historical gas day of 21 October 2026 rather than viewing current values. Operational data may be revised. https://agsi.gie.eu/

4. **ENTSOG**, 8 October 2026. Official announcement of the publication of the Winter Supply Outlook 2026/27 with Summer 2027 Overview. Assessment of the resilience of Europe’s gas infrastructure. The figure of 437 TWh relates to a scenario involving a cold winter, limited LNG supply and minimised Russian pipeline gas deliveries. It represents the combined need for demand reduction and potential unmet demand, not a forecast of a guaranteed shortage. The approximately 11% storage level at the end of winter also belongs to this scenario. Initial storage fill level: 72% as of 1 October 2026. https://www.entsog.eu/media/38034
The full ENTSOG outlook is also available here. This is the report file itself, rather than just the press release: https://www.entsog.eu/sites/default/files/2026-10/SO0072-26_Winter%20Supply%20Outlook%202026-27.pdf.

5. **Gas Infrastructure Europe**, 9 October 2026. Europe enters winter with historically low storage levels, reinforcing the need for LNG imports and storage flexibility. Explains ENTSOG’s stress estimates of 237–437 TWh, low end-of-winter storage levels, the importance of daily withdrawal capacity and the risk posed by late cold spells. https://www.gie.eu/press/europe-enters-winter-with-historically-low-storage-levels-reinforcing-the-need-for-lng-imports-and-storage-flexibility/

6. **European Commission**. Gas storage – Gas storage rules 2025–2027. The 90% target, the period for reaching it from 1 October to 1 December, and the applicable exemptions and flexibility provisions. https://energy.ec.europa.eu/topics/energy-security/gas-storage_en

7. **European Commission**, 8 October 2026. EU gas system prepared for the winter despite lower storage levels. Official assessment of the system's resilience, the role of LNG and the reduced safety margin. https://energy.ec.europa.eu/news/eu-gas-system-prepared-winter-despite-lower-storage-levels-2026-10-08_en

8. **Ekspert**, 7 October 2026. Ekaterina Chaban, "Europe's gas supply model has broken down" (original Russian title: «Схема обеспечения газом Европы дала сбой»); includes comments by Alexey Belogoryev, Research Director at the Institute of Energy and Finance. Supports the economic mechanism: the summer–winter price spread no longer reliably guarantees that gas injection and storage will be profitable. https://expert.ru/ru/tek/skhema-obespecheniya-gazom-evropy-dala-sboy

Section 2. Germany: gas, prices and industry

9. **Bundesnetzagentur**: Aktuelle Lage Gasversorgung. Weekly assessment of German gas supply. For the report covering 13–19 October 2026: around 17.4 TWh of pipeline imports, 1.6 TWh delivered through German LNG terminals and average terminal utilisation of 37.2%; also includes an assessment of supply disruption risks. The page is updated regularly, so the figures for 13–19 October should be checked against that week's report rather than the current page. https://www.bundesnetzagentur.de/DE/Gasversorgung/aktuelle_gasversorgung/start.html

10. **Bundesnetzagentur**: Current status of gas supply / Gas storage levels. Explanations of German gas stocks and target levels for 1 February (usually 30%, with different requirements for some facilities). https://www.bundesnetzagentur.de/EN/Areas/Energy/SecurityOfSupply/GasSupply/start.html

11. **Investing.com**, 20 October 2026 (ICE data). European natural gas prices top €90 per MWh for first time since 2022. Reports that the front-month TTF futures price exceeded €90/MWh intraday; this does not necessarily mean it closed above that level. https://www.investing.com/news/commodities-news/european-natural-gas-prices-top-90-per-mwh-for-first-time-since-2022-93CH-4959837

12. **Yara International**, 22 October 2026. Yara reports solid 3Q amid market volatility. Adjusted EBITDA for the third quarter of 2026 was $675 million, compared with $804 million a year earlier; the release describes the impact of high gas prices and adjustments to European production. https://www.yara.com/corporate-releases/yara-reports-solid-3q-amid-market-volatility/

13. **Yara International**: Third-quarter results 2026. Landing page for the full quarterly report and presentation, including regional operating indicators. https://www.yara.com/investor-relations/latest-quarterly-report/

Section 3. French nuclear power

14. **International Atomic Energy Agency (IAEA)**: Country Nuclear Power Profiles: France. 57 operating reactors, around 63 GW of capacity and a nuclear share of approximately 68% of electricity generation in 2025. https://cnpp.iaea.org/public/countries/FR/profile/highlights

15. **EDF**, 18 December 2025. Estimated nuclear generation in France. Forecast annual output from French nuclear power plants of 350–370 TWh in 2026 and 2027, and the effect of the maintenance programme. https://www.edf.fr/en/the-edf-group/dedicated-sections/journalists/all-press-releases/estimated-nuclear-generation-in-france

16. **World Nuclear Association**, updated 16 October 2026. France – World Nuclear Outlook Report. Further information on the French nuclear fleet, its reliability and generation constraints caused by low river levels and high water temperatures in 2026. https://world-nuclear.org/our-association/publications/world-nuclear-outlook-report/france---world-nuclear-outlook-report

17. **Rosatom State Corporation**, public reporting by its Electric Power Division for 2025. Russian nuclear power plants generated 218.349 billion kWh (approximately 218.3 TWh), compared in Section 3 with EDF's forecast for French nuclear generation. These are figures for Rosenergoatom, not the combined output of all foreign nuclear power plants in which Rosatom has an interest. https://www.report.rosatom.ru/rea

Sections 4–5. National markets, gas transmission and Gazprom

18. **ENTSOG** – European Gas Flow dashboard. Cross-border flows, transport corridors and Europe's gas transmission infrastructure, including the distinction between gas being available overall and being transportable along a particular route. https://gasdashboard.entsog.eu/

19. **UK Parliament** / Department for Energy Security and Net Zero, response dated 14 July 2026. Written question 16797. UK gas storage capacity of 1.7 bcm, equivalent to around seven days of average winter demand. https://questions-statements.parliament.uk/written-questions/detail/2026-07-07/16797

20. **Gas Infrastructure Europe** – Storage Database (2026 edition). Technical characteristics of individual underground gas storage facilities, including working volume and designed injection and withdrawal rates. https://www.gie.eu/transparency/databases/storage-database/

21. **Reuters**, 30 December 2025. Russia's pipeline gas exports to Europe fall by 44% to the lowest in decades. Calculations based on European transmission data: Gazprom supplied

148.4 bcm to Europe, excluding Turkey, in 2021 and around 18.0 bcm in 2025; TurkStream remained the only route for deliveries to Europe. https://www.reuters.com/business/energy/russias-pipeline-gas-exports-europe-fall-by-44-lowest-decades-2025-12-30/

Sections 6–8. The United States, Russian LNG, Asia, Hormuz and the global LNG market

22. **US Energy Information Administration**, 1 September 2026. U.S. LNG exports rose 23% in the first half of 2026 because of higher capacity. US LNG exports averaged 17.4 billion cubic feet per day in the first half of 2026; the forecast is 17.3 billion in the second half and 18.7 billion in the first half of 2027. These figures have been converted to million cubic metres per day in the review. https://www.eia.gov/todayinenergy/detail.php?id=68064

23. **US Department of Energy**, 20 January 2025. U.S. Department of Energy Reverses Biden LNG Pause. Documents the end of the administrative pause, introduced in 2024, on reviewing applications for new export authorisations. https://www.energy.gov/articles/us-department-energy-reverses-biden-lng-pause-restores-trump-energy-dominance-agenda

24. **Reuters**, 22 October 2026. Asia buys more LNG despite surging prices, El Niño clouds outlook. Kpler estimates: Asian LNG imports were expected to reach 23.31 million tonnes in October 2026, with China at 5.47 million and Japan at 4.47 million tonnes; also covers Asian prices and competition for LNG cargoes. https://www.reuters.com/commentary/reuters-open-interest/asia-buys-more-lng-despite-surging-prices-el-nino-clouds-outlook-2026-10-22/

25. **ACER**, 2026. Analysis of the European LNG market developments. In a scenario in which LNG transit through the Strait of Hormuz ceased completely throughout 2026, ACER estimated that global LNG supply would be 27 bcm below the 2025 level. This is not a figure 27 bcm below a scenario in which the strait remains open, nor is it a loss of 27 bcm for Europe alone. https://acer.europa.eu/monitoring/MMR/LNG_market_developments_2026

26. **Regulation (EU) 2026/261** of 26 January 2026 (Official Journal of the EU, 2 February 2026). On phasing out Russian natural gas imports. From 1 January 2027, the transition period ends for imports of Russian LNG under long-term contracts concluded before the specified cutoff date. Other types of contract have different deadlines. The regulation allows a limited emergency suspension of the ban if security of supply is threatened. https://eur-lex.europa.eu/legal-content/EN/LSU/?uri=CELEX:32026R0261 Full text: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32026R0261

27. **Council of the European Union**, 26 January 2026. Russian gas imports: Council gives final green light to a stepwise ban. Official summary of the timetable: LNG imports are phased out from the beginning of 2027, while pipeline gas imports are phased out later. https://www.consilium.europa.eu/en/press/press-releases/2026/01/26/russian-gas-imports-council-gives-final-greenlight-to-a-stepwise-ban/

28. **Institute of Energy and Finance (IEF)**, 21 October 2026. “Constrained gas: where will Russian LNG go after the ban on supplies to Europe?” (original Russian title: «Скованный газ: куда пойдёт российский СПГ после запрета на поставки в Европу»), an Alexey Belogoryev commentary for Forbes reproduced on the IEF website. Estimate: Russian supplies accounted for 10.4% of EU LNG imports in the third quarter of 2026, compared with 10.0% a year earlier. This is an expert estimate, not a Eurostat report. https://fief.ru/media/news/skovannyy-gaz-kuda-poydet-rossiyskiy-spg-posle-zapreta-na-postavki-v-evropu/

29. **Reuters**, 13 July 2026. EU imports record LNG volumes from Russia's biggest plant. In the first half of 2026, the EU received 9.97 million tonnes of LNG from Yamal LNG in 136 cargoes. This provides additional evidence of the project’s significant role in European supplies; the 9.97 million-tonne figure is not cited in the main text. https://www.reuters.com/business/energy/eu-imports-record-lng-volumes-russias-biggest-plant-2026-07-13/

30. **Reuters**, 25 December 2025. Russia's Gazprom supplied 38 bcm of gas to China via Power of Siberia pipeline in 2025. Gazprom’s reported actual exports to China via the Power of Siberia pipeline amounted to 38.8 bcm in 2025; a more precise figure of 38.84 bcm was published later. https://www.reuters.com/business/energy/russias-gazprom-supplied-38-bcm-gas-china-via-power-siberia-pipeline-2025-2025-12-25/

31. **Reuters**, 21 April 2026, based on Sakhalin Energy’s annual report. In 2025, Japanese buyers accounted for 58% of Sakhalin-2 LNG shipments and China for 23.9%; total exports were around 10.3 million tonnes. Russian-language republication: https://lenta.profinansy.ru/news/9253341

32. **HSE University**, Faculty of World Economy and International Affairs. “Global Business Monitor: Sectoral and Regional Trends. 2025 Annual Edition”, “Oil and Gas” section, p. 2. The authors expected substantial new LNG capacity in North America and, closer to the end of 2026, in the Middle East, which could smooth peaks in European demand. The review was a forecast prepared before the crisis in the Middle East. https://www.hse.ru/mirror/pubs/share/1134660873.pdf Edition page: https://wec.hse.ru/gbm/2025annual/

Section 9. El Niño, the polar vortex and weather-related logistics constraints

33. **NOAA Climate Prediction Center**, 8 October 2026. ENSO Diagnostic Discussion. Official assessment of a strong or very strong El Niño and a probability exceeding 83% for January–March 2027; describes the observed state of ENSO. This is a probabilistic seasonal outlook, not a forecast of a specific cold wave or a “Dunkelflaute”. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml

34. **NOAA**, 15 October 2026. El Niño looms large over U.S. Winter Outlook. Official US winter outlook: an increased likelihood of warmer weather in the north and wetter

conditions in the south. It is relevant to storm risks but does not prove that export terminals will inevitably shut down. https://www.noaa.gov/news-release/el-nino-looms-large-over-us-winter-outlook

35. **Ke Ma, Quanliang Chen, Xin Zhou, Yingying Zhong**, 4 September 2026. The influence of stratospheric polar vortex shifts on winter temperatures in China: Role of the North Atlantic Oscillation. Atmospheric Research, article 109313; DOI: 10.1016/j.atmosres.2026.109313. Research on the statistical relationship between shifts of the stratospheric polar vortex into the Asian sector, winter temperature anomalies in China and the role of atmospheric waves. The study does not predict that this configuration will necessarily occur in winter 2026–2027. https://doi.org/10.1016/j.atmosres.2026.109313

36. **Panama Canal Authority**, August 2026. Panama Canal Adopts Additional Measures to Address Reduced Precipitation in the Canal Watershed. Announcement of limits on daily transit slots due to insufficient rainfall. https://pancanal.com/en/panama-canal-adopts-additional-measures-to-address-reduced-precipitation-in-the-canal-watershed/

37. **ICIS**, 21 August 2026. Panama Canal cutting daily transit slots in September amid strengthening El Niño. The figures cited in Section 9: a reduction in permitted transits from 38 to 34 and then to 32 per day. https://www.icis.com/explore/resources/news/2026/08/21/11230088/panama-canal-cutting-daily-transit-slots-in-september-amid-strengthening-el-nino/

38. **Ma Y. et al.**, 22 November 2025. Severe 2023/2024 Winter Subseasonal Weather Extremes Over Eastern China: Two Pathways of ENSO Impacts. Geophysical Research Letters, DOI 10.1029/2025GL119268. Scientific basis for the example involving Rossby wave trains from the North Atlantic, a strengthening Siberian High, cold weather and freezing rain in eastern China. The results describe winter 2023–2024; they do not forecast winter 2026–2027. https://doi.org/10.1029/2025GL119268

39. **NOAA Climate Prediction Center**, 15 October 2026. Prognostic Discussion for Long-Lead Seasonal Outlooks. Official assessment of temperature and precipitation anomalies for winter 2026–2027; supplements NOAA's general outlook. https://www.cpc.ncep.noaa.gov/products/predictions/90day/fxus05.html

Section 11. Public budgets in Germany and France

40. **Eurostat**, 21 October 2026. Government debt at 88.8% of GDP in euro area – second quarter of 2026. France's public debt was 119.1% of GDP and Germany's 63.4% of GDP at the end of the second quarter of 2026 (rounded to "around 63%" in the review). https://ec.europa.eu/eurostat/web/products-euro-indicators/w/2-21102026-bp

41. **Deutscher Bundestag**, 18 March 2025. Mehrheit für Reform der Schuldenbremse [Majority backs reform of the debt brake]. Changes to Germany's debt brake, the exemption of some defence spending and a special infrastructure fund of up to €500

billion. https://www.bundestag.de/dokumente/textarchiv/2025/kw12-de-sondersitzung-1056916

42. **Deutscher Bundestag**, 21 October 2022. 200 Milliarden Euro Abwehrschirm gegen gestiegene Gas- und Strompreise beschlossen [€200 billion protective shield against rising gas and electricity prices approved]. Historical context for a stabilisation mechanism with a ceiling of up to €200 billion; the ceiling is not the same as actual spending. https://www.bundestag.de/dokumente/textarchiv/2022/kw42-de-stabilisierungsfond-915612

43. **German Federal Ministry of Finance**, 22 December 2022. Einstieg des Bundes bei Energieversorger Uniper SE vollzogen [The federal government's investment in energy supplier Uniper SE completed]. Confirms Uniper's financial stabilisation and the role of the WSF state fund. https://www.bundesfinanzministerium.de/Content/DE/Pressemitteilungen/Finanzpolitik/2022/12/2022-12-22-einstieg-bund-bei-uniper-vollzogen.html

44. **INSEE**, 27 March 2026. In 2025, the public deficit stands at 5.1% of GDP. France's general government deficit in 2025 was 5.1% of GDP. https://www.insee.fr/en/statistiques/8961174

45. **Reuters**, 21 October 2026. French 10-year bond yields hit 5%, highest since 2002. The yield on French 10-year government bonds reached 5% during trading. https://www.reuters.com/world/europe/french-10-year-bond-yields-hit-5-highest-since-2002-2026-10-21/ Available Reuters republication: https://ca.investing.com/news/economy-news/french-10year-bond-yields-hit-5-highest-since-2002-4892758

Section 12. A financial crisis without a physical shortage

46. **Reuters / Euronews**, 6 September 2022. Europe power firms need 1.5 trillion euros in margin calls, Equinor says. Equinor's public estimate of around €1.5 trillion in potential collateral requirements for trading positions; this was not an estimate of actual losses by energy companies. https://www.euronews.com/2022/09/06/ukraine-crisis-gas-equinor

47. **Bank for International Settlements**, 13 September 2023. Margins and liquidity in European energy markets in 2022, BIS Bulletin No. 77. Explains changes in margin requirements and the resulting liquidity pressure on energy companies. https://www.bis.org/publications/bulletin-77-margins-and-liquidity-european-energy-markets-2022

48. **Allianz Trade / Atradius / Coface**. Company websites used as background sources on trade credit insurance and the risk of non-payment. https://www.allianz-trade.com/ https://group.atradius.com/https://www.coface.com/

Section 13. Energy poverty and health

49. **European Commission / Eurostat**. Energy poverty. Share of EU residents unable to keep their homes adequately warm: 10.6% in 2023, 9.2% in 2024 and 8.8% in 2025. https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumers-and-prosumers/energy-poverty_en

50. **Eurostat** – table `ilc_mdes01`. Inability to keep home adequately warm. The primary dataset for this indicator. https://ec.europa.eu/eurostat/databrowser/view/ilc_mdes01/default/table

51. **World Health Organization (WHO)**, 2018. WHO Housing and health guidelines. Recommendations on adequate indoor temperatures, the health risks associated with cold, and the particular vulnerability of older people, children and people with chronic conditions. https://www.who.int/publications/i/item/9789241550376

52. **WHO Housing and Health Guidelines**, Chapter 4 – Low indoor temperatures and insulation. Exact wording of the 18°C benchmark for the general population during the cold season, and the qualification that vulnerable groups may require higher temperatures. https://www.ncbi.nlm.nih.gov/books/NBK535294/