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The European Energy Security in the spotlight

TOP CATEGORIES

Contents

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I welcome you to the new HAEE edition "In Focus". Each edition will focus on specific thematic areas of interest in the energy economics sector. I am also very pleased to have on board HAEE members, which will provide valuable input and expertise for each focused topic.

> This edition focuses on energy security and the implications of the Russia-Ukraine war in Europe.

As Heraclitus quoted "change is the only constant in life" and without doubt, this is a time of great and unprecedented changes. Ending EU's energy dependency on Russia is a challenging, time-consuming procedure, which requires strategic planning and a joint attempt to diversify its energy sources. The Russian invasion of Ukraine has further disrupted the energy markets, causing sharp hikes in energy prices and increasing the risk of shortages of imported gas. The immediate response of the Commission proposing the REPowerEU plan, creates a lot of challenges which will require strong political commitment. The resilience of the EU system passes through diversified gas imports, increased RES, larger volumes of renewable gases, and energy efficiency. Energy poverty should be a part of the equation in this hard-to-solve problem and short-term options are necessary to provide relief to citizens and businesses.

In these dark days, there is great potential and several opportunities for Greece to overcome the energy crisis. The initiation of the construction of the FSRU project in Alexandroupolis, the expansion of the storage capacity of the Revithoussa LNG terminal with the additional floating tank, the further utilization of the TAP, and the new planned projects such as the IGB, East-Med, and hydrocarbons exploitation, will transform Greece into an energy hub and a Europe gateway for non-Russian gas.

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Preamble

In 2021 and prior to Russia's invasion to Ukraine, global economies had already started to recover from the economic recession caused by the pandemic COVID-19. In the EU, significant economic growth was recorded with several countries' GDP reaching almost pre-pandemic levels such as Greece. Macroeconomic variables such as inflation and unemployment were seen to improve and expected to reach normalised levels, while emergency and fiscal support measures taken for tackling the socio-economic impacts of the pandemic would gradually be withdrawn. However, limited supplies associated with the pandemic and rapid growth, resulted in higher energy prices with accelerating inflation rates especially towards the end of 2021 and the beginning of 2022. Currently (as of May 2022), with the Russia - Ukraine war in progress, additional strains are placed upon the EU and consequently the world's economies.

The Russian aggression against Ukraine resulted in great geopolitical tension in the European continent and imposed a great threat to energy security in Europe. The EU's over-reliance on energy imports from Russia led up to the Commission's release of the REPowerEU Plan in March 2022, a joint European action for more affordable, secure and sustainable energy. The Plan is mainly focused on the diversification of gas supplies, through higher LNG and pipeline imports from non-Russian providers, and the acceleration of its transition to renewables – especially with the use of biomethane and green hydrogen. Additionally, the REPowerEU foresees an integrated EU energy system based on renewables, with the implementation of energy efficiency measures and higher electrification, so as for the EU to move towards its energy transition into a zero-carbon economy.

> With these developments into consideration, this study focuses on Natural Gas, the EU's dependence on this type of fuel and its response to the impacts of the Russia – Ukraine crisis in terms of energy security.

More specifically, this report adumbrates initially the reasons that led to the EU's dependency on Russian natural gas and the current situation of the European energy sector after Russia's invasion to Ukraine, presenting data on the EU pipeline gas imports, LNG imports, EU gas production and consumption, the EU's underground storage facilities and the unprecedented energy prices.

Ending the EU's energy dependency on Russia is a time-consuming procedure, which requires strategic planning, joint attempts to diversify its energy sources, the identification of its opportunities to ramp up its assets in the energy sector, and the confrontation of its bottlenecks. Under this notion, this report examines the possible challenges and limitations that the REPowerEU plan may entail and the possible opportunities for Greece to overcome the energy crisis.

A strong interdependence: Energy relations between Europe and Russia

Reducing Europe's dependence on Russian gas has been on the table for almost 15 years. Despite the warning signs from the January 2009 crisis that led to the disruption of Russian gas inflows to Europe through Ukraine for two weeks and Russia's seizure of Crimea in 2014, Europe did not reduce natural gas imports from Russia. On the contrary, pipeline gas deliveries increased and imports of Russian gas from the Yamal pipeline started after 2017.

> Russia is one of the world's top gas and oil producers and has production facilities throughout the country. In 2021, it exported an estimated 4.7 million bpd of crude to countries around the world, making up 14% of the world's total supply and putting Russia among the top three crude producers globally (IEA 2022).

Why Europe is historically dependent on Russian gas?

1. Europe's gas demand has remained at high levels, especially over the past five years and Europe's natural gas production has declined rapidly since 2010. In the 2000s, gas production in Europe could satisfy 50% to 60% of its demand with the largest producers being the Netherlands, Norway, and the UK. However, due to the decline of natural gas production in the UK and earthquakes related to gas production in the Netherlands, overall production in Europe has declined sharply in the last years.
2. LNG prices have always been typically higher than Natural Gas as LNG has a more involved production (liquefaction and regasification) and transportation process and LNG infrastructure is not available in each EU country due to physical bottlenecks/ existing infrastructure.
3. The EU relied on Russian gas as a 'transition' fuel in order to reduce greenhouse gas emissions and become climate neutral with plans to phase out nuclear power in several European countries and reduce overall coal consumption.

Key facts for Natural Gas

- Russia is the world's second-largest natural gas producer, having the world's largest gas reserves
- Russia produced 762 bcm of natural gas in 2021 and exported approximately 210 bcm via pipeline, making it the world's largest gas exporter. (IEA 2022)
- Russia is the world's 4th largest LNG exporter, accounting for approximately 8% of the global LNG supply. (IEA 2022)
- The EU is the largest importer of natural gas in the world. Its own natural gas production declined by 7% from 2020 to 2021 and reached 50.6bcm. (Quarterly Report on European gas markets Vol.14 (2021), EC)
- In 2021, the EU's natural gas consumption amounted to 412bcm, up by 17 bcm compared to 2020, and reaching its peak since 2011 (GIE, ENTSOG, HAEE 2022)
- Natural gas net pipeline imports and LNG imports in EU accounted for 337.5bcm and 80bcm respectively. Of the total European gas demand, 41% is imported from Russian pipelines, proving the EU Member States' significant trade and investment exposure to Russian markets.
- In 2021, the EU imported 155 bcm of gas from Russia, 79.3 bcm from Norway, 35.9 bcm from Algeria, 6.75 bcm from TAP and 3.38 bcm from Libya (ENTSOG 2022).
- The largest LNG supplier to the EU were the United States followed by Qatar and Nigeria, at around 22.3 bcm, 16.3 bcm and 11.2 bcm respectively.
- Compared to the 2017-2021 EU average storage, in 2022 the filling rate was lower by 12 percentage points, while in Q1 of 2022 the European Gas stocks were 26.3% and met their lowest price in the 5-year average.

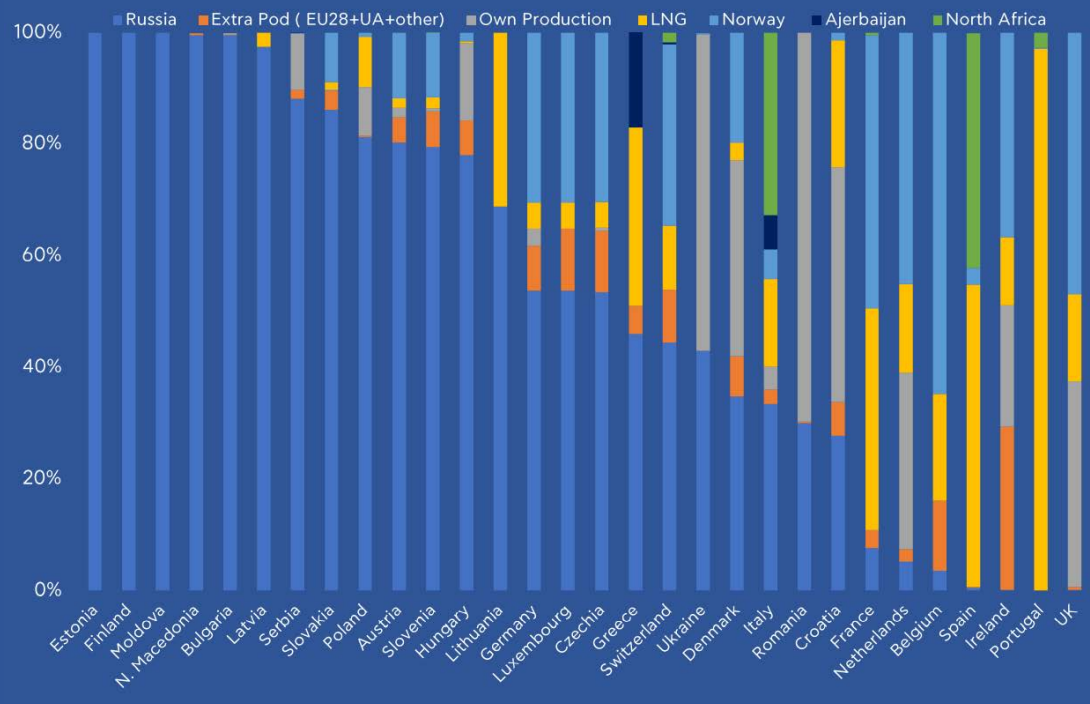
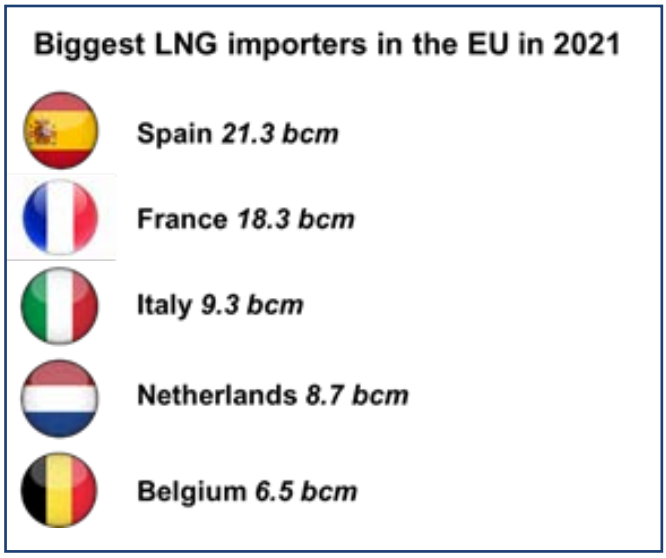


Figure 1 Gas Supply by country of origin in EU27, ACER, DESFA, Bruegel, HAEE analysis



Many European countries are heavily reliant on fossil fuel energy and face the high risk of price socks or even supply shortages, while at least 19 EU countries are highly dependent on Russian gas and face the risk of the latter or even being completely cut off. Eastern European Countries rely almost exclusively on Russian Gas. On the other hand, Russian gas had the lowest share in the total imports in France, the Netherlands and Belgium. Spain, Portugal and the UK are almost independent as they import very small amounts of Russian gas (ACER, DESFA, Bruegel, HAEE 2022). However, despite the level of dependency from third countries and given the strong economic and energy ties within the EU, the energy crisis has a domino effect and affect both directly and indirectly- the European energy market in total.

In the light of the Russian invasion of Ukraine, there was a swift in EU interest in non Russian gas pipeline sources. These were from Norway, Algeria, Libya and Azerbaijan. More specifically, pipelines from Norway are running in full capacity and reach approximately 390MMcm/d, while the ones from Azerbaijan via TAP, are running in full capacity of 27-29MMcm/d. Imports from North Africa to Mediterranean countries – Italy and Spain reached 37.7 bcm in 2021 (The Oxford Institute for Energy Studies, HAEE 2022).

LNG imports reached 80 bcm in the EU in 2021 and accounted for 23% of the total NG imports. The average utilization rate of EU LNG terminals increased from around 40 to 60% in Q1 2022 compared to Q1 2021, due to high NG prices and diversification of natural gas sources in the view of the Russian invasion of Ukraine. Spain is the country with the most LNG terminals in the EU (60bcm/yr.), having at the same time limited pipeline interconnection capacity with the rest of the EU (7 bcm/yr. with France). However, the annual regasification capacity of LNG, after taking into consideration the 19 future LNG Terminals, is expected to increase by 17bcm/yr (according to the construction-expansion plan) and by an additional 105bcm/yr (as planned) until 2030 (ENTSOG, HAEE 2022)

Figure 2 LNG & pipe imports, storage and cross-border Transmission Capacity, GIE, ENTSOG, HAEE analysis

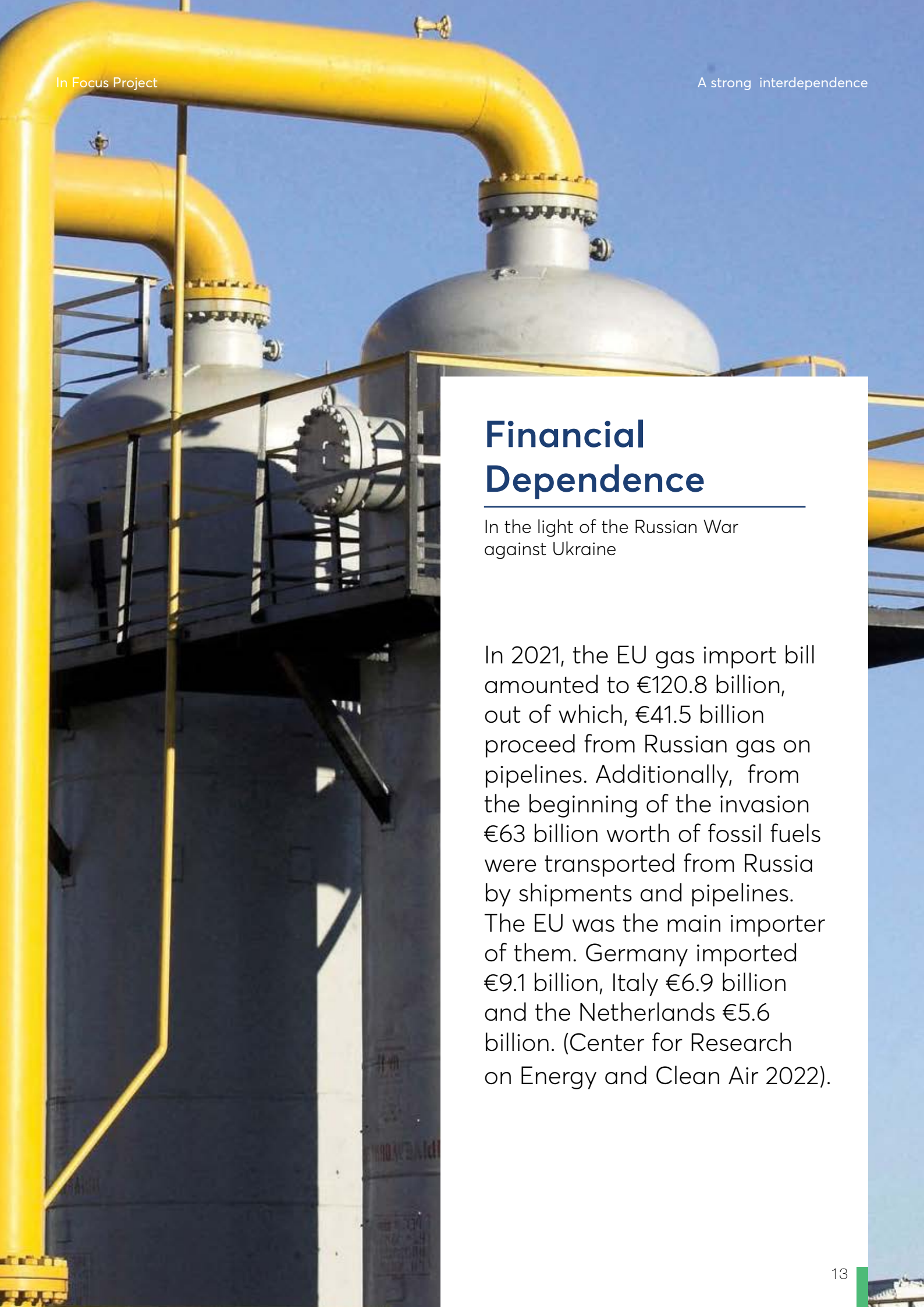
During the last quarter of 2021, the TTF spot price fluctuated from 60 €/MWh in October, to 183 €/MWh in December.The volatility of the European wholeshale gas prices continued in 2022 and the daily average price reached 200 €/MWh in March. Carbon prices followed the inflationary pressure and rose to 88 €/tCO2e and 96 €/tCO2e in December 2021 and February 2022 respectively. The unprecedented wholesale gas prices resulted in soaring wholesale electricity prices and increased bills for European citizens, households, and industries.

Average retail gas prices in the EU increased from €7.0 per 100 kWh in 2020 to €7.8 per 100 kWh by the end of 2021, while in February 2022 the prices went up by an estimated 65% year-on-year. According to Eurostat, the highest rise in household gas prices was noted in Bulgaria (+103%) followed by Greece (+96%) and Estonia (+83%), while the lowest ones were observed in Hungary (€3.1 per 100 kWh), Croatia (€4.0) and Lithuania (€4.1). The average household electricity prices followed the sharp increase and reached €23.7 per 100 kWh. Estonia (+50%), Sweden (+49%) and Cyprus (+36%) witnessed the highest increase. On the contrary, only Slovakia (-6%) and Hungary (-0.1%) faced decreases in electricity prices (European electricity and gas markets Vol.14, EUROSTAT 2022).

With regards to the indigenous gas production in the EU, the Dutch Ministry of Economy and Energy in January 2022 announced an increase of 95% of the Groningen production for 2021-2022 in order for the country to secure its supplies. This decision will lead to a potential addition of 3.7 bcm to the European supply. The UK production has already surpassed the lost ground and returned to its usual performance, while the maintenance of the offshore platform in Tyra,Denmark, which is an important source of the European production (~2bcm) is expected to be completed by 2030 (European gas markets Vol.14, EUROSTAT 2022).

It is evident, that a possible curtailment of Russian gas supply will affect a lot of EU countries and there will be a supply-demand deficit. The physical bottlenecks of the current NG network will complex the actions to diversify NG sources. High LNG volumes have to be secured in the existing facilities, with a current utilization rate between 30 - 70% and the possibility of new projects should be examined. The costs for filling up storage are currently high due to high Natural Gas prices. Based on an estimation by the Bruegel institute, injecting around 700 TWh into EU storage ahead of next winter will be a costly exercise. At current prices, this would cost at least €70 billion, compared to €12 billion for the period 2012-2021.

> The high dependence on Russian gas, the currently high NG prices, and the low NG storage levels combined with physical bottlenecks and long-term contracts, are creating a difficult-to-solve equation. There is a need for political commitment and immediate actions to reduce the consequences to end users and ensure a sufficient gas supply.



Financial Dependence

In the light of the Russian War against Ukraine

In 2021, the EU gas import bill amounted to €120.8 billion, out of which, €41.5 billion proceed from Russian gas on pipelines. Additionally, from the beginning of the invasion €63 billion worth of fossil fuels were transported from Russia by shipments and pipelines. The EU was the main importer of them. Germany imported €9.1 billion, Italy €6.9 billion and the Netherlands €5.6 billion. (Center for Research on Energy and Clean Air 2022).

The economic impact and possible risks of the Russia-Ukraine war on the EU

The severity of the economic impact of the Russia – Ukraine conflict is still uncertain. It depends on a great number of factors such as the duration of the war and how countries will respond in terms of policy making, although the negative effects on global growth are already evident. According to the OECD (Economic Outlook, Interim Report; 2022), model simulations based on the assumption that the commodity and financial shocks observed in the first two weeks of the conflict persist for at least one year, indicate that global consumer price inflation could be raised by up to 2,5% and global GDP growth could be reduced by over 1%.

Across regions the impact of the war may differ especially in terms of proximity. The impact will be harsher on European economies especially for those neighboring Russia or Ukraine and to less extend on other regions such as Asia and the Americas. The extend of impact may be determined by the strength of business and energy relations between a country and the ones in conflict. Accordingly, there will be a greater effect on the gas prices in Europe and less in the rest of the world, however growth will still be affected by global demand as well as household incomes from higher prices.

A major economic risk, and the most worrying one, would be that energy exports from Russia to the EU would cease. In this case and taking into account that supplies from the rest of the world market would not be sufficient to fill in the gap, the impact would be a great blow for global economy. So far gas prices have increased exponentially, and should they continue to soar or even remain at these levels, the OECD predicts that an additional 1,25% would be added to Europe's inflation (3,5% in total) and that European growth will be reduced by over 0,5%.

Even if the worst-case scenario is that energy exports from Russia to the EU cease, still a considerable decline in imported energy inputs would have a great impact on European economies as well.

According to the OECD, if imported energy inputs (fossil fuels, refined fuel products, electricity and gas) were reduced illustratively by 20%, European economies would see a reduction in gross output by over 1% with the greatest shock shown on domestic energy-producing sectors, air transport and chemical and metal manufacturing.

Before Russia's invasion of Ukraine, most advanced economies were to gradually withdraw the emergency fiscal support measures taken for tackling the impacts of the pandemic and tighten their fiscal stance. However, these measures are now being reconsidered due to the impact of the conflict as additional fiscal pressures are being created. While the initial spending priorities are towards the support of the refugees in Europe, others include the alleviation of the effects of the commodity and food price shocks on households and companies through short-term and targeted policies.

On the other hand, for developing countries and emerging-market economies, the fiscal stance is different as they have the challenge of balancing income support, debt sustainability, and investor confidence.

For lower-income countries and households who spent the highest share of their incomes on energy and food, some governments have already introduced measures to mitigate the effects of the vast energy increases. These measures included income support and lower electricity tariffs to low-income households, taxes reduced or cuts on electricity and gas for domestic vulnerable businesses and consumers, excise tax reductions on liquid fuels, energy price freezes or price controls and compensations to distributors for supplying energy products at reduced prices.

Despite the overall reduction in gas demand and that the EU power sector switched partly from gas to coal as an alternative to mitigate the high gas prices, this has only contributed very little since gas-fired generation actually increased by 4TWh in Q1 2022 compared to 2021 due to lower nuclear and hydro production.

Cutting the Cord: EU's response to the energy crisis

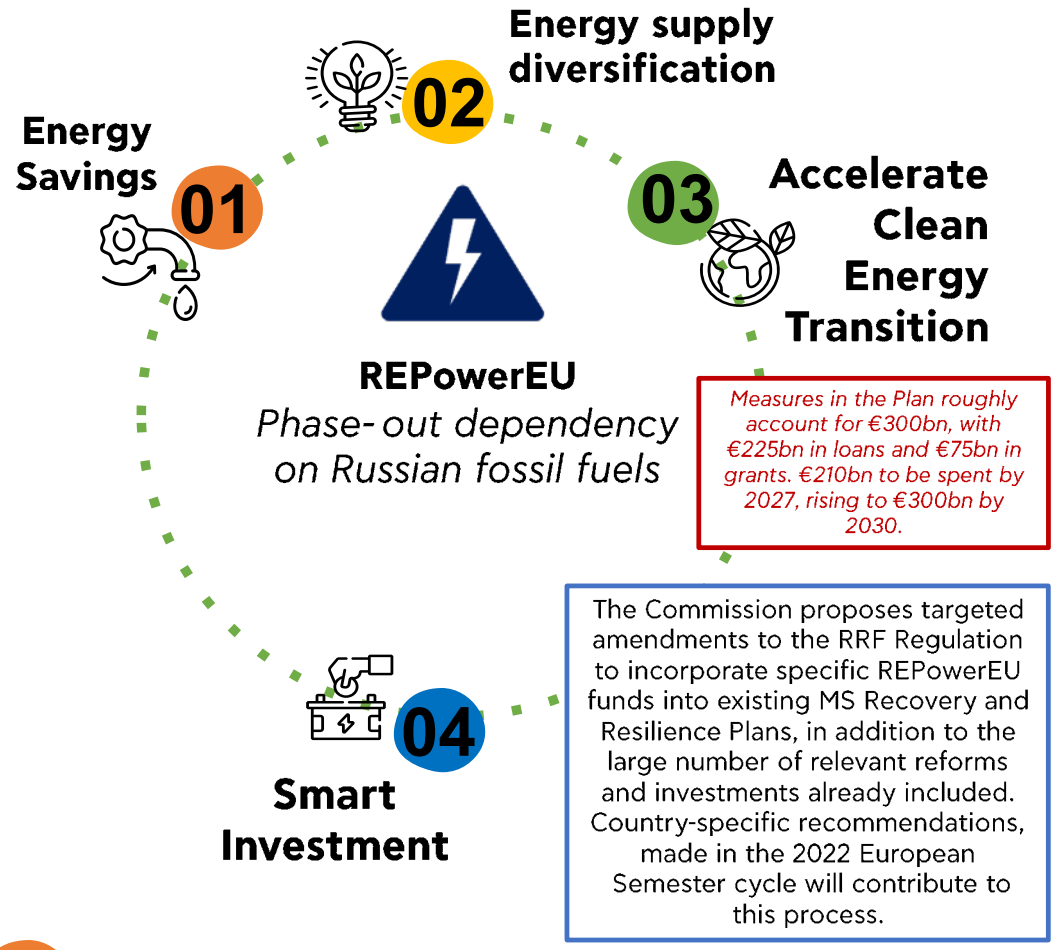
Over the course of time, the European Union has witnessed a growing energy demand and an insufficient domestic production of gas, which led to an indispensable need for measures to be taken in order to secure its gas supply. In 2017, the Security of Supply Regulation ((EU) 2017/1938), established a common framework where the security of supply is considered a shared responsibility between natural gas undertakings, the EU countries, and the European Commission. One of its scopes was to ensure the EU's emergency preparedness and resilience to any potential gas disruptions. This included an early warning system to identify future complications, and the formation of a standing advisory group – the Gas Coordination Group, comprised of experts from the Commission, the EU countries' authorities and leading stakeholders – to assess and consult on the security of supply issues. (European Commission, In focus: Reducing the EU's dependence on imported fossil fuels 2022).

Indeed, and under the scope of the Russia – Ukraine war, Europe found itself at the heart of an international energy crisis and witnessed gas disruptions and unprecedented increase of natural gas and electricity prices that have serious repercussions for governments, businesses, and households and cause potentially significant economic impacts.

The REPowerEU Plan

> The full implementation of the Fit-for-55 targeted actions aspires the reduction of gas consumption by 30% (=100bcm), by 2030. These proposals combined with additional gas diversification measures, increased rates of renewables gases, frontloaded energy savings and electrification, could jointly reach and deliver at least the equivalent of the 155 bcm imports of Russian gas.

In May 2022, the European Commission proposed the 'REPowerEU: a Joint European action for more affordable, secure, and sustainable energy, to make Europe independent from Russian fossil fuels and to initiate the diversification of its sources.
The REPowerEU focuses on the elimination of Europe's dependence on Russian supplies before 2030 and is based, firstly, on diversification of energy sources by increasing of LNG imports and pipeline imports from non-Russian suppliers. Doubling the production of biomethane per year by 2030, especially in the agricultural waste and residues sectors, is considered a second step of the EU's strategy. Further replacement of Russian gas will be accelerated by the establishment of a water-tight regulatory framework to promote hydrogen uptake, to support the development of an integrated gas and hydrogen infrastructure, storage facilities and ports. The development and initiation of more solar and wind energy projects, together with the utilization of heat pumps and the simplification of permitting renewables procedures will further reduce EU's dependence on fossil fuels.



01

"The EU has been working intensively with international partners for several months to diversify supplies8 and mitigate the rise in energy prices"

- *Development of EU Energy Platform for the voluntary common purchase of pipeline fossil gas, LNG, and hydrogen. The Platform will also be available for Energy Community Members, such as Western Balkans, Ukraine, Moldova, and Georgia.*
- *Obligation to fill gas storages to 80% by November 2022 of every year.*
- *Creation of an IT tool to improve the transparency in infrastructure bookings – remaining availability, secondary markets, rerouting, and existing bottlenecks.*

02

"Savings are the quickest and cheapest way to address the current energy crisis"

- *Increase of the binding Energy Efficiency Directive (EED) target from 9%, to 13% .*
- *Implementation of the EU Save Energy Communication, which was released on May 18.*
- *Guidance on 2024 National Energy and Climate Plans (NECPs) to increase the Energy Efficiency target.*
- *Development of the Playing my part Plan in cooperation with the International Energy Agency (IEA) to affect consumers' behavior regarding energy demands.*

03

"A massive speed-up and scale-up in renewable energy in power generation, industry, buildings and transport will accelerate our phasing out of Russian fossil fuels"

- *Increase the target in the Renewable Energy Directive (RED) to 45% by 2030.*
- *Set the target of 320 GW by 2025 and 600 GW of newly installed solar PV capacity installed by 2030.*
- *Double the number of heat pumps in use to 10 million over the next 5 years.*
- *Target 10 million tn of renewable hydrogen production in the EU and the same quantity of imports by 2030.*
- *Implementation of 35 bcm of biomethane production by 2030.*
- *Release of Biomethane Action Plan on the 18th of May.*

Ensuring sufficient gas storage

Given the fact that Kremlin cuts off gas supplies to some nations- as it did to Poland and Bulgaria- if payment for gas sales is not received in rubles, and combined with the insufficient European gas storage, the EU has to build up its strategy for diversifying its sources for next winter.

The Commission sets out a legislative proposal to ensure a level of 90% storage capacity - by October 1st of each year and a mechanism to ensure a fair allocation of security of supply costs. The proposal will act supplementary to the existing Gas Security Supply Regulation, which obliges the Member States to conclude solidarity agreements and to ensure the refilling of storage.

The EU Member-States committed that until November 2022, 54.3 bcm will be net added to underground gas storage facilities to meet the target of 80%, to ensure EU's energy security. Germany, Italy, Netherlands, and France should inject 35.5 bcm cumulatively, since they have the biggest underground storage capacity. European underground storage capacity is approximately 101 bcm, out of which 14.51 bcm is owned by Gazprom Germania in Europe. Its fullness rate (at 11-27% so far) remained at very low levels. It is evident that Europe needs to seek for alternative gas suppliers, other than Russia (mainly LNG cargoes) to fill up its underground facilities (GIE, HAEE 2022).

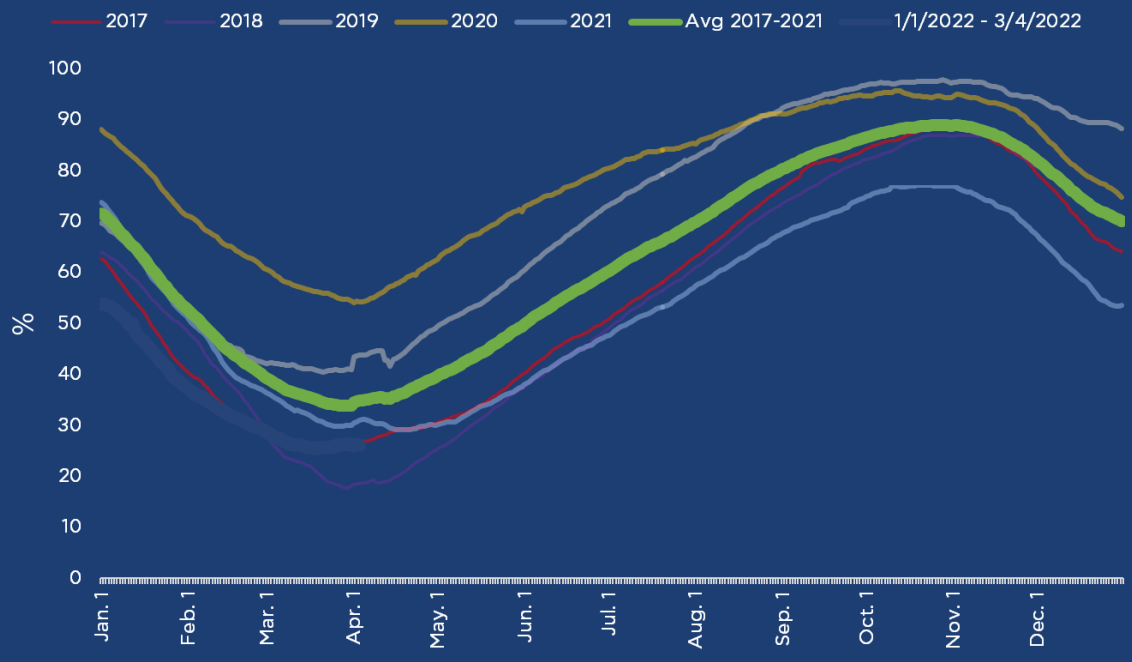


Figure 3 Underground Gas Storage Levels in EU-27 (2017-today), GIE, HAEE analysis

Accelerating the European Green Deal

Following the EU's commitments to the goals of the Paris Agreement, and under the spectrum of the Renewable Energy and Energy Efficiency Directives (RED and EED), the Commission targets a 55% reduction in greenhouse gas emissions by 2030 and the assurance of the EU's energy security. The RePowerEU highlights the EU's potential for a quicker transition into a renewable-based energy market, by scaling up wind and solar power. By the end of May 2022, the European Solar Rooftops Initiative is expected to be realized by the Commission so as to utilise the benefits and the opportunities of rooftop solar energy. Biofuels, mainly biomethane, which has the potential to provide an additional 18bcm by 2030, and blue/green hydrogen, with the potential to reach 10 bcm by 2030 and an additional 10 bcm through imports, can be seen as alternative supply sources.
The need for further investments in infrastructure, especially in cross-border interconnections, the lack of storage facilities, and other bottlenecks that follow the rollout of renewable energy technologies need to be addressed by the European Commission. The Commission will publish in May a Strategy/ Recommendation Plan for facilitating the uptake of renewable energy projects and removing any obstacles.

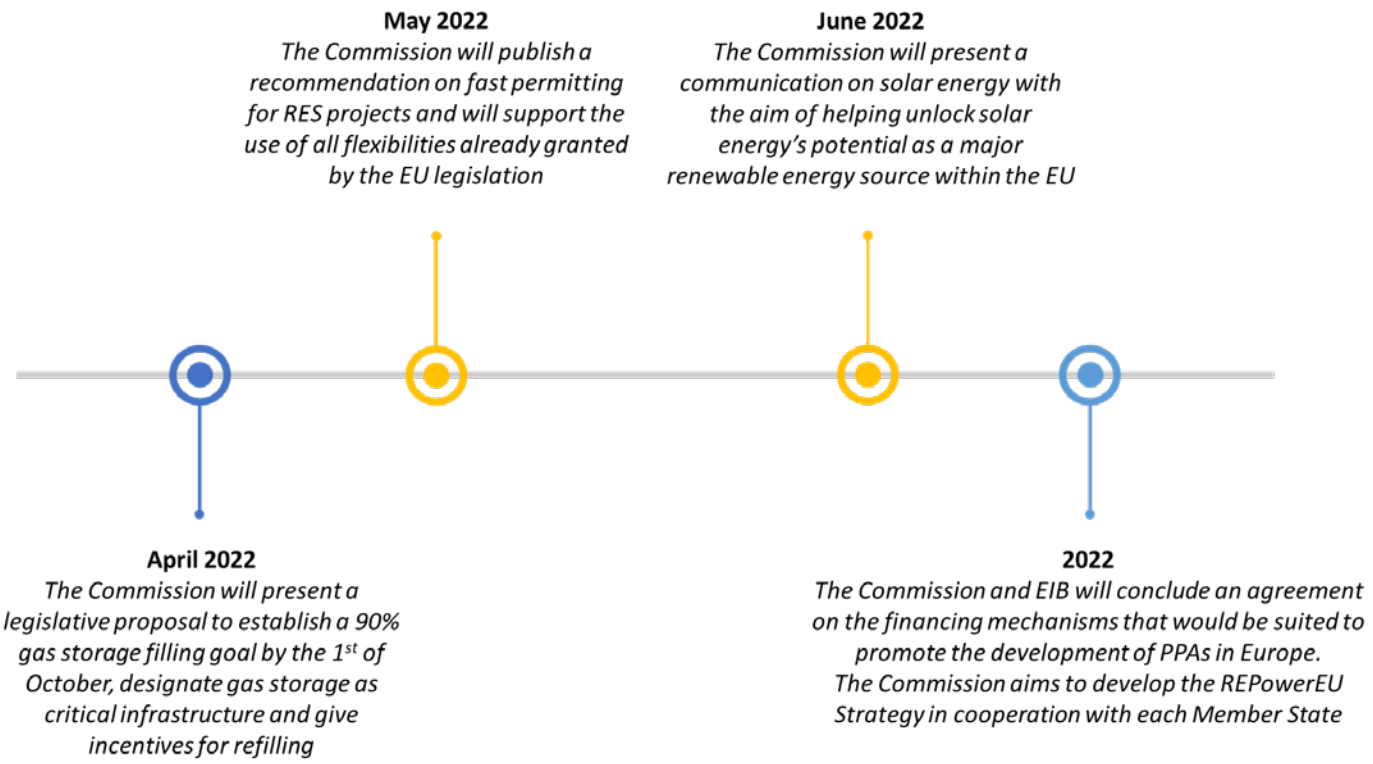


Figure 5 EU's upcoming legislative packages, European Commission

The European Union announced further steps in broadening the sweeping sanctions against Russia in May 2022, by proposing a gradual ban on Russian oil, excluding Russia's biggest bank from the international network and banning three state-owned Russian broadcasters.

The EU's sanctions to Russia

Apart from the EU's Strategy to secure the resilience and security of the EU-wide energy system and in response to the Russian military attack against Ukraine, the European Union is responding by adopting a comprehensive and robust package of restrictive sanctions designed to restrict Russia's ability to finance the war, impose clear economic and political costs on the country, and diminish its economic base. There are sanctions that target Russia's financial and energy sector, transportation and dual-use good and advanced technology items. There are also measures that impose export and import bans, visa sanctions against individuals and entities, and provisions for excluding Russia from public contracts and European money.

In the energy sector, the EU prohibited the sale, supply, transfer or export to Russia of specific goods and technologies in oil refining; and introduced restrictions on the provision of related services. With the introduction of energy-related sanctions, the EU intends to hit the Russian monopoly in the gas sector and also the oil sector and make it impossible for Russia to upgrade its oil refineries. Additionally, the Commission imposed an import ban on all forms of Russian coal.

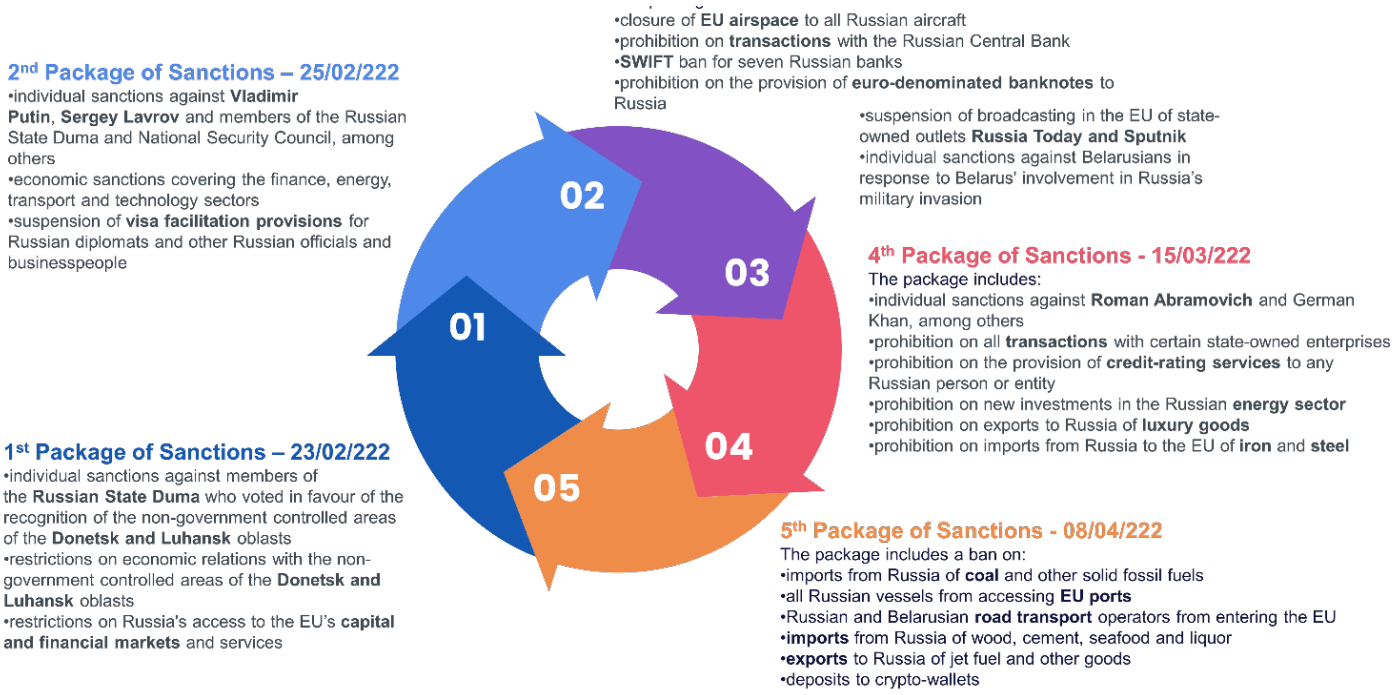


Figure 4 EU sanction packages against Russian Federation, European Commission

EU's Plan: Ambitious or unrealistic? The challenges ahead

So far, Europe is scrambling to get additional supplies of LNG by ship and therefore imports have not made up for the gas losses by pipeline. Imports from North Africa (Algeria and Libya) have diminished and gas supplies from Azerbaijan remain modest. Additionally, LNG is much more expensive as it involves the liquefaction and regasification processes, high transportation costs and since its production is limited, consignments go to the highest bidder. Moreover, existent, under construction and planned infrastructure involve connection to LNG terminals only for some coastal countries but landlocked countries cannot be supplied with LNG as their infrastructure (such as LNG storage facilities), are nonexistent. For example, Germany, which is the largest gas market, does not have any access to LNG or any storage facilities. Also, building new infrastructure (import terminals, pipelines, storage facilities) to connect gas to places that need it, not only need years to build and is hugely expensive, but the risk of investing on stranded assets is very high.

The REPowerEU also recommends larger volumes of renewable hydrogen and biomethane production and imports. Hydrogen energy however, has many benefits as well as drawbacks. Green Hydrogen is a renewable and clean energy source as it is abundant and is carbon free. It is also more efficient compared to other energy sources as it conveys a lot of energy for every pound of fuel compared to diesel or gas. Green hydrogen can be blended into natural gas and can also use existing infrastructure: since it needs to be pressurized and transported to reach the end-user, existing natural gas pipelines, ships or trucks can be used. On the other hand, there are quite a few drawbacks involved using green Hydrogen as an alternative energy source. Green Hydrogen is more expensive than grey and blue Hydrogen. Its large costs come from the cost of infrastructure (solar panels, wind turbines), electrolyzers and transport. Hydrogen is also difficult to store. Due to its lower density, it has to be compressed to a liquid state and stored at lower temperatures so that its effectiveness and efficiency can be guaranteed, making it a difficult fuel to transport in large quantities. Additionally, it is volatile due to its high energy content as well as dangerous as it is extremely flammable. Finally, the current investment and production of Green Hydrogen are not considered that can actually substitute a satisfactory portion of the total energy demand. On a recent project initiative, the European Commission has granted over 1.1bn EUR to seven largescale hydrogen and carbon projects under the Innovation Fund, however, some of them will be completed in the forthcoming years or are still in the feasibility study (Quarterly Report on European gas markets Vol.14, European Commission, 2021).

The most obvious long-term solution ultimately seems to be renewable energy and decreased demand by improving energy efficiency. However, this requires major investments and improvements in technologies such as battery storage, a major component for the intermittency in supply from renewable resources such as wind power. But further investments and improvements translate into high costs as well as time: for example, a wind farm may take several years from planning to operation.

In the long run, the war may have accelerated energy transition but in the short term it could force electricity blackouts, factory shutdowns and unpredictable energy prices. Although renewable electricity has become cheaper and has seen considerable growth in the past years, renewables have only meant to replace coal since gas was to be used as a 'transition' fuel. Yet, renewables have currently been given the burden to replace gas making the decline in coal use to slow down as there are less renewables to replace it. There are also logistical issues concerning the use of renewables in energy needs such as heating. Despite the increase in gas prices and the growing share of renewables in the energy mix, a widespread switch to renewable heat, such as heat pumps, has not yet been spurred. Political stance and unforeseeable political developments may also be challenges for the application of the REPowerEU.The Plan's goal is to reduce by two thirds the EU's demand for Russian gas by the end 2022, which means that the EU will shift away from it gradually. However, this presupposes that the current geopolitical crisis (Russia – Ukraine war, relationships between each EU country and Russia) remains the same or improves. However, as of May 2022, Russia's state-controlled gas company has already shut off supply of natural gas to two EU countries highly reliant on Russian gas, Poland and Bulgaria. Should Russia shut off gas supplies to other EU countries as well, the REPowerEU's goal may be put at risk. Countries that will need to compensate for the gas supply losses, may resort to the use of other low-cost fuel alternatives such as coal. Additionally, the Plan requires the participation, cooperation, and involvement of all state members, though as mentioned earlier, as not all EU countries are equally reliant on Russian fossil fuels, the plan may not be equally and sufficiently supported by all Member States.

Energy independence from Russia in the long-term: **Full Steam Ahead**

1 Full exploitation of the European capacities

One of the first steps that the European countries should take in order to minimize their dependence on Russian gas, is to make sure that they are using their existing supplies efficiently and in full capacity. This will not only help them avoid getting stranded, but it will also further stregthen their energy security.
The use of the Trans Adriatic Pipeline is of strategic importance. The Pipeline is part of the Southern Gas corridor, which transports natural Gas from Azerbaijan to Europe. It connects with the Trans Anatolian Pipeline at the Greek-Turkish border at Kipoi, crosses Northern Greece, Albania and the Adriatic Sea and finally connects with the Italian natural gas network in Southern Italy at San Foca.
The TAP is to facilitate Southeastern European countries to be supplied with natural gas through potential interconnectors. Such an example is the IGB (Interconnector Greece Bulgaria) through which Bulgaria will be able to cover 33% of its total gas demand. Since the TAP exits in Greece, Albania and Italy, there are obviously multiple opportunities for transporting Azeri gas to the wider European Markets.

The current operational capacity of the TAP is 10 bcm/a, however, it has been designed with future capacity of a throughput of 20 bcm/a with the addition of two compressor stations and the modification of the existing ones. This initiation would allow Europe to access additional supplies from the nearby Caspian Sea and the Southern Gas corridor.This project however, would require long-term planning since it is a decision which entails geopolitical complexity and risks.

Lastly, following the European Union's decision, under the upcoming New Taxonomy to include specific natural gas projects in its green investments, Britain should also follow suit. These decisions will help strengthen the continent's energy security and reduce its dependence on Russian gas

2 Greece as an energy hub

The conflict in Ukraine has resulted in a fundamental change in the geopolitical balance of power and in the European energy policy. Within the next few months, the map of Europe will be completely re-defined, while European end-users are called upon to change the way they source and consume their energy.

> The Greek Prime Minister Kyriakos Mitsotakis announced that «Greece, is quickly transformed into an energy hub of the region, but, at the same time, a strategic gateway for the entry of energy resources to Southeastern Europe as a whole.»

In the last few months, various energy-related projects have been announced in Greece. A program to step up oil and gas exploration revealed by the Greek authorities in April, the inauguration of a new liquefied natural gas facility announced in May, and the expected completion of a new natural gas pipeline to Bulgaria in June. More specifically, in May 2022 the Greek government gave the "starting signal" for the construction of the Floating Storage and Gasification Unit (FSRU) of Liquefied Natural Gas (LNG) in Alexandroupolis by Gastrade S.A.

The construction of a floating station for the reception, storage, and regasification of LNG, a subsea, and an onshore gas transmission pipeline through which the natural gas is shipped into the Greek National Natural Gas System (NNGS) and to the end-users, will be included in the FSRU Project.

The Alexandroupolis FSRU is expected to be operational by the end of 2023, with the contracted gasification capacity already reaching up to 60% of the technical capacity of 5.5 bcm per year. The FSRU will also have the capacity to connect with and transmit gas into other gas transmission systems which are planned in the same geographical region, such as the TAP (Trans Adriatic Pipeline), and will be transported to the markets of Greece, Bulgaria, the wider region (Romania, Serbia, North Macedonia, etc.).

It is worth noting that the FSRU Project paves the way for further investments in the energy sector since Gastrade has also submitted an application to the Regulatory Authority for Energy (RAE) for the granting licence for the development of a new Independent Natural Gas System License Project, which will also consist of a Floating Storage & Gasification Unit (FSRU).

At the end of the year, the construction of Motor Oil's "Dioriga FSRU" is expected to begin, while in mid-April Elpedison submitted an application to the Energy Regulatory Authority (RAE) for a license to develop the "Thessaloniki FSRU" which is expected to be operational by 2025.

In order for the country to ensure the adequacy of its natural gas supply and to shield its energy security against the explosive international energy crisis, the Greek Minister of Environment and Energy, announced the expansion of the storage capacity of the Revithoussa LNG station, with the addition of a floating tank that will increase the capacity of the station by at least 150 thousand cubic meters.

The Trans – Antlantic Pipeline, the FSRU, the EastMed Gas Pipeline, the LNG Terminal in Kavala, the IGI Poseidon Gas Pipeline, the Hydro-pumped storage plant, the IGB Gas Pipeline and the EURASIA Interconnector, are 8 EU Projects of Common Interest (PCI), to transform Greece into a regional energy hub.

Moreover, given the government's commitment to energy decarbonization, the national target of 25 GW of RES installed capacity by 2030 and the sound structured renumeration scheme for RES production, the expanded portfolio of private investment opportunities, Greece is aiming to also take the lead in renewables projects expansion.

Over the past several years, Greece has seen a significant increase in the amount investments on renewable energy projects. These include the construction of several wind and solar facilities. The following months the Greek government is expected to introduce a new regulatory framework for the development of offshore windfarms, something that has already cought foreign investor attention.

In this content, the European Commission approved a project to establish a power grid interconnecting Greece and Israel. The project, which is expected to cost around 2.5 billion, will initially supply electricity from the Eastern Mediterranean's natural gas reserves to the continent's consumers. In the future, the same undersea grid could equally carry RES-sourced electricity, produced from the sunbaked lands of the Middle East and North Africa.

3 Greece's potential on Hydrocarbon exploitation

Hydrocarbons will continue to be a key component of the energy mix of the global, European and Greek economies for several years to come. With the new energy reality brought by the Russia – Ukraine war, Greece explores its opportunities in hydrocarbon production. Greece, until recently, has been producing gas but only modest quantities from the concessions in South Kavala and Prinos which seem to have run dry. According to the Institute of Energy of South-East Europe's special report of the Hydrocarbons Committee (Upstream), there are economic and geopolitical benefits from hydrocarbon exploitation in Greece. The report concludes that Greece can and should become a producer of hydrocarbons and an exporter of natural gas. The size and economic value of the hydrocarbon reserves have not been accurately determined so far, however; optimistic estimations based on current data, report of exploitable potential gas resources of around 2 – 2,5 trillion cubic meters of gas in 30 finds, most of them located in deep sea geological formations in the Ionian sea, in western Greece and the south-southwest area offshore Crete. According to the report, if current estimates for potential hydrocarbon reserves are confirmed, Greece will not only fully cover its own gas demand, but will also be able to cover European gas demand by 15 – 20%.

Hydrocarbon exploration requires high investments and modern technology. The presence of energy groups such as ExxonMobil, TotalEnergies, Helpe and Energean as well as the expressed interest of other companies, suggest not only the existence of significant hydrocarbon reserves, but also the growing investment interest.

So far, from the efforts by the Greek State and the joint ventures involving public and private companies, the hydrocarbons industry in Greece has not yet been fruitful and developed to its full potential. Lately, nevertheless, it was announced by the Greek Prime Minister that due to the new energy reality, Greece needs to substitute imports with exploitable sources from national wealth. Under this notion, it was announced that projects for hydrocarbon exploration would be accelerated and upgraded to projects of national importance with a goal of completion of these projects by 2023. These projects are located one in the region of Epirus and five in the sea areas of the Ionian Sea, the Kyparisiakos Gulf and Crete. Under these developments, Greece now has to ensure that these projects progress smoothly by removing possible bureaucratic obstacles, ensure their minimum environmental impact and continue the efforts in attracting investments.

4 Increase of RES exploitation in Greece

The drastic increase of natural gas consumption in Greece during the past years, has resulted in making the country vulnerable to the energy price crisis which started during the second half of 2021 and got worse with Russia's invasion of Ukraine. However, the largest share (two thirds) of the imported natural gas is used in electricity production which offers greater potential for Greece to reduce its dependence on fossil fuels easier, compared to other state members of the EU. The last few years, data show that in Greece the RES use in electricity production has been gradually replacing the use of fossil fuels as a cheaper and carbon-free alternative source of energy. The RES use seems that will continue to increase since the past few years there has been an outstanding interest in RES investments. More specifically, according to IPTO (2022), in 2021 connection offers were granted for 1.346 new RES generation stations with a total capacity of 3 GW, compared to 103 stations with a capacity of 1,6 GW in 2020, while in total since 2015, connection offers for 1.673 stations with a capacity of 7,7 GW were issued. According to IPTO, the investment interest for new RES projects remains high since only last year, it received applications for connection offers that exceeded 12 GW. The Administrator estimates that should successful applications continue at this rate, it is estimated that in the next four years access to new RES projects of up to 12 GW will be ensured.

Investments in RES will also be favored from changes in bureaucratic procedures. As of May 2022, a plan for the simplification of the licensing process and reformation of the institutional framework is on the table. A new development bill has been put to public consultation for the modernization of the licensing process of RES projects and the licensing of electricity production and storage. The Ministry of Environment and Energy has put in consultation the arrangements that will support investments in electricity storage stations with a total capacity of 3,5 GW by 2030, 10 pilot floating photovoltaic parks as well as the amendment to the 75-million-euro threshold for the inclusion of RES projects in the favorable scheme of 'emblematic investments of exceptional importance'. The latter refers to the inclusion of investments in the scheme independent of the amount being invested.

Despite the great potential and the auspicious future of RES in Greece, the new energy reality due to the Russia – Ukraine war, has brought the decarbonization process and green energy transition to a slowdown if not a halt. It has been announced that for new energy needs to be met, for the reduction of energy dependency on Russian gas and for the enhancement of energy security, lignite production will be increased by 50%. This involves the pilot operation of a new plant (Ptolemaida 5) most likely until 2028 (when 2025 was the goal) and the possible extension of operation of the units Agios Dimitrios and Meliti, which were planned to close in 2023.

In addition to the latter and based on the promoted regulations of the aforementioned bill, on the modernization of the second phase of the Renewable Energy Sources (RES) licensing process, a License for the Production of electricity from fossil fuels will continue to be issued by the Energy Regulatory Authority (RAE), for a period of up to 35 years for gas-fired units and up to 20 years for fuel-fired units and diesel, upon request. In fact, this allows the operation to be extended for an equal period of time, although the much-discussed Green Classification Act gives the green light to new fossil gas infrastructure, provided it is fully switched to renewable or low-emission fuels by 31 December 2035.

As for fuel oil, the national climate law that had been put in consultation, provided that from 1.1.2030 its use for the production of electricity on non-interconnected islands will be prohibited. Especially for the licenses for electricity generation with liquid fossil fuels, it is foreseen that by decision of the Minister of Environment and Energy, their maximum validity can be modified according to the national targets for energy and climate, for the reduction of greenhouse gas emissions and the replacement of the relevant units of electricity production from Renewable Energy Sources.

Even before Russia's invasion to Ukraine, and against the Commission's new taxonomy under which the strict criteria set did not favour projects of electricity production plants using natural gas, plans were being made for three new ones in Greece. The construction of the three gas units will start in 2022 in the Northern part of Greece, Thessaloniki, Komotini and Alexandroupolis which with their operation a more than 2,5 GW will be added to the installed capacity of the country's system.

Synopsis

- The EU is the largest importer of natural gas in the world and 41% of its demand is imported from Russian pipelines. However, many EU countries are heavily reliant on Russian gas (e.g., Germany, Estonia, Moldova, Poland, Bulgaria) while others are not (e.g., France, Spain, Portugal), depending mainly on each country's proximity to Russia and how diversified is their energy portfolio.

- LNG and pipeline imports from non-Russian suppliers are considered as the main alternatives to compensate for the losses from Russian imports, while emphasis will also be given to biomethane and renewable hydrogen production and imports.

- The need for further investments in infrastructure, especially in cross-border interconnections, the lack of storage facilities, and other bottlenecks that follow the rollout of renewable energy technologies need to be addressed by the European Commission.

- Green hydrogen, as a mean to reduce the EU's independency to Russian gas also involve the challenges of its high production costs, storage limitations and the requirements in large investments for further technology development and the creation of relevant infrastructure.

- Likewise, the increase of renewables requires major investments and improvements in technology, such as battery storage as well as bureaucratic issues that relate to time-consuming procedures from planning to operation, to be addressed.

- There is a great potential and many opportunities for Greece to overcome the energy crisis. These opportunities involve among others, transforming Greece in an energy hub through the creation of new and existing infrastructure (Revythousa, IGB, Alexandroupolis, TAP), the exploration of possible hydrocarbon reserves and their exploitation if they are determined as economically recoverable, and the increase of use of RES in power production.







Experts' Views

The war in Ukraine and the shift to a climate neutral society in Greece and in Europe

Yiannis Yiarentis

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The war in Ukraine has undoubtedly changed the geopolitical balance of power and has created a new reality which impacts us directly, giving rise to an urgent need for answers to address the numerous problems that have emerged — and it is currently hard to gauge if and when these problems will recede.

Energy is among the sectors which are constantly under great pressure on account of the Russian invasion of Ukraine. This is hardly restricted to Greece inasmuch as energy prices have skyrocketed worldwide. Admittedly, the energy crisis had already become apparent last summer, when the emerging natural gas deficit and the anticipated heavy winter began to drive energy prices upward. The Russian invasion of Ukraine has, in effect, placed unfathomable obstacles in a global market which, however, had already been under extreme pressure.

Developments on the specific front have brought the critical problem of the EU's energy dependence on Russian hydrocarbons to the foreground, given that Europe covers 40% of its total natural gas needs with imports from Russia, which also provides 27% and 46% of Europe's oil and coal imports respectively. In order to address this issue, the EU has adopted the RePowerEU plan, an ambitious framework of proposals aspiring to progressively reduce and eliminate the European Union's dependence on Russian fossil fuels by 2030. At the core of the plan is the need to expedite the penetration of Renewable Energy Sources (RES) in Europe.

> RES are the alternative source which can help countries cope with the problems generated by the energy crisis, reducing supply costs both for consumers and for businesses.
> Moreover, they help countries accomplish the transition to a net zero economy and at the same time remain independent in terms of their energy needs.

The European Union has long set ambitious goals in order to evolve into a climate neutral continent within the next few decades. Recent developments and the war between Russia and Ukraine have expedited these decisions and have brought Europe to the forefront of green energy innovation. These are certainly challenging times, and answers must be found to the difficult issues raised by the war. Eventually, however, and once the transition to exclusively clean forms of energy has been concluded, Europe will once again be in control of its energy affairs and — more importantly — will have become self-sufficient in terms of its energy requirements.

The green transition is a crucial course of action for the Greek government — and it can only be for the country's benefit, given Greece's abundant solar and wind resources. I am confident that this will be a successful undertaking for Greece. However, in order to secure the further penetration of RES in the local market, we need to develop storage infrastructure facilities, upgrade the energy transportation networks, and reinforce society's acceptance of RES.

The potential of hydrogen to support decarbonization strategies and economic growth

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The REPowerEU communication put forward the need to phase out the EU dependence on fossil fuels from Russia and increase the resilience of the EU energy system. REPowerEU emphasized the importance to scale renewable (RE) hydrogen, without compromising the climate ambition targets of the EU Fit for 55. RE hydrogen consumption up to 20 million tons, by 2030, would represent around 6-7% of today's total EU final energy demand and displace 15-30% of current imports of Russian gas.

Today, hydrogen is produced from fossil fuels (grey hydrogen) and used in limited industrial applications such as oil refining and chemicals.

To meet REPowerEU aspirations, hydrogen needs to be produced from RE electricity and at a significant scale. This signals strong opportunities for emergence of new markets for renewable hydrogen in Greece

Long-distance road freight and selected cases of private passenger transport (e.g., regional taxis) stand out as promising markets for hydrogen, in which other decarbonization options fall short. Hydrogen can progressively become commercially attractive to short-distance trains, ships, and aircrafts. Renewable hydrogen has also strong opportunities in industrial applications which involve oil refining, chemicals, and steel production, by replacing conventionally produced grey hydrogen.

Hydrogen is a valuable option to store excess RE electricity produced at Greek islands and, thus, enable further expansion of the RES capacity. The produced hydrogen can be exploited for commercial purposes or power generation at times of peak demand. Developing robust hydrogen ecosystems at the Greek islands can also act as an enabler for jobs and value creation at the local economies, applicable to the Greek morphology. In the mainland Greece, hydrogen can be blended, to some extent, into existing natural gas networks and be distributed to households and services, for heat and other purposes.

Developing a hydrogen ecosystem surrounding the maritime sector is a no-regret option for Greece, considering that Greek-owned fleet represents more than half of the entire EU-controlled fleet. Such an ecosystem would need to focus on delivering high-value zero or low-carbon hydrogen-derived fuels (e.g. synthetic ammonia/methanol, electrofuels) to the maritime sector.

The development of commercial strategies from industry players along with strong governance along the hydrogen supply chain is expected to unfold during the next years, especially in renewable-rich countries such as Greece. As hydrogen economy, within the overall energy transition, is scaling up, economic activity will be accumulated adjacent to the hydrogen value chain.

However, the currently high associated CAPEX of relevant investments (e.g., electrolysers, capture of carbon dioxide) represent a key consideration in view of the needed scaling up. High utilization, direct access to affordable or curtailed RE electricity and R&D, would help reduce such costs. Large infrastructure developments (e.g., conversion, storage, transmission, distribution) are required to ensure the matching between supply and demand at scale, for the relevant market segments.

Short- to medium-term financing will support engagement of market players, along the steps of the hydrogen value chain, with the objective to reduce risk factors to an acceptable level. Several available options are currently in place for "green hydrogen" projects, while financing may also be possible through the EU Innovation Fund and the Recovery and Resilience Fund.

Yet, the availability of financing options cannot by itself alleviate all possible barriers for the hydrogen economy buildup; support is expected from the Greek government, especially in the form of a national strategy that will provide the necessary context for the ecosystem to develop commercial strategies. The selection of the appropriate strategies and commercial business models will trigger investment opportunities and enable a sustainable supply and demand balance within the hydrogen ecosystem. Companies planning their positioning in this market must know that lead times for engaging with the hydrogen supply chain can be lengthy and require a considerable commitment. All things considered, they cannot miss out the opportunity of a sustainable growth potential and should harness the "first mover" positive externalities.

EDA THESS: Challenges and opportunities in the energy sector

Leonidas Bakouras

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Thessalonikh - Thessalia S.A.

We are on the verge of important developments in both the European and the Greek energy market, due to the major upheavals brought about by the energy crisis. The conditions created by the current geopolitical situation and the ongoing energy transition, make the need to support security of supply and the resilience of the EU energy system more urgent than ever.

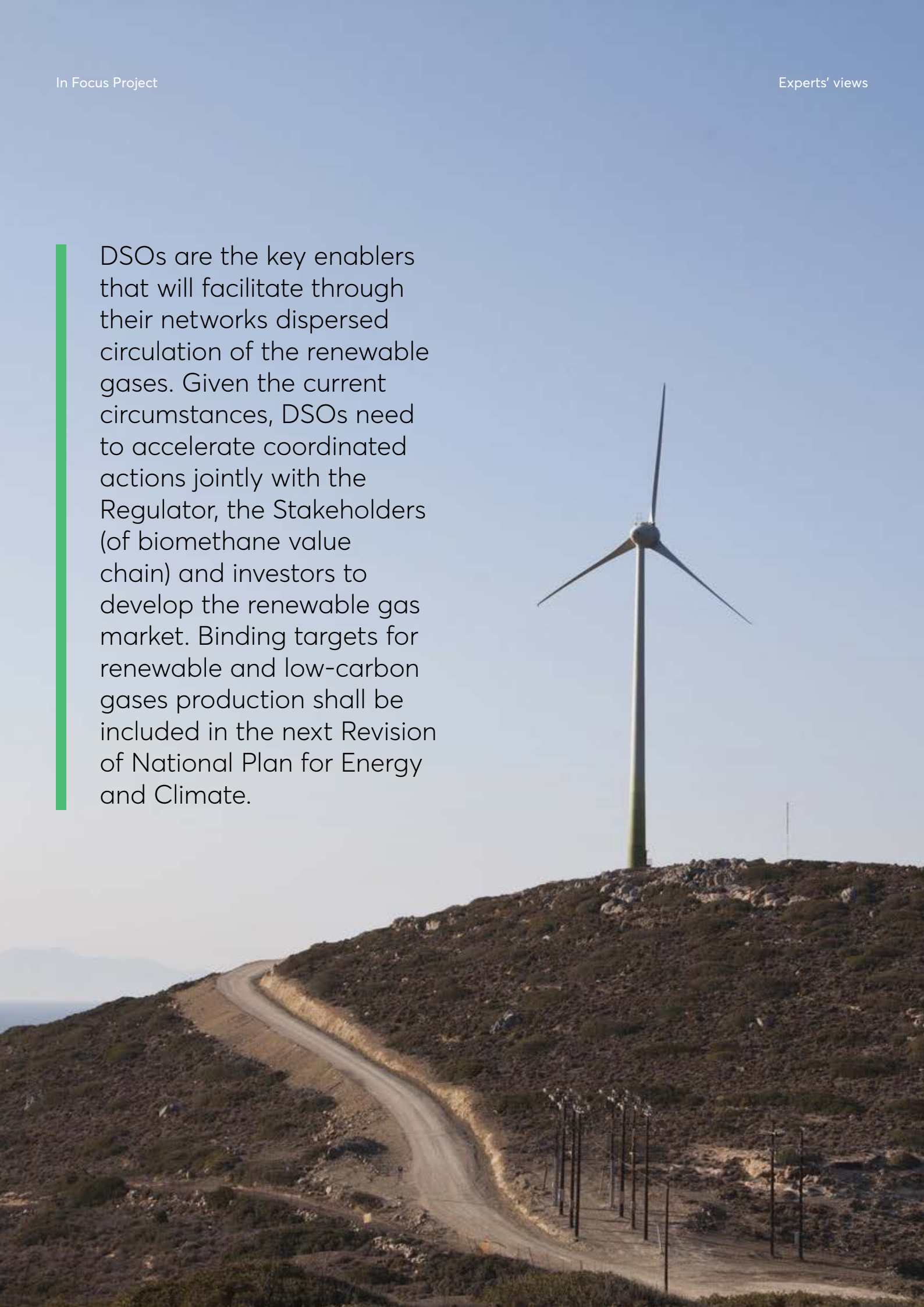
European policy, as reflected in the REPowerEU plan, provides four main pillars for the independence of EU by Russian gas imports: Diversification of gas supply sources, Partial substitution of the quantities by renewable gases (biomethane, hydrogen), Increasing of RES share in electricity generation and Energy savings.

The elimination of Russian gas from the European energy mix shall take place with the maximum possible measures to safeguard security of supply of end consumers. We should ensure (both in the short term and until 2030) that consumers have access to affordable gas, but also more generally to energy at competitive prices. REPowerEU provides for scaling up biomethane production to 35 bcm by 2030 (doubling the target set in Fit for 55 legislative package). There is also a frontloaded target to replace 3.5 bcm with biomethane by the end of 2022. Biomethane can directly "decarbonize" the gas networks with a domestically produced and affordable energy resource.

Existing natural gas distribution networks provide a direct and cost-effective solution both in the short – term: energy crisis response, but also in the long term: to achieve the net-zero objectives set for 2050. The traditional role of gas networks is now transformed, to integrate the decentralized production of renewable gases, biomethane on the first stage and hydrogen in the near future.

With biomethane, gas distribution networks will be able to support a circular economic model, based on the reuse of different types of biological feedstock, for the benefit of local and rural communities.

DSOs are the key enablers that will facilitate through their networks dispersed circulation of the renewable gases. Given the current circumstances, DSOs need to accelerate coordinated actions jointly with the Regulator, the Stakeholders (of biomethane value chain) and investors to develop the renewable gas market. Binding targets for renewable and low-carbon gases production shall be included in the next Revision of National Plan for Energy and Climate.



"Times are challenging but there is a huge opportunity for a fair and just transition ahead of us."

The legal and regulatory framework need to be promtly developed to facilitate biomethane production and injection in the gas grids. At the same time, a consistent support mechanism (feed in tariffs / feed in premium) should be established to incentivize all stakeholders to scale up biomethane production.

Although the objective is ambitious for the level of maturity that Greece has achieved in the respective sector, the goal is not a challenge for EDATHESS but an opportunity to leverage its modern networks. At the moment we are in the process of implementing a study to assess the biomethane production potential in the areas of our License. The study's objective is to estimate the biomass capacity in the wider area of each Municipality and to calculate the potential of biogas and Biomethane production. Our gas distribution networks are largely dispersed in urban and interurban areas, a fact that will facilitate the cost-effective connection of the biomethane plants and the circulation of renewable gases to the end users. It is highlighted that EDA THESS is already leveraging CNG technology to supply off-grid networks. This technology combined with biomethane in the form of Bio-CNG will allow the further reduction of the carbon footprint even in the most remote areas.

RES collocated with batteries: the ready-to-go solution to reduce energy dependency fast and efficiently

Anastasia Sampani

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During the last months Europe is experiencing an unprecedented energy crisis with significant negative effects on families, industries, and growth prospects of our continent. The root cause of the increases in European energy bills is the explosion of natural gas prices. The TTF in the main European gas hub, in the Netherlands, has demonstrated price increases by 226% between the first and the second half of 2021, while the effect on gas and electricity prices was intensified by the recent war, since the biggest gas importer of Europe is Russia. This had an impact on wholesale electricity prices in Europe, which on average increased by 260% compared to one year ago. Governments, industrial players, electricity sector actors and consumers continue to face a strong pressure with impacts of billion euroseach month. The EU imports 90% of its gas consumption, with Russia providing more than 40% of the EU's total gas consumption. However, each European country shows different exposure to Russian imports. Greece is among the countries most dependent on energy imports and among the countries most dependent on Russian gas. In particular, in 2020 Greece imported approximately 40% of the natural gas it consumed from Russia. This percentage, already high enough, would be even greater without the installed capacity of Renewable Energy Sources. What if the installed capacity of renewables was higher? And even more, what if renewable power plants when configured in such way to ensure energy system flexibility and stability?

In the context of the current geopolitical turmoil, the rapid and clean energy transition is more urgent than ever, and renewables are the key driver. Already before the gas crisis, RES power plants have become the cheapest source of energy in the European Union. Renewable energy is affordable since resource is freely and widely available. Another economic benefit stemming from renewables deployment is job creation especially in unprivileged regions, not only during construction but also during the entire lifetime of the plant. On top of that, renewables significantly contribute to security of supply since on one hand they reduce dependence on energy imports and on the other hand their availability and usage is neither linked to nor impacted by political instabilities. The current situation has frontloaded the needs to reduce energy dependency and to secure affordable prices, however the other important priority should not be neglected and that is combating climate change. Renewables are a perfect fit for this priority too since they result in zero-emissions electricity generation and when developed properly can also benefit biodiversity.

So far, we have proven that renewables can effectively reduce our dependence, but how can this be achieved without compromising system reliability and flexibility and without leading to an oversized fleet?

> The colocation of renewable plants with electricity storage (i.e. batteries) is the key solution for the reliant, flexible, sustainable and affordable energy system of the future. Batteries are the key element that can eliminate renewable intermittency and always ensure matching of supply and demand.

They practically transform renewable power plants into dispatchable generating units, able to respond efficiently and in timely manner to system needs, and to participate in ancillary service provision. The colocation of renewables with batteries is a fast solution, due to the high implementation speed of the projects, that facilitates higher renewable penetration without having to wait for long-term grid reinforcement activities, thus a perfect fit for the current emergency that calls for fast and effective actions. The only pieces of the puzzle missing to unlock the benefits of such a configuration are the acceleration of permitting process to bring projects online fast and the establishment of the appropriate regulatory framework enabling the participation of storage in multiple markets and providing proper incentives, translated into robust investment support schemes, to render the investments viable.

> To conclude, in order to safeguard energy security while ensuring resilience and sustainability, it is of utmost importance to assure energy supply in the most environmentally friendly and affordable way, prioritizing renewable energy sources collocated with battery storage systems.

Those projects are a ready-to-go solution responding to the current emergency. Undoubtedly, a successful and overall energy transition and e nergy independence is a rather complicated formula that includes a wide variety of actions, among which are electrification of final consumption, grid reinforcement and digitalization, energy efficiency and behavioral change, demand response and green hydrogen for the hard-to-abate sectors. All those elements can pave the way to a brighter energy future.

The crisis in Ukraine accelerates Europe's energy transition

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The war in Ukraine, on top of the humanitarian cost, has triggered a major global energy crisis. The sanctions imposed by the international community on Russia have sent oil and gas prices soaring, while fears of a complete cessation of Russian energy exports to the West have sustained market uncertainty. After all, Russia is the third largest oil producer and the second largest gas producer in the world. At the heart of the crisis is undoubtedly Europe, which obtains 40% of the gas and 1/3 of the oil it consumes annually from Russia (2021 figures).

The increase in gas prices has also pushed up electricity cost. The countries most exposed to high electricity prices, according to the latest report from the Agency for the Cooperation of Energy Regulators of the European Union (ACER), titled "Preliminary Assessment of Europe's high energy prices and the current wholesale electricity market design", are those with the greatest dependence on gas to meet electricity demand and the lowest interconnectivity with neighboring countries. Among these is Greece, which covers around 40% of its electricity needs from natural gas plants and has relatively low capacity interconnections with its neighbors.

The European Commission has taken a number of steps to protect European consumers and economies from the consequences of the energy crisis, but also to ensure Europe's energy security in the coming years. Among these are an agreement with the US to supply 15 billion cubic meters of LNG in 2022 and full decoupling from Russian gas and oil by 2030. In line with the European Council conclusions, Member States and the Commission have also committed to completing and improving the gas and electricity interconnections throughout the European Union, including full synchronization of power grids to achieve energy security.

In this effort, the acceleration of the energy transition is essential, as it prioritizes the development of renewable energy sources (RES), which are now amongst the most competitive in terms of production costs. Europe plans to boost its investment in RES and is speeding up the relevant licensing procedures, together with the development of the necessary storage capacity in order to support their augmented contribution to the energy mix.

In this context, the role of energy exchanges, such as the Hellenic Energy Exchange (HEnEx), which operates the Energy Trading Spot System (ETSS) and the Natural Gas Trading Platform is indispensable. HEnEx is the Nominated Electricity Market Operator (NEMO) for the Greek Bidding Zone. It provides the market place, trading venues and platforms and delivers efficient price formation, for a secure and reliable energy trading in the South-East European region. Its trading services are based on high European regulatory standards, ensuring transparency of transactions, low transaction cost and elimination of counterparty risk through the clearing and risk management of a Central Counterparty, EnEx Clear. HEnEx provides its trading services equally to all its members, striving to enhance domestic and regional competition, enlarge the trading space and reduce barriers to market entry. More importantly, it facilitates the development of clean energy, by producing the relevant financial indicators and price signals which investors require to plan their investments.

At the same time, it contributes to the optimization of the interconnections between the Greek and European energy networks, which is another prerequisite for the energy transition and can only happen through the operation of an efficient market in which the right price signals are established, based on supply and demand and in real time.
HEnEx, recently launched the Natural Gas Trading Platform, which is an important milestone for the Greek energy market as it allows for a more efficient use of existing gas infrastructure and facilitates investments for the development of new ones that enhance the diversification of sources and supply routes as well as the country's energy security.

> The Natural Gas Trading platform is of strategic importance for Greece, as the creation of the spot gas market will increase the interconnectivity of the gas markets of South East Europe while improving their liquidity and flexibility and increasing the potential of Greece to becoming an energy hub in the region.


Сила
Сибири

Making Energy Storage Systems Smarter

Sam Zheng

Managing Director Huawei Digital Power Greece

HUAWEI

With the continuous increase of penetration of renewable energy, the problem of weak power grids and the requirements for grid connection stability will continue to increase. As a flexible resource, energy storage systems can provide services such as frequency regulation and peak load regulation for the power system, helping renewable energy to evolve from adapting to enhancing power grids. If PV is to become a main energy source, energy storage will make clean energy more efficient and power grids more robust to facilitate the transformation of clean energy.

Energy storage technology is the key for PV to become a main energy source. The PV +BESS must be benchmarked with thermal power to achieve grid parity. LCOS (Levelized Cost of Storage) decreases faster than expected. With digital and information technology integrated with energy storage technology, more possibilities will be created, and energy storage systems (ESS) will be safer, more efficient, stable, easier to maintain, and last longer.

Safety

ESS safety is a major concern in the industry. Fires and explosions in energy storage system projects have caused serious financial losses and social impacts. The main causes of battery cell fire are as follows:

- The structure of ternary lithium battery cell material is unstable. Oxygen is generated at high temperature, which can cause fire and explosion.
- When a defect occurs between electrochemical cells, signals cannot be transmitted to the management system in a timely manner. Usually, an alarm is generated after fire occurs instead of beforehand.
  Key components (such as circuit boards and contactors) are faulty, causing sparks and arcs.

Capacity Mismatch

Available capacity is a major performance indicator of the ESS. The main pain points in the energy storage industry are low battery utilization and capacity mismatch. The main reasons are as follows:

- Mismatch between battery packs in series: Based on the basic features of series circuits, the available capacity of battery packs in series is the capacity of the weakest battery pack. As a result, other battery packs with a higher capacity cannot be fully utilized.
- Mismatch between battery racks in parallel: Based on the basic features of parallel circuits, the available capacity of battery racks in parallel is the capacity of a weakest battery rack. As a result, other battery racks with a higher capacity cannot be fully utilized.
- The difference between the internal resistances of the old and new batteries causes cross current, which increases the battery temperature and accelerates the aging of the new batteries. In addition, more power will be needed for heat dissipation. This further reduces the charging and discharging efficiency.

Short Battery Lifespan

The battery lifespan is closely related to temperature. If the temperature is not within the allowed range, undesired chemical reactions will occur inside the battery, generating unwanted compounds and accelerating the aging of batteries. Currently, the average lifespan of batteries in the market is only about 7 to 10 years. The possible causes of uneven heat dissipation of batteries are as follows:

- Air conditioners are usually used for battery cooling. When a cabinet is far away from the air conditioner, the temperature difference between batteries in the container might be greater than 10°C. As a result, the battery lifespan is shortened by more than 15%. In addition, if the temperature difference between the cabinets connected in parallel is large, the difference in aging increases.
- The temperature rise difference between battery packs further increases the internal resistance difference. Due to the Leaky Bucket Theory, the lifespan of all batteries is further shortened.

Difficult O&M

Onsite commissioning of a plant with an energy storage system is complex, and professional personnel are required to inspect and repair the system after it is put into operation, which is time- and labour-consuming. O&M consists of three parts: onsite installation, routine O&M, and repair.

- Onsite installation: Onsite cabling, commissioning and system thermal commissioning are required during the ESS installation. This process is time-consuming and costly.
- Routine O&M: Even if no fault occurs, ESS maintenance needs to be performed every 6 to 12 months. The maintenance items include the battery maintenance, converter maintenance, HVAC maintenance, and fire extinguishing system maintenance.
- Repair: When a battery pack in a battery rack is faulty, manual repair is required to balance the battery SOC because the system does not have the pack balancing function.

Huawei's proposal
Smart String Energy Storage System Solution

Innovation in energy storage technologies is a key to address the difficulties and challenges in the industry. The concept of a string energy storage system is inspired by string inverters, having advantages in terms of fault rate, system safety, and O&M efficiency and have become a mainstream solution in the industry.
The smart string energy storage system solution integrates digital information technologies with PV and energy storage technologies. Based on the distributed energy storage system architecture, the solution uses innovative technologies such as energy optimization at battery pack level, energy control at battery rack level, digital intelligent management, and fully modular design to achieve higher discharge capacity, optimal LCOS, simplified O&M, high safety and reliability.
The smart string energy storage system solution differs from the traditional centralized energy storage system solution in the following three aspects: string architecture, intelligent management, and modular design, aiming to eventually, achieve the transition from PV parity to PV+energy storage system parity.

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