Energy Security Challenges: Solutions from South-East Europe

Edited by
Slavtcho Neykov,
Zinaida Zlatanova

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ENERGY SECURITY CHALLENGES: SOLUTIONS FROM SOUTH-EAST EUROPE

Edited by:
Slavtcho Neykov,
Zinaida Zlatanova

European Liberal Forum
Rue d'Idalie 11-13, boite 6, 1050 Ixelles, Brussels (BE)
info@liberalforum.eu
www.liberalforum.eu

Liberal Institute for Political Analyses
23, Vrabcha str., 1000, Sofia, Bulgaria
www.lipa.bg

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Table of Contents

Introduction by the Editors 5

Slavtcho Neykov, Chairman of the Board of Energy Management Institute (EMI) Bulgaria,

Zinaida Zlatanova, Board Member at Liberal Institute for Political Analyses, EU Policy Expert | Advocate for Sustainable Development

Chapter 1 8

Bulgaria: Traditional Energy Dependencies vs. Net-Zero Industry Opportunities

Associate Professor Atanas Georgiev, Dean of the Faculty of Economics and Business Administration, Sofia University „St. Kliment Ohridski"

Chapter 2 27

Italy: The energy crisis in Italy: an overview of challenges and mitigation measures

Simona Benedettini, Fondazione Luigi Einaudi, Freelance consultant on power & gas sector regulation for EU and non-EU operators and public bodies

Chapter 3 46

Republic of North Macedonia: Making the Most of the 280 Sunny Days Annually – The Vibrant Case of North Macedonia.

Ivan Durgutov, Executive Director at the European Business Association - North Macedonia

Chapter 4 62

Moldova: From Energy Crisis To Energy Security

Ana Otilia Nutu, Senior energy policy analyst at Expert Forum (EFOR)

Table of Contents

Chapter 5 77

Romania: Energy Consumer Protection and Contracts for Difference in Romania after the Russian Invasion of Ukraine

Corina Murafa, PhD, Independent public policy expert
Christian Busu, Director and university professor, PhD

Stere Stamule, Assistant Professor at Bucharest University of Economic Studies

Chapter 6 92

Slovenia: Slovenia's Perspective: Renewables or Low-Carbon?

Felicita Medved, President of the Novum institute in Slovenia

Chapter 7 118

Ukraine: Traditional Energy Dependencies vs. Net-Zero Industry Opportunities Keeping the lights on in Ukraine: mission (im)possible

Valeriya Izhyk, EU Policy Officer on Ukraine's reconstruction, CEE Bankwatch Network, European Climate Pact Ambassador (2024)

Contributors 136

About the Publishers 140

Introduction

By the Editors:

Slavtcho Neykov, Chairman of the Board of Energy Management Institute (EMI) Bulgaria,

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Since coal was considered a key driver of rapid post-World War II economic development and the peaceful use of nuclear power was negotiated among the six initial signatories of the Euratom Treaty, energy policy has been central to European integration. Yet energy has always been a crossroads of geopolitics, economic, social, and environmental policies. Therefore, it has been a sensitive issue on which countries jealously guard their competence.

The current set of articles aims to provide an overview of the recent energy sector developments with an emphasis on the energy security aspects in the southern and the eastern ends of Europe in light of substantial geopolitical changes in recent years, as well as the specific energy situation at the national level in the region's countries. The publication presents a rapid snapshot of what has been seen as a working solution in an emergency and beyond. The overlapping crises provoked solutions to be taken simultaneously at both the EU and national levels coping with urgencies and building the foundations for the future at the same time.

Considering that the Green Deal legislation will enter the implementation phase within the next five years, this book focuses as much as possible on implementation at the national/local level, providing bottom-up, real-case feedback. This can also help facilitate an evidence-based, forward-looking, and implementation-proof decision-making process.

The national chapters cover Bulgaria, Italy, Moldova, North Macedonia, Romania, Slovenia and Ukraine. On the one hand, the EU member states, although geographically close, have different energy situations, due to initial conditions, readiness, and sector priorities. The candidate-countries chapters provide information on the energy sector developments and an insight into the legal, technological, regulatory, and investment-related experience. These chapters represents a glimpse into the future energy policy of the EU, as the future members will bring their legacy and vision to several dilemmas.

The country's studies naturally deal with the most recent energy crisis amid health and geopolitical events unseen in generations, namely the pandemic and Russia's war of aggression against Ukraine. It is a real-life test for the policies adopted in the last decades and their actual implementations. It is interesting to see, how reforms and projects delayed for years if not for decades are being rapidly implemented in crisis circumstances. A conclusion can be made from the current studies that although the EU has survived these crises, their consequences are currently unfolding. Also, a true energy union for long-term energy security across the EU needs more time and political will, and determination to achieve, as governments struggled to balance sustainability and affordability in the past years of crises.

The following main conclusions can be drawn from the situations described in the country chapters.

The EU sets common goals but the individual problems remain to be solved at the national level. The governments face the dual challenge of cutting energy bills and delivering energy security at the same time while moving towards the decarbonisation goals. The approaches explained in the chapters point out that most governments prefer to focus on the outcomes rather than the means of achieving them when dealing with the crisis and its consequences. An important outcome that can be claimed as a joint success is the strategic decoupling from Russia in the energy field which is almost complete.

The green transition is the underlying topic in all the country chapters in this publication. The seven countries aim to build a renewable-centered energy system regardless of their EU membership status. Despite the different paces of progress in individual countries, the green transition is well on track. However, the rapidly changing reality, including in economic, social, and geopolitical terms requires constant adjustments and a pragmatic end-goals-oriented approach. It was this approach that led to a revival of nuclear energy in Europe after decades of stagnation. Greater reliance on renewable energy reduces the dependency on energy imports. However, decarbonisation should also contribute to the EU's prosperity and competitiveness, economic growth, political stability, and overall development and security of other sectors to avoid the risk of losing the competitiveness of the EU globally.

What distinguishes this transition from previous ones (wood to coal, coal to oil) is its urgency. This requires large-scale investments in a short period. In the first place, investment in technology is universally needed – particularly in energy storage, nuclear, and hydrogen technologies. The security, resilience, and interconnection of the electric grid and energy infrastructure are acknowledged as a high-priority topic across the EU, hence the investment needs are urgent and high. Specific sectors such as digital security, diversification of supply chains of critical raw materials, liberalization, and regulation shouldn't be overlooked either.

What is not explicitly discussed in this publication, because it is not its task, is the pathway to a socially and economically bearable price of the energy transition. Investment, both private and public, would translate into higher costs paid by European consumers, who have already struggled with energy affordability. A just energy transition requires pragmatism and carefully calibrated approaches to leave no one behind, while observing the market and competition principles and preserving the achievements of the Single Market.

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Chapter 1

Bulgaria: Traditional Energy Dependencies vs. Net-Zero Industry Opportunities

Chapter 1

Bulgaria: Traditional Energy Dependencies vs. Net-Zero Industry Opportunities

Associate Professor Atanas Georgiev
Dean of the Faculty of Economics and Business Administration, Sofia University „St. Kliment Ohridski"

Abstract

This paper discusses Bulgaria's transition from traditional energy dependencies, particularly on Russia, towards opportunities in net-zero industries. The focus of the piece is on how Bulgaria, as one of the EU's most energy-dependent countries, can leverage the new industrial revolution driven by investments in net-zero technologies, particularly following European Commission initiatives like the Net-Zero Industry Act (NZIA) and the Critical Raw Materials Act (CRMA) in a global context where the United States has already started adopting the Inflation Reduction Act (IRA) and China has taken a leading position in the production of low-carbon and green energy technologies.

Introduction

Europe has been at the forefront of global climate leadership, particularly regarding policy initiatives. Even before the Paris Agreement, the European Commission has spearheaded efforts for a new climate accord. However, there have been no significant success stories in the past decade, especially among G-20 countries, which account for approximately 80% of global

While the EU is a global leader in policy, it also leads to energy dependency.

carbon emissions. While the EU is a global leader in policy, it also leads to energy dependency. This has created a new ´trilemma´ for the EU to address how to decarbonise the economy in the absence of traditional local energy resources, while the new industrial revolution is driven by investments and consumer goods produced elsewhere[1].

Bulgaria has had mixed results in this context, but could leapfrog in the process. As one of the most energy-dependent countries in the EU, which had most of its imports from Russia, now the country has quickly switched to alternative supplies. In addition, more opportunities may be present with local industries providing critical materials for the energy transition and the nearshoring of net-zero industries.

This paper will present the policy context in global, European, and national terms, the current challenges related to low-carbon industries, and the specific competitive position of the EU against the United States and China. In particular, this analysis will focus on Bulgaria's experiences as a country that has been fully dependent on Russian energy supplies, towards a more

1 European Commission (2023), A Green Deal Industrial Plan for the Net-Zero Age, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023DC0062

There have been no significant success stories in the past decade, especially among G-20 countries, which account for approximately 80% of global carbon emissions.

diversified energy portfolio. The final section will explore whether Bulgaria is positioned well to take advantage of the new European net-zero and low-carbon policies and what the next challenges in this process might be.

Policy Context

In 2024 the European Commission celebrated[2] the adoption of the Net-Zero Industry Act (NZIA). The NZIA was first introduced by the European Commission's President Ursula von der Leyen as a component of the Green Deal Industrial Plan, which was presented at the beginning of 2023. Its purpose is to enhance the EU's competitive advantage by expanding its manufacturing capacity for net-zero technologies and products essential for achieving the EU's ambitious climate goals. The NZIA itself was presented together with the Critical Raw Materials Act (CRMA) and the reform of the electricity market design in the beginning of 2023.

Beyond setting these objectives, the new European legislation has defined a goal to improve the conditions for investment in net-zero technologies by simplifying and accelerating permitting procedures, reducing the administrative burden, and facilitating market access. Public authorities will be required to consider sustainability, resilience, cybersecurity, and other qualitative criteria in procurement procedures for clean technologies and renewable energy deployment auctions. Member States will have the opportunity to support various net-zero technologies, including solar photovoltaic, wind, heat pumps, nuclear, hydrogen, batteries, and grid technologies, by establishing 'strategic projects.' These projects will benefit from priority status at the national level, shorter permitting timelines, and streamlined procedures.

Energy-intensive industries such as steel, chemicals, or cement, which produce components used in these net-zero technologies and invest in decarbonisation, can also receive support through the measures in the Act – a kind of a protectionist measure in response to what has been business-as-usual in many parts of the world in the post-COVID global economic order.

2 European Commission (2024) Net-Zero Industry Act makes the EU the home of clean tech manufacturing and green jobs, https://ec.europa.eu/commission/presscorner/detail/en/ip_24_2309

The NZIA follows another contradictory legislation, adopted by the EU in the past few years. The Carbon Border Adjustment Mechanism (CBAM) which was adopted in April 2023 aims to assign a fair price to the carbon emissions associated with the production of carbon-intensive goods entering the EU, while also promoting cleaner industrial production in non-EU countries[3]. This is a direct countermeasure to the so-called 'carbon leakage', or the 'leaking' of carbon-intensive industries from jurisdictions with heavier CO2 legislation to such with less stringent regulations. The European Commission believes that by ensuring that a price has been paid for the carbon emissions embedded in the production of certain imported goods, the CBAM will align the carbon price of imports with that of domestic production, preventing the undermining of the EU's climate objectives. The CBAM will be fully implemented in its definitive regime starting in 2026, with a transitional phase running from 2023 to 2025.

This gradual implementation aligns with the phase-out of free allowances under the EU Emissions Trading System (ETS), supporting the decarbonisation of EU industry. According to the official messages, the CBAM is designed to comply with WTO rules, but a brief look at the reactions of the USA and other countries shows the opposite[4].

In the United States, less than 2 years ago – in August 2022 – President Joe Biden signed the Inflation Reduction Act (IRA) into law, marking it the most significant legislative action on clean energy and climate change in the American history. The IRA aims to establish a new front against the existential threat of climate change, promoting American innovation to reduce consumer costs while advancing the global clean energy economy. The United States, as a leader in global innovation and industry – specifically in getting patents to factories – has once again chosen to take a prominent role in the international race to provide the technologies and resources necessary for global

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3 European Commission (2024) Carbon Border Adjustment Mechanism, https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

4 Boute, A. (2024). Accounting for Carbon Pricing in Third Countries Under the EU Carbon Border Adjustment Mechanism. World Trade Review, 23(2), 169–189. doi:10.1017/S1474745624000107

decarbonisation and a new industrial revolution. Since the mid-2010s, the USA has gained a significant competitive advantage by becoming energy self-sufficient and re-establishing its role as an energy exporter.

Europe also faces many industrial risks related to the new low-carbon industrial goods coming from China. These include not only solar panels, but wind generators and storage alike, battery electric vehicles and components for them, and, last but not least, the raw and refined materials required for their production. Some analysts predict that China may continue its production rise by the end of the decade with more than 50% in some industries[5]..

Global, European and National Energy Security

The beginning of the 2020s has been marked by a number of global energy emergencies. First, the COVID-19 pandemic struck energy demand worldwide and made it difficult for energy companies to keep pace with needed energy investments. Then, 2021 was the year of a record spike in energy demand, which brought energy prices to a new high. In Europe the price crisis was exacerbated by the natural gas market, which was heavily dependent on Russian supplies and on the volumes of Russian gas in European gas storage facilities[6]. In the beginning of 2022, a new energy crisis emerged with the war in Ukraine and with the cascading sanctions against Russian fossil fuels. In 2023 and 2024 the global energy market instability is not so harsh, but still nowhere near the climate and low-carbon energy goals, set in the end of the previous decade.

The measures implemented by both national and European authorities must address two main directions in the current situation. Firstly, short-term actions are needed to mitigate price shocks. Secondly, national policies and funding should focus on accelerating the industrial transition to reduce consumers' vulnerability to future wholesale price shocks

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5 The Economist (2024) Xi Jinping's misguided plan to escape economic stagnation, www.economist.com/leaders/2024/04/04/xi-jinpings-misguided-plan-to-escape-economic-stagnation

6 ACER (2023) Regulators' monitoring identifies enduring impacts from the disruption of Russian gas, https://www.acer.europa.eu/news-and-events/news/regulators-monitoring-identifies-enduring-impacts-disruption-russian-gas

> It is essential to adopt a long-term vision rather than just financing current consumption..

in energy markets. It is essential to adopt a long-term vision rather than just financing current consumption. However, relying solely on a distant future is also misguided, especially when larger global emitters are not yet fully committed to reducing their emissions.

There is one more very specific challenge in Southeast Europe – balancing decarbonisation goals with industrial competitiveness, and this challenge is even harder to overcome. Similar to the European Union, which relies on imported energy for more than half of its needs, the Southeast European (SEE) region (including also non-members of the EU) is heavily dependent on foreign fossil fuels. Most countries in this region are net importers of electricity. However, several key differences distinguish SEE from other parts of the continent. These include its reliance on local coal, mainly lignite, and the absence of developed local oil or gas resources. Moreover, the overall share of nuclear energy in the energy mix is low, and gas distribution grids are either underdeveloped or nonexistent. The region also has a small share of renewable energy sources (RES), excluding hydro and rudimentary biomass burning. Additionally, the lack of smart grids, microgrids, and prosumers presents a significant challenge, compounded by low personal income and a high percentage of 'energy poor' households.

An emerging opportunity is to join the bandwagon of reindustrialization in a new way – with low-carbon emitting industries which themselves support decarbonisation, e.g., building electric vehicles or batteries for them with less induced carbon emissions than before. Or, producing locally wind generators and solar panels, while at the same time refining and/or producing locally the needed raw materials. This trend may be supported by the already hailed 'nearshoring' of industries after the post-pandemic period as well as by new set of protectionist measures as declared by the specific legislative acts – CBAM, NZIA, and CRMA.

Getting off Russian Fossil Fuels – the Example of Bulgaria

In this complex context, Bulgaria's energy security response has been quite interesting to explore. In 2022, 2023, and 2024, the country implemented several specific measures to counterbalance the total dependency of the national economy on Russian nuclear fuel, gas, and oil. These policies were fully compliant with the REPowerEU plan, which added €210 billion for measures against the dependence on Russian energy in the period until 2027.

First, the natural gas contracting has been profoundly discussed and finally changed. New LNG supplies have been negotiated through the Greek terminal, and a new interconnecting line – IGB, has been finished in order to allow supplies from the east. Since the beginning of 2023 the Bulgarian gas consumption is also dependent on a new 13-year contract between the Bulgarian incumbent Bulgargaz and the Turkish company BOTAS, which has become subject to a scrutiny from the national and the European parliaments alike[7]. Time will show the results from these efforts, but the main change is a fact – Gazprom is no longer selling gas to Bulgarian consumers.

Another successful gas story from Bulgaria is related to industrial energy consumers. Agropolychim, a fertiliser plant in Devnya on the Black Sea coast, has replaced about 98% of its gas consumption in the second half of 2023 – or more than 10% of the national natural gas consumption – with blue ammonia, coming from Saudi Arabia[8]. Blue ammonia is produced through a process that captures and utilises the associated carbon emissions, thus making it possible to decarbonise production and at the same time – to support getting off natural gas in a smart way. Other industrial companies explore ways to decarbonise gas consumption either through biogas or through hydrogen alternatives.

Some other attempts to get off Russian energy have been less speedy. For example, Bulgaria has been trying throughout 2023 to ban import of Russian oil for the only refinery in the country, which is owned by the Russian company

7 Kapital Insights (2023) Bulgaria's backdoor route to reintroduce Russian gas to the EU via Erdogan, https://kinsights.capital.bg/energy/2023/08/03/4514487_bulgarias_backdoor_route_to_reintroduce_russian_gas_to/

8 Agropolychim (2023)

Agropolychim received the first ever shipment of blue ammonia to Europe, https://agropolychim.bg/en/agropolychim-received-the-first-ever-shipment-of-blue-ammonia-to-europe/

LUKOIL. However, the legislative changes entered into force only in March 2024[9]. Even so, this is another successful attempt to stop purchasing directly Russian oil. And last but not least, Bulgaria managed to renegotiate its nuclear fuel supplies. In May 2024 Unit 5 of the Kozloduy NPP has replaced for the first time a quarter of its nuclear fuel with non-Russian supply – a contract has been signed with the US-based Westinghouse and its Swedish branch in 2023. Unit 6 of Kozloduy NPP will get its first batch of French Framatome fuel in the Autumn of 2024, which will start a new era for the Bulgarian nuclear fuel supplies – coinciding with the 50th anniversary since the first unit in the plan started operation[10]. Units 1-4 have been undergoing decommissioning already after their stopping before 01.01.2007 as part of the deal for Bulgaria to join the EU.

In addition to replacing fossil fuel per se, there have been major developments in the renewable energy sector as well. Just in 2023, Bulgaria increased its photovoltaic capacities (PV) by about 1316 MWe, adding 364 MWe until the end of May 2024. This is more than doubling the existing capacities in the end of 2022. The National Electric Company (NEK) also announced in June its plans to match the largest pumped storage hydropower plant 'Chaira', with a capacity of 864 MW, which is currently operating only partially due to technical failures, with two more HSHPPs of roughly the same size each. Together with the new nuclear build, these capacities may mean that Bulgaria could be decarbonizing most if not all of its electricity consumption in about 10 years. Moreover, some of these projects or at least some of their costs may be eligible under the NZIA legislation.

Nuclear Renaissance – Again?

Nuclear energy has become part of the mainstream energy generation during harsh energy times – in the 70s of the 20th century partly due to the Oil Shocks and the willingness of energy-importing nations

9 Bloomberg (2023) Bulgaria to End Russian Oil Imports from March as Lukoil Considers Refinery Sale, https://www.bloomberg.com/news/articles/2023-12-18/bulgaria-to-end-russian-oil-imports-from-march-as-lukoil-considers-refinery-sale

10 World Nuclear News (2024) Bulgaria's Kozloduy using first Westinghouse fuel, https://world-nuclear-news.org/Articles/Bulgaria-s-Kozloduy-using-first-Westinghouse-fuel

to counter-balance the dependence on foreign oil – at least in electricity production. Until the late 80s, there had been a consensus that nuclear has a bright future, as shown by the number of conceived and finished projects. Then the accidents in Three Mile Island and Chernobyl happened and nuclear was dormant for almost two decades. In the wake of the 21st century, it became popular again (the First Nuclear Renaissance), only to become a non-starter again after the accident in Fukushima Daiichi in 2011.

Now, after a decade or so, it seems that there may be a Second Nuclear Renaissance, this time out of emergency considerations – and possibly because of the cascading crises already mentioned above. The new generation of reactors, together with the promise of the Small Modular Reactors (SMR) technology may become part of the mainstream again, even in Europe.

The NZIA identifies a list of 19 Net-Zero Technologies whose manufacturing should be supported by the EU. It is not targeted at innovative but at mostly mature, tried-and-tested technologies, which include not only nuclear but also hydropower, onshore wind, carbon capture, and storage (why not – related to coal?), as well as others[11].

A turning point in the Second Renaissance was the nuclear conference during COP-28 in Dubai in November 2024, but a more detailed vision for the future was discussed at the end of March 2024 in Brussels. World leaders from over 30 countries and the European Union (EU) convened at the inaugural Nuclear Energy Summit in Brussels, which was the world's first high-level meeting dedicated solely to nuclear energy. The President of the European Commission, EU Commissioners, and national European leaders participated in the meeting and discussed perspectives on nuclear. This is a 180-degree turn on the topic, after nuclear was heavily neglected (even if not explicitly 'forbidden') in both the 'Energy and Climate' Package of 2009 and in the European Green Deal Concept from 2019[12].

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11 Florence School of Regulation (2024) Explainer: The EU's Green Deal Industrial Plan, https://energypost.eu/explainer-the-eus-green-deal-industrial-plan/

12 European Commission (2024) President von der Leyen and Commissioners to take part in Nuclear Energy Summit and events on nuclear research and small modular reactors, https://energy.ec.europa.eu/news/president-von-der-leyen-and-commissioners-take-part-nuclear-energy-summit-and-events-nuclear-2024-03-20_en

Source: Stock image from Canva

Bulgaria has been part of this new 'nuclear coalition' since its inception, which could be dated with the gathering of a new European Nuclear Alliance on the initiative of the French President Emmanuel Macron in the beginning of 2023. Its positions have been strengthened and supported by additional countries in March 2024[13].

As part of its new, non-Russian energy policy, the Bulgarian government decided on the construction of new units at the Kozloduy NPP in October 2023 and pushed forward additional decisions on the management, financing, and procurement of the project since then[14]. The Bulgarian Council of Ministers has decided to start the construction process of the new unit 7 and preparatory work for the future unit 8 at the Kozloduy NPP with the US-technology of AP1000 reactors by Westinghouse. These new capacities of 2300 MWe will be larger than the existing ones totaling 2 GWe. Further challenges lie ahead, as the former minister of energy announced at the beginning of 2023, as many critical parts for the existing units are currently only produced by Russian companies, which makes future maintenance dependent on a sole supplier[15].

This transition to alternative non-Russian energy supplies may seem a bit sharp, but it is corresponding fully to the new status-quo on the European continent. However, a general challenge for the whole EU stays – the prices of the alternative energy sources are still higher than the average historical levels in the past decade and moreover – higher than elsewhere in the world. The oil and gas glut in the United States in the past decade or so, after the development of the shale formations started, still gives an industrial competitiveness sharp edge to American companies. The Chinese energy policy and the national regulations there still could not be qualified as a level paying ground vis-à-vis global trade of industrial goods or even raw and refined materials.

13 Ministry of the Economy, Finance and the Recovery of France (2023) Declaration of the EU Nuclear Alliance, meeting of March 4th, 2024, https://presse.economie.gouv.fr/declaration-of-the-eu-nuclear-alliance-meeting-of-march-4th-2024/

14 World Nuclear News (2023) Bulgaria to push ahead with two new units at Kozloduy, https://world-nuclear-news.org/Articles/Bulgaria-to-push-ahead-with-two-new-units-at-Kozlo

15 Nuclear Engineering International (2023) Bulgaria to continue imports from Russia for Kozloduy NPP, https://www.neimagazine.com/news/bulgaria-to-continue-imports-from-russia-for-kozloduy-npp-10701347/

Industrial Competitiveness and Critical Raw Materials

A clear energy transition will rely on local production of net-zero technologies in Europe, which means in the national markets of the member states. The Council of the EU and the European Parliament achieved political consensus on the Net-Zero Industry Act in February 2024 and concurrently, about the Critical Raw Materials Act (CRMA) which was officially ratified on 18 March 2024. The EU wants to keep and achieve new competitive advantages in clean tech sectors where it demonstrates comparative strength such as wind energy, while aiming to reclaim competitiveness in sectors where it has ceded ground such as solar photovoltaic.

The 19 net-zero technologies within the scope of this Regulation are the following:

- Solar technologies, including solar photovoltaic, solar thermal electric and solar thermal technologies
- Onshore wind and offshore renewable technologies
- Battery and energy storage technologies
- Heat pumps and geothermal energy technologies
- Hydrogen technologies, including electrolysers and fuel cells
- Sustainable biogas and biomethane technologies
- Carbon capture and storage technologies
- Electricity grid technologies, including electric charging technologies for transportation and technologies to digitalise the grid
- Nuclear fission energy technologies, including nuclear fuel cycle technologies
- Sustainable alternative fuel technologies
- Hydropower technologies
- Renewable energy technologies, not covered under the previous categories
- Energy system-related energy efficiency technologies, including heat grid technologies
- Renewable fuels of non-biological origin technologies
- Biotech climate and energy solutions
- Transformative industrial technologies for decarbonisation not covered under the previous categories
- CO2 transport and utilization technologies

- Wind propulsion and electric propulsion technologies for transportation

In addition to the 19 Net-Zero Technologies identified by the NZIA, the CRMA legislation must address the issue that many technologies depend on the extraction and processing of critical materials from abroad. For instance, both onshore and offshore wind turbines are expected to see a significant increase in demand for rare earth metals, projected to rise by a factor of 4.5 by 2030 and 5.5 times by 2050, respectively. Similarly, the adoption of electric vehicle batteries is forecasted to greatly escalate the demand for lithium, expected to increase by a factor of 11 by 2030 and 17 times by 2050, respectively. The EU currently relies on a limited number of suppliers for critical technologies across various stages of their supply chains. Furthermore, for certain technologies, this dependency spans the entire value chain.

Acknowledging the crucial importance of ensuring a secure supply of critical raw materials (CRMs) to support both decarbonisation and digitalization transitions, the European Commission has taken proactive steps. Beginning with the EU Raw Materials Initiative in 2008, the Commission followed with its first Communication on raw materials in 2011, which included the initial list of CRMs and undergoes updates every three years[16].

In 2020, the EU introduced its CRM Action Plan alongside the establishment of the European Raw Materials Alliance (ERMA), an Industrial Alliance focused on enhancing strategic autonomy in the CRM sector. The latest update to the list of CRMs in March 2023 included a proposal for the Critical Raw Materials Act (CRMA), marking a significant development in this field.[17]

More specifically, the CRMs initiatives of the EU's reflect its

16 European Commission (2023) Proposal for a Regulation Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials (COM/2023/160), 16 March 2023, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52023PC0160.

17 Ibid.

Table 2.Strategic Raw Materials			
Bismuth	Gallium	Manganese – battery grade	Rare earth elements for magnets
Boron – metallurgy grade	Germanium	Natural graphite – battery grade	Silicon metal
Cobalt	Lithium – battery grade	Nickel – battery grade	Titanium metal
Copper	Magnesium metal	Platinum group metals	Tungsten

Source: European Commission (2023) Proposal for a Regulation Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials

ambition and are based on three main pillars, which have to work synchronously in a mutually supportive manner:

- Developing the critical raw materials value chain in the EU;
- Boosting the diversification of supply and partnering in a mutually beneficial manner in support of global production;
- Fostering sustainable sourcing and promoting circularity.

The CRMA also sets non-binding 2030 targets for the EU along the entire value chain for SRMs. By 2030, the EU aims to achieve:

- 10% of extraction of EU annual demand of SRMs in the EU;
- 40% of processing of EU annual demand of SRMs in the EU;
- 25% of recycling of EU annual demand of SRMs in the EU.

According to the CRMA, the European Union should avoid relying on any single supplier country for more than 65% of its annual demand for all strategic raw materials (SRMs) at any stage within the value chain.

Bulgaria may be positioned to be part of the solution in this strategic goal as well. The country is third in the European Union in Copper production. There are more than 500 companies working in the mining industry and this also includes the largest company in the country by turnover – Aurubis Bulgaria, a copper smelting factory. The company has announced a €400 million investment into decarbonisation and would be one of the best examples of implementing the Net-Zero Industry concept[18]. The company would considerably increase production capacity in Bulgaria by 110,000 t to total 340,000 t a year. Meanwhile it will lower its carbon footprint through indirect Scope 3 emissions. Other good examples in the same region of the country, Srednogorie, include development projects of the three large adjacent mines.

Conclusion

The biggest risk in the current situation is that European energy policy might fragment into uncoordinated national solutions that only address short-term issues. The greatest opportunity, conversely, lies in creating a new energy policy grounded in geopolitical considerations and sound realism. This approach would enable Europe to tackle its energy challenges with a united front and emerge stronger in the long run.

It is crucial to reassess energy security within national energy and industrial policy frameworks, considering the new realities on the ground. Various solutions can be explored, such as conducting energy supply stress tests, increasing the interconnection of gas and electricity transmission systems, undertaking joint investment projects for electricity generation, and eliminating trade barriers between national markets. However, one of the significant challenges for policymakers at both national and European levels will be balancing energy security with the pursuit of decarbonisation goals while at the same time keeping the industrial activity at the level needed to keep the economy afloat.

One may claim that there are many missed opportunities for Bulgaria in the past two decades to reform and decarbonise its energy and industrial sectors. And one would not be wrong – still the national mix is heavily dependent on fossil fuels, and the national industry is quite energy intensive.

18 Aurubis Bulgaria (2024) Aurubis invests € 400 m in its Bulgarian site and starts expansion of tankhouse and solar park, https://www.aurubis.com/en/bulgaria/media/press-releases/aurubis-invests-euro-400-m-in-its-bulgarian-site-and-starts-expansion-of-tankhouse-and-solar-park

However, new opportunities sometimes arise from hardships. As one of the most reliant on Russian energy countries in the EU, Bulgaria still managed to switch from Russian fuel to alternatives (mostly US-ones) in the nuclear, gas, and oil sectors. Many new RES capacities have been built as well, and the industrial sector is in a good position to decarbonise. Legislation on EU-level such as REPowerEU, CBAM, NZIA and CRMA may provide the needed incentives to go further this way.

One more step has to be implemented meanwhile – the adoption of this EU legislation in the national legal framework. Sometimes this goes well, but sometimes it has also gone wrong. In the political instability, created in the period after 2021 – with six snap parliamentary elections – it has

Source: Stock image from Canva

19 Politico (2024), Bulgaria elections postponed as political crisis deepens, https://www.politico.eu/article/bulgaria-elections-postponed-president-rumen-radev-kalin-stoyanov-political-crisis/

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Chapter 2

Italy: The Energy Crisis in Italy: an Overview of Challenges and Mitigation Measures

Chapter 2

The energy crisis in Italy: an overview of challenges and mitigation measures

Simona Benedettini

Fondazione Luigi Einaudi, Freelance consultant on power & gas sector regulation for EU and non-EU operators and public bodies

Abstract

The current paper discusses the main interventions adopted in Italy to mitigate the impacts of the energy crisis on energy bills and energy security. Measures implemented in 2021 and 2022 have been examined. A comparison with the measures adopted in other Member States is also provided. Following the benchmarking analysis, a discussion of the implications of mitigation measures on the effectiveness and harmonisation of the EU energy policy is provided.

Keywords: Italy, energy policy, energy security, energy crisis

Introduction

The energy crisis of 2021 and 2022, following the invasion of Ukraine by Russia, led EU Member States to adopt a variety of policy interventions aimed at diversifying gas supply sources, reducing the impact of gas prices on energy bills, and pushing forward the independence from fossil fuels by making more ambitious decarbonisation targets. However, implementing such policies has followed harmonised patterns across Member States putting at risk the competitiveness of the EU on global markets. This chapter provides an overview of the policy interventions implemented across EU Member States and outlines the risks in terms of competitiveness for the EU as a whole in the global arena. In addition, the chapter outlines the challenges that EU Member States shall face to implement the more ambitious decarbonisation targets as a result of the intention to achieve greater independence from fossil fuels in the medium and long term.

An analysis of the Italian policies to mitigate the impacts of the energy crisis

From a survey of the main measures introduced by the Member States to deal with the exceptional increases in gas and electricity prices, five different types of interventions might be identified:

- measures to contain energy spending by families and businesses;
- measures to tax profits of energy utilities;
- measures to reduce the use of natural gas for electricity generation;
- measures to reduce spikes in wholesale electricity prices;

- measures to cap retail electricity prices.

Italy adopted a wide range of measures across the above-mentioned categories. Key details on the adopted interventions are presented below.

Measures to contain energy spending by families and businesses

Measures relating to the containment of energy spending by families and businesses include a vast set of interventions that can be grouped into the following categories:

- reduction of the value-added tax or other sources of fiscal imposition on electricity and gas consumption such as e.g. excise duties, fees for the financing of incentive schemes for the production of electricity from renewable sources or the promotion of energy efficiency;
- recognition of tax credits on companies' energy spending;
- provision of benefits or strengthening of existing benefits for customers in financial difficulty.

The measures adopted by Italy have mainly concerned the elimination of the so-called general system charges on household and business bills, and the provision of tax credits to companies on the expenditure incurred for electricity and gas supply during the most intense months of the energy crisis. Besides, these measures also refer to the enhancement of tax concessions granted in the form of direct rebates on bills to end customers in economically distressed conditions (the so-called social bonus or discount).

General system charges are components of electricity and gas bills aimed at financing activities of general interest for the national electricity and gas systems. Inter alia, these include components to cover support for renewable sources, to support the promotion of energy efficiency, or research and development activity aimed at technological innovation of general interest to the electricity system.

In Italy, Social bonuses are paid with reference to two parameters: the economic conditions of the household and the size of the household.

As economic conditions worsen and the number of household members rises, the amount of bonus paid increases. The economic situation is measured through the ISEE indicator (Indicator of Equivalent Economic Situation), i.e. by using a synthetic indicator aimed at capturing the income capacity of the household targeted for potential relief.

The following table indicates the main measures adopted between 2021 and 2022 in Italy.

Legislation	Main Measures
Legislative Decree n. 73/2021	• Reduction of general system charges (i.e. component of the electricity bills financing general costs of the electricity system, such as the support to renewable electricity generation) for low-voltage customers
Legislative Decree n. 130/2021	• VAT reduction (5%) on gas consumption bills for all types of customers •Reduction of general system charges (i.e. component of the gas bills financing general costs of the gas system, such as energy efficiency certificates) on gas consumption bills for all types of customers
Legislative Decree n. 4/2022	• Zeroing of general system charges for customers with power capacity >16.5kW (i.e. mainly enterprises) •Tax credit (20%) for the electricity consumption expenditure of energy-intensive enterprises
Legislative Decree n. 17/2022	• Zeroing of general system charges for all types of electricity customers • Increase the amount of the social discount for disadvantaged customers and those with serious health conditions in both the electricity and gas sectors • Tax credit for the gas consumption expenditure for gas-intensive enterprises (15%)

Legislation	Main Measures
Legislative Decree n. 21/2022	• Tax credit (12%) on the electricity consumption expenditure of end customers with power capacity >16.5kW • Tax credit (20%) for the gas consumption expenditure of non-gas enterprises • Increase the tax credit (from 20% to 25%) for the electricity consumption expenditure of energy-intensive enterprises • Extension of the eligibility perimeter of the social discount for disadvantaged customers and those with serious health conditions
Legislative Decree n. 50/2022	• Increase to 25% of the tax credit for the gas consumption expenditure of non-gas intensive companies • Increase to 15% of the tax credit for the electric consumption expenditure of non-energy intensive enterprises (i.e. power capacity >16.5kW)
Legislative Decree n. 115/2022	• Suspension of the right of retailers to perform unilateral modifications of electricity and gas supply contracts until 30/4/2023 • Zeroing of general system charges for Q4 2022 for all types of customers • Reduction of VAT (5%) and general charges on gas consumption bills for all types of customers

Legislation	Main Measures
Legislative Decree n. 144/2022	• Increase to 40% of the tax credit for energy-intensive enterprises • Increase to 40% of the tax credit for gas-intensive enterprises • Increase to 40% of the tax credit for non-gas-intensive enterprises • Increase to 30% of the tax credit for non-energy-intensive enterprises (power capacity >4.5kW)
Financial law for 2023	• Increase to 45% of the tax credit for energy-intensive enterprises • Increase to 45% of the tax credit for gas-intensive enterprises • Increase to 45% of the tax credit for non-gas-intensive enterprises • Increase to 35% of the tax credit for non-energy-intensive enterprises (power capacity >4.5kW)

Other EU countries have adopted similar measures. Here are some examples of this aspect for France, Spain, and Germany[1]:

FRANCE

- From February 2022 to January 2023, the tax on electricity (essentially an excise tax) - the so-called taxe intérieure sur la consommation finale d'électricité (TICFE) - was reduced from €22.50/MWh to €1/MWh for residential customers and to €0.5/MWh for

1 For details and reference on energy crisis' legislative interventions across EU Member States please consult the Agency for The Cooperation of Energy Regualtors: https://app.powerbi.com/

businesses.

- In spring 2021, the French government supported 5.8 million domestic customers with a one-off voucher of €100. Between December 2022 and February 2023, a €200 one-off rebate was given to 13 million vulnerable clients, i.e., clients with income below €10,800/year. In contrast, a one-off support of €100 was given to domestic clients with annual income between €10,800 and €17,400.

SPAIN

- From June 2021 to December 2021, the reduction of VAT from 21% to 10% was approved for electricity customers with installed capacity of less than 10kW.

- From September to December 2021, the reduction of special tax on electricity consumption from 5.11% to 0.5% for businesses and households was introduced.

- From November 2021 to March 2022, the increase in bill relief for vulnerable consumers from 25% to 60% was introduced.

- From July 2022 to December 2022, the reduction of VAT on electricity consumption from 10% to 5% for all end customers was adopted.

GERMANY

- Reduction of the EEG (Erneurbaer-Energien-Gesetz) tax component for covering renewable subsidies on electricity prices from 6.5 cents/kWh to 3.72 cents/kWh (from April 2022 to July 2022) with subsequent zeroing of the same from July 2022. An increase in the discount on electricity supply to vulnerable customers until December 2030 in the form of an 80% reduction in electricity price for the most vulnerable household customers and 65% for vulnerable but characterised by greater severity of economic hardship.

- Modification of the methodology for calculating the price for the last resort service for gas consumers to mitigate the impact of wholesale price volatility on the tariff of last resort. Also, the prohibition of increased raw material costs not exceeding 15 percent per quarter and per consumer subject to Tariff of Last Resort was introduced until 31

December, 2023.

Measures to tax profits of energy utilities

The implementation of taxation measures to cap profits of energy utilities due to spikes in electricity prices took different modalities and targeted different kinds of energy market operators. In the following, a description of such measures is provided.

The first type of intervention is the taxation of the profits of enterprises operating in the electricity, gas, coal, and oil markets through production, sales, or import activities. This measure consists of taxing at a rate in addition to that of ordinary corporate income taxation the profits of enterprises falling into the above categories.

The second type is related to the adoption of measures to oblige certain types of electricity-generating facilities to return to the state part of the revenues earned in the electricity market. Usually, this measure has been applied to owners of generation plants other than those producing on the ground of natural gas. E.g. such generation facilities might be electricity generation plants, based on renewable sources coal-fired plants or nuclear power plants (so-called 'infra-marginal technologies' of electricity generation). Given the operating rules of the electricity market, the increase in wholesale electricity prices has resulted in higher-than-average revenues achievable under 'normal' conditions for these types of plants. Therefore, some member states have intervened by setting wholesale electricity price threshold values (€/MWh) above, which revenues earned by these plants on wholesale electricity markets must be returned. The resources thus collected by the state are usually used to finance measures for the support of household and business bills. This measure, like its predecessor, was then subject to harmonisation by an October 2022 EU Regulation 2022/1854, which sought to standardise the way it was implemented among the EU member states.

Both measures have been implemented in Italy via concrete law-level legislation. Thus, Decree-Law no. 4 of 2022 provided for a two-way compensation mechanism on the revenues earned by certain types of power generation plants: 1) photovoltaic plants with a capacity of more than 20 kW that benefit from fixed premiums deriving from the Conto Energia mechanism, which are not dependent on market prices; 2) plants with a capacity of more than 20 kW powered by solar, hydroelectric, geothermal, and wind sources that do not access incentive mechanisms, which entered into operation before 1 January 2010; and 3) plants subject to the on-site exchange and dedicated withdrawal regime.

The mechanism, referred to as 'two-way compensation', requires plants subject to the measure to return the difference, if positive, between the price achieved on the electricity markets for the sale of the electricity produced and a reference price set by the decree itself. In the case of a negative difference, plant owners retain the difference. The mechanism was applied from February to December 2022. The reference price is differentiated by geographical area and on average is equivalent to a value of €60/MWh.

Further, Decree Law No. 21 of 2022 introduced an additional tax rate of ten percent to be paid by companies engaged in the production, resale, and import of electricity and gas or the production, extraction, resale, import, distribution, and trade of petroleum products. The taxable base for the calculation of the extraordinary contribution is defined as the increase in the balance between active and passive transactions, net of VAT, calculated on the period between October 2021 and March 2022, compared to the same six months relating to 2020 and 2021. The contribution is payable only if the increase in the balance of active and passive transactions exceeds five million Euros, and increases of ten percent or less are not relevant. The measure was later updated by Decree-Law No. 50 of 2022, which increased the rate for the extraordinary contribution from 10 percent to 25 percent. Later, Budget Law 2023 further amended the measure – it provided for the application of a 50 percent rate on the portion of income determined for the computation of the national tax on the profits of enterprises. This was related to the tax period prior to the one in progress on 1 January 2023, that exceeds by at least 10 percent the average of total income determined for corporate income tax purposes earned in the four tax periods before the one in progress on January 1 2022. The amount of the extraordinary contribution may not exceed an amount equal to 25% of the value of equity as of the closing date of the fiscal year prior to the one in progress on 1/1/2022.

Other EU Member States adopted similar measures:

GREECE

In July 2022, the European Commission approved the transitional market mechanism (duration 1 year) that introduces a cap on the revenues of electricity generation plants based on the estimated cost of production of different technologies. The mechanism applies to thermoelectric, renewable, and hydro plants participating in the wholesale electricity market. However, it does not apply to renewable plants that have entered into long-term contracts for the receipt of incentives in the form of feed-in-tariff and feed-in-premium.

SPAIN

From September 2021 until the end of 2023, Spain applied a reduction in revenues, earned by renewable electricity generation plants (including hydro plants) over the reference price set for natural gas-fired power plants (see 'Interventions on wholesale electricity prices' below). Plants, which have not participated in any form of public incentives within the period were excluded from the measure.

GERMANY

From December 2022 until April 2024, a form of taxation of energy companies' extra profits has been introduced in line with the provisions of European Regulation No. 2022/1854 on an emergency intervention to address high energy prices. The measure will partially finance interventions on electricity and gas end prices (see below).

Measures to reduce the use of natural gas for electricity generation

This type of intervention can manifest itself through two different types of measures:

- reduction of electricity consumption during so-called daily peak hours and implementation of the EU Regulation 2022/1854;
- interventions aimed at maximising the production of electricity from sources other than natural gas.

These types of interventions include, for example, the postponement of the closure of some coal-fired or nuclear power plants in Europe; the adoption of special regimes that, together with obligations imposed on the transmission system operator responsible for dispatching electricity in the markets, allow coal-fired power plants to be given priority over gas-fired plants in meeting electricity demand at a given time of day.

Italy adopted both types of measures - these have been adopted by the vast majority of EU Member States.

Measures to reduce spikes in wholesale electricity prices

Measures other than those concerning the limitation of revenues of electricity companies in the form of profit taxation mechanisms fall into this category. The latter, in fact, do not interfere with the way wholesale electricity prices are determined. These continue to be formed according to the rules of all time and are thus left free to take on the values determined from time to time by the meeting of electricity supply and demand.

In contrast, interventions that fall into this typology influence the value that energy prices, may take on during different hours of the day as a result of the encounter between electricity supply and demand in wholesale markets. This is the case with the so-called Spanish and Portuguese tope. The measure consists of an adjustment to the cost of production of electric generation technologies from fossil sources by a value equal to the difference between: 1) a natural gas reference price administratively set through the regulatory measure that introduced the so-called 'tope'; 2) the actual daily natural gas price observed on the Iberian natural gas spot market. The plants covered by the measure are mainly gas-fired electric generation plants although the measure also operates, with appropriate adjustments, for coal-fired power plants. The administratively determined natural gas reference price is equal to, for the first six months of application of the mechanism, €40/MWh. From the seventh month of application of the mechanism, the reference price will be increased by €5/MWh until it reaches the maximum value of €70/MWh.

The adjustment is financed through a contribution bestowed by buying operators in wholesale markets and through additional congestion rents from trading with France. Operators purchasing on wholesale markets contribute to the coverage of the adjustment in proportion to the volumes purchased. The contribution is then passed on to end customers who, however, will still suffer a lower cost than they would have incurred

Interventions in the form of capping final electricity prices, or in the form of setting them, have been adopted by most member states, albeit to varying degrees. I

in the absence of the cap on the gas price for gas-fired power plants. The additional congestion rents obtained in the monthly capacity allocation auctions related to the interconnection with France are those earned each month since the application of the mechanism incrementally compared to those earned in the same month of the previous year.

The adjustment was applicable for 12 months from the date the mechanism took effect (May 2022). For combined-cycle plants, the measure was effectively invariant, since the difference between the fuel price cap and the market price of gas would still be covered by the adjustment. Otherwise, the measure indirectly results in a cap on the revenues achievable in the wholesale market from infra-marginal technologies. The measure has been extended until December 2023.

Italy did not adopt any of these types of measures.

Measures to cap retail electricity prices

Interventions in the form of capping final electricity prices, or in the form of setting them, have been adopted by most member states, albeit to varying degrees. In any case, any form of intervention in the prices charged to final customers required coverage of the losses incurred by suppliers and determined by the difference between the costs they incur in the wholesale supply of electricity and the sale of it at a price lower than the costs incurred.

Italy did not adopt any of these types of measures.

Some of the most important measures launched at the European level with reference to electricity and natural gas end prices are as follows:

FRANCE

Adoption until the end of 2022 of a cap on the final price of natural gas for domestic customers who have decided to join the regulated price regime. The cap was set at the value of the October 2021 gas price. The measure was extended through 2023 with a 15 percent increase and was also extended to SMEs.

Adoption of a cap on the increase in electricity prices for domestic customers who join the regulated price regime. The cap was set equal to 4 percent. The measure was extended through 2023 covering SMEs as well as households. The price of electricity will increase by 15 percent from February 2023 compared to 2022.

GERMANY

Cap on the final price of natural gas for domestic and SME customers starting from March 2023 with retroactive application for January and February 2023 as well. The cap is applied to 80 percent of natural gas consumption and is set at 12 cents per kilowatt hour, which is a discount from the market price.

A similar measure has been introduced with reference to final electricity prices and provides for a cap of 40 cents per kilowatt hour for households and small businesses with annual consumption of up to 30,000-kilowatt hours. The cap applies concerning 80 percent of electricity consumption.

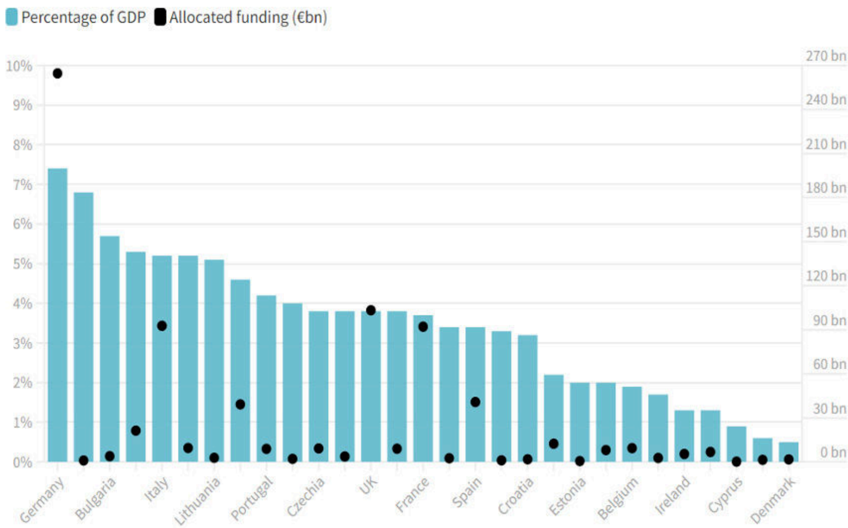
For medium and large enterprises with annual consumption of more than 30,000-kilowatt hours, the cap has been set equal to 13 cents per kilowatt hour, in addition to network tariffs, fees, charges, and taxes. The cap applies with reference to 70 percent of electricity consumption.

For industrial customers, a fixed price of 7 cents per kilowatt hour for gas is to be applied from January 2023 up to 70% of their consumption.

Even though Italy and other Member States adopted similar measures to mitigate the impacts of the energy crisis, such homogeneity does not necessarily translate into a homogeneity also in effects. In this regard, an emblematic fact concerns the amount of public spending (in absolute value and percentage terms compared to GDP) given from the beginning of the crisis to today for the containment of energy spending by families and businesses.

As shown in the Figure below, the amount of aid granted by individual

Member States to businesses and families is very different. While Germany has provided approximately 264.6 billion euros (equal to 7.4% of GDP), Italy and France have allocated 92 billion euros (5.2% and 3.7% of their GDP, respectively). Spain, on the other hand, has reserved only 40 billion euros (3.4% of its GDP) for aid for families and businesses, and Portugal - approximately 9 billion euros (4.7% of its GDP).



geopolitics in more general terms.

In particular, the United States and China appear to become the main contenders in global markets due to the importance that their respective economies have, and will increasingly have, in guaranteeing, respectively energy security and essential materials for the pursuit of increasingly challenging decarbonisation objectives.

Conclusion

In this framework, Europe seems destined to have a secondary role, at least in the medium term, in order to guarantee energy security, in the process of cutting off its dependence on Russian gas, and the necessary resources to complete the energy transition process. However, if Europe manages to exercise its leadership role, adequately supporting its industries and adequately managing its relations with neighbouring countries which can represent an outlet for its energy sector (primarily Africa and the Middle East), new balances could emerge – and this might lead to a situation where the Old Continent will become the guide and model of the geopolitics of decarbonisation.

To this aim, Italy's geographical location offers the opportunity that the country could play a strategic and central role in the geopolitical balance and in the energy transition process, which is taking shape following the Russian invasion of Ukraine. In particular, Italy can aspire to represent a physical, political, and economic bridge between Europe, the Middle East, and Africa, promoting both European leadership in the path of decarbonisation of the energy sector and the privileged channel through which to promote the diversification of energy supply sources, natural gas and, consequently, energy security. In fact, international cooperation incl. that with the African and Middle Eastern regions, constitutes a central pillar of the REPowerEU Plan.

The potential that the Mediterranean regions, and of Italy in particular, can express in facilitating the energy transition process and the security of supplies requires, other conditions being equal, physical infrastructures that allow both Europe and third countries to provide a tangible commercial outlet for collaborations and investments initiated. In this direction, Italy is a candidate to play a top-level role, also recognised by Europe, as demonstrated by the various existing projects.

Thus, in December 2022, the Italian Ministry of the Environment started the authorisation process for the Elmed project, i.e. the electricity connection infrastructure between Tunisia and Italy developed jointly by Terna, the Italian grid manager, and STEG, the Tunisian grid operator. The new connection, which should come into operation in 2028, will connect the Partanna electrical station (in the province of Trapani) with a corresponding station on the Capo Bon peninsula (Tunisia). The project is included both in the Development Plan of Terna's National Transmission Grid and in the List of Projects of Common Interest of the European Commission. The work involves the construction of a submarine electricity connection over 200 km in length which will reach a maximum depth of 800 meters and which will allow the exchange of electricity in a bidirectional mode between Tunisia and Italy for a maximum power of 600 MW. The infrastructure will allow not only to increase the adequacy of the Italian and European electricity system - i.e. to ensure the continuity of supplies in the face of an ever-increasing electrification of final consumption - but also the development of new electricity generation projects from renewable sources both in Italy and in North Africa. These developments will in turn allow to accelerate the production of green hydrogen at sustainable costs and, other conditions being equal, also a European industrial chain in terms of energy transition as underlined several times in the European Commission's Strategy on international cooperation.

In this direction, it is also worth mentioning the construction of the EastMed gas pipeline already included by the EU in 2013 in the list of Projects of Common Interest. The project is also referred to in the REPowerEU Plan as a strategic infrastructure to ensure the diversification of European supply sources. The infrastructure, which should come into operation in 2027, will transport natural gas, and in a subsequent phase also hydrogen, from the Levantine basin off the Israeli coast to Puglia. On this route, the pipeline will cross Cyprus, Crete, and Greece until arriving in Puglia. The annual transportation capacity of the pipeline will be 11 to 20 billion cubic meters per year.

More in general, Italy has been a pioneer among Member States in initiating a policy of diversification of natural gas supplies and can today rely on the following agreements:

Generally speaking, the development of new electricity and gas transport infrastructures is not only a source of greater energy security and an indirect push towards the decarbonisation process. But it is also indirect by encouraging the creation of new energy infrastructures which in turn contribute to the transition and energy security. This is precisely the case

Origin	Destination	Beginning of the Agreement	Volumes (bn m3)/year
Algeria	Italy	S2 2022	4
Algeria	Italy	2023-24	5
Angola	Italy	-	1,5
Azerbaijan	UE	2027	10
Congo	Italy	2023-4	4,5
Egypt	Italy	2022	3

of gas pipeline networks and regasification plants.

New partnerships with Mediterranean countries both for the transportation of gas via pipeline, as in the case of the EastMed project, and in the case of LNG, require an adequate natural gas transportation infrastructure that carries the gas thus supplied from the point of landing to the areas of the country where the greatest consumption is located. In this regard, Italy is already committed to strengthening the so-called Adriatic backbone, i.e. strengthening the gas transport capacity between Sulmona and Minerbio (Bologna). The project consists of building a compression station in Sulmona and a single gas pipeline with three independent sections for a length of approximately 430 km in the Sulmona-Minerbio section. The infrastructure constitutes an enhancement - in the form of a backbone parallel to the existing one - of the infrastructure that transports gas from southern Italy to Minerbio where the methane pipelines wind their way to the main market areas and storage areas of northern Italy. The new gas pipeline will allow us to increase transport capacity along the South-North route by approximately 10 billion m3 per year. The strategic nature of the infrastructure for the area of Central and South-Eastern Europe has been recognised by the European Commission also in the context of the REPowerEU Communication.

In addition to guaranteeing the security of supplies, the creation of new infrastructures produces positive effects on the economic growth and employment of a country through: (i) facilitating the transfer of goods instrumental to the exercise of economic activity; and consequently, (ii) the promotion of the transfer of skills most necessary for the specific economic activities that are established in a territory. In general, infrastructures allow the physical size of markets to be increased, while promoting intense specialisation. The latter is particularly important if – in parallel to the energy transition process - Italy and the other Member States intend to develop national green energy industrial chains that lead to Europe's industrial leadership in this area. In fact, once the character of 'endogeneity' between economic and infrastructural growth has been ascertained, there are numerous contributions in economic theory that have confirmed how the development of infrastructure promotes economic growth and not vice versa.

Further, the creation of adequate infrastructures would in fact make it possible to promote the development of skills and an industrial supply chain to the benefit of local economies and the creation of value from the energy transition process.

Chapter 3

Republic of North Macedonia: Making the Most of the 280 Sunny Days Annually – The Vibrant Case of North Macedonia

Chapter 3

North Macedonia: Making the Most of the 280 Sunny Days Annually – The Vibrant Case of North Macedonia

Ivan Durgutov

Executive Director at the European Business Association - North Macedonia

Introduction

As the European Union strives to enhance its energy security and transition to a sustainable future, the potential of candidate countries like North Macedonia comes into sharp focus. With its abundant sunny days and strategic geographical location, the country is poised to make important contributions to the EU's energy framework, particularly in a regional context. At the same time, in June 2024 the recently established government and the parliamentary majority introduced a several new ministries, including the Ministry of Energy, Mining, and Minerals[1]. While this looks like a good move, the results of this ministry's work in the upcoming period are still to be seen

Meanwhile, on this ground, the current article delves into the various

1 https://vlada.mk/node/36507?ln=en-gb

facets of North Macedonia's solar energy potential, exploring its current landscape, economic and environmental benefits, challenges, and opportunities, and provides recommendations for future development. Also, it discusses in brief the country's main document in the field – the National Energy and Climate Plan – NECP[2].

1. Current Situation – Solid Solar Energy Potential in North Macedonia

Climate and Solar Irradiance

North Macedonia boasts approximately 280 sunny days per year, making it an ideal location for solar energy production. There is even a saying that the sun is so present in the country, it is even on the national flag. The country's Mediterranean and continental climate ensures high solar irradiance levels, which are crucial for the efficiency of solar panels. Solar irradiance, the power per unit area received from the sun, is a critical factor in determining the feasibility and productivity of solar energy projects.

Thus, North Macedonia's high solar irradiance levels, coupled with its long daylight hours, present a significant opportunity for harnessing solar power.

Studies indicate that the average solar irradiation in North Macedonia

2 https://www.economy.gov.mk/content/Official%20NECP_EN.pdf

There have been no significant success stories in the past decade, especially among G-20 countries, which account for approximately 80% of global carbon emissions.

ranges from 4.2 to 5.5 kWh/m^2/day, which is higher than many European countries. This means that within the country, solar panels can generate more electricity per unit area, making solar energy projects more viable and profitable[3].

Geographical Advantages

North Macedonia's strategic location in the Balkans provides additional advantages for solar energy development. The country's varied topography, which includes plains, plateaus, and mountains, offers numerous sites suitable for large-scale solar farms. The flat plains in the Vardar valley and Pelagonia region are particularly well-suited for solar panel installations due to their extensive land area and high sunlight exposure.

Moreover, the country's central location in the Balkans makes it a potential hub for energy distribution to neighbouring countries. This geographical advantage can be leveraged to create a regional solar energy grid, enhancing energy security and cooperation among Balkan states.

1.1 Current Renewable Energy Landscape

North Macedonia has made significant strides in developing its renewable energy infrastructure. The country's first solar power plant, Oslomej, was inaugurated in 2021, marking a significant milestone in its renewable energy journey. With a capacity of 10 MW, Oslomej has set the stage for further solar energy projects[4].

In addition to solar power, North Macedonia also utilises other renewable energy sources, including hydropower and wind energy. However, the country's renewable energy capacity, remains underutilised, with solar power accounting for a small fraction of the total energy mix.

Government Policies

The Government of North Macedonia has recognised the importance of renewable energy and has implemented several policies to support its

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3 https://solargis.com/maps-and-gis-data/download/north-macedonia

4 https://balkangreenenergynews.com/north-macedonia-completes-first-solar-park-on-abandoned-coal-pit/

development. The National Energy Efficiency Action Plan 2025-2030[5] outlines the country's commitment to increasing the share of renewable energy in its total energy consumption. The plan aims to achieve a 23% share of renewable energy by 2025, significantly improving the current situation, with solar power playing a key role in this transition.

Incentives such as feed-in tariffs, tax breaks, and subsidies for renewable energy projects have been introduced to attract private investment. These policies have created a favourable environment for the growth of the solar energy sector, encouraging both domestic and international investors to explore opportunities in North Macedonia.

1.2 Economic and Environmental Benefits

Energy Independence

One of the primary benefits of developing solar energy in North Macedonia is the potential for its independence from energy-related imports. Currently, the country relies heavily on imported fossil fuels to meet its energy needs. This dependence on external sources makes North Macedonia vulnerable to fluctuations in global energy prices and supply disruptions. This was seen as a case especially in the recent crisis with the Covid-19 pandemic and the war in Ukraine, as it was a heavy burden for many other countries worldwide, too.

Therefore, by harnessing its abundant solar resources, North Macedonia can reduce its reliance on imported energy and enhance its energy security. Solar power can provide a stable and sustainable source of electricity, decreasing the country's exposure to volatile energy markets and geopolitical risks.

Economic Growth

The development of the solar energy sector can drive economic growth in North Macedonia by creating jobs, attracting investment, and diversifying the economy. The construction, operation, and maintenance of solar power plants generate employment opportunities across various skill levels. From engineers and technicians to construction workers and administrative staff, the solar energy sector can create thousands of jobs,

5 https://economy.gov.mk/Upload/Documents/d5ffe318c59f4f99944a9aafac9f55db.pdf

contributing to economic development and reducing unemployment[6].

Moreover, the influx of investment in solar energy projects can stimulate economic activity in related industries, such as manufacturing, construction, and services. Local businesses can benefit from increased demand for goods and services, fostering a positive economic cycle.

2. Challenges and Opportunities

Technological and Financial Barriers

Despite the numerous benefits, the development of solar energy in North Macedonia faces several challenges. Technological barriers, such as the high initial cost of solar panels and energy storage systems, can hinder the adoption of solar power. Although the cost of solar technology has decreased significantly in recent years, it remains a substantial investment for many households and businesses.

Financial barriers, including limited access to financing and high interest rates, can also impede the growth of the solar energy sector. Although, there are some forms of incentive stimulations, mainly, for households, the country still lacks a more organised and systematic way of providing aid in this regard. Securing funding for large-scale solar projects can be challenging, particularly for small and medium-sized enterprises (SMEs) and startups.

Policy and Regulatory Framework

A robust policy and regulatory framework is essential for the successful development of the solar energy sector. While North Macedonia has made progress in this area, further improvements are needed to attract private investment and foster public-private partnerships. As stated in this year's progress report by the European Commission, North Macedonia, a country with open accession talks, is moderately prepared in the area of energy. Some progress was made in regional gas interconnectors and in renewable energy, with investments in solar power plants, however, last year's recommendations were not fully implemented.

EC points out that the energy crisis has demonstrated that North Macedonia needs to accelerate its transition towards green energy and reduce its dependence on gas and coal. The report recommends that in the coming year, the country should ensure, a coherent energy policy,

6 https://neighbourhood-enlargement.ec.europa.eu/north-macedonia-report-2023_en

> Collaborating with neighboring countries on joint solar energy projects and integrating into the EU energy grid can enhance energy security and promote regional stability.

improve governance and institutional capacity in the energy sector, improve strategic investment programming and accelerate the transition towards green energy in accordance with the Green Agenda for the Western Balkans and the national energy strategy. In addition, the country should update and implement the national energy and climate plan-NECP), in line with the 2030 Energy Community climate and energy targets, adopt and implement the energy efficiency implementing legislation, complete the unbundling (certification) of the gas transmission systems operators and foster market development and regional market integration.

Regional Cooperation

Regional cooperation presents significant opportunities for the development of solar energy in North Macedonia. Collaborating with neighboring countries on joint solar energy projects and integrating into the EU energy grid can enhance energy security and promote regional stability.

By participating in regional initiatives, such as the so-called Berlin Process or officially, the Western Balkan 6 Initiative, six Contracting Parties - Albania, Bosnia and Herzegovina, Kosovo, North Macedonia, Montenegro, and Serbia integrated into this Initiative to strengthen regional cooperation and drive sustainable growth and jobs. With participation in such initiatives as the Energy Community and the Balkan Green Energy Initiative[7], the country can further leverage shared resources and expertise to advance its renewable energy goals. Regional cooperation can also facilitate the exchange of best practices, knowledge transfer, and capacity building,

7 https://www.energy-community.org/regionalinitiatives/past/WB6.html#:~:text=Launched%20in%202014%2C%20the%20Western,regional%20cooperation%20and%20driving%20sustainable

accelerating the development of the solar energy sector.

2.1 Case Studies and Success Stories

Local Successes

Several successful solar energy projects and initiatives in North Macedonia highlight the country's potential in this sector. The Oslomej solar power plant, with its 10 MW capacity, is a prime example of a successful solar energy project that has garnered international attention. The plant has demonstrated the feasibility of large-scale solar power generation in North Macedonia and has paved the way for similar projects[8].

Another notable example is the installation of solar panels on public buildings and schools across the country, such as the latest news said it about the third biggest city in the country, Bitola[9]. These projects not only generate clean energy but also raise awareness about the benefits of solar power and promote its adoption among the general public.

International Examples

Drawing parallels with successful renewable energy strategies in similar climates worldwide can provide valuable insights for North Macedonia. Countries such as Spain, Greece, and Italy, which have similar climatic conditions, have made significant advancements in solar energy development.

Spain, for instance, has become a global leader in solar energy, with extensive solar power installations and a well-developed regulatory framework. The country's success can be attributed to strong government support, favourable policies, and significant investment in research and development. Macedonian society can learn from Spain's experience and adopt best practices to accelerate its solar energy development.

3. The path forward

Considering the situation as described above, there are several parallel tracks to pursue success. Some of them involve strategic initiatives, innovation and research, public awareness and education and other areas.

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8 https://balkangreenenergynews.com/north-macedonia-completes-first-solar-park-on-abandoned-coal-pit/

9 https://www.bitola.gov.mk преку-проектот-сончеви-училишта-ш/

Strategic Initiatives

To enhance North Macedonia's role in the EU's energy security framework, several strategic initiatives should be considered. First, developing a comprehensive national solar energy strategy that outlines clear goals, targets, and timelines – such a strategy can provide a roadmap for the sector's growth. Certainly, it should be aligned with the EU's energy and climate policies and incorporate input from key stakeholders.

Secondly, dedicated funding mechanisms, such as green bonds and renewable energy funds, should be established to provide the financial resources needed to support solar energy projects. These mechanisms can attract private investment and reduce the financial barriers to solar energy adoption.

Further, investing in research and development (R&D) for advanced solar technologies is crucial for the long-term success of the solar energy sector. North Macedonia can establish research centres and innovation hubs that focus on developing cutting-edge solar technologies, improving energy efficiency, and reducing costs.

In this relation, collaborating with international research institutions and universities can facilitate knowledge transfer and provide access to the latest technological advancements. Additionally, fostering partnerships between academia, industry, and government can drive innovation and create a supportive ecosystem for solar energy development.

Public Awareness and Education

Promoting public awareness and education campaigns is essential for garnering support for the transition to renewable energy. These campaigns can highlight the environmental and economic benefits of solar energy, dispel myths and misconceptions, and encourage adoption among households and businesses.

Educational programs and initiatives can be introduced in schools and universities to equip the next generation with the knowledge and skills needed to participate in the renewable energy sector. By raising awareness and fostering a culture of sustainability, North Macedonia can build a strong foundation for its solar energy future.

On the benefits, but also the recommendations

North Macedonia, but also the Western Balkans as a whole have the potential to make a significant contribution to the EU's energy security and climate goals through the development of its solar energy sector. By leveraging its abundant sunny days, favourable climatic conditions, and strategic geographical location, the country can become a key player in the EU's transition to a sustainable and secure energy future.

The benefits of solar energy extend beyond energy independence and environmental sustainability. The development of the solar energy sector can drive economic growth, create jobs, and attract investment, contributing to North Macedonia's overall development. However, realising this potential requires addressing the technological, financial, and regulatory challenges that currently hinder the growth of the solar energy sector.

Stakeholders, policymakers, and investors are invited to explore the insights presented in this article and collaborate towards harnessing the full potential of solar energy in North Macedonia. By working together, the relevant governments and stakeholders can strengthen the EU's energy security, promote sustainable development, and create a brighter future for North Macedonia and the European Union as a whole. This was the keynote topic of this year's MEF – Macedonian Energy Forum 2024, where high-level politicians, business leaders and diplomatic corps representatives gathered together to discuss ways to achieve greener country and society which will utilise the sun it has for greater goods[10].

Analysis and Discussion

A. Technological Advancements and Innovations

Advanced Solar Panel Technologies

One of the critical factors driving the growth of the solar energy sector is the continuous advancement in solar panel technologies. Over the years, technological innovations have significantly improved the efficiency and affordability of solar panels. In North Macedonia, adopting advanced solar panel technologies, such as bifacial panels, thin-film solar cells, and perovskite solar cells, can enhance the overall performance and cost-effectiveness of solar energy projects.

10 https://mef.mk

Bifacial solar panels, for instance, can capture sunlight from both sides, increasing energy production by up to 30% compared to traditional monofacial panels. Thin-film solar cells, known for their flexibility and lightweight properties, can be integrated into various surfaces, including rooftops and building façades. Perovskite solar cells, although still in the research phase, have shown great promise due to their high efficiency and low production costs.

Energy Storage Solutions

Energy storage is a critical component of the solar energy ecosystem, addressing the intermittency of solar power and ensuring a stable and reliable energy supply. Developing and deploying advanced energy storage solutions, such as lithium-ion batteries, flow batteries, and thermal storage systems, can enhance the integration of solar energy into the national grid.

Lithium-ion batteries, widely used in various applications, offer high

Source: Stock image from Canva

energy density and long cycle life, making them suitable for both residential and commercial energy storage. Flow batteries, which store energy in liquid electrolytes, provide scalability and long-duration storage capabilities, ideal for large-scale solar power plants. Thermal storage systems, which store excess solar energy as heat, can be used for heating applications and power generation during periods of low sunlight.

B. Financing and Investment Opportunities

Public-Private Partnerships

Public-private partnerships (PPPs) can play a crucial role in financing and developing solar energy projects in North Macedonia. By combining public sector support with private sector expertise and investment, PPPs can overcome financial barriers and accelerate the deployment of solar energy infrastructure. The government can provide incentives, such as tax breaks, subsidies, and grants, while private investors can bring capital, innovation, and operational efficiency to the projects.

Green Bonds and Sustainable Finance

Green bonds and sustainable finance mechanisms can provide a reliable source of funding for solar energy projects. Green bonds, specifically issued to finance environmentally friendly projects, can attract a wide range of investors, including institutional investors, banks, and individuals. The proceeds from green bonds can be used to finance the construction, operation, and maintenance of solar power plants, as well as research and development initiatives.

Sustainable finance mechanisms, such as green loans and climate funds, can also support the growth of the solar energy sector. These financing options often come with favourable terms and conditions, encouraging investment in renewable energy projects and promoting sustainable development.

C. Policy and Regulatory Enhancements

Strengthening Legal Protections and Streamlining Administrative Procedures

Ensuring robust legal protections for investors is crucial to building investor confidence and encouraging long-term investment in the solar energy sector. Clear and transparent regulations, along with strong enforcement mechanisms, can provide a secure and predictable environment for investors. Protecting intellectual property rights, enforcing contracts, and resolving disputes efficiently can further enhance the attractiveness of North Macedonia as a destination for solar energy investment.

Sustainable finance mechanisms, such as green loans and climate funds, can also support the growth of the solar energy sector.

D. Regional Cooperation and Integration

Cross-Border Energy Projects

Collaborating with neighbouring countries on cross-border energy projects can enhance regional energy security and promote economic integration. Joint solar energy projects, such as shared solar farms and interconnected grids, can optimise resource utilisation and reduce costs. By participating in regional energy initiatives, North Macedonia can benefit from shared expertise, economies of scale, and increased market access. One of the latest examples, in the concrete case building the first wind park and utilizing the wind which is present in the country, i.e., in the Municipality of Bogdanci[11], near the border with Greece, can be used as a good starting point for building upon a region where the problems are seen as possibilities. These two countries have shown some improvements in their communication and collaboration in the recent year and the energy field should be just an additional one when a cross-border project can take place[12] .

Integration into the EU Energy Grid

Integrating North Macedonia's solar energy production into the EU energy

11 https://www.wbif.eu/project-detail/PRJ-MKD-ENE-001

12 https://www.wbif.eu/10-years-success-stories/success-stories/north-macedonia-plugs-greener-future-through-wind-power

grid can provide additional benefits, including access to a larger market, improved energy security, and enhanced grid stability[13]. By connecting with the EU energy grid, North Macedonia can export excess solar power to neighbouring countries and import electricity during periods of low solar production. This integration can also facilitate the balancing of supply and demand, reducing the need for energy storage and backup power plants.

E. Education and Workforce Development

Training and Certification Programs

Developing a skilled workforce is essential for the growth of the solar energy sector. Implementing training and certification programs for solar energy professionals, such as engineers, technicians, installers, and maintenance personnel, can ensure a steady supply of qualified workers. These programs can be offered through vocational schools, technical institutes, and universities, providing hands-on training and practical experience.

Research and Academic Collaboration

Promoting research and academic collaboration can drive innovation and support the development of advanced solar technologies. Universities and research institutions can collaborate with industry partners to conduct research, develop new technologies, and solve technical challenges. Establishing research centres and innovation hubs focused on renewable energy can create a supportive ecosystem for solar energy development.

Conclusion

North Macedonia's abundant sunny days and favourable geographical conditions present a unique opportunity for the country to become a leader in solar energy. By addressing the technological, financial, and regulatory challenges, and by fostering regional cooperation, innovation, and public awareness, North Macedonia can significantly contribute to the EU's energy security and climate goals.

The development of the solar energy sector can drive economic growth,

13 https://finance.gov.mk/2023/09/23/сефф-2023-побрза-конвергенција-кон-еу-за-п/

create jobs, and enhance environmental sustainability, benefiting both North Macedonia and the broader European region. Stakeholders, policymakers, and investors are encouraged to explore the potential of solar energy in North Macedonia and collaborate towards a sustainable and secure energy future.

In conclusion, the path forward for North Macedonia involves strategic initiatives, robust policies, and active collaboration with regional and international partners. By harnessing its solar energy potential, North Macedonia can play a vital role in the EU's transition to a sustainable and secure energy future, setting an example for other candidate countries and contributing to global efforts to combat climate change.

It is imperative for all stakeholders – including government authorities, private investors, international organisations, and the general public – to take collective action in realising the solar energy potential of the Macedonian sun. By investing in solar energy projects, supporting policy reforms, and promoting public awareness, we can build a resilient and sustainable energy system that not only benefits North Macedonia but also strengthens the EU's overall energy security.

The time to act is now, and the possibilities are as bright as the 280 sunny days that North Macedonia enjoys each year.

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Chapter 4

Moldova: From Energy Crisis to Energy Security

Chapter 4

Moldova: From Energy Crisis To Energy Security

Ana Otilia Nutu

Senior energy policy analyst at Expert Forum (EFOR) - Romania

Abstract

The chapter is a case study on Moldova focusing on how the 2021-2022 energy crisis radically accelerated developments in Moldova's interconnectivity with the EU and decarbonisation. Today Moldova finds itself in a better energy security position than in 2021, having access to market-based, alternative supplies to Russian energy, and is less vulnerable to the Kremlin's blackmail. Challenges remain, as Russia still attempts to use energy to influence political processes within the country, fuel social unrest, and sow divisions at a time when the country faces elections and a referendum that will decide the European future of Moldova.

Introduction

Until the end of 2021, Moldova had been virtually entirely dependent on Russian supplies of electricity and gas. These two sectors are of critical importance for energy security as they are network-bound, which limits effective competition in the absence of adequate transport infrastructure and renders a country dependent on suppliers accessible on the route.

Overall, for the past decade, Russia had been supplying about three billion cubic meters (bcm) of gas to Moldova per year. Of these, one bcm went to the so-called 'right bank' - the Chisinau-controlled territory of Moldova; while the remaining two bcm were sent to the separatist region of Transnistria. The latter consumed most of the gas for the production of electricity in the Russian-controlled power plant at Kuciurgan (owned by Inter RAO); the remaining amounts were envisaged for energy-intensive industries, such as the metallurgical plant at the city of Rabnita.

In effect, Kuciurgan supplied up to 80% of the electricity consumed by the households and industry on the "right bank". However, the option for replacing this "imported" energy was that Chisinau had the alternative to purchase from Ukraine - but if such energy was available. Thus, Russia could, de facto, cut the physical delivery of gas at any time, which would also lead to a potential electricity crisis in case, for any reason, Ukraine was unable to provide the needed quantities of power. This dependence was caused by the lack of other options for physical access to alternative gas and electricity supplies. Moldova's gas grid allowed only physical imports of Russian gas via Ukraine, and both Moldova and Ukraine were connected to the Russian power grid, incompatible with the European continental network.

Given the absence of alternative suppliers, Moldova never had the proper incentives to take steps towards changing the situation – including to fully implement EU rules, liberalise the markets, and diversify away from Russian energy sources.

Physical interconnectivity

Russia's pressures on Europe had intensified well ahead of the full-scale invasion of Ukraine in 2022, and energy was one of the instruments most intensively used by the Kremlin. Thus, in early autumn 2021, Russia decided to cause a wide-scale shortage in the European gas market ahead of the heating season, which put pressure on prices across the continent and triggered concerns that gas in storage would not suffice to get through the winter. Moldova was also affected by the regional gas shortage.

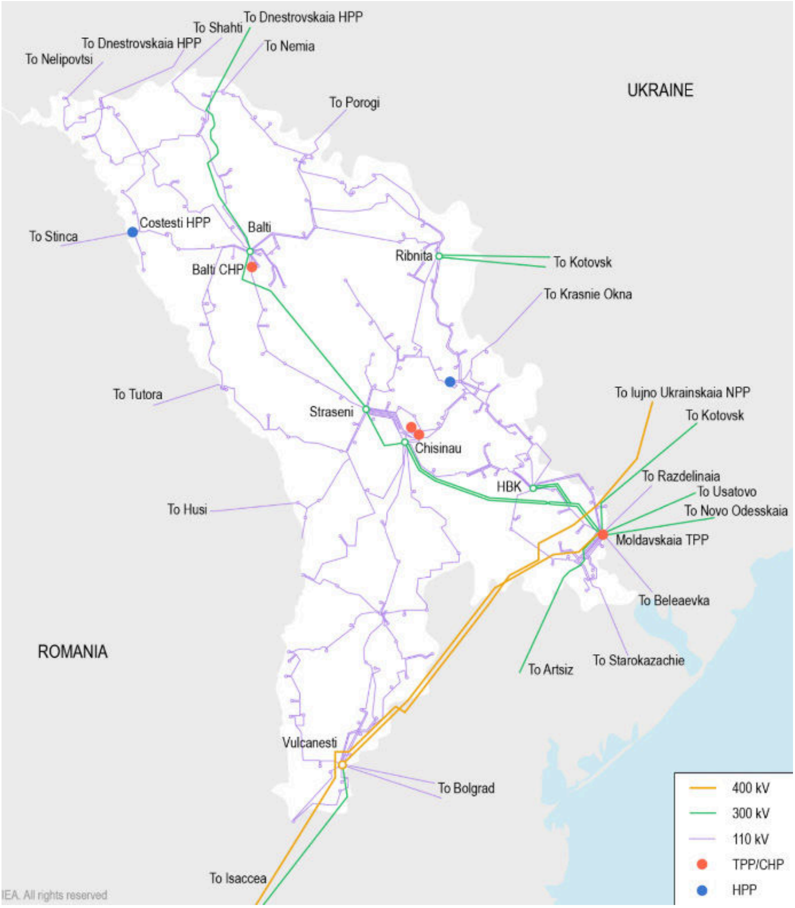
However, Gazprom's market manipulation backfired, and most EU countries woke up in late 2021 to new imperatives of energy security, accelerating interconnections and energy efficiency measures, as well as considering the diversification of energy sources. The gas shortage prompted, inter alia, both Romania and Moldova to accelerate the finalisation of the interconnection on gas (a project, which started in 2014 which was missing the final pieces of a section on Romanian territory[1]) - and to look for diversification of supplies. Though Romania was itself in a gas shortage in 2021 and did not export gas to Moldova, the physical availability of the interconnection meant from the beginning that Moldova could access Romanian storage and had, in principle, a backup in case of a major crisis.

Similar developments took place in electricity: the urgencies related to Russia's aggression accelerated projects that had started many years before. Ukraine and Moldova had been working for several years to disconnect from the Russian power grid and connect to the pan-European continental grid ENTSO-E. One of the tests - a 3-day decoupling from Russia and operation in isolation from both Russia and the EU - started on the morning of February 24, 2022, and Ukraine rejected the idea of reconnecting to the Russian power system after the start of the full-scale war. Both Moldova and Ukraine were connected to the European power grid as an emergency measure in March 2022, though originally the synchronisation was planned to take place only a year later. Again, it was precisely the Kremlin's aggression that prompted a faster decoupling of the region from Russia's energy monopoly: in the case of Moldova, the synchronisation meant that technically it could import electricity right away from Romania. Two years on, Moldova has signed a Memorandum of Understanding with Romania[2] to develop further infrastructure and strengthen institutions, such as energy exchanges and trading platforms; whereas the construction of two power lines is in full swing, expected to be completed the first in 2025, the second in 2027. These would allow imports from Europe to completely bypass the Russian-owned Kuciurgan power plant in Transnistra and avoid even a theoretical situation in which Russia could destabilise Moldova's power system by a 'technical mishap' (see Figure 1 below). Overall, the increasing availability of alternative supplies from Europe over the past two years meant that all forms of energy blackmail that Russia could use gradually subsided.

Figure 1. Moldova's electricity system

1 O. Nutu, D. Cenusa (2016), 'Interconnecting Moldova's Gaz Market: the Iasi-Ungheni Case', https://expertforum.ro/en/files/2016/05/final-report-moldova-gas-interconnection.pdf

2 The memorandum (2023) is available at: https://gov.md/sites/default/files/document/attachments/nu-83-maeie-men-2024_0.pdf



Note: Currently, all power lines pass through Kuciurgan power plant (Moldavskaia TPP, owned by Inter RAO). It is the only supplier of balancing energy (without which Moldova cannot invest substantially in intermittent renewables); and could, in theory, disrupt Moldova's power system by some 'technical mishap'. Source: IEA, https://www.iea.org/reports/system-integration-of-renewables-in-moldova-a-roadmap/context-of-renewables-in-moldova-s-electricity-sector

Historical (real or invented) debts

In the past, Russia had successfully employed different instruments from its energy toolkit against Moldova. Some of these are presented further.

For years, Russia's relationship with Chisinau concerning gas supplies was built on fictions, veiled threats, distortions of facts, and outright lies, covering large-scale corruption. Thus, in 1999, Gazprom gained control over Moldova's gas grid, operated by Moldovagaz, receiving 50% of the company's shares on behalf of arrears accumulated for previous non-paid gas deliveries[3]. Later, Gazprom used the dubious status of the separatist, non-recognized Transnistria to increase Moldova's debts to unbearable levels. Gazprom thus allowed Transnistria to default on payments without cutting supplies for more than a decade. The Kremlin considered the debt as, de facto,'Moldova's' debt, while claiming at the same time this was a purely commercial business deal between corporate entities functioning as in any Western country, and for which the Kremlin itself bore no responsibility. In 2018, the total debt calculated by Gazprom on Moldovagaz (where, as mentioned above, it controlled 50% of the shares) exceeded 9 bn USD, or more than 90% of Moldova's GDP. Chisinau itself allowed the nonsense to continue, partly for lack of alternatives, and partly because it was a lucrative deal for key decision-makers in Moscow, Tiraspol, and Chisinau. In the mid-2010s, for example, Moldovans were buying electricity at prices about 10% higher than on the Romanian market from Kuciurgan power plant through an offshore intermediary (Energokapital), licensed by the Moldovan energy regulator. The Moldovan consumers' money was being syphoned off before reaching Kuciurgan power plant, and the latter had no resources to pay for the Russian gas, the debt accruing on Gazprom's accounting[4].

While Moldova had no physical access to alternative supplies of energy, the deals with Russia were at the same time inescapable. In parallel, they were a good excuse to delay institutional reforms, such as building a strong regulator to ensure offshore traders with dubious track records are no longer licensed to operate, or using the 'unbundling' requirement

3 T. Iascenco (2006), 'Intermediarii facliei albastre' [Intermiediaries for the blue flame], Ziarul de Garda, https://www.zdg.md/old/72/economic/1.php

4 On various corruption scandals concerning Russian energy supplies to Moldova and enhancing Russia's grip on the country, see Expert Forum (2017), 'Energy, Russian Influence and Democratic Backsliding in CEE', https://expertforum.ro/en/files/2017/05/Final-countries-report-coperta.pdf

> Though not necessarily a result of direct Russian influence, Romania's own poor governance in the energy sector played in favor of Gazprom's interest not to have competitors in the region region.

of EU gas directives to recoup the control over the gas grid from the supplier Gazprom. In reality, previous governments in Chisinau also had little political will to effectively join the European Union at some foreseeable point in the future and reform the energy sector, which would have meant reducing the space for corruption in the process. On the other bank of the Prut river, Romania was not particularly interested in accelerating interconnections on gas and electricity due to a set of reasons. First, producers and suppliers would not have been inclined to enter a market in which the incumbents did not follow market rules. Second, exporting gas, even to Moldova, remained a sensitive topic: until the mid-2010s, Romania's own regulation of its gas market was rather targeted at subsidising the local oligarch in the fertiliser industry than at achieving best value for the gas resource in a competitive market. Though not necessarily a result of direct Russian influence, Romania's own poor governance in the energy sector played in favor of Gazprom's interest not to have competitors in the region[5].

On electricity, the situation had additional challenges - most notably, the incompatibility of Romania's and Moldova's power grids (the first, connected to the pan-European continental grid, the latter to Russia). Apart from the construction of simple power lines, this required the installation of specialised equipment (back-to-back stations converting 'European' electricity into 'Russian' one) that was prohibitively expensive and which may have turned out not to be needed in the end, if Moldova and Ukraine were to join ENTSO-E in just a few years[6].

5 See also Expert Forum (2019), 'War by other means: Kremlin's energy policy as a channel of influence', https://expertforum.ro/en/kremlins-energy-policy-as-a-channel-of-influence-a-comparative-assessment/

6 O. Nutu, D. Cenusa (2017), 'The Bridge over the Prut, version 2.0 - the electricity interconnection between Romania and Moldova', https://expertforum.ro/en/the-bridge-over-the-prut-version-2-0/

These obstacles were overcome after 2021-2022 for two main reasons: political will in Moldova and Romania, and the availability of physical interconnections. Both reasons were reinforced by Russia's aggression towards Ukraine. Moldova's government after 2020 is decisively pro-European; whereas Romania had to respond to the energy crisis in Moldova also because several hundred thousand Moldovans have a second Romanian citizenship and vote.

It turned out that the matter of historical debts was easy to solve. Gas consumption is metered separately on the 'right bank' and in Transnistria. Gazprom actually kept separate tabs for the two parties. The 'right bank's debt, if reviewed objectively - as opposed to an arbitration court in Moscow or the board of Moldovagaz controlled by Gazprom itself - is mostly non-existent. In 2022, hoping to pressure Moldova, Gazprom argued it would not continue deliveries unless Chisinau agreed to pay immediately the outstanding debt of 900 mn USD. Chisinau called the bluff and asked for an international audit - which showed that the debt that could be actually documented was not 900 mn, nor 700 mn, but about 9 mn USD[7]. Despite the fact that Moldovagaz' board (with 50% ownership Gazprom) refused to recognise the audit, Chisinau has no intention to pay or continue the discussion, in the end giving up Russian supplies of gas altogether, as explained below.

Effective policy solutions

Moldova's Tasks

As indicated by the diversification and clarification of contractual matters with Gazprom in the past two years, Moldova's best strategy to ensure energy for its consumers is to align with EU rules, become effectively a part of the European energy market, diversify supply and optimise (reduce inefficient) consumption. In fact, it is precisely this strategy that may turn out to solve previously insoluble problems, such as dealing with separatism in Transnistria or in the autonomous region of Gagauzia; and it is completely aligned with the goals of the European Green Deal.

7 The audit report is available at https://energie.gov.md/ro/content/rapoarte, Moldovagaz debt audit: https://energie.gov.md/ro/content/rapoarte

The remaining question is whether Moldovans could pay market prices for energy to compete with other Europeans in a market in deficit, as in 2021-2022. This is the reverse of the concern posed by Romanian energy suppliers in the past: whether they could de facto compete in a market where the incumbents can allow for decades of non-payment or subsidised tariffs. Dealing with this situation requires consistent commitment from Brussels and Bucharest to support the Moldovan budget and provide a social safety net for the most vulnerable consumers while not distorting incentives for energy efficiency and market development.

Thus, in 2022, Russia caused disruptions of energy supplies in Moldova, directly and indirectly, with the intention to cause social unrest and destabilise the political situation in the country ahead of the winter season. The targeted attacks on Ukrainian energy infrastructure from October 2022 onwards caused two blackouts in Moldova, illustrating the country's vulnerability on energy; it also raised the level of urgency in Romania to provide energy supplies in case of need[8].

Though these power blackouts may have been unintentional (just a side effect of the destructions targeted at Ukraine, if that were an excuse), the

8 A. Marculescu Matis (2022) '"Rusia a lasat Moldova pe intuneric". Concret, ce a facut Romania pentru moldoveni in criza energiei' ["Russia left Moldova in the dark". Concretely, what did Romania do for Moldovans in the energy crisis'], https://panorama.ro/romania-republica-moldova-ajutor-energie/

The remaining question is whether Moldovans could pay market prices for energy to compete with other Europeans in a market in deficit, as in 2021-2022.

Kremlin increased the pressures on Moldova systematically by reducing gas supplies by 30% in October, and by 50% in November 2022. It used the pretext of transit disruptions in Ukraine, breaching the contract for supplies to Moldova[9]. The objective of these reductions was to cause tensions between Chisinau and Tiraspol, as the two sides could not agree on how to split the gap in gas supplies. Chisinau insisted on an equal reduction, whereas Tiraspol demanded not to have its gas consumption reduced at all, otherwise threatening to cut the deliveries of power supply from the Kuciurgan plant. There followed a short period in which both sides played hardball: Transnistria cut power supply until the matter was resolved, and Chisinau appealed to Romania to show it has alternatives. Despite Romania providing energy to Moldova not at the market price, but at a regulated price it had also adopted for its own domestic consumers (95 USD/MWh), on the consideration that many Moldovan citizens also have Romanian citizenship, it was still more expensive than Cuciurgan's price (60 USD/MWh)[10].

In the end, Chisinau and Tiraspol agreed to separate completely Transnistria's deal with Gazprom. Since December 2022, Transnistria benefitted the entire quantity of Gazprom's gas, and continues to supply electricity to the 'right bank' at low prices (covering 70% of the consumption), whereas Chisinau procures gas elsewhere, from Romania, Azerbaijan, or various gas traders in Europe[11].

9 Jurnal.md (2022), 'Gazprom reduce din nou cantitatea de gaze naturale livrate Republicii Moldova' [Gazprom reduces again the gas supply to Moldova], https://www.jurnal.md/ro/news/bc28603afaa8e8d1/gazprom-reduce-din-nou-cantitatea-de-gaze-naturale-livrate-republicii-moldova.html

10 R. Pirca (2022), 'Producatorii de energie din Romania, obligati sa vanda curent Moldovei la un pret extrem de mic' [Romanian energy producers, required to sell electricity to Moldova at an extremely low price], Wall Street Romania, https://www.wall-street.ro/articol/Economie/290476/producatorii-de-energie-din-romania-obligati-sa-vanda-curent-moldovei-la-un-pret-extrem-de-mic.html

11 E. Lupu (2024), 'Destabilizare in Transnistria. Chisinaul cumpara curentul pentru a mentine stabilitatea regionala' [Destabilisation in Transnistria. Chisinau buys electricity to maintain regional stability], https://bani.md/destabilizare-in-transnistria-chisinaul-cumpara-curentul-pentru-a-mentine-stabilitatea-

EU's Tasks

It must be added that the EU's contribution has been of paramount importance to secure energy provision at affordable prices, to increase interconnectivity with Romania, and to leverage Romania's support. Both the gas and electricity interconnections with Romania have been and are supported by EU funds, either grants or loans through EBRD and EIB. The EU provided financial assistance for energy consumers to deal with energy price increases at the height of the crisis[12]; it also delivered emergency supplies; besides, it invested significant resources for energy efficiency measures, particularly for buildings. These forms of support must continue, accelerating the development of interconnectors and of the institutional setup for a fully (physically and commercially) integrated Moldovan energy market in the EU's gas and electricity markets.

The acceleration of these reforms, both in Brussels and Chisinau, pay off. Following the developments with the energy supply, in reality, Chisinau has increasing leverage over Transnistria and may in fact play this card intelligently to reintegrate the separatist region. No one, neither Tiraspol, nor Chisinau, has the interest of causing a humanitarian crisis in Transnistria by cutting energy. Transnistria itself cannot support the separatist so-called authorities without the financing from the Kremlin in the form of free or low-cost gas, which feeds 40-50% of the region's budget[13]. In theory, Russia could abandon permanently Transnistria to cause serious damage to Moldova by triggering such a humanitarian crisis, but that route is one way only, and the Kremlin would lose the very last serious card it has over Moldova. In the past two years, de facto, Transnistria's dependence on Chisinau has grown more substantial, while Moscow's leverage declined accordingly. After Ukraine shut down its

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regionala/

12 In November 2022 the EC announced a 250 million EUR financial support precisely to deal with the social impact of the energy prices - see Statement by President von der Leyen at the joint press conference with Moldovan President Sandu (2022), https://ec.europa.eu/commission/presscorner/detail/en/statement_22_6762

13 Stiri.md, (2022), 'Tofilat: fara gaz rusesc, Transnistria se va confrunta cu o criza umanitara', https://stiri.md/article/politica/tofilat-fara-gaz-rusesc-transnistria-se-va-confrunta-cu-o-criza-umanitara/

borders with Transnistria right after the beginning of the full-scale war, the region can only export items such as (gas-subsidized) metallurgical products from Rabnita plant to the EU via the 'right bank'. In addition, the agreement for gas transit between Ukraine and Russia expires at the end of 2024. From that moment onwards, Transnistria's physical access to Russian gas will require transit through the 'right bank', which is another leverage that Chisinau can use to pressure for reintegration[14].

Instead of conclusion: Russia's remaining tool in energy is disinformation

Overall, Russia seems to have lost the main advantages it once had on Moldova's energy sector precisely as a result of its aggression against Ukraine - yet another wild miscalculation, on a par with the 'three days to Kiev', 'we will freeze Europe', and 'we did it to stop NATO from expanding'.

However, the Kremlin will continue to seek to destabilise the political situation in the country by disinformation, as well as other forms of hybrid aggression imaginable, from cyberattacks to direct financing of anti-European politicians. Figures such as the runaway oligarch Ilan Shor or his party colleague Evghenia Gutul, the controversial governor of Gagauzia playing the 'soft separatism' card, are the first examples that come to attention[15].

In October 2024, Moldova has presidential elections coupled with a referendum for EU accession. The latter topic is extremely sensitive for the Kremlin and likely a target for huge disruption efforts; in 2025 Parliamentary elections will follow, in which the current pro-European leadership will face serious challenges, particularly from Kremlin-backed factions, but also from citizens dissatisfied with the current pace of

14 D. Dermenji (2023), 'Transnistria ar putea ramane fara gaz in 2024' [Transnistria could remain without gas in 2024], https://moldova.europalibera.org/a/transnistria-ar-putea-ramane-fara-gaz-rusesc-in-2024-expert-chisinaul-trebuie-sa-fie-gata-de-reintegrare-/32483922.html

15 Gutul has just been put by the US on a sanctions list for her connections with the Kremlin; she also meets regularly with Putin. A. Tanas (2024), 'US sanctions pro-Russia governor of Moldova's Gagauzia', https://www.reuters.com/world/us-sanctions-pro-russia-governor-moldovas-gagauzia-region-2024-06-12/

> Moldova's energy sector becomes increasingly difficult as Moldova gets more and more integrated into European markets and rules, Russia still has a good energy narrative it has been using successfully in the past.

reforms. While direct interference with Moldova's energy sector becomes increasingly difficult as Moldova gets more and more integrated into European markets and rules, Russia still has a good energy narrative it has been using successfully in the past. That is, 'Russia can always provide a better energy deal than Europe'. Indeed, it can provide lower prices for some time, but at the enormous expense of political freedom. Gutul herself, as representative of the pro-Russian politicians in the country used the 'better Russian energy deal'[16] card successfully both before being elected and in her conflict with Moldova's president Maia Sandu (who refused to appoint her in the government because of Gutul's controversies).

Disinformation concerning energy prices, along other narratives attempting to discredit the EU and pitch a part of the population against Europeanization reforms, may be particularly harmful for the EU referendum in October. Energy would thus remain Russia's remaining leverage to watch, precisely as the referendum overlaps with the beginning of the next heating season.

16 The fake narrative was debunked by the fact checking website veridica.ro, 'Fake news: Evghenia Gutul aduce gaz de 10-20 de ori mai ieftin in Gagauzia decat tariful actual' [Evghenia Gutul brings gas to Gagauzia 10-20 times cheaper than the current price], November 7, 2023, https://www.veridica.ro/stiri-false/fake-news-evghenia-gutul-aduce-gaz-de-10-20-de-ori-mai-ieftin-in-gagauzia-decat-tariful-actual

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Chapter 5

Romania: Energy Consumer Protection and Contracts for Difference in Romania after the Russian Invasion of Ukraine

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Corina Murafa, PhD

Independent public policy expert

Christian Busu

Director and university professor, PhD

Stere Stamule

University Lecturer at Bucharest University of Economic Studies

Abstract

Compared to other EU Member States, Romania is in a relatively advantageous position with regard to diversified supply and energy independence (import dependency of 32.6% vs. 60% EU average). However, the dependency on Russia in certain key supplies (e.g.: natural gas, oil) stood relatively high, at approximately 30%, before the invasion. Russia's full-scale invasion of Ukraine triggered unprecedented electricity prices in Romania, which led the government to implement a cap and compensation system for domestic consumers and small business, and Contracts for Difference Scheme for private investors.

Romania has always been one of the few European countries to enjoy a diversified, relatively low-carbon energy mix and a low import dependency in the energy sector.

This article presents two case studies of energy policy interventions that illustrate how an EU Member State, namely Romania, dealt with the consequences of the Russian invasion of Ukraine and assesses the effectiveness and impact, short-term and long-term, of both interventions. These two instruments are a Contracts for Difference scheme and a cap and compensation system for end-user prices.

Keywords: *energy resilience, geopolitical turmoil, energy poverty, contracts for Difference, renewable energy support*

Context

State of play in the energy market of Romania before the Russian invasion

Romania has always been one of the few European countries to enjoy a diversified, relatively low-carbon energy mix and a low import dependency in the energy sector. Before the Russian invasion, Romania's overall dependence on energy imports stood at 32.6% (Source: National Statistics Institute). Energy independence has been considered a crucial national policy goal in the past decades, including to the detriment

of overt enthusiasm over the integration in the Single Energy Market. However, the August 2020 version of the National Energy Strategy for 2020 - 2030 with a 2050 perspective, acknowledged the fact that energy independence as a concept must be replaced with energy security. It also foresaw, as one of the eight strategic objectives, that Romania become a regional energy security supplier, primarily through the exploitation of its Black Sea natural gas reserves, but also through the ramp-up of domestically produced renewables. Thus, as Romania is one of the few EU Member States with domestic oil and gas production and with a full nuclear cycle (including uranium mining), its energy import dependency before the full-scale invasion started was low. Although there was a slight increase, energy import dependency was still low in 2021 for Romania compared to other Member States, where energy import dependency stood at close to 60%. More specifically by type of fuel the energy import dependence in 2021 stood at 26.2% for coal, 67.9% for oil, and 25.4% for gas. Gas had faced the sharpest increase, from merely 11.4% in 2017 to 23.7% in 2020 and 25.4% in 2021, due primarily to a reduction in internal natural gas production[1].

In February 2022, the month when the Russian invasion started, Romanian gas imports represented 29.18% of its consumption (approximately 24% from Russia and 4% from other sources, namely the CEE markets, via the interconnector with Hungary), while domestic production stood at 70.82%[2]. As far as oil is concerned, Russian imports totalled approximately 32% of all of Romania's oil and oil products imports, and Romania was not importing any electricity from Russia, but approximately 4% of its electricity imports originated from Ukraine in 2021.

As far as solid fuels (namely coal) are concerned, Romania had a similarly advantageous position as for other energy sources, in the sense that

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1 Data compiled based on Romanian National Energy Regulatory Authority (ANRE) monthly monitoring reports of the natural gas market, available at https://anre.ro/despre/rapoarte/ (last accessed 1.09.2024);

2 Source: Romanian Economic Monitor, available at https://econ.ubbcluj.ro/roem/ and National Energy Regulatory Authority Monthly Natural Gas Monitoring Report, February 2022, available at https://anre.ro/wp-content/uploads/2023/03/Raport-lunar-de-monitorizare-a-pietei-interne-de-gaze-naturale-pentru-luna-februarie-2022.pdf (Both last accessed on 15 June 2024);

close to 90% of its total inland consumption is based on domestic sources. Nonetheless, out of the 1,611 thousand tonnes it imported, 1,024 thousand tonnes (63%) came from Russia.

Table 1. sums up Romania's Russian import dependency.

Table 1: Romania's Russian energy import dependency before the Russian invasion

Fuel Type	Proportion in energy mix
oil and oil products	36%
natural gas	30%
coal and coal products	14%
renewables	12%
nuclear	8%

Source: European Commission, Romania Energy Snapshot October 2022

Even though, at least as far as oil and gas were concerned, Romania had a relatively weak position vis-a-vis Russia. However, it was not through security of supply issues that the country was mostly hit in the aftermath of the conflict, but through the energy prices spike. As the electricity market is interconnected with the European one, the electricity price hikes on the European markets quickly reverberated in Romania. On the other hand, what must be noted is that electricity prices had started to increase about six months before the invasion, demonstrating the volatility of fossil energy prices and the broader vulnerability of energy markets to external price shocks, even in the absence of an overt military confrontation, let alone in the case of one.

Several policy responses were implemented right after the invasion, and two of them shall be further presented in more details - the cap and compensation mechanism for end-user prices and Contracts for Difference.

Case study 1: Policy measures to address energy poverty

Policy responses after the Russian invasion

As wholesale prices increased by up to 400% and as the energy market was fully liberalised for domestic consumers, the first response the government took was focused on regulating energy prices. Thus, the Romanian government enacted a series of ad hoc legislative decrees to mitigate the impact of escalating prices on specific consumer categories and compensate suppliers through levies imposed on the extraordinary profits of energy producers.

The initial policy intervention materialised in March 2022 (EGO 27/2022) and entailed the capping of end-user prices for households and natural gas prices for consumers. Under this scheme, prices were capped at 0.68 RON/kWh for households with average monthly consumption below 100 kWh, 0.8 RON/kWh for households with average monthly consumption between 100 kWh and 300 kWh, and a maximum of 1 RON/kWh for non-households. Similarly, natural gas prices were capped at a maximum of 0.31 RON/kWh for households, regardless of consumption levels, and at 0.37 RON/kWh for non-households and heating producers delivering thermal energy to households. These price caps were initially intended to be in effect from April 2022 to March 2023, but currently got extended to 2025, requiring an immense budgetary effort: in 2023 alone the budget deficit rose from 2.6% to 3.6% due to the cap and compensation system, as its value fluctuated from 0.5 billion EUR in 2022, to 2 billion EUR in 2023, going back down in 2024, as markets calmed down.

The implementation of this policy approach necessitated frequent and ad hoc corrections, occurring at bi-weekly intervals, indicating the limited capacity of national authorities to adopt robust, evidence-driven policy measures and foster stakeholder consensus. To sum up, the overarching ad hoc response of the government was a comprehensive re-regulation of various market segments through the implementation of a price cap and compensation system, which also included the centralisation of electricity purchasing, incurring considerable costs. This expenditure was only partly offset by the levies collected from energy companies.

One interesting failed policy during the crisis was the adoption of energy demand reduction measures. These were notably absent. Proposals for voluntary or even mandatory demand reduction measured by the

> Renewables emerged as a prominent substitute, effectively displacing coal owing to favourable weather conditions, namely mild winter temperatures, and more stringent storage obligations.

European Commission[3] were met with resistance from national decision-makers, citing concerns over energy sovereignty, existing relatively low energy consumption per capita compared to the European average, and the well-being of citizens. Nonetheless, final energy consumption did decrease in 2022 by 8% (in contrast to the rising trend in the years before), partially through changes in energy consumption behaviour, but also through voluntary measures taken primarily by public administration.

The Recovery and Resilience Facility, as well as the subsequent Repower EU package, focused a lot on increasing the country's energy resilience, primarily through investing in carbon-free domestic production and by encouraging the prosumers movement[4].

Despite the absence of binding final energy consumption reduction targets, the altered consumer behaviours and effective public policies, particularly concerning public building administration, engendered noteworthy energy savings. Nonetheless, domestic gas and coal production did not experience a commensurate rise to compensate for the shortfall in Russian imports. Rather, renewables emerged as a prominent substitute, effectively displacing coal owing to favourable weather conditions, namely mild winter temperatures, and more stringent storage obligations. To the surprise of many, wind and solar

3 See Commission proposal for a Regulation on coordinated demands reduction measures for gas and Communication 'Save gas for a safe winter' available at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:4614900, last accessed 1 September 2024;

4 For a brief reference, see the Country Factsheet for Romania's RRF and REpowerEU, available at https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/romanias-recovery-and-resilience-plan_en#repowereu-measures-in-romanias-plan, last accessed 1 September 2024;

photovoltaics did not exhibit the projected growth, with the state-owned hydropower producer, Transelectrica, assuming the role of the 'saviour' within the national energy system.

In a bid to curtail end-user energy prices increases and to prevent the intensification of energy poverty, a phenomenon that was affecting a significant share of the population even before the crisis, comprehensive price regulation measures were implemented across the board, as described earlier. However, this approach was not without significant trade-offs, as the gains of private players were channelled into a complex and cumbersome cap and compensation system, detracting from potential investments in Indigenous production, novel technologies, and overall security of supply.

The effect of the cap on the energy poverty in Romania

Energy poverty is a critical problem that disproportionately affects certain groups. Combating energy poverty requires targeted strategies that ensure that vulnerable populations are adequately supported. Although there is a law on the definition of the vulnerable consumer, it is not fully applied, in the sense that measures are operationalised only in the form of direct social transfers to households with incomes below a certain ceiling, without considering other vulnerability criteria, such as age, poor housing condition, high energy costs, etc. For over 10 years, despite a legal obligation of the Government to implement a National Plan on Energy Poverty, this has not happened. As a result, when the energy prices crisis in the aftermath of the invasion occurred, the lack of an effective policy coordination mechanism for addressing energy poverty in a targeted manner created a vulnerability in terms of the policy process, because the government had not effective mechanism to direct additional subsidies only to the vulnerable population.

Although growing rapidly, the purchasing power of households in Romania is still relatively low compared to the EU average. On the other hand, the inequality of income distribution creates a significant blanket of vulnerable consumers. At the European level, at the end of 2023, Romania is in the upper half of the value of electricity and natural gas prices for domestic consumers, despite price capping measures. Thus, affordability of the price is a first-order problem, which translates into a high level of energy poverty. Energy poverty is more present in rural areas, especially due to poor housing conditions and poor heating options.

In 2022, 17.8% of Romanian households struggled to pay utility bills, placing Romania third in Europe for energy poverty, following Greece and Bulgaria, according to EUROSTAT[5]. Additionally, 15.2% of Romanians were unable to adequately heat their homes, compared to the EU average of 9.3%[6]. These indicators alone are insufficient to fully capture energy poverty, as they are incomplete and subjective. A more comprehensive assessment, including the weight of energy expenses relative to household budgets, reveals that Romania made progress in reducing energy poverty until 2021, but this trend reversed sharply in 2022 due to the pandemic and the Ukraine war, despite measures like price caps and subsidies[7].

It is not possible to specify how energy poverty would have evolved without the compensation-ceiling mechanism for energy prices, but it is clear that the mechanism did not manage to curb the acceleration of the phenomenon, despite the impressive budgetary commitments. The big problem is that more and more Romanians who previously had no difficulties with the level of bills, end up in a state of energy poverty and the whole socio-economic spectrum is affected, including the middle deciles. The population as a whole is concerned about this phenomenon and it must be taken serious-ly. Financial measures - such as the compensation-ceiling mechanism and heating aids - are im-portant, but they do not produce the expected effect. This means that the causes of energy poverty, which persist and produce effects, are not adequately addressed. Financial measures to combat ener-gy poverty, unaccompanied by structural measures, are not enough. Furthermore, more efficient spending of public money to mitigate energy prices increases would have been brought about by an effective targeting of vulnerable consumers, not a blanket protection mechanism for all consumers irrespective of their financial means. This approach,

5 Source: EUROSTAT Arrears on Energy Bills Indicator, available at https://ec.europa.eu/eurostat/databrowser/view/ilc_mdes07/default/table?lang=en, last accessed 1 September 2024;

6 Source: EUROSTAT Arrears on Energy Bills Indicator, available at https://ec.europa.eu/eurostat/databrowser/view/ilc_mdes07/default/table?lang=en, last accessed 1 September 2024;

7 Source: Romanian Energy Poverty Observatory Annual Monitoring Report, available at https://saracie-energetica.ro/orse-saracia-energetica-afecteaza-jumatate-dintre-gospodariile-din-romania/

however, necessitates a significant dedication of administrative resources to understanding energy poverty, monitoring the phenomenon, and identifying affected groups.

Case study 2: Contracts for Difference

Description of the CfD Scheme (CfD=contracts for difference)

On January 24, 2024, the Ministry of Energy sent the notification regarding the State Aid Scheme in the form of contracts for difference for the production of electricity from onshore wind energy and photovoltaic solar energy, following the Commission Communication – Temporary Crisis and Transition Framework for State Aid measures to support the economy following Russia's aggres-sion against Ukraine (hereinafter referred to as CTCT (TCTF)) under section 2.5.2 Operating aid granted to accelerate the introduction of renewable energy and energy storage.

The implementation of the Contracts for Difference (CfD) scheme in Romania marks a pivotal ad-vancement in the nation's renewable energy strategy. By mitigating the financial risks associated with fluctuating electricity prices, the CfD mechanism ensures a stable and predictable revenue stream for investors. This stability is a crucial incentive for both domestic and international stakeholders to in-vest in renewable energy projects, thus driving substantial growth in the sector.

One of the foremost benefits of the CfD scheme is the enhancement of investment security. The guaranteed income provided by the scheme attracts capital to renewable energy projects, fostering an environment conducive to long-term, sustainable energy development. This security is particularly vital in encouraging investments in emerging technologies and large-scale renewable projects that might otherwise be deemed too risky.

Moreover, the CfD scheme contributes significantly to the stability of the energy market. By decou-pling revenues from volatile market prices, the scheme ensures that energy producers can plan and operate with greater financial predictability. This predictability, in turn, benefits consumers through more stable energy prices and helps avoid sudden spikes that can result from market fluctuations.

From an environmental perspective, the CfD scheme is instrumental in reducing Romania's green-house gas emissions and decreasing dependence on fossil fuels. By promoting the development of wind, solar, hydro, and biomass energy sources, the scheme supports Romania's commitments to international climate agreements and EU renewable energy targets. The transition to a greener energy mix not only helps combat climate change but also improves air quality and public health.

Despite the evident benefits, the successful implementation of the CfD scheme necessitates careful management. Establishing appropriate strike prices requires thorough market analysis and forward-looking policy planning. Additionally, the scheme demands a long-term commitment from the gov-ernment to maintain investor confidence and ensure its continuity.

According to the provisions of the state aid scheme, the CfD mechanism represents a bidirectional mechanism in which payments for difference may be made under a CfD contract in the following situations:

- by the CfD counterparty to a CfD beneficiary representing the product value between the quantity of electricity produced, measured, and delivered to the SEN (Sistemul Electroenergetic National - National Electric Power System (NEPS)) by the CfD project and sold on organised markets, and the difference value between the strike price and the reference price in situations where the reference price is lower than the strike price; or

- by a CfD beneficiary to the CfD counterparty representing the product value between: the quantity of electricity produced, measured, and delivered to the NEPS by the CfD project and sold on orga-nized markets, and the difference value between the reference price and the strike price in situations where the reference price is higher than the strike price.

Operating aid is granted monthly through payments for the difference in energy produced, measured, and delivered to the NEPS subject to the CfD contract and traded on any organised electricity market only if the reference price is lower than the bid strike price. The reference price means the weighted average of prices (euro/MWh) from any day-ahead markets (PZU (DAM)) operated by any electrici-ty market operator in Romania where the weighting is done with the traded volumes on each such market by CfD beneficiaries who use the same technology, calculated and established by ANRE (NERA) for each monthly billing period following the formula established in the CfD contract and the methodology to be developed and approved by NERA for this purpose. If NERA considers that the reference price no longer reflects market prices, or if notified by more than 50% of CfD benefi-ciaries that the reference price no longer reflects market prices, NERA may review the reference price after consulting all CfD beneficiaries. The strike prices applicable to the auctions for 2024 will not exceed the values of 91 euros/MWh for electricity produced in onshore wind installations and 93 euros/MWh for electricity produced in photovoltaic solar installations, as resulted from the model-ling carried out by NERA. Beneficiaries of the scheme who can sign CfD contracts can only be elec-tricity-producing enterprises registered in Romania for tax purposes.

The provider of the state aid is the Ministry of Energy. The state aid scheme establishes how operat-ing aid will be granted through Contracts for Difference for investments in the production of electric-ity from renewable sources using onshore wind energy and photovoltaic solar energy.

- This scheme aims at concluding Contracts for Difference by December 31, 2025, for pro-jects with a total capacity of 5,000 MW using eligible solar photovoltaic and onshore wind energy production technologies through the organisation of two rounds of auctions in 2024 and 2025 as follows:

- 2,000 MW of installed capacity, of which 1,000 MW of installed capacity for electricity production from onshore wind sources, and 1,000 MW of installed capacity for electricity produc-tion from photovoltaic solar sources as a result of a first CfD auction with a separate bidding proce-dure for each technology, which will take place by the end of the first quarter of 2024.

- 3,000 MW of installed capacity, of which 1,500 MW of installed capacity for electricity production from onshore wind sources, and 1,500 MW of installed capacity for electricity produc-tion from photovoltaic solar sources as a result of a second CfD auction with a bidding procedure for each technology, which will take place by the end of the second quarter of 2025.

The state aid scheme applies from 2024 to the end of 2025, and the period for making payments of the difference is 15 years from the date of commissioning of the electricity production installations.

The CfD beneficiary is obliged to sell the quantity of electricity produced, measured, and delivered to the NEPS by the commissioned capacity covered by the CfD contract only on organised markets, and compliance with this obligation, in order to prevent possible voluntary exclusion from the CfD scheme, will be verified annually by NERA, subject to the penalties applicable in this situation.

In the case where a CfD beneficiary engages in the sale of electricity through bilateral contracts, a profit-sharing mechanism applies, which will be established by NERA in accordance with the methodology developed and approved by NERA for this purpose. The state aid granted under this state aid scheme cannot be cumulated with any other state aid for the same investment project.

Romania's CfD scheme represents a transformative policy tool in the nation's pursuit of sustainable energy development. By offering financial stability and reducing investment risks, the scheme catalyses the growth of the renewable energy sector. It fosters market stability, supports environmental goals, and positions Romania as a proactive player in the global transition to clean energy. Through strategic implementation and steadfast government support, the CfD scheme has the potential to significantly advance Romania's energy independence and environmental sustainability.

Romania's CfD scheme represents a transformative policy tool in the nation's pursuit of sustainable energy development.

All in all, Romania has adequately met the challenges following Russia's aggression in Ukraine. It implemented concrete mechanisms, such as a cap and compensation system to keep the energy bills for end users in check, and a Contracts for Difference mechanism to attract new investors in renewable energy. This paper highlighted both the promises and the limitations of these mechanisms. The main policy lesson that can be driven is the need to use data and evidence in all stages of the policy cycle, from problem definition to evaluation, yet constant use of data is particularly important in the implementation stage, to detect and correct early on deviations from expected results. Using data effectively requires enhanced administrative capacity. As the paper shows, both policy interventions described are vulnerable precisely because of the lack of administrative capacity. For example, the successful implementation of the CfD scheme requires establishing appropriate strike prices, which demands high public management analytical capacity. The ability to protect vulnerable consumers in front of energy prices volatility, entails the ability to perform permanent, effective, data-based monitoring of energy poverty, alongside the identification and targeting of vulnerable consumers. Ultimately, using scarce public budgets efficiently in the energy sector, either through consumer- or investor-targeted interventions, while having the ability to increase energy security and performance of the energy system, requires significant, long-term resource dedication in public management and public administration capacity building.

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Commission proposal for a Regulation on coordinated demands reduction measures for gas and Communication 'Save gas for a safe winter' *available at* https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:4614900, last accessed 1 September 2024;

Eurostat - Indicators on energy poverty https://ec.europa.eu/eurostat/databrowser/view/ILC_MDES01__custom_1485289/default/table?lang=en *and* https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200120-1), last accessed 20 July 2024;

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Romanian Economic Monitor, *available at* https://econ.ubbcluj.ro/roem/ *and National Energy Regulatory Authority Monthly Natural Gas Monitoring Report, February 2022, available at* https://anre.ro/wp-content/uploads/2023/03/Raport-lunar-de-monitorizare-a-pietei-interne-de-gaze-naturale-pentru-luna-februarie-2022.pdf *, both last accessed on 15 June 2024;*

Romanian National Energy Regulatory Authority (ANRE) monthly monitoring reports of the natural gas market, *available at* https://anre.ro/despre/rapoarte/, last accessed 1.09.2024;

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Chapter 6

Slovenia: Slovenia's Perspective: Renewables or Low-Carbon?

Chapter 6

Slovenia's Perspective: Renewables or Low-Carbon?

Felicita Medved

President of the Novum institute in Slovenia

Introduction

The European energy and climate policy aims to achieve climate neutrality by 2050 by gradually increasing the use of renewable energy sources (RES), enhancing energy efficiency, and reducing dependence on fossil fuel imports. This transition is expected to lower electricity prices while simultaneously decreasing carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions in the atmosphere.

However, despite growing awareness of the consequences of excessive GHG emissions and financial investment to reduce them, improvements are often modest. CO_2 concentrations are still rising rapidly, reaching a new all-time high in 2023[1]. Three-quarters of GHG emissions originate from various forms of energy production, with electricity generation being the most significant contributor, accounting for over a third of CO_2 emissions worldwide. As we look to the future, the importance of electricity will continue to grow, with many emission reduction strategies

1 See UN Environment Programme (2023, November 20). 'Emissions Gap Report 2023', Emissions Gap Report 2023 | UNEP - UN Environment Programme

depending on the electrification of transportation and the adoption of heat pumps for heating purposes[2].

The principal documents detailing EU Member States' key climate targets and actions for the next decade and beyond are National Energy and Climate Plans (NECPs)[3]. Following the adoption of the NECP in 2020[4], the Slovenian government was required to submit the final updated NECP to the European Commission by the end of June 2024[5]. Both the

2 I. Legnar (2024), 'Pot do nizkoogljične družbe', Delo, 20 April, https://www.delo.si/sobotna-priloga/pot-do-nizkoogljicne-druzbe?fbclid=IwZXh0bgNhZW0CMTEAAR3famgDiHw97ZvxWe7o2vWvsJW3egxEG1VYhkBkmQ84iZGeNoywiqlae7A_aem_PU0lhmc3mBKinmG2Vrtg_w

3 The NECPs were introduced by the Regulation on the governance of the energy union and climate action (EU)2018/1999, agreed as part of the Clean energy for all Europeans package which was adopted in 2019. These plans address five dimensions of the EU energy union: decarbonisation, energy efficiency, energy security, internal energy markets and research, innovation and competitiveness. See: National energy and climate plans (europa.eu)

4 Government of the Republic of Slovenia (2020), 'The Government adopts the Integrated National Energy and Climate Plan of the Republic of Slovenia', 27 February,The Government adopts the Integrated National Energy and Climate Plan of the Republic of Slovenia | GOV.SI

5 See: Ember, A live EU NECP target tracker, A live EU NECP target tracker | Ember (ember-climate.org)

initial and the updated plans are primarily focused on renewable energy sources (RES). Simultaneously, in May 2024, the National Assembly decided to hold a consultative referendum on a new nuclear power plant (JEK2) in November 2024, notwithstanding the recommendation of the Climate Council, an independent advisory body to the government, that the energy mix should have been addressed earlier[6]. Additionally, the President of the Republic had called for a transparent and well-informed debate on the construction of the nuclear power plant and for the referendum question to be clarified and amended[7]. Proponents of nuclear power see it as the only way to ensure domestic electricity generation and achieve high self-sufficiency. Opponents argue for greater reliance on RES and energy saving, emphasising the risks associated with nuclear power plant operations and the financial aspects of such investments[8]. In parallel, the debate on the Šoštanj coal-powered plant (TEŠ) has been less contentious. Its closure is a widely accepted goal by 2033 at the latest[9].

On this ground, this paper aims to examine the potential future of energy in Slovenia, with a particular focus on the transition to a low-

6 Republika Slovenija, Podnebni svet (2024), 'Zapisnik o 7. seji Podnebnega sveta', 21 May, Climate Council | GOV.SI, Zapisnik_o_7-_seji_Podnebnega_sveta_z-dne-21.-5.-2024.pdf (gov.si)

7 Predsednica Republike Slovenije Nataša Pirc Musar (2024), 'Poziv za podrobno, pošteno in nepristransko obveščanje o gradnji JEK 2', 13 May, https://www.predsednica-slo.si/sl/objave/poziv-predsednice-republike-slovenije-natase-pirc-musar-za-podrobno-posteno-in-nepristransko-obvescanje-o-gradnji-jek-2?fbclid=IwZXh0bgNhZW0CMTAA-AR1wxsP9AQMF9Je79FBBOC3i48Nz62e2wT3ve7SprqxlcNPc9cVvLy2o1HQ_aem_-Byf2U8uYwTCbZcJ0PyP1g

8 Depending upon the results of the upcoming referendum, there is a possibility for a second referendum before the final decision, which is expected in 2028.

9 Recent proposals suggest closing TEŠ within two years, instead of 2033 as planned, due to its significant financial losses and environmental impact. The Prime Minister has confirmed the preparation of a scenario for the early closure of TEŠ. V. Hozjan (2004), 'Premier potrdil pripravo scenarija za predčasno zaprtje TEŠ', Energetika.net, 29 April, Premier potrdil pripravo scenarija za predčasno zaprtje TEŠ (energetika.net)

> It is essential that the decarbonisation of the electricity sector relies heavily on low-carbon sources and avoids the use of coal and gas-fired power plants.

carbon electricity system. Firstly, the objectives and proposed future scenarios of the NEPN will be presented in brief along with the potential of RES in Slovenia. Thereafter, the government's scenarios will be evaluated in comparison to an alternative approach initiated by the Slovenian Academy of Sciences and Arts (SAZU). Lastly, the proposition that an energy transition strategy prioritising renewables over other low-carbon alternatives is unlikely to meet the climate neutrality targets set for 2050 remains open to debate.

On this ground, the aim of this paper is to examine the potential future of energy in Slovenia, with a particular focus on the transition to a low-carbon electricity system. Firstly, the objectives and proposed future scenarios of the NEPN will be presented in brief along with the potential of RES in Slovenia. Thereafter, the government's scenarios will be evaluated in comparison to an alternative approach initiated by the Slovenian Academy of Sciences and Arts (SAZU). Lastly, the proposition that an energy transition strategy prioritising renewables over other low-carbon alternatives is unlikely to meet the climate neutrality targets set for 2050 remains open to debate.

Low-carbon electricity generation

The carbon intensity of power plants can be classified according to their source of energy, ranging from high-carbon fossil fuel-based power plants to low-carbon technologies such as hydro, nuclear, solar, and wind. Nuclear energy has the lowest carbon intensity, at 5 gCO_2/kWh. In comparison, hydroelectricity has a carbon intensity 2 times higher, solar panels around 8 times higher, and batteries and biomass 50 times higher (between 230 and 250 gCO_2/kWh)[10].

10 Power plants are considered low-carbon if their total emissions are less than 100 grams of CO_2 released per kilowatt-hour (kWh) produced, encompassing emissions from the entire lifecycle of the power plant, including

It is essential that the decarbonisation of the electricity sector relies heavily on low-carbon sources and avoids the use of coal and gas-fired power plants. Nevertheless, this does not imply that the sole objective of low-emission electricity generation is to install as many low-carbon power plants as possible, irrespective of the specific type chosen. The electricity system is characterised by a high degree of complexity, given that the production of electricity must always be in exact alignment with the consumption of electricity. Achieving precise balancing of these two variables represents a significant challenge[11]. It is for this reason that the interconnected European grid, the largest in the world, plays a pivotal role, in facilitating monitoring of consumption changes across a vast network of power plants.

The capacity of power plants to maintain constant power output and adjust generation to meet current demands varies considerably. Thermal and nuclear power stations, along with hydropower plants, are able to provide a continuous supply of electricity. However, hydroelectric power stations may encounter difficulties during prolonged dry spells. Gas-fired thermal power plants can be quickly started and are the most responsive to fluctuations in the grid, while hydroelectric and coal-fired power plants require a longer adjustment period for their output. Nuclear plants take the longest to respond. Solar and wind power plants operate differently. As their output is wholly dependent on daily and seasonal cycles and on the current weather, they do not contribute to the stabilisation of the electricity system. Rather, they introduce more variability.

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construction and decommissioning. See: [Life-cycle greenhouse gas emissions of energy sources - Wikipedia]

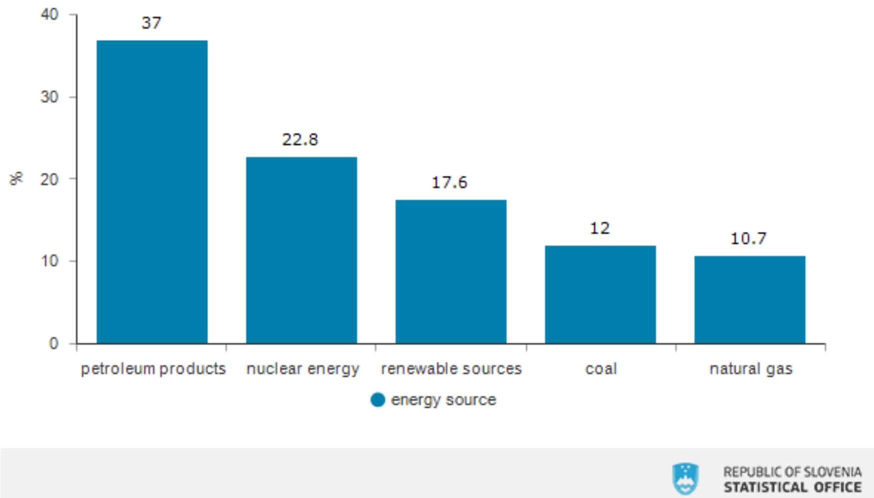
11 When consumption and production are synchronised, the frequency of electricity is the same across Europe, namely 50 hertz (Hz). The addition of further electricity consumers without an increase in power plant output would result in a reduction in frequency. A drop to just below 49 Hz could result in a failure of the power system, potentially leading to a blackout. Nevertheless, this scenario is unlikely, as the power system typically adjusts generation in time or disconnects consumers to prevent the frequency from falling below 49.8 Hz. Conversely, if a significant number of consumers are disconnected rapidly and power plants are unable to reduce output at an adequate rate, the frequency will increase. Without deactivating some generators, a frequency reaching 51 Hz could also result in a blackout. I. Legnar (2024).

Ensuring a constant power output from the grid and preventing frequent blackouts is far more complex than merely building numerous plants, particularly when it involves solar or wind. The integration of RES into the grid poses significant challenges, such as network inadequacy and the necessity for real-time network management to ensure stability. The complexity of these challenges makes it hard to foresee the outcomes when planning an integrated energy future[12].

Current energy mix and electricity balance sheet

IIn 2022, less than half of the energy demand (47%) in Slovenia was met by domestic energy resources, the rest being imported. The entire quantity of petroleum products was imported. In the structure of supplied energy, petroleum products dominate with 37%, followed by nuclear energy with 23%, renewable energy sources, including hydropower with almost 18%, coal with 12%, and natural gas with almost 11%[13].

Figure 1: Share of sources in energy supply, 2022*



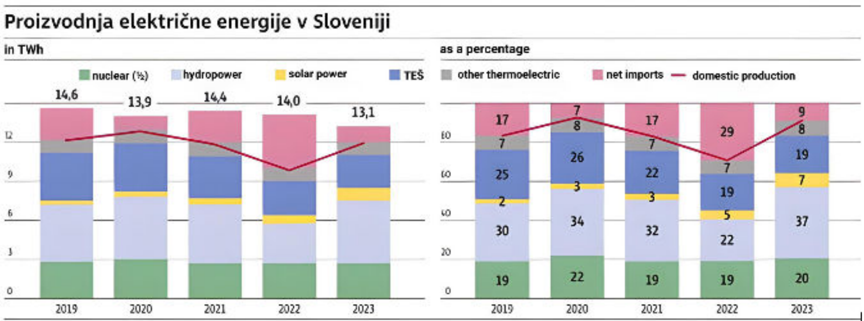
* the total does not add up due to rounding

12 I. Legnar (2024).

13 Republic of Slovenia Statistical Office (SURS) (2022), 'Energy supply, 2022', 15 May, [Energy supply, 2022 (stat.si)]

In 2023, Slovenia needed a total of approximately 14 TWh of electricity. 90% of this electricity was generated domestically. In the previous year, Slovenia had to import almost 30% of its electricity needs due to a drought. Typically, imports account for between 10% and 20% of the electricity supply[14]. In recent years, hydroelectric plants have supplied between 30 and 35% of the country's electricity needs. The most reliable and stable source is the Krško Nuclear Power Plant (NEK), which provides 20% of annual electricity needs. This figure represents only Slovenia's share of the plant, the other half of the output being allocated to Croatia under an intergovernmental agreement. Fossil fuel power plants, mainly TEŠ, contributed a similar amount of electricity or up to a third of the supply. Solar power is becoming increasingly significant, contributing around 8% of the national total, while the two wind turbines provide a negligible half a thousandth[15].

Figure 2: Electricity production in Slovenia (in TWh and as a percentage)



Source: B. Kordež (2024).

14 Slovenia has been self-sufficient only once, in 2009, due to significantly lower consumption as a result of the crisis. B. Kordež (2024), 'Prav je, da damo na mizo vse dejanske stroške', Delo, 1 June, https://www.delo.si/sobotna-priloga/prav-je-da-damo-na-mizo-vse-dejanske-stroske?fbclid=IwZXh0bgNhZW0CMTEAAR1Zft65US84NshDQaFK0GbUNq08iWbXsSc2GeDahYioEIsQEH7eE_-Rkr0_aem_WJSOCNeB3Qo6rFUdKDRXxA

15 B. Kordež (2024). See also Republika Slovenija, Ministrstvo za okolje, podnebje in energijo, 'Letna energetska bilanca republike Slovenije', Portal Energetika - Letna energetska bilanca republike Slovenije (energetika-portal.si).

Objectives and scenarios of the National energy and climate plan

> After the crisis, Slovenia diversified its sources by importing Algerian gas through Italy and making other purchases from the European gas market, significantly reducing its dependence on Russian gas

The NECP aims to establish a comprehensive and integrated strategy for Slovenia's energy future. To do so, the document sets out the main task of balancing the three key pillars of energy policy: climate sustainability, security, and competitiveness of energy supply[16].

The Slovenian government has set a target to reduce GHG emissions by at least 37-40% by 2030 compared to 2005 levels and by at least 55% by 2033. These objectives are reflected in the ambitious targets of achieving a 30-35% share of RES in final energy consumption and a minimum 52% share of RES in electricity generation by 2030, to further increase these percentages by 2040 and 2050[17].

With regard to the security of the electricity supply system, at least 85% of electricity is to be generated by domestic power plants by 2030, rising to 100% by 2040. The objective is also to cover at least 80% of peak demand on the electricity transmission network with local generation capacity by 2030 and to maintain at least 80% coverage of electricity demand

16 Government of the Republic of Slovenia (2023), Draft update proposal (2024), Integrated national energy and climate plan of the Republic of Slovenia, 27 June, 88f140fc-424f-4740-8b6f-6d4d89b2a701_en (europa.eu), p.27.

17 These objectives are in alignment with Slovenia's commitment to honour the Paris Agreement, which aims to limit the increase in global temperature to below 2°C by reducing GHG emissions and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. Additionally, they align with Resolution on Slovenia's Long-Term Climate Strategy until 2050 (ReDPS50) (PISRS), which aims to reduce GHG emissions by 80 - 90% compared to 2005, while also accelerating policies to adapt to climate change and ensure climate security for the population. NECP (2023), pp. 27- 28.

after 2033, i.e., in the post-coal era[18]. It is also expected to accelerate the development of energy storage technologies, infrastructure, and services[19].

Securing a competitive and reliable gas supply, which is entirely imported, remains an important objective. Until recently, natural gas was used for backup and peak power generation at the Šoštanj and Brestanica thermal power plants. Energetika Ljubljana is expected to gradually and steadily utilise natural gas for heating and electricity generation in the coming years, primarily as a replacement for imported coal. Prior to the crisis, caused by the war between Russia and Ukraine, the majority of natural gas supplies came from Russia via Austria. After the crisis, Slovenia diversified its sources by importing Algerian gas through Italy and making other purchases from the European gas market, significantly reducing its dependence on Russian gas[20]. In future, production of electricity from natural gas is expected to increase. To lessen reliance on fossil fuels, the aim is to boost the share of gaseous RES so that they account for at least 10-30% of the total gas supply by 2030[21] and to attain at least a 5% share of renewable gaseous fuels and a 1% share of renewable liquid fuels from domestic sources by 2030[22].

The continued use of nuclear energy for electricity generation is being contemplated from a strategic standpoint, including the potential construction of a new nuclear power plant or small modular nuclear reactors (SMRs)[23].

Hence, until 2030, the electricity generation sector will maintain its substantial reliance on a primary resource mix. After 2033, a significant

18 NECP (2023), pp. 22-23.

19 This is set to include the construction of a pumped hydroelectric power station, two large-scale electrolysis plants for the storage of electricity generated in hydrogen, and the accelerated installation of battery storage. NECP (2023), pp. 22-23 and 62.

20 NECP (2023), p. 135.

21 NECP, p. 42.

22 NECP (2023), p. 23.

23 NECP (2023), p. 65. On small modular reactors (SMRs) see e. g. International Atomic Energy Agency (IAEA), https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs

decarbonisation process is expected to begin, starting with the phasing out of coal. This will be followed by the decommissioning of the thermal power plants (TEŠ 5 and TEŠ 6). The existing nuclear power plant (JEK) is expected to remain in operation until 2043, contingent upon the approval of operational extension permits.[24]

For future sustainable and self-sufficient electricity generation, the NECP proposes two scenarios: (i) a scenario where electricity is generated exclusively from RES by 2050 (100% RES). This approach assumes the maximisation and dispersion of various RES and technologies to support larger generation facilities. In particular, this includes solar and wind, which would be complemented by additional, larger hydroelectric plants[25]; (ii) a scenario where RES is combined with a newly built nuclear power plant after 2040 (RES+Nuclear). This scenario includes slightly less solar and wind and the installation of a new nuclear power plant (JEK2) by 2040[26].

Renewables

As early as 2009, Slovenia pledged to attain a minimum of 25% share of RES in its final energy balance by 2020, and a 39.3% share in electricity generation[27]. By 2020, a 24.1% share of RES was reached, increasing

24 See NECP (2023), pp.141-142.

25 Biogas, bioliquids, woody biomass, ambient energy, and other renewable energy sources (RES) are not the specific focus of this article. Together, they are projected to contribute 10,623 GWh to the total gross end-use energy by 2023, which is estimated at 19,547 GWh. NECP version 4.0 (2024), p. 51.

26 NECP (2023), pp.142-143; Republika Slovenija, Ministrtsvo za okolje, podnebje in energijo (2024), 'Celoviti nacionalni energetski in podnebni načrt Republike Slovenije' Osnutek predlega posodobitve, vsrsion 4.0., February, p. 255. Osnutek posodobitve NEPN (verzija 4.0), februar 2024 (energetika-portal.si)

27 F. Al-Mansour, B. Sucic & M:Pusnik (2014) 'Challenges and prospects of electricity production from renewable energy sources in Slovenia', Energy, 77, 73-81.Challenges and prospects of electricity production from renewable energy sources in Slovenia - ScienceDirect ; A. Senegačnik et al. (2023), 'Integration of renewable energy sources for sustainable energy development in Slovenia till 2050', Sustainable Cities and Society 96, 104668, Integration of

slightly to 24.6% in 2021, with electricity production from RES accounting for 40%. The target was met through the purchase of a statistical transfer[28]. In 2023, this purchase was not needed as Slovenia has reached 25.3 % share of RES[29]. The initial NECP set a goal for Slovenia to achieve at least 27% RES by 2030[30]. The most recent version of NECP has increased this target to 35.1% by 2030, and 54.7% in the electricity sector[31]. In view of this much higher ambition, let us take a look at the potential of solar, wind and hydro energy in Slovenia[32].

Solar

Slovenia's largest renewable energy potential is solar power. It is experiencing a significant upswing and is meeting the projected targets. However, the efficiency of solar power plants in Slovenia is only about one-eighth of their rated capacity. Under the 100% RES scenario, it is anticipated that solar electricity generation will increase from 1.8 TWh in 2025 to 3.8 TWh by 2030, and then to 9 TWh by 2040. Meanwhile,

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renewable energy sources for sustainable energy development in Slovenia till 2050 - ScienceDirect

28 NECP (2023), pp.106-107.

29 B. Tavčar (2024), 'Lani smo imeli dovolj obnovljivih virov, ne bo treba plačevati drugim', Delo, 18 June, https://www.delo.si/novice/okolje/lani-smo-imeli-dovolj-obnovljivih-virov-ne-bo-treba-placevati-drugim?fbclid=IwZXh0bgNhZW0CMTEAAR1ciwF5kH_S94xxpduFwvshP69NhWCLD-zmOHAcQ738uwCoGuOYrM8dRpc_aem_-VrVk5o3FvanfW8T-RGTZg

30 Government of the Republic of Slovenia (2020) 'Integrated National energy and climate plan of the Republic of Slovenia', 27 February, p.18, si_final_necp_main_en_0.pdf (europa.eu)

31 NECP version 4.0 (2024), p.47. This version was drafted after the assessment by the European Commission. See: European Commission (2023). Commission Recommendation, Assessment (SWD) and Factsheet of the draft updated National Energy and Climate Plan of Slovenia', 18 December, Commission Recommendation, Assessment (SWD) and Factsheet of the draft updated National Energy and Climate Plan of Slovenia - European Commission (europa.eu)

32 Biogases, bioliquids, woody biomass, ambient energy and other RES remain outside the scope of this article. All together they are projected to contribute 10.623 GWh to the total gross end-use by 2023, estimated at 19.547 GWh. NECP, version 4.0 (2024), p. 51.

the RES+Nuclear scenario forecasts a marginally lower production of 7.8 TWh by 2040, as detailed in Table 1[33]

Table 1: Solar power targets 2020-2024 (GWh)

Scenario	2020	2025	2030	2035	2040
100 % RES	368	1,822	3,757	6,314	8,960
RES + NP	368	1,822	3,757	6,037	7,834

Source: NECP, version 4.0 (2024), p. 223.

Wind

While Slovenia has significant solar potential, its wind potential is limited[34]. It can be argued that Slovenia lacks a viable wind energy perspective. The main challenge is the lack of consistent winds throughout the day and night. In addition, when winds do occur, they tend to be strong, requiring wind turbines to be shut down to avoid damage. As a result, the potential for wind energy use is limited and significantly lower than in other EU member states[35]. Offshore wind farms are not feasible and few onshore sites with potentially adequate wind speeds meet environmental and societal standards, or do not satisfy the required distance from settlements for noise protection. Nevertheless, the NECP has set a goal to boost electricity production from the present 6 GWh to 356 GWh by 2030, and possibly to 1,232 GWh by 2040 in a 100% RES scenario, or to 998 GWh in a RES+Nuclear scenario, as outlined in Table 2.

33 NECP, version 4.0 (2024), p. 223.
34 A. Senegačnik et al. (2023). See also: J. Rakovec et al. (2209), Vetrovnost v Sloveniji (Ljubljana: Založba SRC). SZGG09_Rakovec_et_al (uni-lj.si)
35 See: Global Wind Atlas and New European Wind Atlas

Table 2: Wind power targets 2020-2040 (GWh)

Scenario	2020	2025	2030	2035	2040
100 % RES	6	6	356	697	1,232
RES + NP	6	6	356	697	998

Source: NECP version 4.0 (2024), p. 224.

Hydropower

Slovenia has exploited roughly 90% of its hydroelectric potential[36]. Nevertheless, there is a scope for further development of both large and small hydro. The latter have traditionally harnessed the energy of watercourses throughout the country. As shown in Table 3, the installed capacity of small hydro is projected to increase from 425 GWh in 2030 to 487 GWh in 2040, while large hydroelectric plants are expected to grow from around 4.3 TWh in 2030 to 4.5 TWh in 2040. This expansion is to be achieved through the renovation of existing facilities, the construction of new facilities already in the pipeline, and the anticipation of additional new projects. The expansion of hydropower is also constrained by environmental protection regulations[37].

Table 3: Electricity generation in large and in small hydropower plants, 2020-2040 (GWh)

	2020	2025	2030	2035	2040
Large HP *	4,063	4,020	4,292	4,415	4,539
Small HP	407	413	425	450	487

36 A. Senegačnik et.al. (2023).

37 NECP, version 4.0 (2024), pp. 224-226. As pointed out in NECP, also the orientations set forth in the Resolution on the Spatial Development Strategy of Slovenia 2050 will have to be adhered to in plans to accelerate the current electricity production from hydropower plants.

***Without pumping HP**

Source: Adapted from NECP version 4.0 (2024), p. 227.

To accelerate the deployment of renewable energy technologies and their geographical distribution, the Slovenian government is facilitating this process through 'positive legal discrimination[38].' The approach is reflected in recently enacted legislation that classifies renewable energy projects as 'projects of overriding public interest[39].' This legal status is based on the assumption that, unless proven otherwise, the benefits of GHG emissions and increasing energy security from these projects outweigh any negative environmental (and other, e.g. public health) impacts.

It is certain that the construction of new renewable energy facilities will significantly affect both the natural and societal environments. The installations situated outside of Natura 2000 areas, covering over 37% of the territory of Slovenia, or those deemed to have a negligible environmental impact, will not suffice to fulfill the NECP objectives[40]. With a substantial number of projects currently in the development phase, there is a high level of concern and discontent. In particular, local communities that would be directly affected by the negative impacts of the wind industry, as well as segments of the professional and non-governmental sectors, are increasingly opposed to the further constructions of wind farms. These groups are arguing for a more balanced, evidence-based and environmentally and socially responsible approach to energy policy. They demand transparency in administrative procedures and decision-making, and scientific rigour to ensure that biodiversity, private property and the public good are not sacrificed for

38 NECP (2023), p. 42.

39 See: Energy Act https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2024-01-1288 and Renewable Power Generation Facilities Act, https://www.uradni-list.si/1/objava.jsp?sop=2023-01-2478 On 24 October 2023, the European Commission published a Communication (COM/2023/669) on a "European Wind Energy Action Plan" with specific objectives and measures for a joint effort to expand wind energy capacity. The EU has decided to speed up the authorisation process for wind and solar power projects. This means a maximum of two years for new projects and one year for conversion projects.

40 NECP (2023), pp. 52-53.

the sake of short-term industrial profits. Scepticism about the long-term economic impact of subsidising the production and operation of wind turbines is also growing[41].

It is understandable that a regulatory framework is needed to steer the energy system towards climate neutrality and to deploy technologies that meet the targets set. However, there is a risk that existing renewable energy legislation will support one objective while ignoring or neglecting others, as the pursuit of carbon neutrality involves significant trade-offs with environmental and other legally and socially valued objectives, which may result in only modest climate mitigation benefits[42].

A third alternative

41 Besides concerns about, inter alia, effects on nature and the landscape, deforestation and potential consequences for drinking water resources, the absence of a regulatory framework to regulate noise from wind turbines is particularly problematic as well as the pollution caused by wind power plants, including the release of harmful chemicals such as per- and polyfluoroalkyl (PFAS) and bisphenol A as well as waste management plan. See e.g. T. Ogrin (2023)., 'Hrup vertnih elektrarn je zdravju škodljiv', Pogumen.si, 13 November,

https://pogumen.si/2023/11/13/hrup-vetrnih-elektrarn-je-zdravju-skodljiv-1-del/ ; D. Loredan / Civilna iniciativa za zaščito Senožeških Brd (2024), 'Nemudoma ustavite vse postopke umeščanja vertnih elektrarn v občini Divača, saj je vsaka nadaljnja aktivnot nedopustno zapravljanje davkoplačevalskega denarja!', 2 July, https://anaasicsic.com/2024/07/02/nemudoma-ustavite-vse-postopke-umescanja-vetrnih-elektrarn-v-obcini-divaca-saj-je-vsaka-nadaljnja-aktivnost-nedopustno-zapravljanje-davkoplacevalskega-denarja/?fbclid=IwZXh0bgNhZW0CMTEAAR31rROty-gDV9rGeWo7zAH08vVrbCAstXMyopiHbCfELvLwYaljVrWk1RU_aem_8C7eai0k02iJeERGuaQKlw

42 See e.g. Similä, J., Soininen, N., & Paukku, E. (2021). 'Towards sustainable blue energy production: an analysis of legal transformative and adaptive capacity.' Journal of Energy & Natural Resources Law, 40(1), 61–81. https://doi.org/10.1080/02646811.2021.1875687 ; Similä, J., Soininen, N., & Paukku, E. (2021). 'Towards sustainable blue energy production: an analysis of legal transformative and adaptive capacity.' Journal of Energy & Natural Resources Law, 40(1), 61–81. https://doi.org/10.1080/02646811.2021.1875687

During the public consultation on the NECP, the two scenarios presented in the plan, namely the scenario that electricity is generated entirely from RES by 2050 and the scenario that combines RES and the newly built nuclear power plant by 2040, were highlighted as being problematic for two main reasons. First, they are based on overly conservative estimates of future electricity end-use. Second, they assume a significant share of electricity generation from intermittent RES.

It is somewhat surprising that the authors of the NECP, who have produced an exhaustive and highly detailed document, have not addressed a fundamental question that should be at the core of any energy and climate strategy: how much energy will a country need in the future to facilitate economic growth and ensure the prosperity of its population, and to provide sufficient electricity to facilitate an energy transition from fossil to low-carbon energy sources? This question was examined by a working group within the Development Council of the Slovenian Academy of Sciences and Arts (SAZU). Total electricity consumption is projected to more than double over the next 25 years (from 14.3 TWh in 2025 to 30.4 TWh in 2050). The energy transition will require an increase in electricity consumption three times higher than the increase in Slovenia's development to the level of today's most developed European countries (12.2 TWh and 3.8 TWh respectively)[43].

The expected rapid expansion of solar and wind power generation in both NECP scenarios is projected to increase their shares of the total electricity generation mix to 60% in the 100% RES scenario and 38% in the RES+Nuclear scenario by 2050. Integrating a large amount of electricity from solar and wind sources into the grid could lead to significant instability in the electricity system. To counter this, it is crucial to ensure the availability of adequate capacity from alternative flexible and stable energy sources, such as gas and coal-fired thermal power plants, and to secure a large capacity for storing daily and seasonal electricity excess (pumped storage hydroelectric plants, batteries, electrolysers) to

43 A. Mervar et al. (2022), 'Strategija razvoja elektroenergetsko-podnebnega sistema Slovenije do leta 2050', Slovenska akademija znanosti in umetnosti (SAZU), [Strategija razvoja elektroenergetskega sistema Slovenije do leta 2050 (sazu.si)]

offset the daily and seasonal variances between energy production and consumption. The authors of the SAZU strategy criticise the NECP for its insufficient backup and peak energy storage provisions, except for pumped storage, making the NECP's electricity concept both implausible and technically unsustainable. They propose an alternative approach, asserting that a green transition in Slovenia's electricity sector is achievable. Their approach emphasises the provision of a stable, reliable and affordable electricity supply, mainly through the use of low-carbon nuclear and hydropower, which are projected to account for 69% of total electricity production by 2050. Solar and wind power are also forecast to contribute 16%, with energy storage and hydrogen gas power plants accounting for the remaining 15%.

> The construction of wind power capacity necessitates further investment in the transmission network.

In view of optimal sustainable energy transition Damijan and Babič (2024) analysed the three concepts according to five key criteria: (i) decarbonising electricity generation, (ii) ensuring the necessary amounts of energy for development and energy transition, (iii) ensuring energy autonomy, (iv) rationality in terms of the investments, and (v) ensuring a competitive cost price for electricity[44].

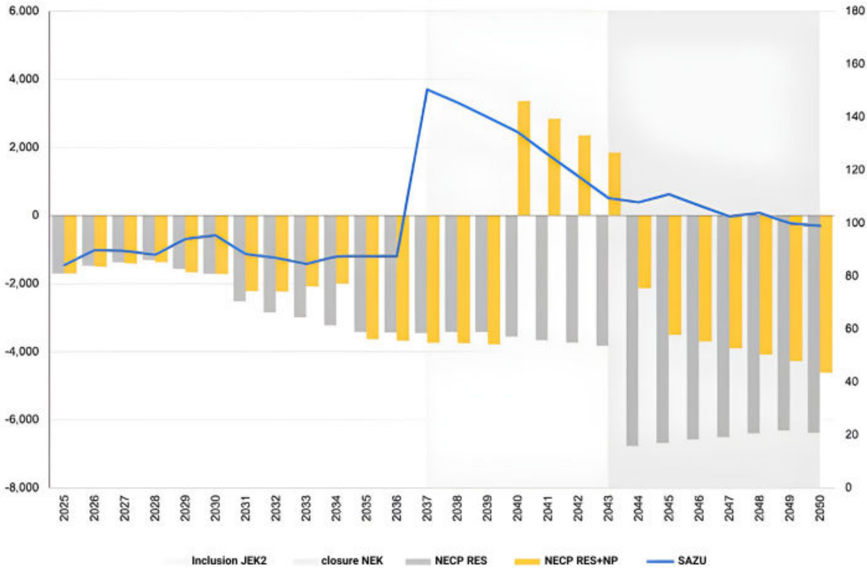
Energy volumes and security perspectives

The SAZU concept ensures the availability of sufficient volumes of energy for development and energy transition needs beyond 2037. In both NECP electricity end-use scenarios, a deficit in energy production is projected (2-3 TWh annually between 2030 and 2040 and 3-6 TWh after 2043). The SAZU concept demonstrates a maximum import dependency of 5%, whereas both NECP scenarios indicate a significantly higher import dependency, reaching 15% to 25% annually. Such a high level of import

44 Damijan, J.P. & D. Babič (2024). 'Optimalen trajnostni energetski prehod v Sloveniji', Delo, 6 April, https://www.delo.si/sobotna-priloga/optimalen-trajnostni-energetski-prehod-v-sloveniji

dependency is problematic from the perspective of Slovenia's strategic security, as well as representing a significant systemic exposure to imports and electricity price volatility. With the increasing shift towards RES in Europe, the differences between daily and seasonal electricity production and consumption are expected to increase in the future, leading to instability of national electricity systems and even higher price volatility.

Figure 3: Projected electricity production 2025-2050



Source: Delo, 2024

Investment and cost price perspectives

The varying energy densities of different energy sources and the differing technical characteristics of energy installations lead to electricity systems with diverse designs, requiring different investments in base load, replacement generation capacity, energy storage, and distribution and transmission networks. For instance, systems that rely on distributed generation sources, such as solar, necessitate substantial investments to upgrade the distribution network for peak generation. The construction of wind power capacity necessitates further investment in the transmission network. In contrast, systems based on centralised generation sources (hydro, thermal, and nuclear) require less supplementary investment in distribution and transmission networks, as well as in energy storage and backup capacity. Consequently, the total investment needed by 2050 is significantly lower in the SAZU concept (€18.4 billion) compared to the two NECP scenarios (€24.8 billion and €30 billion[45]). On a per unit of energy produced basis, the investment required in the SAZU scenario is €54.3/MWh, while in the NECP scenarios, it is between €100 and €103/MWh. This indicates that, per unit of energy produced, the 100% RES scenario is 84% and the RES+Nuclear scenario is 90% more costly than the SAZU in the period to 2050[46].

The integration of RES into the grid incurs extra costs that escalate with the degree of integration. At low-RES levels (under 10%), these additional costs are roughly half of the plants' production costs. For moderate to high-RES levels (over 20%), the integration costs become comparable to the production costs, and at 40% RES, they match the typical production costs of wind and solar plants in Europe. In the SAZU concept, these cost prices would be around €100/MWh until 2037, and could fall to around €70/MWh with the commissioning of the new nuclear power plant (JEK2). In contrast, in the two NEPN scenarios, the costs rise to 150 €/MWh by the mid-2030s and remain between 120 and 150 €/MWh after 2040. The significantly higher share of hydro and nuclear power in the SAZU concept, and thus lower integration costs, are the main reasons for these differences.

Decarbonisation perspective

The experience of European countries with a high share of electricity from RES shows that increasing their share in electricity generation does not significantly reduce CO_2 emissions, primarily due to their dependence on flexible carbon energy sources.

45 The former includes investments in batteries, electrolysers and replacement capacity in gas-fired power plants, which the NECP concepts do not, although they will be needed. J. P. Damijan & D.Babič (2024).

46 Damijan, J.P. & D. Babič (2024).

The contrast between Germany and France clearly demonstrates this point. Although Germany increased its RES from 14% in 2007 to 60% in 2023, it only managed to reduce its CO_2 emissions per kWh of electricity generation by nearly one-fifth (from 550 to 440 gCO_2/kWh). In contrast, France, with a 60% reliance on nuclear power, has consistently maintained its CO_2 emissions from electricity generation at an average of about 40 gCO_2/kWh throughout the same period, which is merely a tenth of the emissions produced by Germany[47].

The analysis for Slovenia shows that until 2037, the three alternative scenarios are quite similar, with emissions significantly decreasing (from about 280 gCO_2/kWh to around 200 gCO_2/kWh). The marked divergence after 2037 is due to the integration of a new nuclear power plant (JEK2) into the grid, as outlined in the SAZU concept, leading to a drop in CO_2 emissions to 40 and subsequently below 25 gCO_2/kWh. In the 100% RES scenario, the annual decrease in CO_2 emissions is minimal, ranging from 160 to 200 gCO_2/kWh. The RES+Nuclear scenario shows a distinct trend, with a brief reduction in CO_2 emissions post-2043, following the shutdown of the Krško Nuclear Power Plant, paired with an increase in electricity imports, causing a rebound in emissions to levels seen before the closure. In other words, Slovenia's annual CO_2 emissions from electricity generation and consumption per unit of energy produced could be reduced by more than 90% between 2025 and 2050 under the SAZU approach. This reduction is significantly more ambitious than that proposed in the NECP scenarios, which only envisage a reduction of between 35% and 42% over the same period. These differences can be explained by the fact that the NECP scenarios require burning more gas and importing 15-25% of electricity due to the unfavorable source mix and insufficient production[48].

It is a reasonable conclusion that an optimal mix of low-carbon energy sources, mainly nuclear and hydro, is crucial to ensure adequate electricity for Slovenia's development, to maintain energy security at competitive prices and to achieve decarbonisation of electricity generation and consumption. Energy strategies relying solely on RES

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47 J. P. Damijan (2024), 'NEPN je pravljična energetska zabloda', Pravna praksa, 43 (5) 3 https://www.pravnapraksa.si/?Id=450

48 J.P. Damijan & D. Babič (2024).

or an over-reliance on RES are not technically feasible and require substantially higher investments, which may hinder the achievement of climate decarbonisation targets[49].

These findings are consistent with those reported in the scientific literature for other countries, which indicate that pure RES power systems are highly susceptible to daily and seasonal fluctuations. Furthermore, the necessity for substantial fossil fuel resources, energy storage, and grid enhancements makes them extremely costly at high shares of RES in terms of investment costs and the resulting energy price. Furthermore, studies indicate that even if a 100% renewable European electricity system were to operate with the same level of system adequacy as the current system, it would not deliver the necessary emission reductions to meet Europe's 2050 climate targets.

The way forward

The main shortcoming of the Slovenian NECP is its ideological rather than scientific basis. The plan sets arbitrary targets for energy decarbonisation, including the share of renewables in total energy consumption and targets for different types of energies. Consequently, it is plausible to expect that these targets will not be met or that they will lead to an excessively expensive energy supply, with the risk of energy poverty among the population and an economic downturn. Conversely, the SAZU approach offers a more viable solution for Slovenia to effectively manage the transition to a more sustainable and climate-neutral energy future, while ensuring the reliability of energy supply, safeguarding economic development and well-being, preventing the emergence of energy poverty, ensuring the stability of electricity systems and preserving Slovenia's strategic energy autonomy.

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49 E.g. Zappa W., Junginger M. & M. van den Broek (2019), 'Is a 100% renewable European power system feasible by 2050?', Applied Energy (2019) 233-234, 1027-1050, 10.1016/j.apenergy.2018.08.109 ; S. Pfenninger & J. Keirstead (2015), 'Renewables, nuclear, or fossil fuels? Scenarios for Great Britain's power system considering costs, emissions and energy security'. Applied Energy 152, 83-93, https://doi.org/10.1016/j.apenergy.2015.04.102 ; J. Emblemsvåg (2022), 'Wind energy is not sustainable when balanced by fossil energy', Applied Energy 305(2):117748, DOI:10.1016/j.apenergy.2021.117748

In light of the impending closure of TEŠ, a critical juncture has been reached that demands a resolution regarding Slovenia's future trajectory. It is to be hoped that the Slovenians will choose the way forward that is grounded in evidence-informed decision-making, rather than one that is ideologically driven, emotionally influenced, or contingent on the immediate political landscape.

The main issue today seems to be the preference for renewables over other low-carbon alternatives. In any case, carbon-neutral electricity production will be a major task to achieve, given that even the lowest emitting power plants release small amounts of CO_2 that need to be removed by sinks that are still under development. However, aiming for carbon neutrality from renewables while phasing out the lowest emitting technologies simultaneously, adds to the complexity of the electricity system and makes carbon neutrality appear almost utopian. Critics of nuclear technology who advocate a future powered solely by renewables require a significant leap of faith in a technological breakthrough in electricity storage. But this could be seen as a risky bet on potentially undeveloped technologies. The technology needed to store electricity on a large scale for long periods of time does not yet exist. While it may be possible to achieve this in the coming decades, there is no certainty, as experts say. Given the vital role of energy in the functioning of a country, it is to avoid unnecessary risks. The electricity supply plan for the next two to three decades must therefore be based on a realistic assessment of the technical possibilities and scientific knowledge currently available.

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Chapter 7

Ukraine: Keeping the lights on in Ukraine: mission (im)possible

Chapter 7

Ukraine: Keeping the lights on in Ukraine: mission (im)possible

Valeriya Izhyk

EU Policy Officer on Ukraine's reconstruction, CEE Bankwatch Network, European Climate Pact Ambassador (2024)

Abstract

Russia destroyed over half of the energy capacity of Ukraine since its full-scale war of aggression in 2022. Despite the ongoing effort of the country to keep the lights on via swift repair works and scheduled blackouts, Ukraine should come up with a more resilient plan on how to provide energy security under such unprecedented circumstances. This article gives a general overview of Ukraine's energy security case since the Russian full-scale war of aggression, starting from the country's synchronisation with the European electricity grid till the Ukraine Recovery Conference in Berlin on 11-12 June 2024. Contrary to emergency support, which was mostly provided to repair centralised energy systems, it is recommended to pay more attention to securing energy resilience via small decentralised renewable installations plus storage.

Keywords: *blackouts in Ukraine, energy resilience of Ukraine,*

Russia destroyed over half of the energy capacity of Ukraine since its full-scale war of aggression in 2022.

Ukraine power system emergency synchronisation, Ukraine energy crisis, green reconstruction of Ukraine.

On the attacks over the energy sector

Russia commenced an unprovoked full-scale war of aggression on Ukraine on 24 February 2022 – and so far, this already resulted in direct damage of almost US 152 billion and US 486 billion of the total cost of reconstruction and recovery in Ukraine (as of 31 December 2023)[1]. This does not take into account the damage to Ukraine's population, ecosystems, and environment.

Since the beginning of 2024, the cost of damage has risen even higher due to the ongoing Russian missile and drone attacks on the energy infrastructure. This led to all-Ukraine blackouts that lasted more than 8 hours per day in some regions leaving millions of people without energy;

1 World Bank. Ukraine (2023), 'Third Rapid Damage and Needs Assessment (RDNA3): February 2022 - December 2023 (English)', (Washington, D.C.: World Bank Group), p. 9. https://documents1.worldbank.org/curated/en/099021324115085807/pdf/P1801741bea12c012189ca16d95d8c2556a.pdf

in some cases, this also affected the water supply since it is also pumped by electricity.which had most of its imports from Russia, now the country has quickly switched to alternative supplies. In addition, more opportunities may be present with local industries providing critical materials for the energy transition and the nearshoring of net-zero industries.

Russia has been taking the pillars of Ukraine's energy resilience one by one. Thus e.g., during the first months of the invasion, it occupied Zaporizhzhia Nuclear Power Station, which is the largest nuclear power plant in Europe and among the ten largest in the world. Periodically, Russia terrorises Ukraine and the rest of the world by putting the station in an emergency condition[2].

Nuclear power generation used to be a major contributor to Ukraine's energy security. Before 2022, Ukraine had 15 reactors responsible for over half of its baseload power generation. The other approximately 15% of the electricity mix comes from coal, 10% - from hydro, and renewable sources account for less than 15% of the power output[3].

The coal generation, which is the second provider of grid stability and also serves the balancing capacities of the grid, has been constantly targeted by Russia since the first winter of war in 2022, causing power outages and blackouts all over Ukraine. Thermal power plants are also crucial for the centralised heating system of the country.

On 6 June 2023, Russia destroyed the dam of the Kakhovka hydroelectric power station on the Dnipro river[4]. This damage has resulted in the loss of 350 MW of hydro-generation capacity in the region. Assuming an average household in Ukraine consumes around 3,000 kWh per year (a reasonable estimate for many European countries), the 1 TWh annual production of Kakhovska HPP could theoretically supply electricity to approximately

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2 International Atomic Energy Agency (2024), 'IAEA Director General Statement on Situation in Ukraine', 7 April, https://www.iaea.org/newscenter/pressreleases/update-220-iaea-director-general-statement-on-situation-in-ukraine

3 Statista (2023), 'Distribution of electricity generation in Ukraine in 2023, by source', https://www.statista.com/statistics/1237676/ukraine-distribution-of-electricity-production-by-source/

4 J. Glanz, M. Santora, P. Robles, et al (2023), 'An inside job', New York Times The, 16 June, https://www.nytimes.com/interactive/2023/06/16/world/europe/ukraine-kakhovka-dam-collapse.html

333,333 households[5]. Apart from that, it caused unprecedented damage to Ukraine's environment and ecosystems.

Finally, Russia has also destroyed and slowed down renewable deployment in Ukraine. Ukraine used to be ranked 7th in Europe for the development of solar generation[6]. Currently, about 13% of Ukrainian PV locations are under occupation; about 8% of the solar capacity installed has been destroyed or damaged, including hundreds of prosumer installations[7].

When it comes to wind generation, by December 2023, Ukraine had an installed wind energy capacity of 1,860 MW90. However, over 71% of this capacity is currently situated in the temporarily occupied territories. As of now, at least ten wind turbines are known to be damaged or destroyed as a result of the hostilities by the Russian army[8].

In March 2024, Russia changed its tactics. Previously, it used to damage Ukraine's energy transformers, transmission, and distribution lines to cut the electricity flow in the country. As of March 2024, the aggressor has destroyed entire power plans leaving craters where power plants used to be situated.

As of mid-June 2024, more than half of Ukraine's energy system is off the grid. The much-needed relief can be provided through a timely and enough air defence system. On the other hand, a centralised energy

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5 Energy Community Secretariat (2022), 'The role and importance of Kakhovska HPP to the Ukrainian power system', https://www.energy-community.org/dam/jcr:7de657c5-fc93-49b8-b5f2-575c32c8456e/REPORT%20-%20Kakhovska%20HPP.pdf

6 IRENA (2022), 'Renewable Energy Statistics 2022', https://www.irena.org/publications/2022/Jul/Renewable-Energy-Statistics-2022

7 GOPA International Energy Consultants GmbH (2024), 'Post War Development of the Renewable Energy Sector in Ukraine', Vienna: Energy Community Secretariat, p. 67. https://www.energy-community.org/dam/jcr:063d888c-dd3d-469c-a2b3-68d6130b30f5/intec%202024%20UA%20post%20war%20RE%20Develoment.pdf

8 L. Bilozerova (2023), 'Andriy Konechenkov: during the two years of the war, about 230 MW of wind generation was introduced', Ukrainian Energy, 23 November, https://ua-energy.org/uk/posts/andrii-konechenkov-za-dva-roky-viiny-vvedeno-blyzko-230-mvt-vitroheneratsii

system, even though diversified, eased Russia's destabilising Ukraine's energy security as all it takes is destroying big power plants.

Ukraine's reaction – what has been done and what is upcoming

Ukraine's energy security could have been jeopardised even more if Ukraine had not made a historical shift in the first months of the Russian full-scale invasion. Since 2014, Russia has invaded Eastern Ukraine and illegally annexed Crimea. Afterwards, the Ukrainian authorities repeatedly called Europe to decouple its energy from Russia, and have been moving in this direction itself.

Back in 2017, Ukraine committed to synchronise with the European Network of Transmission System Operators for Electricity (ENTSO-E). After numerous gas disputes with Russia, it was a matter of time before the aggressor would weaponise energy commodities against Ukraine and Europe, let alone strategic interconnected infrastructure.

According to the plan, on 24 February 2022, the Ukrainian Power System started functioning in an isolated mode from the Russian Integrated Power System (IPS). The so-called 'island mode' test, conducted from 24 to 27 February 2022, was one of the technical preconditions for Ukraine to join the ENTSO-E.

On the first day of the Russian war, when hundreds of missiles were launched to target Ukraine, it was clear that Russia would not reconnect the country to its grid. Moreover, any physical connection or knowledge of Ukraine's critical infrastructure would jeopardise Ukraine's energy security.

Synchronisation with the European grid was the most tangible act of European integration, as it meant that Russia would no longer control the technical aspects of Ukraine's network. Besides, this would allow Ukraine to further intensify market integration with the European electricity markets, which would strip Russia of one more leverage against Ukraine.

Even though it was planned to be completed by 2023 anyway, Ukraine requested emergency synchronisation of the Ukrainian power system with ENTSO-E and was officially unified on 16 March 2022. It took less than a month to complete the necessary technical measures, which were initially scheduled to be fulfilled over a year.

> Synchronisation with the European grid was the most tangible act of European integration, as it meant that Russia would no longer control the technical aspects of Ukraine's network

However, the situation clearly indicated that not only Ukraine's energy security was at stake. The neighbouring Moldova does not operate its grid independently of Ukraine. Therefore, in case Ukraine had failed to comply with the necessary steps to synchronise with the European grid, it would have caused humanitarian crises in both countries.

Such a leapfrog in Ukraine's energy security would not have happened without the political will from Ukraine and the European Union, technical preparedness, and well-coordinated crisis management on both sides[9]. It is, though, important to remember that Estonia, Latvia, and Lithuania are still part of Russian IPS, and should accelerate their decoupling[10].

At the end of 2023, ENTSO-E confirmed that the Ukrainian transmission system operator (TSO), Ukrenergo, had achieved compliance with all requirements for permanent synchronisation. Ukrenergo also became a full member of ENTSO-E on 1st January 2024, while the Moldovian TSO, Moldelectrica, will continue to achieve the same compliance[11].

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9 V. Izhyk (2022), 'Ukraine Power System Emergency Synchronisation with the Continental Europe Power System', Fund of the President of Ukraine, p. 15. https://assets-global.website-files.com/63513cd413c869465c6d3b4a/63873c6bc5d6d0a6e3daad79_pow2.pdf

10 European Commission (2023), 'Estonia, Latvia & Lithuania agree to synchronise their electricity grids with the European grid by early 2025', European Commission, 3 August, https://energy.ec.europa.eu/news/estonia-latvia-lithuania-agree-synchronise-their-electricity-grids-european-grid-early-2025-2023-08-03_en

11 ENTSO-E (2024), 'Two years since Ukraine and Moldova synchronised electricity grids with EU', ENTSO-E, 15 March, https://www.entsoe.eu/news/2024/03/15/two-years-since-ukraine-and-moldova-synchronised-

Following the technical integration of the grid, Ukraine started to further harmonising its electricity market rules as to be able to trade electricity with the European Union. Based on system security and stability simulations, ENTSO-E increased Ukraine and Moldova electricity trade capacity limit to 550 megawatts (MW), which came into force as of 1st March 2024[12].

Since the beginning of March 2024, Ukraine has been powering thousands of homes in neighbouring Hungary, Moldova, Romania, Poland, and Slovakia, exporting over 13 gigawatt hours (GWh) mostly from solar and hydro plants[13]. Just for a month, Ukraine was a powerhouse for Europe, exporting around €1 million in electricity daily to its neighbours[14].

Ukraine's increased import capacity to Hungary, Slovakia, and Romania allowed the country to generate substantial financial revenue into the state budget plunged by a third since Russia unleashed its war. Considering traditional metallurgy, agriculture, and fertiliser trade revenues were ousted, the role of electricity trade came out on top.

However, this trend did not last too long. As Russia carries on the attacks on the national energy generation facilities, it leaves Ukraine with no other option but to start large-scale electricity imports from the European Union. In practical terms, this, however, increases the electricity prices for Ukrainians and impedes powering the wartime arms industry gravely needed for self-defence.

Furthermore, the import capacity is limited. Ukraine can currently import no more than 1,7 gigawatts (GW) of electricity from the EU states simultaneously.

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electricity-grids-with-eu/

12 ENTSO-E (2024), 'Further increase in the trade capacity with the Ukraine/ Moldova power system', ENTSO-E, 28 February, https://www.entsoe.eu/news/2024/02/28/further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/

13 A. Sabadus (2024), 'Ukraine expands EU energy exports in fresh display of wartime resilience', Atlantic Council, March 12, https://www.atlanticcouncil.org/blogs/ukrainealert/ukraine-expands-eu-energy-exports-in-fresh-display-of-wartime-resilience/

14 G. Gavin, V. Jack (2024), 'Putin is bombing Ukraine into darkness — and leaving Europe short of power', POLITICO, April 18, https://www.politico.eu/article/russias-bombing-ukraine-darkness-leaving-europe-short-power/

In this context, it should be noted that the demand is 9 GW[15] since two major power plants went offline: the Dnipro Hydroelectric Power Plant in the Zaporizhzhia region, Ukraine's largest hydropower plant, and the Trypilska thermal power plant, which was completely flattened.

On top of that, Russia damaged the gas transportation system for underground storage facilities in western Ukraine. This system serves as the biggest gas storage in Europe and contributes not only to Ukraine but to the neighbouring countries' energy security, especially Hungary and Slovakia, which usually diverted from the EU's decision to provide more air defence to Ukraine.

At the latest Foreign Affairs Council, held on 27 May 2024, which covered a discussion on the EU's military support for Ukraine, and particularly the implementation of the decision taken by the Council in March on a new, dedicated Ukraine Assistance Fund under the European Peace Facility[16], Hungarian and Slovakian officials explicitly expressed themselves against providing supporting air defence systems[17].

A few key points on the planning and the support – short, mid, and long-term options

In the short-term perspective, the Ukraine Energy Support Fund, set up in agreement with the European Commission and the Ministry of Energy of Ukraine, should provide much-needed relief to the energy infrastructure destroyed and damaged by Russia. As of 14 June 2024, the total pledged was EUR 495 million, and the total transferred was EUR 399 million[18].

15 P. Polityuk, K. Donovan, D. Evans, (2024), 'Ukraine's electricity imports remain high even as power line undergoes repairs', Reuters, June 4, https://www.reuters.com/business/energy/ukraines-electricity-imports-remain-high-even-power-line-undergoes-repairs-2024-06-04/

16 Foreign Affairs Council (2024), 'Foreign Affairs Council, 27 May 2024', Council of the European Union, 27 May, https://www.consilium.europa.eu/en/meetings/fac/2024/05/27/

17 T. Benakis (2024), 'Hungary and Slovakia block EU military aid to Ukraine', European Interest. 27 May, https://www.europeaninterest.eu/hungary-and-slovakia-block-eu-military-aid-to-ukraine/

18 Energy Community, 'Ukraine Energy Support Fund', https://www.energy-community.org/Ukraine/Fund.html

Additionally, there were a few other solidarity campaigns aimed at fulfilling the immediate power needs of Ukrainians. The Emergency Response Coordination Centre under the European Commission has mobilised 3 191 generators and 14 transformers. Furthermore, a new energy hub in Poland has been created to support the delivery of international assistance[19].

Despite the unquestionable relief that generators provide to small businesses and municipalities, which have become the Centres of Invincibility for citizens, there is a downside to this form of support. Running a generator comes with an additional cost, stemming from the fuel price, while emissions contribute to the already grave air quality in Ukraine.

On 20 June 2022, President Volodymyr Zelenskyy, at the Supreme Commander-in-Chief's Staff meeting, tasked the government to simplify the installation of solar panels and batteries for households[20]. As a result, it is expected that the connection procedure will be significantly simplified, along with an affordable concessional interest-free loan programme for 5 years[21].

In the mid-term perspective, Ukraine should swiftly move from a centralised to a decentralised energy system powered by solar and wind installations. A techno-economic modelling conducted by Berlin Economics concludes that a viable pathway towards a significantly enhanced solar PV roll-out in Ukraine is possible[22].

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19 DG ECHO Daily Map (2024), 'Russia's War on Ukraine. Generators and transformers offered to Ukraine', 11 June, https://erccportal.jrc.ec.europa.eu/API/ERCC/Maps/DownloadPublicMap?fileN=MainFile&forceDownload=False&contentItemID=4895

20 V. Romanenko (2024), 'Zelensky held a meeting: he wants solar panels in every school and hospital', Ukrainian Truth, 20 June, https://www.pravda.com.ua/news/2024/06/20/7461779/

21 V. Volokita (2024), 'The state gives maximum 'green light' for the development of distributed generation - State Energy Supervision', Economic Truth, 25 June, https://www.epravda.com.ua/news/2024/06/25/715727/

22 P. Bilek, R. Stubbe, H. Weser (2024), 'A Solar Marshall Plan for Ukraine: Empowering Ukraine's brighter future: bottlenecks and key policy reforms needed to boost solar PV deployment', Greenpeace, p. 23, https://www.greenpeace.de/publikationen/20240607-greenpeace-report-BE-solar-marshallplan-ukraine-encv.

Ukrainian civil society organisations were also advocating for 'greening' the emergency response to the blackouts in Ukraine[23]. The delivery of more than 15,000 solar panels to Ukraine, coordinated by the EU Civil Protection Mechanism contributed to the formation of a new narrative of the sustainable reconstruction of Ukraine's energy sector[24].

It is not only 'greener' but also more cost-efficient to rely on Ukraine's energy resilience on renewables. In the energy sphere, the country is so vulnerable due to its high centralisation and concentration. In other words, if there are up to 30 power plants on which the whole electricity generation relies, it seems easier to take offline all those plants than if there are 1300 decentralised energy installations. Thus, it is more costly to destroy the energy system, which is built on microgrids and more self-sufficient. In fact, many of the local authorities have already realised it and have respectively started to cofinance off-grid renewables to cover their own needs and be independent of the centralised provider. More than 500 municipalities applied to Ukrainian NGO Ecoclub to co-finance solar panels on hospitals' rooftops and power water utilities.

More than two years of war showed that if system reliability is the primary concern, a solar installation plus storage should be the primary solution. This type of station offers operational flexibility in both grid-connected and autonomous modes, providing effective demand-side management and reliability, especially valuable during outage condition[25].

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23 K. Krynytskyi, D. Sakaliuk, D. Tsutsayev (2023), 'Solar to the rescue: photovoltaic energy systems can support Ukrainian communities and cities during the emergency response and in the longer term', Ecoaction, February, https://en.ecoaction.org.ua/wp-content/uploads/2023/03/briefing-solar-to-the-rescue.pdf

24 European Commission (2024), 'The European Union mobilises additional assistance to support Ukraine', European Commission, 12 June, https://civil-protection-humanitarian-aid.ec.europa.eu/news-stories/news/european-union-mobilises-additional-assistance-support-ukraine-2024-06-12_en

25 V. Lytvyn, M. Lukyanyk, M. Illinov, A. Martynyuk (2024), 'Financing Renewable Energy Projects in Ukrainian Municipalities', Ecoclub, March, p. 5, https://ecoclubrivne.org/en/download/20007/?tmstv=1718563059

In the mid-and-long-term perspective, Hungary, Slovakia, Romania, and Poland should consider the possibility to increase their export capacity to Ukraine as to provide more emergency power flows. This requires that several projects on hold or delayed should be restored and completed as soon as possible. Here are some examples for illustration.

A new Mukachevo-Kapusany 400kV transmission line between Ukraine and Slovakia will eliminate the existing restrictions on power flows between the Slovak and Ukrainian power systems, on the one hand, and the Hungarian, Romanian, and Ukrainian power systems on the other[26].

The project has already been identified as a Project of Common Interest (PMI) and envisages increasing the capacity of the Ukraine-Slovakia interconnector to 1 GW. However, according to the project timeline, the construction completion is scheduled for the end of 2028 and EUR 24 million have not been secured yet[27], which complicates further progress.

One more GW can be achieved via the restoration and commissioning of the Khmelnytskyi NPP – Rzeszów (Poland) transmission line, and an additional 1 GW – via Pivdneukransk power transmission line with Romania. The potential total cross-border capacity of Ukraine's power system with ENTSO-E countries could reach 6 GW.

Completion of the infrastructure projects and further fulfilment of the post-synchronisation technical and regulatory measures will unfold hand-in-hand with the EU accession negotiations. On 25 June 2024, the official process kicked off, safeguarding Ukraine's further alignment with the EU green and digital transition.

The Commission's first annual enlargement report on Ukraine concluded that the country has a good level of preparation in the area of energy [28]

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26 Energy Community, https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL07.html

27 Three Seas Summit (2024), 'Reconstruction of the OHL 400 kV Mukachevo-Kapusany section from SS 400 kV Mukachevo to the state border in Zakarpattia region', Vilnius, https://projects.3seas.eu/projects/reconstruction-of-the-ohl-400-kv-mukachevo-kapusany-section-from-ss-400-kv-mukachevo-to-the-state-border-in-zakarpattia-region-submited-by-ukraine

28 European Commission (2023), 'COMMISSION STAFF WORKING DOCUMENT "Ukraine 2023 Report"

In addition, within Ukraine's obligations, the government together with Ukrainian civil society organisations, developed the National Energy and Climate Plan which reflects how Ukraine will gradually reach the targets established in the European Green Deel package[29].

What are the obstacles?

Russia keeps on committing attacks on civilian energy infrastructure making reconstruction plans outdated with every new assault. Therefore, planning energy resilience is constantly updated on a rolling basis. In its turn, Ukraine's allies and partners should react to on-demand needs versus planned needs which is unusual and burdening from the budget planning perspective.

As a result, there is a lack of incentives for investors, knowing that there is no stability and predictability in how the situation evolves. Moreover, the fact that the collective West cannot secure a sufficient amount of air defence systems for Ukraine further decreases investment certainty in Ukraine's energy sector.

Even if there was a decision to unfold renewable investments in Ukraine, the country's grid is not ready for new deployments and needs an upgrade and kilometres of new cables. Since 80% of balancing capacities are down, Ukraine would not be able to stabilise the grid. Therefore, for some time, thermal plants' restoration and renewables' deployment would need to go in parallel.

On Ukraine's side, there are still regulatory and policy challenges that haven't been resolved even before the Russian full-scale invasion. Some

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accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions', European Commission, 8 November, p. 120, https://neighbourhood-enlargement.ec.europa.eu/system/files/2023-11/SWD_2023_699%20Ukraine%20report.pdf

29 Ministry of Economy of Ukraine (2024), National Energy and Climate Plan of Ukraine until 2030, 28 June, https://www.me.gov.ua/Documents/List?lang=uk-UA&id=76f559ff-4fc5-4441-b73a-1ff1a5b781cf&tag=NatsionalniiPlanZEnergetikiTaKlimatuNaPeriodDo2030-Roku

of them are too costly to reintroduce during wartime, such as, for instance, accumulated debt for retrospectively changed feed-in tariffs.

In addition, there is still a prevailing narrative in the Ministry of Energy of Ukraine that fast recovery and reconstruction of the energy system of Ukraine can only be done via fossil fuels and in a centralised way, while municipalities are believed to be incapable of leading renewable projects.

Finally, there is a workforce shortage to conclude all the works associated with installation, maintenance, and repair. To illustrate the situation, on the second anniversary of the full-scale invasion in February 2024, leading Ukrainian electricity producer DTEK stated that 252 of its employees had been killed while working to keep the system operational[30].

Some recommendations

1. Any energy reconstruction effort will be offset by the lack of air defence systems in Ukraine. For all the solidarity support to protect critical energy infrastructures, the European Union should secure a closed sky over Ukraine at least on the border with the EU's neighbouring countries.

2. Building a new factory to produce spares and equipment as to facilitate faster repairs to Ukraine's power infrastructure in the EU near the Ukrainian border is a must.

3. International financial institutions should secure cheaper loans and lower the threshold for investment to allow smaller municipalities to participate in borrowing directly communicating with donors.

4. The Ukrainian government should focus with priority on small decentralised energy generation rather than restoring or building fossil-fuel projects with longer deployment time and higher maintenance costs.

5. Handing over more technical know-how on smart grids and small grids is crucial.

6. Explicit attention to battery storage should be considered at national

30 DTEK (2024), 'Ukraine's DTEK commits to new energy system but warns of attacks', DTEK, 23 February, https://dtek.com/en/media-center/news/ukraines-dtek-commits-to-new-energy-system-but-warns-of-attac/

level and supported by concrete steps throughout the country.

7. The levies on renewable technology import to Ukraine should be lifted by European member states and Ukraine.

8. Preparation of skilled workers to facilitate small renewable installations plus storage to increase communities' readiness for further power outages should be started on the ground of national planning.

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List of Contributors

Bulgaria: Associate Professor Atanas Georgiev, PhD, is Dean of the Faculty of Economics and Business Administration, Sofia University 'St. Kliment Ohridski'(FEBA, SU).

Associate Professor Atanas Georgiev, PhD, is Dean of the Faculty of Economics and Business Administration, Sofia University 'St. Kliment Ohridski'(FEBA, SU). He is also Head of Department 'Industrial Economics and Management' and Director of the master's programs 'Energy Markets and Services' and 'Nuclear Technologies, Management, and Innovations' and Director of the FEBA Net-Zero Lab at FEBA. Atanas is a member of the MB at the National Committee of Bulgaria for the World Energy Council and the Electric Mobility Industrial Cluster (since 2019). He is also an Independent Member of the Supervisory Board at UniCredit Bulbank. He is also the publisher of the 'Utilities' magazine.

Italy: Simona Benedettini, Fondazione Luigi Einaudi, Freelance consultant on power & gas sector regulation for EU and non-EU operators and public bodies

Simona Benedettini (Fondazione Luigi Einaudi) is an energy economist, specialising in energy policies, regulation, and competition in energy markets. In these areas, Simona works as a freelance consultant, carrying out impact analysis and assessment activities to support the definition of policies, strategic positioning, and advocacy activities of private operators and public institutions. At the European level, Simona supported the European Commission in defining policies for the digitalisation of the energy sector and the financing of cross-border infrastructures. Simona has a PhD in Law and Economics from the University of Siena and has been a visiting scholar at the University of Illinois. Simona is the author of academic publications and articles in the press on energy policy and competition.

Republic of North Macedonia: Ivan Durgutov, Executive Director at the European Business Association - North Macedonia

Ivan Durgutov holds an LLB and LLM from Ss. Cyril and Methodius

University in Skopje, North Macedonia. He began his career in legal services, excelling in HR, public speaking, and project management. After completing the Bar Exam and Court Interpreter Exam, he became a SUSI alumnus at Washington State University (2019). Currently, Ivan is part of the European Business Association in Skopje and the Liberal Institute Skopje, where he supports different areas of project management. His diverse experience includes leading civil society projects focused on renewable energy, youth, and EU integration. Passionate about multiculturalism, Ivan values continuous learning and thrives in international environments.

Moldova: Ana Otilia Nutu, Senior energy policy analyst at Expert Forum (EFOR) - Romania

Ana Otilia Nutu is a senior energy policy analyst with the Romanian think tank Expert Forum (EFOR). One of her key research interests over the past decade has been the Russian energy leverage over countries in the Black Sea region and the links between energy dependence, political and governance processes, and democratic backsliding. She coordinated advocacy projects with partners from Moldova, Ukraine, Georgia, Bulgaria, and Hungary, forewarning jointly Western Europe against increasing energy dependency on Russia in projects such as Nord Stream 2, in order to avoid the experiences of Eastern Europe.

Romania:

Corina Murafa, PhD, Independent public policy expert

Dr. Corina Murafa is an independent public policy expert, activist, and university lecturer in climate, energy, and sustainability. She has been collaborating with large non-profit, public, and private organisations, such as the World Bank, European Commission, Frankfurt School of Management, Ashoka, the Environmental Defense Fund, the Prime Minister's Office, OMV Petrom, Deloitte, and various other national governments, NGOs and think tanks. Since 2023 she has given a voice to civil society organisations, working on climate and energy in Brussels, as a member of the European Economic after having served a similar position at national level in the past four years. Her work focuses mostly on the just energy transition, energy poverty and ESG transformations in corporations. She is a member of the Romanian Energy Poverty Observatory and a lecturer, PhD, at the Faculty of Business Administration at Bucharest University of Economic Studies, having a solid academic background through studies and long-term fellowships in energy and climate economics and policy at UC Berkeley, Hertie School of Governance, New York University, the Bucharest University of Economic Studies.

Christian Busu, Director and University Professor, PhD

Cristian Busu is a director and university professor, PhD, with over 20 years of experience in business administration, portfolio management, strategic management, financial planning, and corporate governance. Having strong experience as an executive and non-executive director, successfully managed business in the energy sector, financial market, and also in the public sector. His work experience includes: university professor, network director within a commercial bank, state secretary within the Ministry of Energy, president of the largest utility company Electrica SA, vice-President of SIF Oltenia - one of the largest investment funds. Board member experience: Fondul Proprietatea, Electrica, SIF Oltenia, Central Depository, Electromagnetica, Argus, Flaros, and Turism Felix.

Stere Stamule, University Lecturer at Bucharest University of Economic Studies

Stere Stamule, Bucharest University of Economic Studies, Bucharest; Romanian Institute for Economic Forecasting, Romanian Academy, Bucharest, Romania, stere.stamule@fabiz.ase.ro, PhD in Marketing, is a University Lecturer at the Faculty of Business Administration in foreign languages, Bucharest University of Economic Studies. He is a lecturer of European Business Environment, Quality, and Innovation in Business and Economic Projects and Business Games (teaching in German and English). His current interests include relationship marketing in the energy field, energy communities, renewable energies, and the role of entrepreneurship in stimulating economic growth in developed and developing countries.

Slovenia: Felicita Medved, President of the Novum institute in Slovenia

Felicita Medved is a human geographer with research interests in political and economic geography, migration and citizenship, and in politics and policies of the European Union. She served as a member and president of the Board of Directors of the European Liberal Forum from 2010 to 2016.

Currently, she is the president of the Novum institute in Slovenia.

Ukraine: Valeriya Izhyk, EU Policy Officer on Ukraine's reconstruction, CEE Bankwatch Network, European Climate Pact Ambassador (2024)

Valeriya Izhyk is an EU Policy Officer, working on the green and inclusive reconstruction of Ukraine, currently based in Brussels. She was the youngest civil servant joining the Directorate General for Strategic Planning and European Integration in public administration reform in Ukraine. Since the Russian full-scale invasion, she coordinated the Electricity Working Group at the Council of European Energy Regulators, assisting in synchronising Ukraine with the Continental Europe Power system. Valeriya's primary goal is to influence European decision-makers and other donors to ensure that Ukraine is rebuilt up to sustainable standards with the Ukrainian people's interests in mind. She is a graduate of the European Politics MA program at the College of Europe. Valeriya also promotes 'build-back-better' reconstruction as a European Climate Pact Ambassador.

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