РОЗДІЛ V. МІЖНАРОДНІ ЕКОНОМІЧНІ ВІДНОСИНИ

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Alona Bilokon,
GCIP regional accelerator center for innovation, technology,
and start-ups in Mykolaiv region of Ukraine,
alona.bilokon@gmail.com
ORCID ID: 0000-0003-1644-4397
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EU HEADING FOR NET ZERO: REDEFINING THE EUROPEAN ENERGY MARKET

The European energy market plays a crucial role in the economic growth, security and sustainability of the EU as well as the European region. The imperative to combat climate change and achieve net-zero emissions has set the EU on a transformative path towards redefining its energy market. As the demand for energy continues to rise, it is vital to look into the challenges the European energy market faces, in order to analyze what positively affects the EU energy transition, and design the set of recommendations that foster competition, innovation, and environmental responsibility. This article outlines a comprehensive strategy to redefine and enhance the European energy market by addressing key challenges and leveraging opportunities for a sustainable and resilient energy future. While the EU has a significant opportunity to achieve the energy transition by 2050, sustained action is required from policymakers, industries, and citizens to address the challenges. Strengthening the European energy market through robust policies, innovation, and inclusive engagement can lead to a sustainable, climate-neutral future, presenting not only an environmental imperative but also an opportunity for economic growth, job creation, and improved energy security. Collective efforts and steadfast commitment can propel the European energy market toward influencing global actions for a more sustainable and resilient planet for future generations. However, the transition is not without its challenges. Overcoming dependencies on fossil fuels, integrating

intermittent renewable energy into the grid, securing adequate funding, and addressing social and economic impacts, especially for communities reliant on fossil fuel industries, require immediate attention. Technological advancements, investments in clean energy technologies, and research and development efforts are vital for a successful transition. Global collaboration remains fundamental in addressing climate change effectively. The EU's continued engagement with other nations and the establishment of a cohesive global framework for combating climate change are crucial. Harmonizing regulatory and policy frameworks, implementing carbon pricing mechanisms, and promoting cross-border cooperation are essential for fostering a conducive environment for renewable energy investments and innovation. Additionally, engaging citizens and stakeholders through awareness campaigns, educational initiatives, and involving communities in renewable energy projects are key components for successful energy transition.
Key words: energy transition, EU, European energy market, sustainable development, net zero.

Альона Білоконь,
кандидат історичних наук,
Регіональний акселераційний центр GCIP для інновацій, технологій
та інноваційних стартапів у Миколаївській області,
ORCID ID: 0000-0003-1644-4397

ЄС НА ШЛЯХУ ДО ЧИСТОГО НУЛЯ: ПЕРЕОСМИСЛЕННЯ ЄВРОПЕЙСЬКОГО ЕНЕРГЕТИЧНОГО РИНКУ

Європейський енергетичний ринок відіграє вирішальну роль в економічному зростанні, безпеці та стійкості ЄС, а також європейського регіону. Необхідність боротьби зі зміною клімату та досягнення вуглецевої нейтральності поставила ЄС на трансформаційний шлях до переосмислення свого енергетичного ринку. Оскільки попит на енергію продовжує зростати, життєво важливо розглянути виклики, з якими стикається європейський енергетичний ринок, щоб проаналізувати, що позитивно впливає на енергетичний перехід ЄС, і розробити набір рекомендацій, які сприятимуть конкуренції, інноваціям та екологічній відповідальності. У цій статті викладено комплексну стратегію переосмислення та вдосконалення європейського енергетичного ринку шляхом вирішення ключових проблем і використання можливостей для сталого та стійкого енергетичного майбутнього. Незважаючи на те,

що ЄС має значну можливість здійснити енергетичний перехід до 2050 року, для подолання викликів від політиків, галузей промисловості та громадян потрібні постійні дії. Зміцнення європейського енергетичного ринку за допомогою надійної політики, інновацій та інклюзивного залучення може призвести до сталого, кліматично нейтрального майбутнього, представляючи не лише екологічний імператив, але й можливість для економічного зростання, створення робочих місць та покращення енергетичної безпеки. Колективні зусилля та непохитна відданість можуть підштовхнути європейський енергетичний ринок до впливу на глобальні дії для більш сталої та стійкої планети для майбутніх поколінь. Однак перехід не позбавлений проблем. Негайної уваги потребують подолання залежності від викопного палива, інтеграція відновлюваних джерел енергії в мережу, забезпечення адекватного фінансування та вирішення соціальних та економічних наслідків, особливо для громад, які залежать від промисловості, що працює на викопному паливі. Технологічний прогрес, інвестиції в екологічно чисті енергетичні технології, а також науково-дослідні роботи є вкрай важливими для успішного переходу. Глобальна співпраця залишається фундаментальною для ефективної боротьби із викликами, пов'язаними з глобальним потеплінням. Таким чином, постійна взаємодія ЄС з іншими країнами та створення єдиної глобальної структури для боротьби зі зміною клімату є надзвичайно важливими. Гармонізація нормативно-правових та політичних рамок, впровадження механізмів ціноутворення на викиди вуглецю та сприяння транскордонному співробітництву мають важливе значення для створення сприятливого середовища для інвестицій у відновлювану енергетику та інновацій. Крім того, залучення громадян і зацікавлених сторін через інформаційні кампанії, освітні ініціативи та залучення громад до проектів з відновлюваної енергетики є ключовими компонентами успішного енергетичного переходу.

Ключові слова: енергетичний перехід, ЄС, європейський енергетичний ринок, сталий розвиток, чистий нуль.

1. INTRODUCTION

Aim of the Study. The main aim of this study is a comprehensive analysis of the energy transition of the European Union as well as the ways it affects the European energy market. To achieve this goal, several research tasks have been established: outline the challenges that the European energy market faces, analyze

the factors contributing to positive repercussions for the EU energy transition, and design a set of recommendations for redefining the energy market in Europe.

Methodology. This study employs a mixed-methods research design, incorporating both qualitative and quantitative approaches to comprehensively redefine the European energy market in the context of achieving net-zero emissions. For the purpose of this research, secondary data has been collected, including: a) official reports and documents: a comprehensive review of policy documents, energy reports, and strategic plans from the European Union and member states have been held to comprehend the regulatory framework and policy initiatives driving the shift toward net-zero emissions; b) market data and statistics: secondary data related to energy consumption, renewable energy capacity, fossil fuel use, and carbon emissions have been compiled from reputable sources such as Eurostat [1], International Energy Agency (IEA) [2], and European Environment Agency (EEA) [3]. Quantitative data gained from official reports and statistical sources have been subjected to descriptive analysis to highlight trends, changes in energy consumption patterns, and shifts in market shares. In the light of the conceptual framework, this study is guided by the multi-level perspective (MLP) [4] framework, which provides a lens, through which to analyze the interactions between technological innovation, societal norms, and institutional arrangements in driving sustainable energy transitions.

The global consensus on the urgency of addressing climate change is driving an unprecedented shift in energy paradigms. As the effects of climate change intensify and concerns about energy security grow, nations are recognizing the imperative to transition from fossil fuels to sustainable, low-carbon alternatives. The EU, a vanguard in climate action, has set its sights on a transformational goal – achieving net-zero greenhouse gas emissions by 2050. Such a bold commitment necessitates a comprehensive overhaul of the energy sector, touching upon every facet of energy production, consumption, and distribution.

At the heart of the EU's net-zero aspirations lies the profound transformation of the European energy market. Traditionally characterized by a complex interplay of diverse energy sources, regulatory frameworks, and market structures, the European energy market now faces a radical shift towards sustainability and decarbonization. This transition demands an intricate remodification of the market's architecture – from fossil fuel dependency to a reliance on renewable sources, from centralized power generation to decentralized energy systems, and from passive consumers to empowered prosumers who actively participate in energy production and management.

This article makes a profound research of the European energy market's transformation on their path to net zero. By delving into policy frameworks,

renewable energy integration, technological innovations, cross-border cooperation, economic implications, and international collaboration, this study illuminates the complex and intertwined facets of the EU's energy transition. This article may give insights into the challenges, opportunities, and transformative potential that characterize the European energy market's journey towards a sustainable and net-zero future.

2. RESEARCH RESULTS

European energy legislation has significantly triggered the transition from fossil fuels to renewable energy sources, leading to increased investments in wind, solar, and other renewables, this way contributing to a more sustainable energy mix.

– **Laws and Regulations**

Governance regulation requires each EU member state to develop a National Energy and Climate Plan (NECP) [5] outlining their contributions to achieving the EU's energy and climate objectives, including net-zero emissions by 2050. Emission Trading System (EU ETS) [6] is a cornerstone of the EU's efforts to combat climate change. It establishes a cap-and-trade system for greenhouse gas emissions from industries and power generation, incentivizing emission reductions. Renewable Energy Directive (RED) [7] sets binding targets for the share of renewable energy in the overall energy consumption of EU member states. It promotes the development of renewable energy sources, such as wind, solar, hydro, and biomass, and establishes measures for their integration into the energy market. Energy Efficiency Directive (EED) [8] focuses on improving energy efficiency by establishing binding energy-saving targets while calling for member states to develop energy efficiency plans, implement energy-saving measures, as well as promote energy-efficient technologies. Effort Sharing Regulation [9] binds national targets for sectors not covered by the EU ETS, such as agriculture, waste, and buildings, to ensure overall emissions reductions across the EU.

– **Programs and Initiatives**

The European Green Deal [10] is a comprehensive plan to make Europe the world's first climate-neutral continent by 2050, comprising a wide range of initiatives and strategies for achieving net-zero emissions. Horizon Europe [11] is the EU's research and innovation program that encompasses funding for clean energy research, development of renewable technologies, and initiatives to advance energy transition. Renewable Energy Financing Mechanisms [12] provide various funding programs and mechanisms, such

as the Connecting Europe Facility (CEF) [13] and the Innovation Fund, support renewable energy projects and technology deployment. As a part of the European Green Deal, Just Transition Mechanism [14] aims to support regions and industries most affected by the transition to a climate-neutral economy. Covenant of Mayors for Climate and Energy [15] is a network of local authorities committed to climate action and energy transition, promoting cooperation and best practices at the local level. European Fund for Strategic Investments (EFSI) [16] aims to mobilize private investment in sustainable projects, including energy transition initiatives.

Challenges of the European Energy Market in Terms of Energy Transition

The energy transition of Europe faces several challenges to be addressed in order to successfully achieve the net-zero emissions goal by 2050 [17]. The first challenge is fossil fuel dependency, which is still a regrettable reality of many European countries. Therefore, phasing out fossil fuels and transitioning to renewable energy sources requires significant investments in renewable infrastructure and the development of new technologies. The next challenge is grid integration, that is to say, the integration of intermittent renewable energy sources like solar and wind into the existing grid. For the time being, it poses technical challenges, including upgrading and modernizing the grid to accommodate fluctuating energy supply and demand patterns to ensure a stable and reliable energy system. The third problem is connected to efficient energy storage, which is critical to balancing energy supply and demand and ensuring continuity during periods of low renewable energy production. Scaling up energy storage technologies like batteries and hydrogen storage is a key challenge. Apart from these, there are several questions still open in the field of investment and funding, which requires substantial financial backing. Ensuring access to adequate funding for renewable energy projects, grid upgrades, and research and development initiatives is crucial to accelerating the energy transition. The next challenge is linked to the social and economic impact, which implies that the energy transition may lead to job displacements in certain sectors, particularly in regions heavily reliant on fossil fuel industries. Managing the social and economic repercussions of the transition is essential to ensure a just and fair shift to a low-carbon economy. Essentially for the EU energy market are the regulatory and policy frameworks: aligning regulatory frameworks and policies across EU member states to support the energy transition can be complex. Harmonizing regulations, carbon pricing

mechanisms, and subsidy schemes is crucial for a consistent and coordinated approach. Furthermore, the lack of technological innovation can be among the problems. Continued research and development are needed to improve existing renewable energy technologies and develop new solutions. Innovation is crucial for reducing costs, increasing efficiency, and expanding the adoption of clean energy technologies. Additional challenges are concerned with infrastructure and land use, implying that expanding renewable energy infrastructure requires careful planning and land use considerations. Balancing the need for renewable energy projects with environmental and social concerns can be challenging. Additionally, global cooperation has its peculiarities: addressing climate change is a global challenge, and the success of the European energy transition depends on international collaboration. Engaging with other nations, especially major emitters, is essential to create a global framework for climate action. And finally, one of the most important challenges is energy security. As the energy mix shifts towards renewables, ensuring energy security becomes paramount. The EU must balance renewable energy sources with other energy options to maintain a secure and reliable energy supply.

Addressing these challenges requires strong political will, collaboration among member states, private sector engagement, and active involvement from citizens. Policymakers must focus on creating supportive environments, promoting innovation, and developing strategies that foster a sustainable and inclusive energy transition.

What May Be Beneficial for the EU Energy Transition?

The European Union has a significant opportunity to implement the energy transition and achieve net-zero emissions by 2050. The EU has demonstrated a strong commitment to addressing climate change and transitioning to a sustainable, low-carbon energy system. Several factors contribute to the beneficial effect of the EU energy transition. First and foremost, it involves policy commitments. The EU has created ambitious goals and policies to combat climate change and transition to renewable energy. The European Green Deal, which aims to make Europe the first climate-neutral continent by 2050, provides a comprehensive framework for achieving the energy transition. Secondly, it is a regulatory framework, including carbon pricing mechanisms and emissions trading schemes, which provides economic incentives for reducing greenhouse gas emissions and investing in clean energy in the EU. International collaboration is another important factor. The EU is actively engaging in international collaborations and agreements to ad-

dress climate change on a global scale. International cooperation is essential to tackle climate issues effectively and create a level playing field for clean energy technologies. The next beneficial factor is concerned with strong investment and funding. The EU is actively investing in renewable energy projects and sustainable infrastructure. The European Investment Bank and the European Commission's funding programs support research, innovation, and the scaling up of clean energy technologies. It is crucial to point out the renewable energy growth, which has been steadily increasing in Europe over the years. The continent has seen significant growth in solar and wind energy capacity, and several member states have already achieved remarkable shares of renewables in their energy mix. Additionally, the cross-border cooperation refers to positive factors. Cross-border cooperation and energy infrastructure development are crucial elements in enhancing the integration of renewable energy sources and ensuring energy security. The EU is actively promoting energy interconnections and smart grids to facilitate efficient energy flows. Special attention is given to technological advancements in clean energy technologies, energy storage, and grid management, which are driving the transition to renewable energy sources. The falling costs of renewables and energy storage solutions make them increasingly competitive compared to conventional fossil fuels. Finally, it is vital to mention public awareness and support for climate action and clean energy solutions. Citizens are increasingly demanding a transition to sustainable energy and putting pressure on policymakers and industries to act.

While these numerous challenges remain, namely, the need for continued investments, technology advancements, and addressing the social and economic impacts of the energy transition, the European Union market is well-positioned to achieve the ambitious goal of net-zero emissions by 2050. With ongoing commitment from governments, industries, and citizens, the EU can lead the way in creating a sustainable and resilient energy future.

How to Strengthen the European Energy Market?

The European energy market is characterized by diversity in energy resources, national policies, and regulations, resulting in fragmented and sometimes inefficient markets. To maximize the benefits of energy integration and optimize energy resources, this article outlines possible strategic measures:

– Enhancing cross-border cooperation and infrastructure. Promoting cross-border cooperation and building a robust energy infrastructure is vital in order to facilitate energy flows and enhance market integration. The EU should prioritize investments in interconnectors, storage facilities, and smart grids to ensure

efficient utilization of renewable energy sources and improved energy security. Furthermore, encouraging the development of a European electricity market will strengthen the region's resilience to supply disruptions.

– Fostering competition and market liberalization. To achieve an efficient energy market, it is essential to promote competition and liberalization. Simplifying regulatory barriers and reducing market distortions will encourage new entrants and innovative business models. By ensuring transparent and non-discriminatory access to infrastructure, the EU can enable small-scale producers, community-driven projects, and prosumers to participate actively in the energy market.

– Supporting renewable energy and decarbonization. To address climate change and reduce dependency on fossil fuels, the EU must accelerate the transition to renewable energy sources. This requires setting ambitious targets for renewable energy deployment, coupled with adequate financial incentives and support mechanisms. Additionally, providing support for research and development in clean energy technologies will spur innovation and facilitate the integration of renewable energy into the grid.

– Enhancing energy efficiency and demand-side management. Improving energy efficiency is a cost-effective approach in order to reduce energy consumption and greenhouse gas emissions. The EU should implement stringent energy efficiency standards for appliances, buildings, and industries. Encouraging demand-side management through smart metering and time-of-use pricing will empower consumers to adjust their energy consumption patterns and reduce peak demand.

– Ensuring energy security and diversification. Energy security is a cornerstone of a robust energy market. The EU should promote energy diversification by reducing its reliance on a single energy supplier and enhancing the use of indigenous energy resources. Diversification can be achieved through the development of a diversified energy mix, increased storage capacity, and the use of renewables.

– Emphasizing digitalization and data privacy. Digital technologies play a crucial role in transforming the energy sector. Utilizing advanced analytics as well as integrating digitalization can optimize energy distribution and consumption. However, it is essential to prioritize data privacy and cybersecurity to ensure the trust and confidence of consumers and stakeholders.

– Promoting social inclusivity and fairness. As the energy transition unfolds, policymakers must consider the social impact of these changes. Energy poverty must be addressed through targeted support for vulnerable groups, energy efficiency initiatives, and affordable access to clean energy.

To sum up, the advancement of the European energy market requires a comprehensive and coordinated approach. By focusing on enhancing cross-border cooperation, fostering competition, supporting renewable energy, and promoting energy efficiency, the EU can create a sustainable, secure, and competitive energy market that benefits all its citizens and contributes to global climate goals. Implementing the proposed measures will require close collaboration between member states, stakeholders, and the private sector. Policymakers must ensure that these strategies align with Europe's long-term energy vision while remaining adaptable to evolving technological advancements and changing market dynamics. Only through collective efforts and commitment to a sustainable energy future can the EU achieve its goals and lead the way in the global fight against climate change.

3. CONCLUSIONS AND PROSPECTS FOR FUTURE RESEARCH

The energy transition is an ambitious and imperative undertaking for the European energy market to combat climate change and achieve net-zero emissions by 2050. This research article has explored the challenges and opportunities in redefining and strengthening the European energy market to navigate this transformative journey successfully. The European Union's commitment to the net-zero goal, as demonstrated by the European Green Deal and other policy initiatives, provides a strong foundation for the energy transition. By setting ambitious and binding goals for emissions reduction and renewable energy deployment, the EU has signaled its determination to lead the global fight against climate change.

Renewable energy sources, such as solar, wind, hydro, and geothermal power, play a central role in the energy transition. Encouraging their widespread adoption requires supportive policies, financial incentives, and innovative technological solutions. The growth of renewable energy capacity across Europe over the past decade is a testament to the progress achieved, but further efforts are needed to ensure a complete shift away from fossil fuels. Energy efficiency is another essential aspect of the energy transition. Enhancing energy efficiency in buildings, transportation, and industries is a cost-effective way to reduce energy consumption and greenhouse gas emissions. Setting stringent efficiency standards, incentivizing energy-saving measures, and promoting sustainable practices are crucial steps in this direction.

However, the energy transition goes hand in hand with major challenges. The dependency on fossil fuels, the integration of intermittent renewable energy

into the grid, and the need for adequate funding are significant obstacles that demand immediate attention. Additionally, managing the social and economic impacts of the transition, especially for communities and workers in fossil fuel industries, is critical to achieving a just and fair transition. Technological advancements and research and development efforts are vital for driving the energy transition forward. Investments in clean energy technologies, energy storage, and grid modernization are needed to overcome technical challenges and ensure a reliable and resilient energy system.

The energy transition is a global endeavor, and international collaboration is fundamental in addressing climate change effectively. The EU should continue to engage with other nations and work towards a cohesive global framework to combat climate change. Regulatory and policy frameworks play a crucial role in facilitating the energy transition. Harmonizing regulations, introducing carbon pricing mechanisms, and promoting cross-border cooperation are necessary so as to create a conducive environment for renewable energy investments and innovation. Moreover, engaging citizens and stakeholders is essential for the successful energy transition. Public awareness campaigns, education in energy efficiency, and involving communities in renewable energy projects can build support and mobilize actions at the grassroots level.

In conclusion, the EU has a significant chance of achieving the energy transition by 2050. The EU's commitment to ambitious goals, their increasing adoption of renewable energy, advancements in clean energy technologies, and international cooperation are positive indicators of progress. However, there are challenges that require immediate and sustained action from policymakers, industries, and citizens. By strengthening the European energy market through robust policies, innovation, and inclusive engagement, the EU can lead the way towards a sustainable, climate-neutral future. The energy transition is not just an environmental imperative; it represents an opportunity for economic growth, job creation, and improved energy security. With collective efforts and unwavering commitment, the European energy market can inspire and influence global actions towards a more sustainable and resilient planet for generations to come.

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