



Károli Gáspár University of the Reformed Church Doctoral School of Law

Market and Technology Regulation Doctoral Program

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**THE CHALLENGES AND OPPORTUNITIES OF HUNGARIAN ENERGY
REGULATION IN LIGHT OF ENERGY SOVEREIGNTY IN A EUROPEAN CONTEXT**

THESES OF THE DISSERTATION

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Abstract

The research focuses on the challenges and opportunities of independent and sustainable security of supply, with particular emphasis on energy sovereignty, decarbonization, and secure energy supply.

The dissertation examines the research topic in seven chapters: after presenting the conceptual and hypothetical foundations, it reviews the relevant literature and domestic and EU energy regulations, and then analyses in detail the energy sectors of Hungary's most important allies. In addition to the V4 countries, the research also provides a European perspective by comparing the energy policies and national energy and climate plans of Austria, Germany, and France. The combined application of the two levels of analysis enables identification of structural differences between regional patterns and European energy policy directions. The research clearly shows that the countries examined have markedly different approaches to nuclear energy and renewable energy sources, which distinguish the energy policy strategies of pro-nuclear and anti-nuclear states. The research is supplemented by an analysis of legal cases, which provide deeper insight into the current energy law issues and regulatory challenges facing the countries concerned.

The concluding chapter of the dissertation summarises the main findings of the research, highlighting new conceptual and methodological approaches, as well as policy recommendations, to strengthen the security of supply and energy sovereignty. In addition to *de lege ferenda* proposals, the thesis also recommends introducing further regulatory and financial incentives to facilitate the development of an independent, sustainable, and flexible energy system for the future. The concluding section summarises the research's scientific contributions and presents recommendations to support future work of energy policymakers, highlighting the researcher's independent intellectual and scientific achievements.

1. Outline of the research project, objectives and choice of topics

The research focused on the issue of independent and sustainable security of supply. The expected growth in population and GDP over the coming decades is projected to drive a significant increase in energy demand. This poses a serious challenge for meeting sustainability and environmental protection goals. Finding the optimal balance between centralised and decentralised energy infrastructures, redefining responsibility for security of supply, ensuring a carbon-free electricity supply for European consumers, reducing dependence on imports of fossil fuels, and the growing strategic role of renewable energy sources and nuclear energy are all key issues that continue to shape policy and industry debates. The research seeks answers to

several current energy policy issues, with a particular focus on energy sovereignty, decarbonization, and energy security. These topics play a decisive role in both domestic and EU strategic documents. They are of particular importance in the comparative analysis of the countries examined's National Energy and Climate Plans (hereinafter: NECPs). The dissertation is divided into seven chapters. After presenting the topic selection, hypotheses, and basic concepts relevant to the research, the thesis reviews energy regulation at the domestic and European Union levels. It then analyses the energy sectors of Hungary's most important and historically closest allies, with particular regard to the current energy market situation and the most significant challenges facing these countries.

The analysis of the V4 countries is justified not only by their historical cooperation and shared strategic thinking, but also by the fact that, despite their similarities, they differ significantly in their geographical conditions and energy policy orientations.

These commonalities and differences make it relevant to compare their energy policy decisions and to explore how countries in the region are responding to the challenges of sustainable, independent security of supply, as well as the potential for future cooperation within the V4 framework. The study is complemented by a European perspective, with a particular focus on Hungary's western neighbours, exploring the specificities of their energy sectors, regulatory options, and strategic dilemmas. The analysis of these countries contributes to understanding how they shape EU energy policy and strengthen energy security and energy sovereignty. Given that the scope of the thesis did not allow for a detailed examination of all EU member states, the assessment of nuclear energy, a decisive yet highly controversial area for energy independence and security of supply, was a key criterion in the selection process. Based on these considerations, Germany and France were included, as these two Member States represent markedly different approaches to energy policy. In addition, the inclusion of Austria was justified, as the country has an outstanding position in terms of energy self-sufficiency, and its decentralised energy system is one of the leading European examples of the successful operation of renewable energy structures.

Last but not least, the selection criteria also included the fact that these countries have a long history of technical and technological solutions and energy innovations, and their economic development and energy policy decisions have a direct impact on the energy sector of all EU Member States. France is a leader in nuclear energy production and use, while Germany has consciously moved away from nuclear energy in recent years, shifting its energy policy towards renewable energy sources. Austria, on the other hand, has never used nuclear energy in its energy production. Based on these differences, the paper clearly outlines the circle of pro- and

anti-nuclear countries. While France and the V4 countries reinforce the former group, the anti-nuclear approach is represented by Germany and Austria. The examination of these three additional countries has enabled us to go beyond the V4 perspective and provide a broader picture of the practical implementation of EU climate policy efforts, as well as to explore how different energy strategies reflect the European Union's political position and long-term objectives. The selection of these countries was therefore not random, but based on a conscious methodological decision. Their energy policy models represent different development paths, allowing comparison of strategic approaches and exploration of common patterns and structural differences. The study thus provides a comprehensive picture of the different paths to European energy sovereignty and lays the foundation for concluding relevant to Hungary. Thanks to this, the study is conducted on two levels of analysis. On the one hand, it provides a regional perspective by comparing the V4 countries, justified by their historical cooperation, geographical proximity, and similar economic and political challenges. On the other hand, the analysis is complemented by a European-level overview that examines the energy strategies of EU member states, which represent markedly different approaches to nuclear energy, renewable energy sources, and security of supply. The combined application of the two levels enables identification not only of regional patterns but also of structural differences in European energy policy directions.

For the selected countries, the most relevant legal cases are also analysed, providing deeper insight into the current energy law issues and challenges they face. They clearly illustrate how the energy policy decisions of individual countries are closely intertwined with the European and international energy regulatory environment and geopolitical processes.

In its comparative analysis of national energy and climate plans, the research examines strategic issues and long-term objectives for the energy sector in the selected countries, primarily from the perspectives of security of supply and climate policy. The research found that most EU Member States see nuclear energy as one of the possible means of achieving security of supply and climate neutrality. At the same time, it has also become clear that there are significant differences between Member States on this issue. Among other things, these differences justified examining the energy sectors of France and Germany as two markedly different examples of attitudes towards nuclear energy production.

Several points in the paper address the situation in Ukraine, with particular attention to the geopolitical context that significantly impacts the region's energy supply and economy. Nevertheless, the comparative analysis does not cover Ukraine's energy policy and regulatory environment. The current geopolitical situation entails several regulatory uncertainties that

directly affect the country's security of supply and require extraordinary energy regulatory measures. All this results in a dynamically changing environment in which a comparative analysis cannot be guaranteed to be objective. In addition, the narrow time frame of the thesis was, in itself, a challenge for presenting a snapshot of the energy sector in the countries under review, and the inclusion of such a rapidly and complexly changing element would have further limited the temporal and methodological scope of the analysis. Furthermore, Ukraine's EU accession process raises several legal harmonisation issues that fall beyond the scope of this research.

When selecting the topic, the primary objective was to ensure it was timely and that the knowledge gained during the study could be applied in future research. The thesis aims to present the most critical connections between energy sovereignty and security of supply, starting with historical background and conceptual frameworks, through methodological approaches, to the analysis of energy policy and legal frameworks. A further aim of the research is to ensure that the topic of energy sovereignty is a central element in each chapter of the thesis and is interpreted in accordance with the specific characteristics of that section, emphasising its decisive role in the development of a secure and sustainable energy supply. Finally, the research explores the market difficulties characteristic of the industry and, in light of these, identifies areas where further measures and future interventions may be necessary.

In the concluding section of the paper, the research results are presented, including the support options relevant to the domestic energy sector, the main conclusions, and recommendations for policymakers.

2. Description of the research and analysis, presentation of the methodological framework, and list of sources

At the start of the research, several questions were raised, some of which were gradually answered during the review of domestic and international literature, as this is an extremely fast-changing and developing field. At the same time, analysing the questions that had already been clarified led to the identification of further problems, due to the specific regulatory and technological nature of the topic and its geopolitical significance, which enabled the formulation of new hypotheses. Russia's invasion of Ukraine on February 24, 2022, marked a historic turning point for European energy and security policy, triggering a fossil fuel crisis and highlighting the dependence of all European Union member states on Russian gas imports. Numerous studies, action plans, and strategic decisions have focused on ending dependence on Russian fossil fuel imports. To regain its energy sovereignty as soon as possible, the EU is using

all available means to reduce its demand for fossil fuels and promote the transition to renewable energy. Current geopolitical events, the rapidly evolving legal environment driven by the energy crisis, the increasingly precarious security of supply, and the drastic shift away from Russian fossil fuels have made research on the chosen topic even more exciting.

When formulating the hypotheses, the main emphasis was on applying legal science methods. Based on an analysis of relevant studies on the topic, the hypotheses were defined as follows, following a logical structure from the general to the specific. *If a country is objectively energy sovereign, it does not necessarily mean it is also subjectively energy sovereign (H1). Neither objective nor subjective energy sovereignty can be achieved without a secure energy supply. (H2). Natural gas, as an energy source that provides system-level flexibility, will continue to play a key role in long-term energy regulation (H3).*

The studies examined in this research clearly showed that the desire to reduce fossil fuel consumption drastically is not solely driven by a quest for energy sovereignty. A commitment to higher sustainability standards reinforces this aspiration, as the world strives to dramatically reduce greenhouse gas emissions while confronting numerous future challenges to mitigate the adverse effects of climate change. In connection with this topic of particular importance, the following hypothesis has been formulated: *increasing the share of renewable energy sources and maintaining and strengthening the role of nuclear energy in the energy mix are key conditions for enhancing security of supply and meeting EU-level carbon-neutrality targets (H4).*

During investigations aimed at supporting the defined hypotheses, several other scientific questions arose. For example, the energy mix of the countries studied, the focus of their energy strategy, what they understand by sustainable and secure energy supply, how they interpret energy sovereignty, and the degree of import dependency. How does this affect secure energy supply? What is the degree of dependence on Russian gas? How has the role of natural gas changed since the war, and what is its position on nuclear energy production? Is it possible to speak of energy sovereignty in an objective sense in a cross-border, integrated energy market? The answers obtained during the research contributed to the development of a new scientific methodology and conceptual system that serves to strengthen independent and sustainable security of supply. The results obtained in this way are presented in the individual chapters, which are also discussed separately in the concluding chapter of the thesis.

Due to the complexity of the topic, the examination of the hypotheses required a distinctly interdisciplinary approach, which also influenced the methodological framework, combining legal, economic, and political science perspectives. In preparing the thesis, the researcher used

comparative document analysis as well as descriptive and comparative analysis methods. Through these methods, the circumstances and data uncovered from the processing of extensive literature and relevant documents on the energy sectors of the countries examined are presented in a consistently uniform structure, with the same depth of analysis. One of the focal points of the methodological approach is text and discourse analysis techniques, which play a prominent role in scientific interpretation. Another key pillar of the thesis's methodological framework is the analysis of relevant regulatory systems. On the one hand, this includes a detailed examination of domestic energy regulation. On the other hand, it extends to the exploration of international and European Union legal and institutional structures that directly or indirectly influence the functioning and development of the energy sector. Thirdly, the methodology also includes an analysis of relevant legal cases that use practical examples to highlight the specific features and challenges of applying the regulatory framework. Within the qualitative approach, the legal cases identified for individual countries are presented using the case study method, highlighting the relevant circumstances, the decisions taken, and the conclusions that can be drawn from them.

The research is based on primary and secondary sources. Primary sources include the most critical domestic and international studies, models, and strategic materials related to energy sovereignty, sustainable security of supply, and energy transition, as well as relevant legislation. The thesis discusses issues related to the energy mix, climate policy, and import dependency from the perspectives of diversification and supply security, drawing on numerical data and reports from internationally renowned and recognised energy policy research institutes. Secondary sources include historical works, articles, analyses, and conference publications on the subject of the study, as well as publications by companies playing a key role in the energy sector and official statements by representatives responsible for policy. Due to the subject's particular geopolitical significance and topicality, it was essential to monitor the daily domestic and international print and online press, which helped track events that changed daily. During the analysis, sources of varying scientific value were explored through library research and online data collection. In addition to regular consultations with the research supervisor, professional consultations were held with experts familiar with the topic, market analysts, and leaders of companies and research institutes that play a key role in the sector. The extensive collection of material enabled a more in-depth analysis. The processed documents and articles provided a comprehensive picture of the similarities, differences, challenges, and opportunities across the countries' energy sectors. The research also enabled exploration of how the energy

visions presented in various strategic documents and scientific journals relate to one another and how they affect our lives today, from economic and technological perspectives.

Today, energy law is becoming increasingly important in light of the fight against climate change and the European Union's energy dependence. The number of publications on energy law in Europe has been growing since the 1980s. Still, in Hungary, fewer publications with a purely energy law focus and scientific merit have been published. It is important to emphasise that the domestic publications that have seen the light of day enhance the scientific significance of the topic through their professional quality.¹

The paper highlights that energy law is a unique field of study in many respects, closely related to several other disciplines. As a result, other disciplines will inevitably be touched upon in the course of the study. Thus, the paper also briefly touches upon the economic aspects of energy law. One such topic is GDP, an economic indicator of a country's gross domestic product. It measures the total value of all goods and services produced in a given country during a specific period. This indicator helps understand and compare countries' economic performance and growth. These products typically cannot be produced without energy consumption. Energy and its regulatory environment are increasingly permeating every aspect of our lives. Just think about it: without electricity, water supply, lighting, cooling, heating, internet service, and our basic work tools, such as telephones and computers, none of these would function. Without energy, transportation and healthcare would come to a standstill. With today's accelerated technological development, no field of science can be divorced from energy, energy law, and its regulation. As we have seen above

This paper focuses primarily on energy law, but the field's interdisciplinary nature also necessitates a limited presentation of specific technical and technological contexts. This approach is supported, on the one hand, by the practical experience gained by the researcher in the course of his professional activities to date and, on the other hand, by the literature on sectoral administration and energy regulation, which consistently points to the mutual determination of the technological background and the legal system of norms. The interpretation and dogmatic analysis of energy law norms is inseparable from the technological and industrial processes that are the subject of regulation and determine their applicability and effectiveness. Consequently, the description of the technical and technological background is not an independent line of analysis, but a contextual, supplementary element that serves to substantiate the legal examination and is limited to the necessary extent. Accordingly, the thesis

¹ Szuchy Róbert, Az energijog fogalma és dogmatikai elhelyezése, In: Studia In Honorem Éva Jakab, Szerk.: Boóc Ádám - Pókecz Kovács Attila, Patrocinium Kiadó, Budapest 2023., ISBN 978-615-5961-97-7, 296. o.

addresses only those technological aspects essential to legal interpretation, the exploration of regulatory logic, and the answering of research questions, while keeping in mind the legal nature of the research topic and maintaining its focus on energy law.

NECPs cover all energy sources and numerous technological issues, including geothermal energy, biomass, hydrogen, nuclear technology, natural gas, crude oil, and coal. The researcher clearly states in the dissertation that although the energy sector is highly diverse, the scope of the thesis does not allow for a scientific, detailed presentation of all energy sources and technological solutions. Due to their topicality, diversity, and complexity, these topics warrant separate research areas. The focus of the study is therefore on nuclear energy, renewable energy sources, electricity, and natural gas, which play a decisive role today. This approach allows the issues under examination to be presented not only from the perspective of a single energy sector, but also in a global context. This requires a comprehensive understanding of the production, technical safety, transport, and consumption characteristics of multiple energy sectors, along with their economic and legal contexts. The thesis can also be considered a pioneering undertaking, as it presents the regulation of the energy sectors under examination in a unified structure, placing them on a single platform with the same depth of analysis.

The thesis examines a highly complex subject area in a rapidly changing legal, social, and geopolitical environment, where clear, dogmatic guidelines are not always available. The research provides a partial overview of the international and Hungarian energy market situation, while at the same time seeking to formulate timeless conclusions that go beyond the current situation through dogmatic clarification. After presenting the domestic regulatory environment, the thesis provides a detailed analysis of the relevant EU regulatory frameworks and the energy policies of selected countries, thereby placing the study's subject in a broader international context. This necessarily limits the analysis to a specific time frame, as the individual findings are valid only for a given period and are relatively short-term. At the same time, scientific rigour requires that conclusions about the future be based on past facts and the current state of affairs, thus providing a solid foundation for examining future goals, opportunities and prospects, as well as for developing subsequent recommendations and proposals.

From a research perspective, it is essential to define the most critical concepts accurately and in line with the literature. In the first section of the thesis, the researcher pays particular attention to the interpretation of basic concepts relevant to energy law, particularly the interpretation of sustainable security of supply and energy sovereignty, as these issues have become the focus of national and international discourse as a result of recent geopolitical and economic events in the energy sector that continue to shape our present. The clarification of these concepts is based

on definitions from domestic and international literature, thereby ensuring terminological accuracy and scientific soundness. Although energy sovereignty and energy security of supply emphasise different aspects to some extent, both are important for a sustainable and reliable energy supply. Today, one concept cannot be separated from the other, and both must be taken into account when developing energy strategies and making long-term decisions that ensure sustainability and security of supply.²

Russia's full-scale invasion of Ukraine has forced the European Union and its member states to reassess the importance of strengthening their energy sovereignty. However, EU member states have so far viewed this challenge primarily through the prism of access to energy resources to maintain security of supply. However, today's deep geopolitical uncertainty and the threat of climate change mean that policymakers need to interpret energy sovereignty more broadly, taking into account the role of green energy and energy efficiency.³

The vast majority of research and literature on energy sovereignty typically dates from the last two to three years. Previously, the issue arose only sporadically in relation to specific areas. Currently, the focus remains on decoupling from Russian raw materials rather than on the actual ability to be self-sufficient. However, the trend is clear: suddenly, the topics of energy security and the green transition have appeared in the program plans of almost all authoritative research institutes. Most domestic and international research institutes typically link energy to sustainability, which is logical on the one hand but, on the other, precludes them from addressing energy sovereignty issues solely. Energy security has also become an evolving concept, as its scope is constantly expanding. A review of the literature has shown that neither the concept of energy security nor that of energy sovereignty has yet achieved a universally accepted scientific definition. Energy security has also become a cornerstone of energy policies worldwide, playing an essential role in the consequences of the energy transition. Today, energy security studies have moved away from the classical approach and have become an interdisciplinary field. The concept of energy security has become linked to other environmental, social, political, and security issues.

Given that the geopolitical events of the past 4-5 years have brought the issue of energy independence into focus alongside climate protection, bearing in mind the geographical characteristics of the countries under study and considering the efforts of individual countries

² Matthias Buck, Alexander Dusolt, Fabian Hein, Christian Redl, Andreas Graf, Michaela Holl, Oliver Sartor, Claudio Baccianti, Regaining Europe's Energy Sovereignty 15 Priority Actions for RePowerEU, Agora Energiewende, Regaining Europe's Energy Sovereignty 253/04-I-2022/EN, Version 1.3, March 2022. 2.o.

³ Szymon Kardas, Energy Sovereignty Index, Understanding Europe's energy sovereignty, September 2023. See: <https://ecfr.eu/special/energy-sovereignty-index/> (Downloaded: June 13, 2024.)

to achieve security of supply and energy sovereignty, it proved necessary to create new concepts during the research, which will be developed in this thesis. The changes that permeate our lives today have placed the issue of energy independence in a different dimension; it can no longer be examined in terms of an absolute definition, particularly given the different geographical conditions mentioned above. This is why it is necessary to introduce the concept of energy sovereignty in both objective and subjective senses. After all, a country's efforts to achieve energy sovereignty can be right and appropriate even if its geographical conditions are not particularly favourable. In such cases, achieving energy sovereignty in the subjective sense is not a vain dream. Although not without challenges, it can be an achievable goal.

The methodological framework and sources used in the research have been reviewed above. The research is based on a wide range of sources, including relevant EU and international legislation, regulatory authority guidelines and decisions, court rulings, and the latest domestic and international legal literature. Below is a summary of the dissertation to supplement the above, followed by the most important research results and further research directions identified during the study.

3. Summary of the dissertation by structural unit

The *first chapter* of the dissertation defines the purpose and methodology of the research, which have been described in detail above. After setting up the hypotheses, the *second chapter* presents the most essential concepts from the research perspective, followed by a detailed and comprehensive analysis of the related literature. The analysis clearly shows that the available sources do not provide a uniform, clear conceptual framework for defining energy sovereignty. Due to this shortcoming, the thesis introduces a new conceptual definition in this chapter.

The *third chapter* of the thesis examines the domestic and EU legal frameworks for energy regulation. This chapter aims to provide a concise yet comprehensive overview of the four key pillars of energy regulation: the current legal framework for renewable energy sources, nuclear energy, natural gas, and electricity.

The *fourth chapter* of the dissertation aims to provide a general overview of the current situation in the energy sector of the countries selected for the study, exploring areas where we can learn from both our close and distant neighbors, and highlighting opportunities for cooperation that can help not only our country, but also the energy sovereignty and security of the entire region in the future. The current energy mix, carbon dioxide emissions, the diverse market structure, the most important market players, and the relevant legal frameworks are presented in the same

depth and structure for each country. The chapter also presents specific legal cases affecting individual countries, raising energy policy issues that have a significant impact on Europe's energy security, the development of geopolitical relations, and the increasingly narrow boundaries between Member State competences and EU regulation in the field of energy. The analysis made it clear that most of these cases were not exclusively technical in nature, but were also significantly politically motivated. At the same time, the legal arguments and frameworks were formulated in each case, ensuring the legality and technical soundness of the decisions.

The *fifth chapter* of the thesis shows what future measures the countries at the centre of the research have defined to achieve their energy independence, energy security, and decarbonization goals, based on their currently available national energy and climate plans. Following a brief presentation of the legal background of the NECPs, this chapter analyses and compares the countries examined's climate plans. Based on the studies and national energy and climate plans examined during the research, it became clear that independent and sustainable security of supply—albeit in different ways across countries—is closely linked to a diversified resource structure and the most significant possible share of renewable and/or nuclear energy. The value of the chapter is enhanced by the tabular comparison, which clearly shows the current state of each country's energy sector based on NECPs, as well as planned future changes across several key areas. The table also clearly illustrates energy efficiency targets, the current level of import dependency, the volume of final energy consumption, and the role of each energy source in energy production. The table also shows that climate policy in the countries examined falls within the remit of a specific ministry in each case, which clearly demonstrates the strategic importance and institutional embeddedness of this area. In addition, it shows which ministries are responsible for preparing national energy and climate plans in each country, highlighting policy coordination mechanisms. A general critical observation is the lack of detailed action plans and cost calculations for each specific objective.

The *sixth chapter* of the thesis presents how and to what extent the hypotheses established during the research were confirmed. Of the four hypotheses, three were fully confirmed, and one was only partially confirmed. This chapter also contains several critical comments and suggestions. Among other things, criticism was levelled at the European Council's ideology-driven sanctions and greening efforts. Critical comments were also made regarding the energy sovereignty index created by the European Council's Institute for Foreign Relations. It became clear that the European Union's legislative framework needs to be reviewed. The paper makes specific proposals for legislative changes, as the current legal framework allows the European Union and the Council to pursue their foreign policy objectives under the guise of energy policy,

placing individual member states in a difficult position. Emphasising the need to ensure a level playing field, the chapter proposes granting exemptions from several rules and granting concessions to countries disadvantaged by their geographical and natural conditions, through no fault of their own. In addition to conceptualisation, the thesis also introduces an energy import dependency correction and creates a reinterpreted energy sovereignty index based on ideal, objective data. Finally, the dissertation concludes with *seventh chapter*, a summary.

The paper contains numerous observations, suggestions, and critical comments that transparently present the research results, thereby enhancing its uniqueness and value. Below, the summary is expanded with a detailed description of the research results, with special emphasis on the research's uniqueness and future relevance.

4. Conclusions and recommendations, a thesis-like summary of the new scientific results

The following section concludes the research work with a detailed presentation of the study's most important scientific results, highlighting their novelty, scientific added value, and practical applicability.

4.1.1. Dogmatic foundation of concepts

One of the key results of the research is the dogmatic foundation of subjective energy sovereignty. As mentioned above, based on the literature reviewed during the research, there was a clear need to introduce a new concept. The literature examined presented several approaches to defining energy sovereignty. As a result, it became necessary to develop this concept, which is still inadequately addressed. Energy sovereignty is a key concept for the energy supply of all countries. The research highlights that autarky cannot be a realistic goal in the 21st century. After all, the objective goal of complete energy independence is difficult to reconcile in a world where the energy industry is deeply embedded in global economic and financial networks. A country's energy supply is not only the sum of available capacities across different technologies, but also the result of dynamics arising from a complex interplay of economic and geopolitical factors.

In light of the above, according to the researcher, *objective energy sovereignty can be said to exist when a country, based on its own decisions and independently of others, from its available natural resources, ensures security of supply and maintains a continuous and reliable energy supply, regardless of how environmentally sustainable or competitive the available energy sources are.*

One of the main results of the research is a new concept, according to which *the subjective energy sovereignty of a country means its ability to ensure security of supply based on the principle of free self-determination, even with limited own resources, in such a way that it can remain secure even in exceptional situations, thanks to a diversified resource structure and varied transport routes, taking into account environmental considerations, affordability, and reliable availability.*

In the narrow sense, energy sovereignty means that the energy used can be produced entirely locally, without imports, at the individual or national level, ensuring a secure and affordable energy supply. In a broad sense, however, energy sovereignty can also be said to exist when the conditions for energy sovereignty in the objective sense cannot be met, or can be met only in part, for geographical reasons. Still, the missing energy can be obtained securely for the country in question, using different transport routes, a diversified source structure, free from dependence on a single supplier, in an affordable way and without obstacles. Of course, competitiveness and environmental considerations must be taken into account, with security of supply remaining a priority. Based on the above, the concepts defined and created place the interpretation of energy sovereignty and energy security within a new, systemic framework and contribute to the scientific clarification of the conceptual framework.

4.1.2. Hypotheses and their results

The results of the hypotheses established at the beginning of the research can be briefly summarised as follows.

- The research found that hypothesis *H1* was confirmed. Based on this, *if a country is energy sovereign in an objective sense, it does not mean that it is also energy sovereign in a subjective sense.* The dissertation shows that among the countries examined, some could achieve energy sovereignty in an objective sense if they were able to ignore climate policy objectives. This is primarily due to their significant coal reserves. Thus, with their available energy resources, they would be able to cover their energy consumption even from their own sources. This example clearly illustrates that a country may be objectively energy sovereign but, subjectively, not so. One reason for this is the strict environmental regulations that limit the use of fossil fuels.
- Based on the studies reviewed during the research, hypothesis *H2* was also confirmed, i.e., *neither objective nor subjective energy sovereignty can be achieved without a secure energy supply.* During the research, we saw that energy security and energy sovereignty go hand in hand. The Scientific Advisory Board of the European Academies has also confirmed that security of energy supply is a fundamental prerequisite for energy sovereignty.

- Based on a combined assessment of the energy regulatory frameworks of the countries examined in the research, their national energy and climate plans, relevant energy market statistics, related literature, and the energy mixes presented in the country analyses, it can be concluded that natural gas continues to play a significant role in energy production. This finding is consistent with hypothesis *H3*, which posits *that natural gas, as an energy source that provides system-level flexibility, will continue to play a key role in long-term energy regulation*. Natural gas offers an interim solution that provides time for the infrastructure needed for green energy production to be built, while helping achieve these goals. In other words, it builds a bridge between the future energy sector and the present, thereby contributing to sustainability and energy security.
- Based on the literature reviewed and the above, it can be stated that hypothesis *H4* was only partially confirmed. According to the specified assumption, *increasing the share of renewable energy sources and maintaining and strengthening the role of nuclear energy in the energy mix are key conditions for enhancing security of supply and meeting EU-level carbon-neutrality targets*. The results of the research show that while some countries may be able to ensure security of supply without nuclear energy thanks to their favourable geographical conditions and significant domestic resources, for other countries, limited domestic energy resources mean that doing without nuclear energy would pose a serious challenge to maintaining security of supply. The results of the research confirmed that most of the countries studied envisage strengthening security of supply through a complex, multi-pillar approach, in which both nuclear and renewable energy play a decisive and growing role. It was found that in countries with limited natural resources, no coastline, and no high mountains or rivers with abundant water flow, achieving carbon neutrality goals without nuclear energy seems impossible.

4.1.3. Further research findings and recommendations

- *Energy import dependency correction* – When developing the energy sovereignty index, taking into account each country's different geographical conditions, an essential step in the research was the introduction of an energy import dependency correction. This is particularly important in countries with only land borders and limited domestic resources. This correction would ensure that countries are not ranked lower on the index simply because their natural conditions are unfavourable. In addition to defining the formula underlying the correction factor, the paper also presents its practical application. Its novelty lies in accounting for countries' natural and geographical constraints when evaluating the multi-source structure. It can handle the structural differences arising from countries' different geographical conditions, thereby ensuring

comparability between energy sovereignty assessments and the principle of equal treatment. The diversification factor in the formula enables identification of countries that rely more on imports but can still secure their supply by acting as prudent stewards and striving to build flexible energy systems that use multiple channels and technologies. The use of the correction factor is recommended both in the development of the reinterpreted energy sovereignty index and in the determination of the energy import dependency rate published by Eurostat.

- *Reinterpreted energy sovereignty index* – its essence lies in being a complex, quantitative indicator that measures the independence, adaptability, and resilience of a given country's energy sector. This index helps put the concept of energy sovereignty on a new footing, taking into account not only the diversity of energy sources and technologies, infrastructure development, import dependency, and the share of clean energy, but also energy efficiency, storage capacities, and geographical conditions. It can serve as a strategic compass for policymakers and investors, helping them make informed, risk-sensitive, and future-proof decisions in the energy sector. It is imperative to develop and apply a flexible methodology grounded in objective data that also accounts for short-term market changes. An index based on objective criteria must avoid political influence and the effects of economic lobbying. The dissertation shows that the newly proposed index is based on objective criteria and relies on primary and secondary dimensions. One of the starting points for the methodology developed was inspired by critical comments on the index published by the European Union Institute for Foreign Relations in 2023. Such a critical indicator system cannot be based on subjective elements, so it was a priority during the research to ensure that the method relied exclusively on measurable, regularly updated, and transparent data sources and used a carefully designed weighting structure, thereby eliminating the subjective elements of previous approaches. A comparison of the methodology used by Kardaś and the approach proposed by the doctoral candidate shows that while Kardaś bases his index on four indicators, one of which is explicitly subjective, the new approach integrates seven indicators. Four of these are based on publicly available, regularly updated, and reportable databases, which ensure the transparency and objectivity of the index. The remaining three indicators within the secondary dimension are also publicly available, but are based on data that has not yet been reported. The methodology is presented in tabular form, detailing the indicators assigned to each dimension, their justifications, weighting ratios, and the significance of their roles. The values of the primary dimensions are determined by the median of the available statistical data over the past three years, ensuring stability and temporal balance of the index. The novelty of the methodology lies in placing the assessment of energy sovereignty within a transparent system that integrates

seven indicators across objective primary and secondary dimensions, and in applying the import dependency correction developed during the research. This correction ensures equal treatment, takes into account the different geographical conditions of the countries, and evaluates the diversification of the resource structure. *This methodological approach, especially with the introduction of the correction, is consistent with the concept of energy sovereignty in a subjective sense as defined in the research and substantially supports its practical interpretation.* Although the practical applicability of the methodology is also supported by case-study-type illustrations, demonstrating that it can be effective even in acute situations, further testing and fine-tuning in a test environment are still recommended.

Overall, the reinterpreted energy sovereignty index, based on objective criteria, can serve as an effective tool for assessing a country's current energy dependence and security of supply, as well as for identifying areas for improvement. In this way, it can provide a reliable point of reference for both investors and policymakers.

- *De lege ferenda proposal for EU-level regulation* – Based on the studies examined during the research, it was concluded that EU energy policy and the powers of sanctions legislation need to be reformed to preserve the energy sovereignty of Member States. To safeguard the security of supply and competitiveness, clauses should be introduced into the Council's sanctions regulations to ensure that sanctions to be imposed cannot be automatically applied to the energy sector. Based on the principle of equal treatment, it would be essential to examine each Member State's situation individually. Where the planned intervention would cause security of supply problems and disproportionately severe economic consequences, the possibility of individual exemptions should be ensured. In future EU-level legislation, it would be justified to take into account the technological characteristics of Member States' energy supply. This aspect should be particularly emphasised when developing sanctions, as their impact may vary significantly across countries depending on each country's energy structure.
- *De lege ferenda proposal concerning Article 215(1) TFEU* – The doctoral thesis proposes that in future, decisions relating to the energy structure and supplier contracts affecting all energy markets should be based on unanimity among Member States. On this basis, it is proposed that Article 215(1) of the Treaty on the Functioning of the European Union be amended accordingly. Which currently adopts the proposed measures by a qualified majority.

- *De lege ferenda proposal concerning Article 194(2) TFEU* – It is also proposed to supplement Article 194(2) of the Treaty as follows: the measures taken –...– the measures taken shall not affect the Member States ... suppliers, if this would have a demonstrable negative economic impact.
- *Proposal to introduce tax and quota concessions* – The results of the research confirmed that achieving energy independence, climate neutrality, and sustainability are among the European Union's key strategic objectives. However, these objectives cannot be achieved under the same conditions for all Member States. It is therefore proposed to provide preferential carbon credit purchasing opportunities to countries that invest in energy efficiency improvements, as well as to countries that have only land neighbours. To strengthen the energy independence of EU Member States without a coastline, it is also proposed to establish a targeted EU investment fund and introduce preferential credit facilities to support innovative energy projects. Due to their geographical location, these countries have more limited access to renewable energy sources, particularly offshore wind and marine energy, which is why it may be justified to grant them carbon allowances and targeted tax breaks. The spread of renewable energy sources requires flexible, rapidly adjustable capacities to balance production fluctuations. It is therefore recommended that combined-cycle gas turbine (hereinafter: CCGT) power plants be exempted from the obligation to pay carbon dioxide quotas and receive targeted tax breaks. These power plants have the lowest specific emissions among fossil-fuel technologies and play a key role in ensuring the electricity system's flexibility. Their rapid controllability is essential for balancing fluctuations in renewable energy production, thereby contributing to the development of a sustainable and stable energy system and supporting the country's long-term energy independence goals.
- *Proposal to introduce a carbon tax refund system* – The paper also proposes the creation of legislation aimed at a partial refund of the carbon tax. The aim would be to allow countries that can demonstrate they are investing carbon tax revenue in technological innovations that strengthen security of supply, develop energy infrastructure, and reduce emissions to reclaim part of the carbon tax they have paid. The advantage of this proposal is that part of the carbon tax revenue could be reinvested in the economy, thereby encouraging developments in energy storage, renewables, and efficiency, while reducing import dependency and strengthening security of supply.
- *Proposal to establish a National Energy Sovereignty Fund* – In connection with the above, a further proposal is to establish a National Energy Sovereignty Fund, the primary purpose of which would be to support investments that promote self-sufficiency and strengthen energy

security. The primary source of revenue for the fund could be a 55% refund of carbon dioxide tax revenues.

The proposals outlined above aim to promote a fair and balanced energy transition and strengthen security of supply by taking into account the different circumstances and capabilities of each Member State. All of this can contribute to the European Union as a whole moving forward in a unified and effective manner towards a future that is independent, sustainable, and capable of guaranteeing long-term security of supply.

5. Further research opportunities and directions

During the writing of this thesis, several exciting topics for further research emerged. The following is a non-exhaustive list of identified research directions, highlighting how the area under investigation can be expanded, thereby demonstrating the key role and future significance of the chosen topic.

- It would be worthwhile to examine the energy transition efforts of all of Hungary's neighbouring countries in a separate study, possibly with a narrower focus, such as the regulatory environment of energy communities, its impact on security of supply, and energy sovereignty, based on a comparative analysis.
- A promising area of research would be to explore and analyse in greater depth the possibilities for cross-border storage and to examine how exploiting these possibilities could contribute to strengthening security of supply in the broader region. Another promising area of research is the definition of a legal framework for regional cooperation to ensure the future security of supply. In addition, it could be an exciting task to explore the potential offered by the LNG and offshore wind energy capacities of neighbouring countries to support the development of regional cooperation.
- Another exciting, but challenging, area of research is the development of energy regulation in Ukraine and its possible short- and long-term impact on the European Union's energy policy.

6. Doctoral candidate's list of publications

Published works:

1. **Éva Csáki-Hatalovics**, *Models of National Economy Administration and their Appearance in Gas Industry*, In: Szabó, Miklós (szerk.), Doktoranduszok fóruma: Miskolc, 2015. november 19.: Állam- És Jogtudományi Kar Szekciókiadványa, Miskolc, Magyarország: Miskolci Egyetem (2016) 314 p. pp. 67-73., 7 p., (Technical study: Scientific)
2. Robert Szuchy (szerk.); Arpad Homicskó (szerk.); **Eva Csaki-Hatalovics** (szerk.), *Selected articles from the KRE Energy Law Forum 2016*, Budapest, Magyarország: Patrocinium Kiadó (2017), 125 p., ISBN: 9789634131601, (Conference proceedings: Scientific)
3. **Hatalovics Éva**, *Gázipar és gazdasági igazgatás – összefüggések történeti aspektusból*, ÚJ MAGYAR KÖZIGAZGATÁS 9: 2 pp. 31-35., 5 p. (2016), Matarka, (Technical article: Scientific)
4. *Szuchy Róbert; Csáki-Hatalovics Éva, Az energiajog legújabb kihívásai*, In: Szuchy Róbert (szerk.), *Az üzleti jog egyes modern kihívásai*, Budapest, Magyarország: Károli Gáspár Református Egyetem, Állam- és Jogtudományi Kar (2017) 282 p. pp. 201-282., 82 p., (Technical study: Scientific)

Publications awaiting publication:

5. **Éva Csáki-Hatalovics**, *Zsolt Czékmann, Gyula Balázs Csáki-Hatalovics*, *Impact of the Nord Stream gas pipeline sabotage on the energy security of Germany and the V4 countries*, Central European Academy, *Journal of Agricultural and Environmental Law* (Accepted)
6. **Csáki-Hatalovics Éva**, *A fenntartható és független ellátásbiztonság a Paks II. projekt kontextusában*, *Gazdaság és Jog* (Accepted)
7. **Csáki-Hatalovics Éva**, *A magyar energiaszabályozás I. – A villamosenergia- és a megújuló energia-szabályozás jogszabályi keretei*, *GLOSSA IURIDICA* (Accepted)
8. **Csáki-Hatalovics Éva**, *A magyar energiaszabályozás II. – A földgáz- és az atomenergia-szabályozás jogszabályi keretei*, *GLOSSA IURIDICA* (Accepted)
9. *Pónusz Mónika; Csáki-Hatalovics Éva, Gyüre Annamária Csilla, Kővágó Györgyi, Simay Attila Endre, Vegyi anyag használata az ellátási láncban és annak egyes jogi vonatkozásai*, *GLOSSA IURIDICA* (Under negotiation)
10. **Csáki-Hatalovics Éva**, *Az energetikai igazgatás fogalma és intézményrendszere, az energetikai igazgatásban résztvevő szervek funkciói*, *Studia Iuris* (Accepted)
11. *Andó Éva, Pónusz Mónika, Kővágó Györgyi, Csáki-Hatalovics Éva, Kommunikáció és vezetés szerepe az ellátási láncokban*, *Tanulmánykötet*, Patrocinium Kiadó (Accepted)