

13 СОВЕТУВАЊЕ CONFERENCE

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North Macedonia

KRKOLEVA:

YOUNG ENGINEERS ARE
OUR MOST IMPORTANT
INVESTMENT

JOVEVSKI:

MEPSO AND MAKO CIGRE – A PARTNERSHIP
FOR THE DEVELOPMENT OF THE TRANSMISSION
SYSTEM AND THE MONITORING OF EUROPEAN
ENERGY RESEARCH

**46 ENGINEERS 20 VISIONS:
MEPSO PART OF MAKO CIGRE 2025**



NATIONAL COMMITTEE OF NORTH MACEDONIA IN CIGRE

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The Macedonian National Committee of CIGRE - MAKO CIGRE, for more than three decades, has represented a relevant professional and scientific platform for the development and advancement of the power sector in the Republic of North Macedonia. As part of the international association CIGRE, MAKO CIGRE aims to encourage the systematic study of issues related to electricity generation, transmission, and distribution, along with their associated technical, economic, environmental, and regulatory aspects.

Founded in 1921 in Paris, CIGRE today stands as a leading international association in the field of the energy industry, bringing together experts from over 90 countries and operating through 16 study committees and hundreds of working groups. As an equal member since 1995, MAKO CIGRE actively supports CIGRE's mission to promote professional knowledge exchange and collaboration among industry, academia, and institutions.

The MAKO CIGRE Conferences represent a central event in the professional calendar of the electrical engineering community. They serve as open scientific and technical forums where research results are presented, the challenges of modern power systems are discussed, and definite technological and systemic solutions are proposed.

The 13th MAKO CIGRE Conference 2025, through 16 study committee sessions, covered the most relevant and topical themes, including the integration of renewable energy sources, system resilience to climate and human-induced risks, the digital transformation of the sector, and sustainable management of energy resources.

This electronic newsletter contains the papers presented by colleagues from AD MEPSO at the Conference, which represent a significant contribution to advancing technical knowledge and its practical application in the field.

MAKO CIGRE remains true to its fundamental mission – to create an environment where expertise, innovation, and professional collaboration drive progress in the power sector, today and in the future.



cigre 2025

North Macedonia

Interview with Aleksandra Krkoleva Mateska, Vice President of MAKO CIGRE

YOUNG ENGINEERS ARE OUR MOST IMPORTANT INVESTMENT



At a time when the energy sector is facing notable challenges, such as digitalization, integration of renewable energy sources, and ensuring system stability amid rising demand, the role of professional associations is becoming increasingly important. MAKO CIGRE, as the national committee of the international organization CIGRE, has been a key factor for three decades in generating and sharing knowledge, setting professional standards, and supporting young engineers. In an interview with Aleksandra Krkoleva Mateska, Vice President of MAKO CIGRE, we discuss the role of the engineering community, the importance of regional cooperation, technological trends, and the association's vision as an essential platform for professional networking and technological advancement..

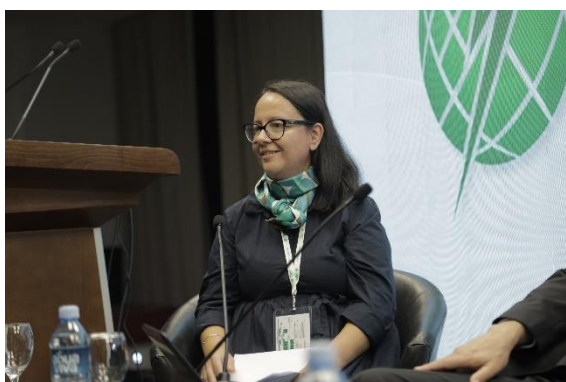
As a longtime member of the Committee that has acted for more than three decades in the energy field, what position does MAKO CIGRE play for the energy community in Macedonia, and how has MAKO CIGRE changed throughout the years?

- MAKO CIGRE was founded thirty years ago by a group of enthusiasts from the academic

community and the power industry. Among the founding committee members were Prof. Minovski and engineers Dimitar Stojanov, Dragan Mihajlov, Nikola Cherepnalovski, and Panzo Andonov. Their goal was to ensure CIGRE's continued presence in the country following the breakup of Yugoslavia and to promote cooperation, knowledge exchange, and experience sharing among engineers dedicated to power systems. As a long-time member and volunteer, I can confirm that while the association's core goals remain unchanged, its activities have evolved to meet modern power system challenges. In the early years, MAKO CIGRE focused on organizing the first conferences, structuring the association's work, and its study committees. Over time, the scope of activities expanded to include a broader range of initiatives. Through expert forums that brought together professionals from the energy sector, MAKO CIGRE encouraged discussion of key issues in the energy sector reform process. The association also initiated debates on technical standards used in electrical engineering, particularly in areas where our members identified gaps and the need for improvement.

In the past decade, MAKO CIGRE has actively supported student initiatives at technical faculties, awarded scholarships, and recognized students who achieved outstanding results in power engineering studies. As a socially responsible organization, MAKO CIGRE has organized and participated in several blood donation events and hosted lectures to raise

awareness among younger generations of the importance of engineering as a profession. In recent years, efforts have focused on strengthening cooperation with energy-sector companies, particularly by involving smaller enterprises as collective members. Throughout all these years, MAKO CIGRE has enjoyed consistent support and collaboration with the three major power companies — MEP SO, ESM, and EVN Macedonia.



This conference takes place every two years. What were the core objectives of the 13th counselling and what trends did you observe at the most recent CIGRE conference?

- The MAKO CIGRE Sessions cover topics related to the scope of the organization's 16 Study Committees, which means that virtually all major areas of the power sector are represented—from the technical characteristics and application of electrical equipment to the operation of transmission and distribution systems, distributed generation, electricity markets, materials, information systems, and telecommunications. I am pleased to note that this year's session included papers from all these fields, with particular focus on topics currently at the forefront of the power industry—such as the operation of transmission and distribution systems under conditions of high penetration of renewable energy sources, the integration of

energy storage systems, and the functioning of electricity markets. Another positive trend was the increased participation of young engineers, many of whom were authors or co-authors of numerous papers presented at the conference.

Viewed through numbers, how many papers were presented and from which countries were the participants? Do you note a growing trend in participation?

- This year, 136 papers were submitted and reviewed; most were presented at the Conference, and the authors were mainly from Macedonia and the region. This Conference had more than 370 participants, thus placing it among the most visited.

Which subjects dominated at the panel discussions this year? What areas drew the most interest from the representatives of the academic community, industry, and engineers—digitalization, the electricity market, or energy storage?

- At the MAKO CIGRE Conference, it is customary to hold a panel discussion immediately after the official opening. This year, the panel focused on the topic "Challenges of Modern Power Systems," featuring speakers with outstanding professional backgrounds. Among them was Goran Majstrovic, Vice President of the CIGRE National Committee of Croatia and Head of the Transmission and Distribution Department at the Hrvoje Požar Energy Institute in Zagreb. The session also included Aleksandar Paunoski, Deputy Director and Member of the Management Board of MEP SO, and Prof. Mirko Todorovski from the Faculty of Electrical Engineering and Information Technologies at Ss. Cyril and Methodius University in Skopje. Their presentations sparked a broad discussion on the key challenges facing power systems today,

particularly the need to upgrade and modernize transmission and distribution networks as essential infrastructure to enable higher penetration of renewable energy generation, as well as the importance of new technologies and the challenges posed by digitalization in the energy sector. This year, we also introduced a new session dedicated to applications and tools developed by members of the academic community that have the potential for real-world implementation. Our goal was to highlight academic capacity for innovation in developing practical solutions and to encourage stronger collaboration with industry. I sincerely hope this session will become a tradition at future MAKO CIGRE gatherings.



MAKO CIGRE actively supports students by helping organize the Student Conference on Energy Efficiency and awarding scholarships to top students from FEIT and the Technical Faculty in Bitola. Do you think this is an effective way to motivate young engineers? What else could be done to make the energy sector more appealing to future students?

- Students are the future of our profession, and they need the greatest support during their studies and the early stages of their careers. We reward the best graduates in power engineering because their hard work and dedication should

serve as an example to current and future students.

Engineering is a demanding and responsible profession that requires commitment and lifelong learning. All stakeholders, such as universities, companies, and institutions, should work together to inform perceptions among high school students about the importance and potential of this profession. Many of them are not fully informed about the key role engineering plays in shaping the modern world.

In the digital era, energy holds fundamental importance, and this message must be passed on to future generations. In this regard, MAKO CIGRE will continue organizing events such as workshops, lectures, and student challenges to engage young people and promote the engineering profession.

Why is this type of counseling important for advancement of the energy sector in the country and region in general? Do MAKO CIGRE take part in creating energy politics on national level?

- The process of transforming the energy sector has always been in the spotlight among the engineering community, and our members have expressed their views through public forums where new legislation and industry reforms were discussed. The influence on policymaking is indirect yet fundamentally important, grounded in the insights, knowledge, and experience of professionals in the field. The MAKO CIGRE councilings are also an important platform where the engineering community discusses key challenges in the sector, using scientific and technical papers as a foundation. The exchange of ideas and the reasoning behind different viewpoints, supported by technical and scientific understanding, should contribute to the

development of energy policies. This year, the event was also attended by representatives from the Ministry of Energy, Mining, and Mineral

Resources, who had the opportunity to hear firsthand from the engineering community about the operation of advanced power systems and the challenges they face.

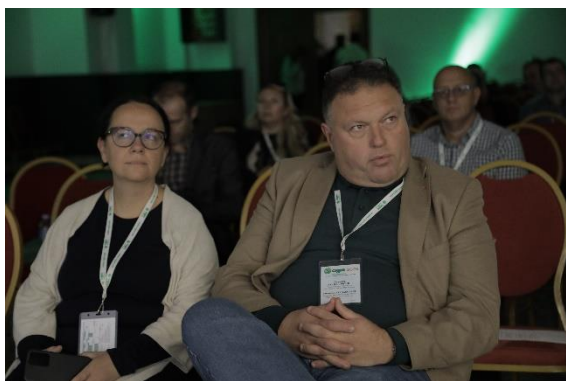


What do you see as the main challenges facing the energy sector in the region, and what role do engineers and electrical specialists play in addressing them?

- The power sector is facing a wide range of challenges. In recent years, these have included integrating renewables, cross-border exchanges, and the development and operation of electricity markets. Today, the focus has shifted toward power systems with a high penetration of renewable-based generation, maintaining operational limits and overall system stability,

and ensuring the efficient use of all available resources, as well as electrification of other industries and the digitalization of power systems—all while investment in the development, reinforcement, and modernization of transmission and distribution networks, which form the backbone of critical infrastructure, is becoming increasingly difficult to secure. Looking ahead, the challenges are expected to grow even more demanding, given the rising frequency of both natural and human-induced events that can disrupt power system operation,

damage infrastructure, and lead to severe socio-economic impacts. Still, as CIGRE President Prof. Konstantin Papailiou noted on the occasion of the 30th anniversary of MACO CIGRE, "There has never been a more exciting time to be an electrical engineer and to work in the energy industry".



MAKO CIGRE is an equal member of the international Council CIGRE and participates in activities related to its domain. To what extent does the exchange of experience and knowledge at European level contribute to the development of the power system in Macedonia?

- The exchange of knowledge and experience among professionals in the field is one of CIGRE's core objectives. Our colleagues regularly contribute their papers to the international CIGRE Sessions held every two years in Paris, and

some are also involved in CIGRE working groups. In addition, we actively participate in SEERC – the regional branch of CIGRE that brings together national committees from Southeast European countries. In fact, our committee has been engaged with SEERC since its establishment, and our experts have consistently been represented at SEERC's sessions.

Where do you see the MAKO CIGRE Conference in five to ten years?

- I hope that with each future Conference we will introduce new aspects and our organization will improve. I would like our conferences to remain significant events for the engineering community, where we can exchange knowledge, discuss challenges, offer solutions, and network. Our motto for the 30th anniversary was "Cooperation – Experience – Networking", which will continue to be the thread connecting the members, all authors of the papers, and participants. I hope that we will have more authors and participants from other countries, which will make our association more internationally visible and recognized. Finally, I hope that the younger colleagues will actively participate in organizing events, bringing new energy and ideas.

Interview with Vase Jovevski, TGO Director

MEPSO and MAKO CIGRE - A PARTNERSHIP FOR THE DEVELOPMENT OF THE TRANSMISSION SYSTEM AND THE MONITORING OF EUROPEAN ENERGY RESEARCH

AD MEPSO is long-term and strategic partner of MAKO CIGRE. As one of the key drivers of the development and modernization of the transmission system, MEPSO, with its engineers and experts, actively participates in MACO CIGRE's scientific and technical activities, conferences, and working groups. This type of partnership enables continuous knowledge exchange and innovation, directly contributing to higher technical standards and the implementation of European trends in North Macedonia's energy system.



In an interview with Vase Jovevski, Director of the TGO and MEPSO's representative in the Organizing Committee of MAKO CIGRE, we discuss the importance of this collaboration, the contribution of our company's engineers to the advancement of the power system, the challenges and priorities MEPSO faces amid the energy transition and increasing grid flexibility, as well as the support for young engineers and the company's connection with the academic community.

AD MEPSO is a long-standing partner and active participant in the MACO CIGRE Conference. As the company's nominated representative in the Organizing Committee, how do you assess the importance of this collaboration for the development of the power system and for keeping pace with European trends in the energy sector?

- The International Council on Large Electric Systems (CIGRE, Conseil International des Grands Réseaux Électriques) is a global non-profit association that unites the power industry community — experts, engineers, researchers, and companies — to exchange knowledge and experience, develop standards, and foster innovation in the energy industry. Founded in 1921 in Paris, CIGRE today has national committees in more than 100 countries, including the Macedonian MACO CIGRE, established in 1994, through which North

Macedonia became a full member of the organization. Beyond MEPSO's role as one of the main sponsors of the conference, the company's collaboration with MACO CIGRE is of exceptional — and above all, strategic — importance from several perspectives: technical development and innovation, education and professional capacity building, where employees have the opportunity to contribute to scientific and technical papers, establishing connections with other companies, and perhaps most importantly, presenting MEPSO to the international community as a modern, flexible, and forward-looking transmission system operator ready to meet upcoming challenges. In short, this collaboration strengthens MEPSO's reputation as a transmission system operator that follows European trends in the energy sector, with MEPSO working groups also participating in CIGRE events abroad and in other foreign committees.



To what extent does the participation of MEPSO's engineers and experts contribute to the advancement of technical standards and power system operation?

- Surely. The participation of MEPSO's engineers and experts in the MAKO CIGRE conferences,

held every two years, significantly contributes to enhancing technical standards and improving MEPSO's overall operations. The involvement of MEPSO's professionals in the scientific and technical sessions through their authored papers enables valuable professional networking with colleagues from other companies and the academic community, thereby increasing each individual's potential for professional growth. Investing in the professional development of every employee at MEPSO is, in essence, an investment in the company's own development. Moreover, it serves as an important motivator for retaining young, qualified professionals within MEPSO—a company that carries the vital responsibility of maintaining and advancing the power system in North Macedonia.

MAKO CIGRE serves as a platform for exchanging ideas and experiences, presenting innovations, and discussing practical solutions and new developments. Have any of the analyses, papers, or discussions from past conferences been applied in MEPSO's operations so far?

It is interesting to note that CIGRE — and, consequently, MACO CIGRE — has, over time, established itself as a foundation and source of numerous initiatives, serving as a place where ideas and research are translated into practical solutions. There are several analyses and papers originating from MACO CIGRE that have proven valuable and relevant to MEPSO and have later been implemented in practice. Some of these include: a study on the stability and reliability of the transmission system, which was later used in planning the construction and reconstruction of new 400 kV and 110 kV transmission lines, as well as in the development of new 400 kV substations; and a presentation on the operation and maintenance of high-voltage equipment, which laid the groundwork for

applying new diagnostic methods for transformers and circuit breakers through the analysis of specific so-called “fault gases.” The recommendations from this study were subsequently incorporated into MEPSO’s regulations and preventive maintenance programs for high-voltage equipment.



There are also other examples in the areas of relay protection, SCADA systems, and renewable energy integration, which perhaps deserve a dedicated report of their own.

The energy sector is facing major challenges — the energy transition, the integration of renewable energy sources, and the need for increased grid flexibility. What are MEPSO’s key technical and organizational priorities in this context, and does MAKO CIGRE play a role in addressing them?

- Today, the most significant challenges for transmission systems are no longer the traditional ones—such as generation shortages—but new and more complex issues related to the integration of renewable energy sources, digitalization, and increased coordination with distribution networks. A key factor in ensuring system flexibility is energy storage—through battery systems, hydrogen, and, of course, hydropower plants, particularly pumped-storage facilities. Batteries provide excellent short-term flexibility (from seconds to

hours), while hydrogen and pumped-storage hydropower plants enable long-term storage—for example, during winter periods when solar generation is limited. To successfully address challenges such as reduced system inertia and variable production from wind and solar sources, we need to reinforce and make our transmission networks more flexible, while simultaneously building stronger interconnections with other sectors, such as transport, industry, heating, and even hydrogen production and use. This means that the future energy system will not rely solely on traditional electricity but will evolve into an integrated, interdisciplinary system. All these topics, along with many other discussions and conclusions, were part of the main panel session at this year’s 13th MACO CIGRE Conference, where MEPSO played an active role. Mr. Aleksandar Paunovski, Deputy General Director of MEPSO, participated in the session, once again confirming MACO CIGRE’s role as a body that anticipates challenges and actively contributes to finding solutions for them.

What themes were relevant for the challenges that MEPSO faces?

The topics very accurately reflect the current challenges faced by MEPSO. Digitalization and the development of smart grid management systems are particularly important for enhancing both efficiency and security. The integration of renewable energy sources requires increased flexibility, modernization of the 110 kV network, and the implementation of new technological solutions, such as energy storage and dynamic capacity management. MEPSO is already engaged in several initiatives in this direction, ranging from the development of a new digital SCADA platform and the introduction of the digital substation concept, to improving coordination with distribution

operators and preparing for the future regional electricity market.

In recent years, we have witnessed regional integration and increased cooperation among transmission system operators. Conferences of this kind contribute significantly to more effective regional energy cooperation, particularly in the context of interconnectivity, cross-border capacity management, and handling crisis situations. They provide a platform for sharing best practices, aligning operational procedures, and fostering mutual understanding, which ultimately strengthens the reliability, resilience, and efficiency of the regional energy system?

- MAKO CIGRE Conferences are important for the strengthening regional cooperation . They serve as a platform where transmission system operators, experts, and institutions share their experiences and approaches in addressing common technical and operational challenges. In recent years, with growing market integration and the increasing role of renewable energy sources, coordination and joint planning among operators have become crucial. These conferences contribute to building trust and improving mutual understanding, which directly impacts interconnections, market integration, and the digital transformation of power systems in the region.

Collaboration with the academic community and support for young engineers are an important part of MAKO CIGRE's vision. MEP SO plays a key role in developing a new, young workforce by providing practical experience, mentorship, and opportunities to participate in technical projects and industry initiatives. There is certainly room for closer engagement with student activities at MAKO CIGRE, such as internships, workshops, joint research projects, and knowledge-sharing sessions, which would help bridge the gap between academic learning and real-world power system operations?

- At the global level, within CIGRE, a section called NGN (Next Generation Network) has been established, representing an important initiative to ensure knowledge continuity and prepare the next generation of engineers for the challenges of maintaining and managing power systems. In North Macedonia, an NGN section has not yet been formed; however, this does not mean the idea is lacking—in fact, it is quite the opposite. In collaboration with universities, one of the goals and tasks for the near future is precisely the establishment of such a body, which will significantly contribute to increasing interest in energy-related programs and transferring knowledge to the younger generation of engineers. MEP SO's role, as well



as my role as a member of the Board of Directors of AD MEPSO, is to support all initiatives that foster the development and enhancement of young engineers' knowledge. We are, of course, open to collaboration by providing a practical environment for developing technical skills and promoting the professional growth of future engineers..

What is the role of MAKO CIGRE in the future? Do you expect it to gain broader influence in the policy-making process, not only at the technical but also at the regulatory level?

- The primary role of MAKO CIGRE, as an advisory body providing professional and technical expertise, is to connect experts from the energy sector and promote the exchange of knowledge and experience. Its potential

expanded role as a consultative and advisory entity is evident, especially given that we are in an era of transition toward green energy and digitalization. In this context, CIGRE positions itself as a bridge between the expert community and policy-makers. Accordingly, in the future, MAKO CIGRE is expected to be involved as an advisory body in the preparation of laws and secondary legislation in the energy sector, as well as to establish closer cooperation with the Energy Regulatory Commission, particularly in areas such as the integration of renewable energy sources and cybersecurity.



46 ENGINEERS 20 VISIONS: MEP SO PART OF MAKO CIGRE 2025***Detection of Defects in the Autotransformer 400/ 110 kV 300 MVA in SS Bitola 2***

Milosh Bukvikj, Ivan Grigorieviki, Vilma Minovska, Filip Petkovski

In the event of a hazard, on-site testing of transformers is of great importance, as it enables detection of whether a fault has occurred, its extent, and whether the transformer can be returned to service — a matter of critical significance for the transmission system operator.

The focus of this paper is the detection of a fault in a 400/110 kV, 300 MVA power autotransformer. It explains the field tests conducted to determine the fault location and severity, intending to determine whether the transformer can be re-energized or whether additional factory- or service-level diagnostics are required..



<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/A2.184.txt.pdf>

Diagnostic Techniques for Power Transformers Based on Frequency Domain Analysis

Liridon Lutfiu



This paper comprises several chapters that elaborate on both theoretical and practical measurements of power transformers. The fundamental theory underlying the frequency response analysis (FRA) method is examined, explaining how transformer issues can be detected and how errors are measured using the FRA technique. All possible transformer connection combinations are analyzed in detail. Additionally, the MEGGER software, which facilitates measurements using this method, is reviewed. Potential errors encountered during FRA measurements are also discussed. A comparison between the Omicron and MEGGER software tools for the same measurement procedure is provided. Finally, experimental tests on multiple power transformers are conducted, and the resulting data are used to compare testing methods along with their respective advantages and disadvantages.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/A2.231.txt.pdf>

HPP Cebren Project: Strategic role and Technical Risks Assessment

[Kliment Naumovski](#)

The paper presents a comprehensive technical overview of the Čebren project, highlighting its strategic importance in the development of the national power system. It emphasizes Čebren's role as a key facility for providing seasonal flexibility, frequency stability, and long-term energy storage—factors crucial for the reliable and sustainable integration of renewable energy sources. The authors also explore external influences and potential challenges that could directly impact the project's technical performance and overall success..



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Technical Analysis of the Solutions for Connection of HPP Cebren and HPP Galishte

[Aleksandar Paunovski](#)



The paper presents a technical analysis of possible connection solutions for the HPP Cebren and the HPP Galishte to the Macedonian electricity transmission network. Two connection options are analyzed. The first option involves constructing a conventional 400/110 kV Mariovo substation with 110 kV connections from both hydropower plants.

The second option proposes a more compact solution, consisting of block connections at generator voltage through high-voltage single-phase

transformers and short transmission lines directly connected to the future 400 kV Mariovo switchyard. The analysis provides the microlocation of the facilities relative to the proposed power plant sites, as well as proposed single-line diagrams showing the leading electrical equipment and transmission line connections to the national power system.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/A3.253.txt.pdf>

The Importance and Need for Changing the Methodology for Preparing Cost–Benefit Analyses when Evaluating Transmission System Development Projects, According to the 4th Edition of the Guidelines Created by ENTSO-E

Sasha Maksimovski

The paper aims to highlight the importance and necessity of applying the methodology for preparing cost–benefit analyses when evaluating transmission system development projects, which has been developed by ENTSO-E and summarized in the document known as the 4th edition of the Guidelines for Cost–Benefit Analysis, in accordance with the requirements of EU Regulation 2022/869 on guidelines for trans-European energy infrastructure.



Furthermore, in implementing the investments identified in the Transmission Network Development Plan for the period 2025–2035, it is particularly important to ensure compliance with and application of the cost–benefit analysis methodology, including projects of Common Interest (PCI) and projects of Mutual Interest (PMI) identified in the list of TYNDP projects. It should be noted that AD MEPSO is required to adhere to the methodologies used in network studies, market analyses, and related modeling methodologies, particularly the Take Out One at the Time (TOOT) and Put In One at the Time (PINT) methods, as well as other methodologies concerning the calculation of costs (CAPEX and OPEX), investment justification indicators (NPV, BCR), socio-economic benefits, environmental protection, evaluation of hybrid projects, and other methodologies accepted by ENTSO-E. In preparing the paper, the 4th edition of the Guidelines for Cost–Benefit Analysis was fully utilized, so that the content of the paper corresponds to the structure of the Guidelines, but with a much narrower scope. The paper consists of five sections (1) Description of the approach, methodology, and indicators for project evaluation (2) Types of methodologies by area (3) Determination of capital and operational expenditures (CAPEX, OPEX) (4) Method for calculating investment justification indicators (NPV, BCR) (5) Concluding recommendations.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C1.234.txt.pdf>

Description of the State of the Power System in Southwestern Macedonia During the Outage of Both Power Transformers at TS Bitola 2

Zlatko Acevski, Done Aspirovski

The stable operation of the power system is a fundamental criterion for ensuring the continuous and reliable transmission of electricity from the generation capacities to all consumers connected to the transmission network. When one or more elements of the transmission network fail, specific transient processes occur in the power system, which may compromise its stability and, consequently, the secure, high-quality, and reliable delivery of electricity to consumers. In such situations, the operational controllers at



MEPSO's National Control Center face specific challenges in managing the power system to maintain stable operation. Since power system management occurs in real time, the actions taken by on-duty dispatchers often require immediate decision-making under stressful conditions.

This paper analyzes the state of the power system in Southwestern Macedonia under conditions in which both 400/110 kV power transformers at TS Bitola 2 are out of service, resulting in no transformation of electricity from 400 kV to 110 kV. Significant operational issues in the power system were observed during the winter months, when electricity consumption is higher. The paper describes the measures and actions taken to overcome this situation and ensure the stable operation of the power system.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.163.txt.pdf>

The Role of the Battery Energy Storage and Connection Procedure to the Transmission Network



Stefan Naskoski, Aleksandra Agovska

The growing integration of solar and wind generation has increased the need for Battery Energy Storage Systems (BESS) to support grid balancing, stability, and optimization. This paper analyzes key techno-economic indicators focusing on the Levelized Cost of Storage (LCOS), provides a comparative assessment of different battery technologies, and examines

the impact of aging and degradation on their performance and economic viability. Additionally, it includes a comparative analysis of European regulations and the national legal framework, as well as a systematic overview of the procedure for connecting BESS to the transmission network. The study also presents a quantitative SWOT analysis and offers recommendations for further integrating and developing battery storage systems within the power grid.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.173.txt.pdf>

Comparison of Different Types of Inverters and Their Impact on the Transmission Network

Aleksandar Zhupanoski, Jane Petreski

Modern power systems are undergoing a significant transition toward renewable energy sources and decentralized generation capacities, leading to increased use of inverter-based resources. This shift presents both opportunities and challenges regarding system stability, particularly for transmission networks originally designed for conventional synchronous generation. This study analyzes two main types of inverters: grid-forming and grid-following, providing a comparative analysis of their technical characteristics, advantages, and limitations. Grid-forming inverters can independently generate and maintain voltage and frequency, making them crucial for weak or isolated networks. In contrast, grid-following inverters operate dependent on the existing grid, synchronizing with the system's voltage and frequency. The paper examines the control strategies of both inverter types. Grid-forming inverters use advanced control techniques to establish a stable reference point within the network, while grid-following inverters rely on phase-locked loops to track existing grid conditions. Technical challenges associated with these inverters, such as dynamic stability, fault response, and contribution to system inertia, are also analyzed. Special attention is given to the application of these inverters for stabilizing the Macedonian transmission system, where the increasing share of inverter-based renewable sources necessitates new approaches for maintaining network stability.



The study explores the benefits and limitations of both inverter types in the context of the Macedonian power system to propose optimal integration strategies. Recommendations will include potential improvements to existing grid codes, the role of hybrid inverter-based systems, and the importance of advanced grid-support functions to ensure a secure and stable power transmission system.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.175.txt.pdf>

Non-Frequency Ancillary Services for Power System Management and Possible Procurement Methods

Igor Stojanovski, Sime Kuzarevski, Despina Sokolova, Nenad Jovanovski



Directive (EU) 2019/944 [1] (Electricity Market Directive) mandates a market-based, transparent, and non-discriminatory procurement of non-frequency ancillary services (NF-AS) for power system management. These services primarily involve voltage regulation within control areas and the provision of reactive power. In this context, MEPSO, as the transmission system operator, and North Macedonia, as an EU candidate country, aim to transpose the requirements of European regulations fully. Experience shows that most EU countries have developed market-based concepts for procuring NF-AS.

The proposed NF-AS procurement system is based on a three-pillar concept (A, B, and C), allowing flexibility in market-based reactive power procurement. Since reactive power is required locally and the conditions and requirements of transmission and distribution systems vary across voltage levels, a specific approach is needed. Therefore, a differentiated design for the three pillars at each voltage level is necessary to ensure adequate voltage stability and supply security. The main priority of this procurement concept is to maintain high system reliability.

Pillar A – Immediate grid code requirements: Pillar A provides the operator with a secure and economical source of reactive power. It includes reactive power management mechanisms that the operator can activate, primarily through generation units. The right to request these services is a unilateral option belonging exclusively to the operator.

Pillar B – Market procurement: Pillar B envisions market-based procurement in which capacity and/or reactive energy, and remuneration (delivery and/or price), are entirely determined by supply-and-demand principles.

Pillar C – Procurement of fully integrated network components: This pillar provides a secure, predictable source for the operator to deliver reactive power to meet operational security requirements.

This paper analyzes possible methods for providing NF-AS, a key component of the three-pillar concept, and examines their targeted, structured vertical provision of reactive power among system operators.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.254.txt.pdf>

Efficient Utilization of Cross-Border Capacities in the MEPSO Control Area

Zhivorad Serafimovski, Jane Gerasimovski, Igor Stojanovski, Borko Alekovski



The calculation and allocation of cross-border transmission capacities are key mechanisms that define the performance of the electricity market and affect its liquidity. In operational practice, cross-border transmission capacities are calculated for different timeframes: year-ahead and month-ahead, but not day-ahead or intraday. The determination of cross-border capacities defines the value of available cross-border capacity, power flows, and the level of security of the transmission network.

On the other hand, increasing the efficient use of interconnection capacities is a prerequisite for integrating the internal electricity market, providing greater incentives for the introduction and expansion of generation capacities, adopting new technologies, and reducing final electricity prices for end consumers. One of the conditions for the efficient utilization of cross-border capacities is the implementation of European Network Codes (NC/GL), particularly for this segment, as well as of European Regulation (EU) 2015/1222 on Capacity Allocation and Congestion Management (CACM). This regulation establishes and governs the operation of Single Day-Ahead Coupling (SDAC).

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.255.txt.pdf>

WAMS Implementation MEPSO's Transmission Network

Bojan Petrusheviki, Vancho Shahpanski, Stefanija Spasovska

The liberalization of the electricity market presents a new challenge for the supervision and management of the transmission system. Today's monitoring and control systems, due to their design, cannot fully respond to rapid changes in the transmission system, which may lead to system collapse. Therefore, the implementation of new monitoring and control technologies is necessary.

The WAMS (Wide Area Monitoring System) enables real-time visualization of potential deviations from normal network parameters and provides operators at the National Dispatch Center with information

to restore normal operating conditions. The WAMS system has been implemented in the transmission network in its first phase, covering several locations at 400 kV.

Upgrading the system with new PMU (Phasor Measurement Unit) devices and appropriate software for graphical and textual presentation of acquired, archived, and processed PMU data will ensure a high level of quality in monitoring the security and stability of the power system and interconnections in real time.



<https://makocigre.mk/sovetuvanja/y/2025/pdf/C2.169.txt.pdf>

Impact of Distributed Renewable Energy Sources on Transmission Network Losses

Romeo Josifoski, Stefaniya Simovska, Kristina Ginova, Despina Sokolova

This paper will analyze the impact of renewable energy sources (RES) connected to the distribution network on transmission network losses. It will examine how the system functioned previously, how it operates now, and how these changes have affected losses before and after this mode of energy transfer. The study will also address the variability of renewable generation during periods of energy shortages, increased consumption, and higher losses, and it will explore how the transmission system operator maintains the stability of the entire transmission network under such challenging conditions.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.176.txt.pdf>



Market balancing and Market Monitoring through the Transparency Platform, analysis of the Balancing Platform, from old to new processes

Dionis Tanaskoski, Daniela Gavriloska



By using the Transparency Platform (EMFIP) of the European Network of Transmission System Operators (ENTSO-E), fast and efficient collection of data from all involved stakeholders is enabled (Transmission System Operators – TSOs, National Regulatory Authorities for Energy – NRAs, and the European Union Agency for the Cooperation of Energy Regulators – ACER). The ACER Market Monitoring platform directly

retrieves data from the Transparency Platform. These two platforms provide data that are used by: traders, transmission and distribution system operators, regulatory energy authorities, academic institutions and students, as well as any entities or institutions that require this information.

The balancing market is a segment of the Transparency Platform through which Transmission System Operators transparently publish data about their systems. Key elements of market monitoring for balancing include: quantities, prices, and costs of balancing services; cross-zonal sharing and exchange of balancing services; specification of balancing products; analysis of the balancing segment of the platform; imbalance volumes and prices, and other aspects, which will be presented in detail in this paper.

During the use of the Transparency Platform for the Balancing Market and Market Monitoring, the need arose to process a very large number of input and output data. This created the necessity to analyze and reconfigure both data and processes to enable easier and more transparent use of the platforms.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.229.txt.pdf>

The Role of Battery Energy Storage Systems in the Power System (PES)

Ivona Josifoska, Martina Bogdanovska, Stefan Spasovski, Sandra Ivanovska

In recent years, the use of Battery Energy Storage Systems (BESS) has become increasingly important in the power system (PES) due to the growing integration of renewable energy sources and the need for greater flexibility and stability. Batteries enable the storage of electrical energy during periods of low demand and its utilization when demand is high or renewable generation is insufficient. They play a key role in maintaining the balance between generation and consumption, improving power quality, providing reserves, and stabilizing frequency. This paper explores the roles, advantages, disadvantages, challenges, and prospects of batteries in modern power systems.



<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.246.txt.pdf>

Prospects and Challenges of Hydrogen Energy as an Alternative to Fossil Fuels

Stefan Spasovski, Sandra Ivanovska, Ivona Josifovska, Martina Bogdanovska



Hydrogen, as an energy carrier, holds significant potential to play a pivotal role in the global transition from fossil fuels to sustainable energy sources. Owing to its characteristics as a clean fuel and its capacity for storage and transport, hydrogen is increasingly recognized as a promising solution for mitigating greenhouse gas emissions. This paper examines the prospects of hydrogen energy utilization, as well as the barriers to its large-scale adoption. The analysis focuses on

various hydrogen production methods, infrastructural and economic challenges, and emerging technological and developmental trends that are expected to enable more efficient integration of hydrogen into industrial applications, transportation, and the broader energy sector.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C2.248.txt.pdf>

Control Buildings in High-Voltage Substations with Low Energy Consumption in Accordance with National Energy Efficiency Requirements

Vlatko Galabov, Dejancho Tenev, Dragan Smilevski, Dragan Trenchovski

In the substations SS Skopje 2, SS Kavadarci, and SS Samokov, the control buildings experience significant energy consumption, particularly for heating, cooling, and lighting, due to structural characteristics, insufficient thermal protection, and outdated technical systems. The structural design of all three facilities is based on a reinforced concrete frame system, with walls lacking thermal insulation, roofs lacking verified insulating layers, and windows that have been partially replaced, but without confirmation of compliance with thermal standards.



According to the recommendations from the conducted energy audits and technical specifications, the reconstruction measures include thermal insulation of the façade using insulating panels (EPS), refurbishment of the roof structure with the addition of a thermal layer, supplementary insulation of internal boundary walls adjacent to unheated spaces, and adaptation of internal spaces in accordance with current needs and organizational requirements.



The lighting will be replaced with LED fixtures, and the heating and cooling systems will be based on energy-efficient devices with the possibility of utilizing renewable energy sources. By implementing these measures, the buildings are expected to achieve energy efficiency levels in accordance with national requirements for low-energy public buildings, improving the energy class to at least C, and in some cases, up to class B. This is anticipated to reduce the energy demand for

heating, enhance indoor comfort, and optimize maintenance and operational costs.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C3.242.txt.pdf>

Assessing Consumer Perceptions and Willingness to Pay for Renewable Energy Sources

Branka Vasikj, Elena Achkoska



In recent years, the integration of renewable energy sources has been essential for the global energy transition and the mitigation of climate change. This trend of incorporating renewable energy and its importance in addressing climate challenges extends to North Macedonia as well.

This paper thoroughly investigates consumer attitudes in our country and their willingness to pay for green energy. The study analyzes the current state of renewable energy integration in North Macedonia and the factors influencing consumers' attitudes and preferences toward green energy. Particular emphasis is placed on their awareness, knowledge, and perception of renewable energy sources..

A quantitative approach was employed using a structured survey to assess consumer awareness, attitudes, and willingness to pay for green energy. The study identifies factors that facilitate or constrain acceptance of renewable electricity and examines the influence of public acceptance, education, and environmental concern on consumer attitudes. Sociodemographic variables, including gender and employment status, were analyzed to understand their impact on energy-related decision-making.



<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C5.230.txt.pdf>

Use of Batteries (BESS) in the Power System

[Nikola Pangovski](#)



With the increasing use of renewable energy sources, optimizing energy use through price arbitrage is becoming increasingly important. This paper investigates the concept of daily arbitrage using Battery Energy Storage Systems (BESS) to leverage price fluctuations—lower electricity prices during daytime solar generation and higher prices at night. Through a specific example, it examines how BESS can store excess electricity produced during peak solar output and release it during the night or periods of higher demand, effectively reducing

electricity costs and enhancing grid stability.

The study explores the operational mechanisms behind this arbitrage strategy, including the integration of BESS with solar photovoltaic (PV) systems and standalone operation. It also highlights key challenges—such as storage efficiency, battery degradation, and regulatory barriers—while providing insights into future trends in energy arbitrage as technological advancements continue.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/C5.222.txt.pdf>

Strategic Approaches to Cybersecurity in the Energy Sector: Experiences and Challenges

[Enis Drndar, Vlatko Galabov](#)

In the context of increasing cyber threats and geopolitical uncertainty, cybersecurity has become a critical strategic priority for organizations managing critical infrastructure, particularly in the energy sector. Energy companies, whether involved in the generation, transmission, or distribution of electricity, are increasingly exposed to cyber threats that can severely disrupt the stability, confidentiality, and continuity of services. The growing digitalization and interconnectivity of systems further increase the complexity of risk management.

This paper presents a strategic approach to cybersecurity at the corporate level within the energy sector, focusing on organizational setup, the development of security policies and controls, and the economic aspects of cybersecurity investments. Emphasis is placed on integrating cybersecurity into corporate strategy, defining policies and controls, fostering awareness and culture, and establishing mechanisms for long-term resilience.



The experiences and insights presented in this study stem from the practical implementation of a cybersecurity framework in an organizational and operational context. The paper addresses the challenges organizations face in transitioning from a reactive to a proactive cybersecurity approach. Special attention is given to evaluating cybersecurity investments from the perspective of national security and sustainable economic development, considering the critical nature of the infrastructure involved.

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/D2.249.txt.pdf>

Implementation of Advanced Technologies Using Optical Fibers in the Revitalization of 400/110 kV Substations at AD MEP SO

[Dimitar Iliev](#)

A dynamic system such as electricity transmission is subject to changes driven by various factors, making its reliability and power quality dependent on continuous efforts to develop more efficient and innovative processes. The ultimate goal is to ensure satisfied and secure consumers of electricity supply services. To this end, AD MEP SO places significant emphasis on improving operational processes by developing and modernizing its own optical network, thereby enhancing reliability in the management and operation of the transmission system. The revitalization of 400 kV transformer substations, the replacement of primary equipment, and the implementation of advanced technologies such as optical fibers represent a further step toward the complete digitalization of North Macedonia's transmission system..

<https://mako-cigre.mk/sovetuvanja/y/2025/pdf/B3.139.txt.pdf>





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