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UPDATED ELECTRICITY TRANSMISSION SYSTEM DEVELOPMENT PLAN OF MONTENEGRO

2023-2032

- DRAFT -

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Summary of abbreviations

Abbreviations of countries:

Abbreviation	Country	ISO abbreviation
A	Austria	AT
AL, ALB	Albania	AL
BG, BUL	Bulgaria	BG
BiH, B&H	Bosna and Herzegovina	BA
GR	Greece	GR
CRO	Croatia	HR
I, IT, ITA	Italy	IT
KS	Kosovo	XK
MNE	Montenegro	ME
MK, MKD, FYROM	North Macedonia	MK
RO, ROM	Romania	RO
SLO, SI	Slovenia	SI
TR, TUR	Turkey	TR
UA, UKR	Ukraine	UA
RS, SRB	Serbia	RS

other abbreviations:

ACER	The Agency for the Cooperation of Energy Regulators (ACER) of the European Union
ATC	Available Transfer Capacity
BCE	Base Case Exchange
B/C	Benefit/Cost Ratio
CBA	ENTSO-E Cost Benefit Analysis Methodology
CEPA	Cambridge Economic Policy Associates
CGES	Transmission System Operator of Montenegro
OHL	Overhead line
EENS	Expected Energy Not Supplied
EPS	Electric power system
EMI	Electricity Market Initiative
EMS	Transmission System Operator of Serbia (Elektromreža Srbije)
EPCG	Electric Power Utility of Montenegro (Elektroprivreda Crne Gore)

ENTSO-E	The European Network of Transmission System Operators for Electricity
GTC	Grid Transfer Capacity
HPP	Hydroelectric power plant
HVDC	High-voltage direct current cable
IRR	Internal Rate of Return
SEE	Southeast Europe
KOSTT	Transmission System Operator of Kosovo
MKI	Ministry of Capital Investments of Montenegro
MEPSO	Transmission System Operator of Macedonia
sHPP	Small hydropower plant
NPP	Nuclear power plant
NOS (BiH)	Independent System Operator of Bosnia and Herzegovina
NPV	Net Present Value
NRL	No Realistic Limit
NTC	Net Transfer Capacity
TSO	Transmission system operator
OST	Transmission System Operator of Albania
PS Transformer	Phase-shift Transformer
ToR	Terms of Reference
SECI	The Southeast European Cooperative Initiative (project)
SEW	Social and economic wealth
RAE, REGAGEN	Energy Regulatory Agency of Montenegro
TE	Thermal power plant
TERNA	Transmission System Operator of Italy
TR	Transformer
TS	Substation
TSO	Transmission System Operator
WB6	Western Balkan 6 countries (Albania, Bosnia and Herzegovina, Montenegro, Kosovo, North Macedonia and Serbia)

1 Legal framework for the adoption of the Development Plan

Pursuant to the Energy Law of Montenegro [1] the electricity transmission system operator is required to perform electricity transmission under conditions set out by the license according to the objectivity, transparency and non-discrimination principles. In order to play that role, the most important one, i.e. to fulfil requirements set before it during operation, pursuant to Article 87 of the Energy Law of Montenegro (Official Gazette of Montenegro, no. 28/2025), the electricity transmission operator is required to develop a ten-year transmission system development plan. Pursuant to the cited provision, starting from the state and level of utilisation of the system, the Transmission System Operator establishes a ten-year transmission system development plan in such a way that it is aligned with

- the National Energy and Climate Plan, taking into account projects for the construction of facilities for electricity generation, and especially projects for the use of energy from renewable sources,

- the development plan of neighbouring transmission systems, and regional investment plans, taking into account projects of common interest for the Community and projects of mutual interest,

- the needs of the development of the transmission and distribution system.

The transmission system operator determines the development plan based on direct and constant monitoring of system operation and overview of the trend of needs, as well as data and information obtained from all relevant entities. In case of need, the operator updates the development plan by including possible changes arising from objective reasons or the obligation to construct facilities in accordance with confirmed international agreements. Accordingly, the transmission system operator submits annual investment plans prepared according to the needs of system user, which shall be consistent with the prepared (updated) ten-year transmission system development plan.

The transmission system operator, Crnogorski elektroprenosni sistem AD Podgorica (hereinafter: CGES), is authorised and responsible for technical criteria of planning and electricity consumption forecast, which are harmonised with technical standards laid down by the Transmission Grid Code **Error! Reference source not found.** (hereinafter: the Code) and the Energy Development Strategy [6] in Montenegro (as a strategically valid document until the adoption of the National Energy and Climate Plan), provided that every three years, a development plan for the next 10 years is prepared and submitted to the Energy and Water Regulatory Agency (hereinafter referred to as REGAGEN) for approval.

It should be noted that the preparation of the National Energy and Climate Plan of Montenegro (hereinafter: the NECP of Montenegro) is in progress, but at the time of preparation of the Updated Development Plan 2023-2032, it has not been adopted, and in accordance with Article 18 of the Code, the Energy Development Strategy of Montenegro by 2030 is applied as a strategic document.

REGAGEN has prescribed the Rules for Developing and Monitoring the Implementation of Ten-Year Electricity Transmission System Development Plans **Error! Reference source not found.** (hereinafter: the Rules for Planning) that determine the content, method and procedure for preparing and conducting a public discussion, as well as the procedure for granting consent and the method of monitoring the implementation of the ten-year electricity transmission system development plan.

In accordance with Article 4 of the Rules for Planning, the Development Plan aims to present in detail the state of the electricity transmission system in Montenegro in the year preceding the planning period, determine guidelines for its development in accordance with the needs of system users, as well as necessary infrastructure investments in accordance with the proposed development of the transmission system. The Development Plan is based on the existing and planned generation and system load and contains measures that guarantee the ability of the system to meet the needs for electricity transmission and long-term security of supply.

2 Methodological approach for preparing the Updated Development Plan

The methodological approach for preparing the (updated) plan implies a series of activities needed to be carried out in order for the Plan to lead to its purpose, which is system planning that allows a reliable and secure operation of the electric power system as well as the possibility of connection of new sources and consumers, in accordance with needs of system users.

The procedure itself for preparing the Updated Development Plan has started with a series of activities by CGES, principally with the aim of collecting data and informing transmission system users (CEDIS, EPCG) and competent state entities (Ministry of Energy) on the time schedule of preparing the Plan.

The methodological approach for preparing the Plan consists of the following components:

- Collecting data from transmission system users that include:
    - CEDIS,
    - EPCG,
    - Direct consumers,
- Collecting data by the competent state entity (Ministry of Energy).)
- Collecting data on development plans of neighbouring systems, or systems whose development projects may have an impact on CGES transmission network;
- Development of market and network scenarios of electricity exchange in the region;
- Identification of bottlenecks in the transmission network;
- Geographic overview of total available power by points in the system free for the connection of new users (ΔGTC) based on the current state of the transmission network;
- Identification of necessary projects;
- Cost-benefit analysis (ENTSO-E CBA 4.0);
- Development plan for new projects.

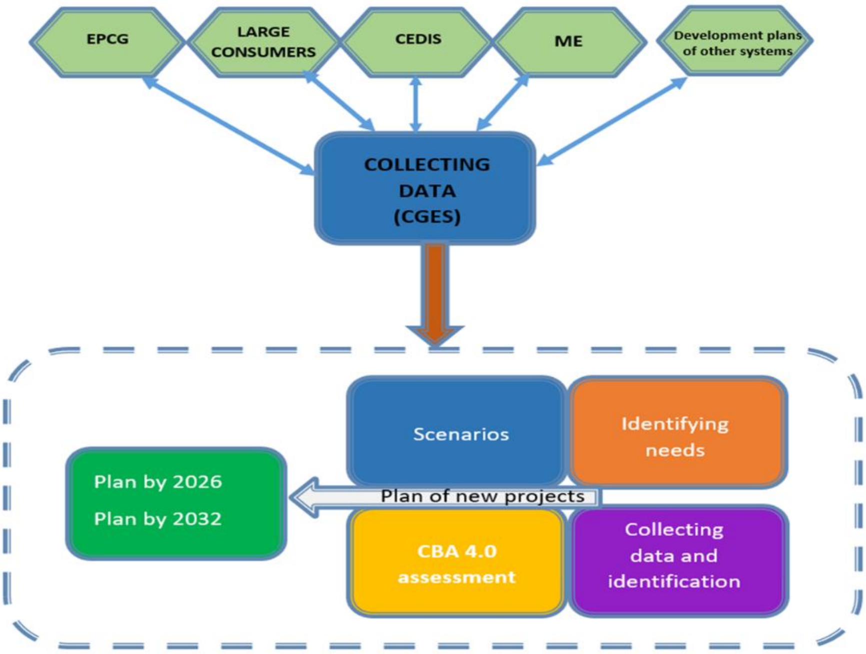


Figure 2-1 Methodological approach for preparing the Plan

Market analyses imply the calculation of social and economic wealth from construction of new transmission facility, for society as a whole (including the region), where this benefit is a consequence of merging two price areas and the equalisation of prices between them, i.e. using generation units with lower generation costs. If some project of transmission system contributes to the equalisation of prices between two price areas, market analyses show how much impact this project has on society as a whole.

Based on electricity market models, characteristic hours (usually with maximum and minimum consumption, maximum and minimum commercial exchange at the border of the transmission system of Montenegro, with maximum and minimum transits) were selected based on which market models were developed.

Further analyses were done on market models that gave results in the form of need to reinforce the transmission system in order to satisfy the needs of the existing and new transmission system users in the safest and securest way.

Total benefits calculated in network and market analyses make the total benefit for society (by a new facility). The mentioned analyses are done to do an estimate of necessary investments and their cost-effectiveness during operation.

Then a financial plan was determined for each new facility, which together with other investments (reconstructions, revitalisations, replacements of obsolete equipment, protection systems, surveillance systems, exchange and storage of data, etc.) make a unique investment plan.

2.1 Methodology and criteria for transmission system planning

With the deregulation of the electric power sector and liberalisation of electricity market, instead of central management and planning, it appears a big number of competitive participants that act independently and whose coordination needs to be agreed at the higher level, or at the level of system possibilities and needs, whereby the major role should be given to transmission system operator. In such conditions, transmission system development planning becomes an extremely complex task in which planners must take into account a big number of unknowns and uncertainties in terms of technical, economic and regulatory constraints.

Transmission system development plans must prove sufficiently robust and adequate to satisfy a wide range of possible future states of the system. Therefore, it is no longer just desirable, but also necessary, that market analyses precede network analyses that will optimise the operation of the generation portfolio, make a plan for engagement of generation units, but also identify certain specific (non-characteristic) hours, for which it is necessary to do an analysis of the state of the system. Such practice of using both market and network analyses in preparing development plans is used also in processes of Pan-European transmission system development planning by ENTSO-E.

Of course, system specificities were also taken into account and an optimal way to fulfil both conditions was found, complying with the fact that ENTSO-E methodologies are made for an open electricity market.

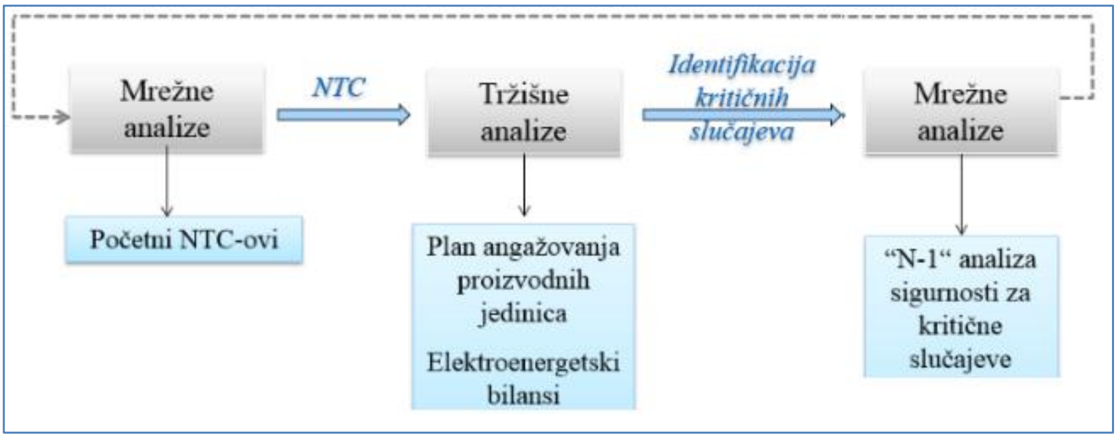


Figure 2-2 Interaction between market and network analyses

For certain projects, it was not possible to give a detailed analysis of benefits that could be monetized, but it was provided a rationale of needs for implementing such projects. Such projects include purchase of certain equipment, repairs of obsolete elements and similar.

The price of EENS for 2030 is based on the ERAA 2023[1] methodology with a maximum market price cap of 4,000 €/MWh[2]. For the price of losses and electricity not supplied from other generation facilities (except WPP Krnovo and WPP Možura), the price obtained from market analyses based on expected opportunities in the system managing for a given year in the future was used. Namely, according to Article 9 paragraph 6, as well as Article 28 of the Methodology for Determining Regulatory Allowed Revenue and Prices for Use of Electricity Transmission System [13], the price of electricity to cover justified losses is determined in the manner defined by law. Since the analyses within the subject Updated Plan are based on simulations of the electricity market, as provided by the ENTSO-E guidelines [8], the prices of losses and techno-economic analysis are taken from the results obtained from market analyses.

Generally speaking, the ENTSO-E CBA methodology is applied on interstate projects (regional projects), or on internal projects having an impact on a certain region.

2.2 Electricity market simulations

Within market simulations, it has been optimised the operation of mixed hydro-thermal systems of Europe with the aim of maximising the well-being of the Pan-European electricity market, taking into account available energies from renewable sources, constraints in the transmission network, as well as market interactions between modelled countries. Analyses were conducted for 2026 and 2032.

Market simulations were performed in the programme package Antares. The engagement of generation capacities shall be determined for all 8,760 hours, with the optimisation of total costs of operation of the overall modelled system and application of short-term marginal costs. During simulations, the commercial constraints of transmission (NTC) will be taken into account with the assumption of ideal market (without application of market power) and price inelastic consumption.

By the conducted simulations, the following output data of interest for network analyses are obtained for each year in each analysed year:

- engagement of generation units of Montenegro (8,760 hour values),

[1] https://www.entsoe.eu/outlooks/eraa/2023/report/ERAA_2023_Annex_2_Methodology.pdf.

[2] https://www.entsoe.eu/outlooks/eraa/2023/report/ERAA_2023_Annex_3_Detailed_results.pdf.

- import/export positions of Southeast Europe countries,
- commercial exchanges of Montenegro by borders.

Transmission network constraints between price areas are outlined through NTC values according to the latest data from ENTSO-E TYNDP 2024, as well as system consumption in Southeast Europe and renewable resource development scenarios.

In the available SECI models for 2025 and 2030 (updated to 2032), depending on the area, generation plants are modelled as follows:

- by power plants for Albania, Bosnia and Herzegovina, Bulgaria, Greece, Croatia, Montenegro, Northern Macedonia, Romania, Serbia, Kosovo and Slovenia,
- by technologies for Austria, Czech Republic, Hungary, Italy, Poland and Slovakia,
- spot markets: Germany and Turkey.

The Montenegrin electricity transmission system was modelled according to the available data for the target year and based on the applications for connection, for which connection possibility analyses were conducted. In these terms, the inputs received from EPCG are included in part of the planned generation capacities, but also all generation facilities for which a connection possibility analysis was conducted (a complete list is given in the Annex 11.4**Error! Reference source not found.**).

It should be noted that only WPP Gvozd I (I phase of installed power of 54.6 MW) and SPP Krupac (installed power of 50 MW) were considered in the average year 2026, for which the investor indicated 2026 as the year of commissioning. All other power plants (indicated in the attachment) were analysed in the cross-section year of completion of the Updated Plan (2032), bearing in mind that for the these power plants, the investors, in accordance with their time schedule (for power plants for which an agreement on the construction of connection infrastructure and connection of generation facility was signed), i.e. in accordance with their estimate given to CGES as an input for the needs of preparing this document, they indicated the year corresponding to the period 2026-2032 as the year of commissioning.

2.3 Technical criteria and constraints in EPS operation

In addition to criteria and methodology described within Market Analyses, a summary of other criteria is given within this chapter, which may be included in Technical Criteria, which are included in the Code.

The planned construction, reconstruction and upgrade of transmission facilities must ensure preconditions for the development of generation and distribution capacities, electricity market developments and reliable and quality supply of electricity for the forecasted level of consumption.

For the identification of eventual problem and transmission system planning, TSO shall use the following planning criteria:

1. Technical criteria and constraints under normal operational conditions;
2. Technical criteria and constraints under difficult operational conditions;
3. Criteria for allowed short-circuit currents; and
4. Criteria for commissioning new network elements or reconstructing existing ones.

2.4 Assessment of candidates for construction by the CBA methodology

Impact of potential future transmission facilities is analysed through more criteria of cost-benefit analysis determined by ENTSO-E. According to this approach, scenarios of new transmission facilities are assessed through different benefit categories and compared according to their indicators. Indicators of benefit categories are a result of network and market analyses.

Pursuant to the Rules and ENTSO-E CBA 4.0 Methodology [8] of 2024, the results of the study will show the following indicators based on which projects/clusters (presented compared to the defined techno-economic analysis template for infrastructure projects) will be evaluated:

1. K1 – Social and economic wealth (it is used only for those internal projects that can have a significant cross-border impact such as interconnection projects or can solve internal bottlenecks, which leads to large internal benefits that are achieved by reducing the generation of redispatching costs [€/year]
    a. K1.1 Energy cost savings [€/year]
    b. K1.2 Gas emission cost savings [€/year]
2. K2 – Change in CO_2 emissions [t/year] and [€/year]
3. K3 - Integration of renewable energy sources [MW] or [MWh/year];
4. K4 - Non-CO2 emissions [t/year];
5. K5 - Network losses [MWh/year];
6. K6 - Adequacy [MWh/year];
7. K7 - Flexibility:
    a. K7.1 Balance energy exchange [ordinal scale],
    b. K7.2 Balance capacity exchange;
8. K8 – Stability:
    a. K8.1 Qualitative indicator [ordinal scale],
    b. K8.2 Frequency stability,
    c. K8.3 Needs for no-load start-up services [€/year], and
    d. K8.4 Needs for voltage/reactive power management services;
9. K9 - Avoidance/postponement of remedial actions on existing elements [€];
10. K10 - Change in redispatching needs [€/year];
11. K11 - Robustness [ordinal scale].

In addition to the listed cost-effectiveness ratios, two additional indicators are presented as expense-related indicators:

1. T1 CAPEX [€],
2. T2 OPEX [€/year].

Indicators of benefits from construction of certain projects were obtained by applying calculation WITH and WITHOUT project, whereby obtaining its impact of benefit on the transmission network and generally overall system of Montenegro. For cases where monetization of project benefit was not possible, its benefits were given descriptively.

ENTSO-E CBA methodology is applied in European practice on regional projects, or on internal projects having an impact on the region.

2.5 Grid Transfer Capacity (ΔGTC)

Another important indicator of the readiness of the transmission network to receive new generation and consumption facilities is the Grid Transfer Capacity at the connection points of the transmission system, and within this Updated Plan, an analysis was performed in accordance with the Transmission Grid Code and the current Methodology for Calculating Available Connection Capacities.

This Methodology determines the method of calculating the Grid Transfer Capacity at the existing connection points of the electricity transmission system that does not require further development of the system to permanently preserve the guaranteed transmission parameters.

The Grid Transfer Capacity is the highest allowed exchange capacity at a connection point that does not require further development of the system to permanently preserve the transmission parameters guaranteed by the Transmission Grid Code.

The calculations are based on the following assumptions and steps.

2.5.1 Definitions

The previously occupied capacity at the connection point is determined individually for generation (AACG) and load (AACL) and for the maximum and minimum operating mode of the system for each substation of the electric power system of Montenegro:

AACGmax: Maximum previously occupied generation capacity, based on the highest hourly generation in the last 12 months.

AACGmin: Minimum previously occupied generation capacity, based on the lowest hourly generation in the last 12 months.

AACLmax: Maximum previously occupied load capacity, based on the highest hourly consumption in the last 12 months.

AACLmin: Minimum previously occupied load capacity, based on the lowest hourly consumption in the last 12 months.

2.5.2 Network topology

The transmission network of Montenegro has been presented using a nodal model consisting of the following elements.

- Nodes: substations with modelled overloads, generation connected to individual points of the system, including key hydroelectric power plants such as Piva and Perućica.
- Overhead lines/transmission lines (400 kV, 220 kV and 110 kV), cables, transformers, interconnections to Serbia, Bosnia and Herzegovina, Kosovo and Albania and Italy.

The electric power systems of the neighbouring countries and the countries of Southeast Europe have been modelled based on the ENTSO-E model and the SECI model that are available for the target year and are adapted to the budgets with the aim of obtaining as realistic results as possible (used data from the past, based on recorded snapshots).

Two models of the Montenegrin transmission system were considered:

2025 – current transmission network model for characteristic states:

- A model prepared for congestion forecasts for a day in advance and combined with other models of the synchronous area of continental Europe;
- Includes the usual topology and the topology of elements of the Montenegrin system.
- The initial utilisation of Montenegrin hydroelectric power plants enables the necessary adjustments for potential capacity increases in the sense of increasing generation or consumption in the analysed node (SS).

Calculation is done individually for all existing SS in the transmission system.

2.5.3 Calculation method

At the point of connection, a virtual power plant with a large installed capacity is modelled, whereby for the calculation of the maximum power of connected generation, the power of the power plant is raised in steps of 5 MW, and in the remote system (considering the smallest impact on power flows and loads of neighbouring systems, Austria was chosen), generation is lowered by the same value.

In the same way, the consumption in a certain node increases, while the generation in a "remote" node in one of the neighbouring systems increases.

Calculations of power flows and security analyses of the N-1 system are carried out, until an overload is detected in the transmission network of Montenegro.

The maximum connected power for generation (GTCG) and load (GTCL) is calculated as follows:

$GTCG = BCG - BCL + \Delta CG$

$GTCL = BCL - BCG + \Delta CL$

where:

- ΔCG – generation power increase in the node,
- ΔCL – power consumption increase in the node,
- BCG/BCL – base power of generation/consumption in the node.

The remaining transmission capacity for generation (RTCG) and consumption (RTCL) is calculated as follows:

RTCG (RTCL) = GTCG (GTCL) – TRMG (TRML) – AACGmax (AACLmax) + AACLmin (AACGmin) where the TRM margin of error of the power flow calculation is 10 MW.

3 Scenario description

The European Energy Union Strategy, published by the European Commission in February 2015, emphasised the need for integrated governance to ensure that all energy activities at EU, national, regional and local levels contribute to the goals of the Energy Union. This will, by 2030, expand the scope beyond climate and energy policy to include all five key dimensions of the Energy Union: 1. Energy security, 2. Internal energy market, 3. Energy efficiency, 4. Decarbonisation and 5. Research, innovation and competitiveness.

The National Energy and Climate Plans (NECPs) should cover the period from 2021 to 2030, paving the way for achieving the agreed 2030 targets, upgrade on what each party needs to deliver concerning its policies and include a perspective by 2050 to ensure consistency with the long-term relevant policy objectives at EU and Energy Community level.

As a member of the United Nations, Montenegro, by ratifying the Paris Agreement, has committed itself to joining the international community aimed at reducing greenhouse gas emissions. In addition, as a member of the Energy Community and a candidate for EU membership, Montenegro has committed itself to meeting the objectives of the Energy Community and the European Union in the areas of renewable energy, energy efficiency and greenhouse gas emission reductions. In order to meet these obligations and achieve the set goals, Montenegro must harmonise and coordinate its energy and climate policy. Integrating environmental and climate change issues into ambitious development and energy policies and strategies is one of the country's biggest challenges in joining the European Union.

Bearing in mind that the preparation of the National Energy and Climate Plan (NECP) of Montenegro is in progress, until its adoption, the Energy Development Strategy of Montenegro by 2030 shall be used as a strategic document for the purposes of preparing the Updated Development Plan (in accordance with Article 18 of the Rules for Planning). Accordingly, no analysis has been done within this document according to the scenarios that would be included in the NECP, so the results and input data of current studies ([15], EMI project and other) were used. The plans from the Energy Development Strategy were adapted compared the inputs received by the affected entities, and as such were used as the basis for the preparation of the document in question.

The EPS model includes Montenegro as well as other European countries modelled with the following level of detail:

- Consumption: total consumption defined by medium hour loads.
- Conventional generation capacities (TPP, HPP): each power plant separately or power plants grouped by clusters with corresponding technical and economic parameters.
- Renewable energy sources (wind, solar energy): total available hour generation for each technology in accordance with hour CF factors, treated as “must run“ priority generation.
- Transmission constraints on interconnections defined by NTC values.

The source of data for Montenegro are questionnaires received from users of transmission system of Montenegro (EPCG, CEDIS, Ministry of Energy, investors of facilities intended to be connected to the transmission network...), received transmission network development plans of neighbouring countries, and for other European states relevant studies ERRA 2023, TYNDP 2024, as well as climate databases.

The scenarios for the development of new sources are contained through a market simulation defined based on the probability of sequential hourly simulation of electric power system operation applying the following simulations:

- application of the Monte Carlo method that includes different combinations of wind, sun, hydro generation as well as different changes in demand in respect of weather conditions (changes in wind speed, hydrological conditions, temperature) and different levels of unavailability of thermal units due to failures or maintenance;

- hydro-thermal optimisation (optimal dispatching by the hour) to minimise system operation costs;
- compliance with characteristics and constraints in the transmission network (NTC or GTC constraints with direct load flow in accordance with PTDF factors).

3.1 Transmission system development objectives

The objective of the (Updated) Development Plan is defined by Article 4 of the Rules for Planning, which clearly stated that the Plan should show in detail the state of the transmission system in Montenegro in a year preceding the planning period, lay down the guidelines for its development according to the needs of system users as well as necessary investments in accordance with the proposed transmission system development.

The backbone of this transmission network development planning is the Energy Law, i.e. those of its articles related to the (Updated) Transmission Network Development Plan. It was pointed out that in preparing the (Updated) Development Plan, the Energy Law places special emphasis on supporting the achievement of a number of long-term objectives, the most important of which is reliable, secure and quality electricity supply, which coincides with the mission of CGES.

Objective 1 - Elimination of observed uncertainties in the past period

At the beginning of analyses, the (Updated) Development Plan aims to show in detail the state of the transmission system in Montenegro to identify bottlenecks that contribute to reduced electricity exchange, both within the same price zone and between different price areas, all with the aim of creating conditions for uninterrupted trading in electricity. Therefore, the emphasis is not only on the development of the domestic electricity market but also the complete European electricity market.

At the 110 kV voltage level, except for projects of internal 110 kV network and solving of radially powered distribution transformer stations 110/x kV, in a transparent and non-discriminatory manner, CGES plans and implements projects for connecting the transmission and distribution system, as well as projects for connecting facilities to the transmission system of Montenegro, which enables the placement of all volumes of electricity generated and its and its reliable and efficient transmission to customers, i.e. end consumers.

Objective 2 - National system security

The Development Plan must be based on the existing and planned generation and system load and contain measures guaranteeing the system capability to meet the needs for electricity transmission and long-term power supply security.

At the same time, the necessary enhancement and construction of new transmission system facilities are defined to timely initiate procedure relating to their designing, provision of funds, construction and commissioning.

Objective 3 - Security of uninterrupted electricity trade in the region

The transmission systems of the countries in the SEE region are, compared to other ENTSO-E regions, less interconnected. In recent years, there has been a significant increase in new installed power in renewable sources, especially wind power plants and solar power plants.

Planned projects in the SEE region's transmission network (new facilities and reconstruction of existing facilities) over the next decade aim to increase security of supply, support the integration of renewable sources, couple electricity markets in the region and strengthen interconnections between transmission systems and increase available transmission capacities.

Objective 4 - Proper planning to minimise capital investments in the transmission network

First of all, it is necessary to take into account that during the preparation and selection of a technical solution, in a way that among the possible technical solutions that meet the requirements and constraints, the following is chosen:

- a solution that causes minimum investment costs in achieving objectives, and
- a solution that allows reducing total operation costs of operators or, if this is not possible, that causes the smallest increase in these costs.

The law clearly defines that the TSO maintains, modernises, improves and develops the electricity transmission system with clearly defined planning objectives:

- determines the technical and technological conditions for connecting electric power facilities, devices and plants into a single system;
- develops the transmission network by not limiting the purchase and sale of electricity within the technical-technological possibilities of the transmission system;
- plans the operation of the transmission system, in cooperation with the market operator and operators of other systems;
- resolves overloads of certain transmission system elements, taking into account the equal position of all transmission system users.

Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth

Grid planning must take into account different technologies (wind power plants, solar power plants, gas power plants, coal fired power plants, hydropower plants etc.) and energy that produce and which, with the aim of supplying certain consumption, must be transferred by using transmission system at small or big distance. Therefore, transmission grid planning refers to forecasting how much energy (and power) will be needed to satisfy consumption, while for planning and selection of transmission elements, it is important where this energy will be generated and consumed. Although transmission costs are considerably lower than generation costs, just a well-constructed transmission system allows optimal use of generation capacities and available energy, increasing energy efficiency and reducing total costs in the longer time period.

In the process of planning the development of the transmission system, the so-called "golden network", a network that will have no restrictions, but aims to develop a dynamic, flexible and robust network, adaptable to future changes in generation and consumption.

Within market simulations, it has been optimised the operation of mixed hydro-thermal systems of Europe with the aim of maximising the well-being of the Pan-European electricity market (not just the national market), taking into account available energies from renewable sources, constraints in the transmission network, as well as market interactions between modelled countries.

Objective 6 - Coupling the European electricity market

An important segment of the strategic transmission system development in the next updated ten-year period remains the construction of interconnections to neighbouring systems, primarily with Bosnia and Herzegovina, Serbia, Kosovo and Albania, which ensures a high level of security of consumer supply throughout Montenegro in the observed period. The project of connecting with Serbia with a new 400 kV interconnection is part of the construction of the so-called Trans-Balkan Corridor, which aims to increase the capacity of the Western Balkans interconnection in the east-west and north-south directions, thus allowing the integration of renewable sources, primarily in Montenegro, and the delivery of energy to neighbouring countries.

Objective 7 - Strategic directions for environmental protection improvement and development

Within this objective, it is necessary to first adjust your own operations for the purpose of the following activities:

- Management of hazardous materials (insulating oils);
- Construction of new "ecological" oil pits or reconstruction of existing ones;
- Introduction of new information technologies - GIS for the purpose of monitoring system parameters;
- Active participation in the harmonisation of legal regulations;
- Preparation of studies in the field of environmental protection;
- Energy efficiency projects - pilot projects.

Objective 8 – Improving the quality of performing the core activity and performing daily activities

In accordance with the development of business processes, the need to provide the resources necessary for the establishment, implementation, maintenance and continuous improvement of the control and protection system, telecommunication infrastructure and other elements of the transmission network has arisen. In addition, this objective is directed to the improvement of conditions and the procurement of funds for higher quality and more efficient performance of daily activities within ordinary business processes.

4 Starting point for preparing the Updated Development Plan

4.1 Energy balance in the previous period

Figure 4-1 shows the balance of consumed electricity for the previous five years (2020-2024). If only the actual for the period 2022-2024 is observed, it can be concluded that there was a slight increase in consumption. However, compared to 2020 and 2021, it has been concluded that the consumption is lower, primarily due to the drastic reduction in the consumption of KAP as one of the most significant direct users of the transmission network.

Distribution consumption makes most of the electricity consumption, but the total electricity consumption was significantly determined by the consumption of three existing direct consumers: KAP, KAP, ŽICG and Željezara (Steel Mill).

It is evident that there was a jump in peak loads in some SSs, so that the transformers in SS Danilovgrad and SS Bar were loaded up to 80% of their apparent power. In accordance with the above, it is necessary to foresee the installation of a second transformer in SS Danilovgrad, and to consider the installation of a transformer of higher power in SS Bar.

For SS Herceg Novi, CEDIS sent a request to increase the transformation capacity, which also implies the need to purchase a transformer with a larger capacity.

During 2021, there was a significant reduction in KAP's consumption, which in total affects the energy balance of Montenegro in the sense that it imports significantly less than in previous years, with the fact that KAP finally drastically reduced consumption in 2022/2023.

When it comes to exchanges at borders, during the previous 3 years (Figure 4-2), the highest level of exchange was achieved with Bosnia and Herzegovina in 2024 of about 3.844 TWh of imports, as well as with Albania in the same year of about 1.320 TWh of exports. This leads to the conclusion that CGES' network was mainly used for electricity transit, which clearly indicates that it is necessary to think about new interconnections at these borders.

When it comes to the border with Italy (HVDC), electricity was mainly directed towards Italy, which resulted in a significant increase in transit compared to the period before 2022, so that in 2023 it reached 4.196 TWh of exports to Italy.

CGES does not take into account the distribution network in its network simulations (the distribution network model has not been processed), which is in line with the established practice of other ENTSO-E transmission network operators, unless a TSO specifically models the distribution network due to special needs and effects on the transmission system.

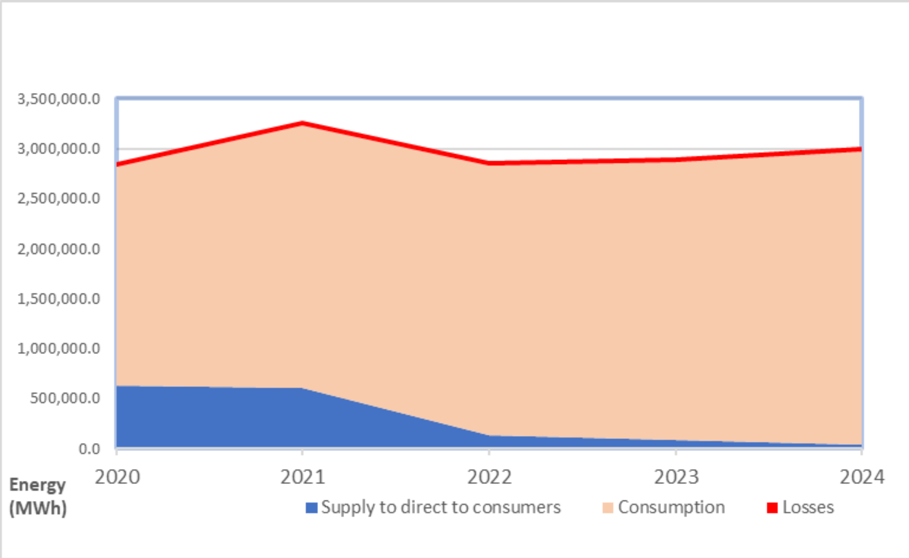


Figure 4-1: CGES consumption balance 2019-2021

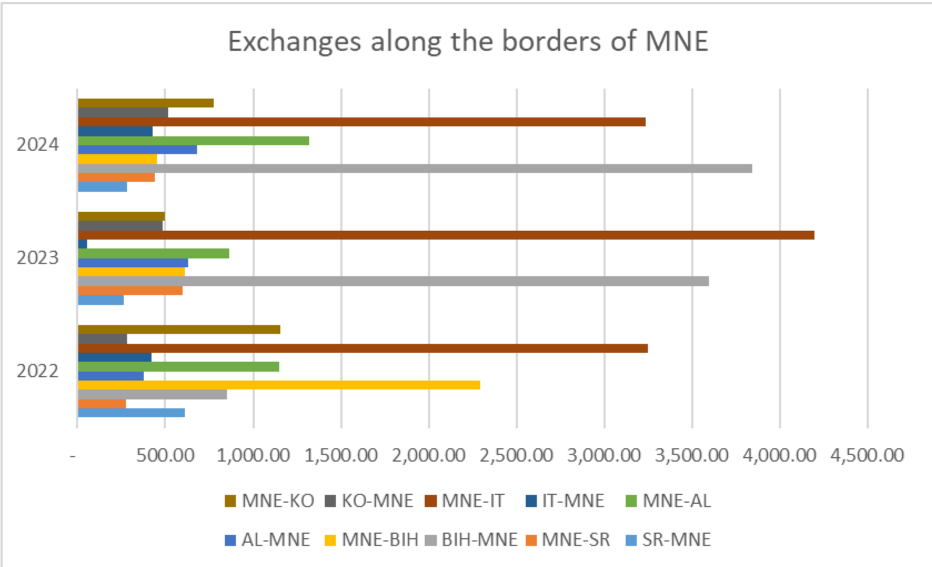


Figure 4-2: Graph overview of electricity exchange along the borders of Montenegro 2022-2024

Electricity consumption by large consumers is determined based on the consumption by KAP, Željezara, and railway infrastructure, i.e. electric traction substations. The graph (Figure 4-3) shows realised values of consumption of large consumers from 2020 to 2024, where it is clear that the largest part of the total consumption of large consumers is “other” consumption, which consists of auxiliary consumption: Monteput doo, JP Željeznice CG (Railways of Montenegro), TPP Pljevlja, Rudnik uglja (Coal Mine) - crushing plant and CGES 400 kV switchgear, and auxiliary consumption of WPP Krnovo and WPP Možura. Practically, in recent years, KAP has stopped participating significantly in consumption, as it was in the previous period, when it covered up to a dominant 90%.

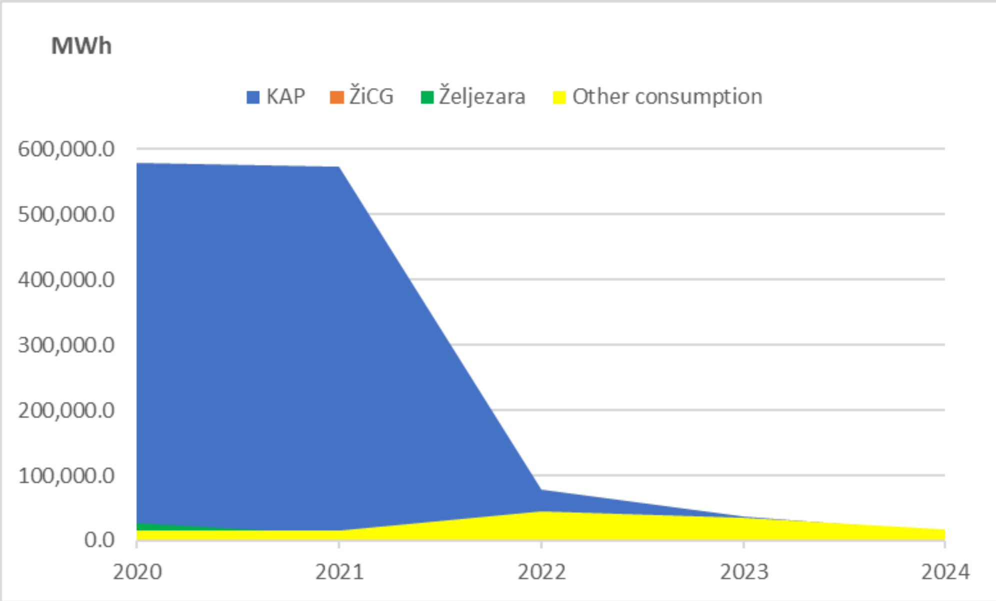


Figure 4-3: Graph overview of electricity consumed in Montenegro

KAP – Kombinat Aluminijuma Podgorica (Podgorica Aluminium Plant), which in the period by 2021 participated in the total consumption in the range of 17-33% of the total energy consumed (Figure 4-3), drastically reduced consumption after this period, and accordingly, in all analyses within the plan in question, KAP was not involved in the model.

Željezara Nikšić – the second-ranked direct consumer with a share of the total consumed electricity in the system annually significantly declines over the last two years. For the upcoming period, no increase in the load on the steel mill is expected, i.e. as with KAP, this consumer was not modelled.

ŽICG – electric traction substations, including four facilities located in Bar, Trebješica, Podgorica, Mojkovac, have their share of 0.6% of total electricity consumption of the Montenegrin system, with an expected peak load of 6 MW, evenly distributed across the existing four electric traction substations.

Table 4-1: Realised consumption in the period 2022-2024 at the points of electricity takeover from the transmission system of CGES

Elektroenergetski objekat	2022						2023						2024					
	Zima			Ljeto			Zima			Ljeto			Zima			Ljeto		
	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)
TS Andrijevica	2,032.94	3.47	2.08	5,019.92	5.36	2.25	2,607.99	5.17	1.93	3,984.00	5.59	2.25	2,380.90	4.98	2.08	6,681.86	5.62	2.25
TS Bar	100,343.28	44.40	14.65	106,836.07	50.03	15.75	111,390.80	45.11	15.00	116,657.95	57.79	16.13	116,732.52	52.83	14.65	127,943.63	59.05	15.75
TS Berane	39,426.55	16.69	7.69	37,031.82	15.71	4.90	38,496.44	18.25	7.76	34,934.98	16.66	4.94	46,202.26	21.14	7.69	44,154.20	16.99	4.90
TS Budva	121,694.37	51.04	1.90	153,482.30	73.79	1.57	138,294.33	55.78	1.90	166,413.48	78.08	1.57	141,280.50	55.93	1.90	180,511.26	80.23	1.57
TS Cetinje	37,725.51	14.06	7.34	25,227.49	11.81	4.89	39,069.33	17.80	7.40	27,547.41	18.16	4.93	37,324.71	17.64	7.34	22,532.84	19.79	4.89
TS Tivat	73,235.63	28.31	22.99	75,071.41	30.66	23.57	82,011.66	34.95	23.64	80,118.10	33.86	24.23	86,414.78	33.14	22.99	89,005.66	41.50	23.57
TS Herceg Novi	95,490.74	36.07	6.82	102,997.64	45.19	6.22	102,858.99	40.88	6.99	108,556.94	47.88	6.38	103,145.77	38.37	6.82	113,817.14	50.83	6.22
TS Danilovgrad	32,155.41	15.14	4.30	28,483.55	14.91	5.21	27,980.03	13.12	4.41	27,828.88	15.13	5.35	33,514.26	14.00	4.30	30,459.01	16.49	5.21
TS Podgorica1	140,445.69	61.09	12.66	129,073.55	59.23	13.46	158,883.88	63.04	12.94	143,187.43	64.95	13.76	166,095.65	64.77	12.66	152,365.08	73.63	13.46
TS Podgorica3	111,851.43	43.74	2.62	94,918.73	42.96	3.38	111,682.23	45.89	2.57	92,374.40	40.18	3.31	110,321.66	43.78	2.62	100,231.02	44.73	3.38
TS Podgorica4	133,551.52	59.42	15.50	118,855.12	47.11	11.50	131,233.93	54.65	15.69	105,761.30	44.52	11.65	131,924.42	51.53	15.50	111,513.16	45.59	11.50
TS Podgorica5	92,298.66	36.90	11.30	79,694.08	30.66	7.92	93,344.66	39.40	21.67	76,579.02	32.11	8.12	93,718.46	37.13	11.30	81,433.29	34.56	7.92
TS Mojkovac	16,545.04	9.70	20.82	15,645.46	7.20	16.55	15,666.99	7.80	21.67	13,656.49	7.63	17.22	17,973.89	8.47	20.82	17,511.81	8.20	16.55
TS Niksic	88,848.13	30.74	15.79	69,338.32	26.71	12.98	85,895.13	30.75	16.20	65,303.01	25.91	13.32	87,800.64	30.78	15.79	63,340.53	25.17	12.98
TS Klicevo	34,483.09	11.58	19.88	25,868.36	9.72	15.12	36,751.15	13.47	20.60	27,022.33	10.69	15.66	37,364.91	13.98	19.88	25,586.31	11.01	15.12
TS Kotor	57,846.10	29.24	9.10	57,866.18	28.55	6.65	60,859.77	24.51	9.81	60,635.81	28.02	7.16	60,422.69	26.78	9.10	64,490.87	28.58	6.65
TS Pljevlja	64,268.94	61.09	7.76	57,945.99	19.55	8.26	61,292.67	63.04	11.94	54,248.66	19.72	10.70	55,185.04	64.77	7.76	47,225.80	16.86	8.26
TS Ribarevine	48,329.07	16.59	6.32	42,679.15	15.18	6.78	48,896.66	16.62	6.48	44,523.79	14.93	6.96	54,638.64	19.47	6.32	48,699.11	16.76	6.78
TS Brezna	2,913.85	3.70	2.13	3,874.94	4.74	0.89	5,100.90	5.97	2.17	8,646.51	8.14	0.90	3,779.96	6.40	2.13	4,514.58	5.98	0.89
TS Ulcinj	47,454.08	19.55	8.74	65,310.92	38.44	11.58	48,860.39	19.66	9.10	69,838.39	42.09	12.05	52,617.66	24.60	8.74	76,079.09	43.96	11.58
TS Vilusi	3,539.10	1.24	0.51	3,399.67	1.27	0.34	3,569.06	1.23	0.51	3,464.06	1.23	0.35	2,962.26	1.32	0.51	3,504.61	1.26	0.34
TS Virpazar	17,429.57	12.69	4.33	28,596.65	15.60	3.66	18,513.78	17.94	4.37	23,667.70	14.34	3.69	21,175.50	15.39	4.33	27,727.45	12.21	3.66
TS Lastva	2,319.04	0.73		2,304.37	0.82		2,377.97	0.78	0.74	2,380.43	0.79	0.75	2,366.02	0.77	0.73	2,298.90	0.77	0.74
TSZabljak	0.00	0.00	0.00	0.00	0.00	0.00	270.56	5.39	5.12	0.00	0.00	0.00	10,335.85	6.51	6.19	10,247.40	4.79	4.55
Ostali potrošači	84,626.57	33.42	11.30	54,219.52	21.48	3.38	55,547.22	33.47	9.81	32,510.86	15.81	5.35	23,820.06	14.10	19.88	10.52	10.52	15.12

4.2 Share of the installed generation capacities by generation category

This chapter presents an overview of technical features of the existing generation facilities of the Montenegrin EPS and the share of generation by individual generation categories.

HPP Perućica - the oldest facility of the Montenegrin EPS that was put into operation in 1960.

The main technical features of HPP Perućica are as follows:

- Installed power of 330 MVA (307 MW i.e. 5x38 MW and 2x58.5 MW),
- Seven generating units with horizontally mounted synchronous generators.

The eighth generating unit with the capacity of 65 MVA (58.5 MW) is planned to be installed for which all conveyance and outfall features were built along with ancillary and common drive mechanisms and a place defined for the installation into the power house.

HPP Piva - a hydroelectric reservoir power plant with one of the largest concrete arch dam in the world has been operating since 1976.

The main technical features of HPP Piva are as follows:

- Installed power of 360 MVA (342 MW - 3×114 MW).

TPP Pljevlja is a condensation thermal power plant designed with two blocks of 210 MW. Water reservoir along with all auxiliary, technical and control-administration facilities (except for decarbonisation and re-circular cooling system) were designed for two blocks, but currently there is only one block.

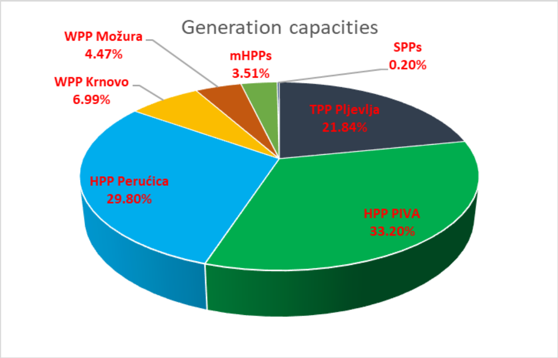
The main technical features of TPP Pljevlja are as follows:

- Installed power of the power plant is 225 MW;
- After the performed reconstruction (2009), technological repairs and improvements of the whole plant, annual generation goes even beyond 1400 GWh.

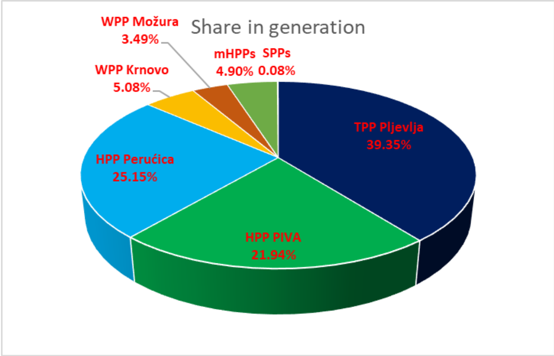
TPP Pljevlja is a base power plant in the Montenegrin EPS, and its significance is reflected in coverage of constant load diagram.

WPP Krnovo - WPP Krnovo has been in operation since 2017, with the total installed power of 72 MW and annual generation of about 170-200 GWh.

WPP Možura - WPP Možura has been in operation since 2018. The total installed power of 23 wind turbines is 48 MW, with a planned annual generation of 120-130 GWh.



Generation capacities of Montenegro 2024



Annual generation of Montenegro 2024

Figure 4-4: Distribution of annual capacity/generation in 2024 by power plants

4.3 Share of electricity generated by generation category

The diagram (Figure 4-5) shows annual generation in the Montenegrin EPS by power plant type in the period 2020-2024. It can be concluded from the diagram that on average over 60% of annual generation in the Montenegrin EPS comes from hydropower plants (provided that the generation in 2020 and 2022 was lower than 50% due to a poor hydrological situation).

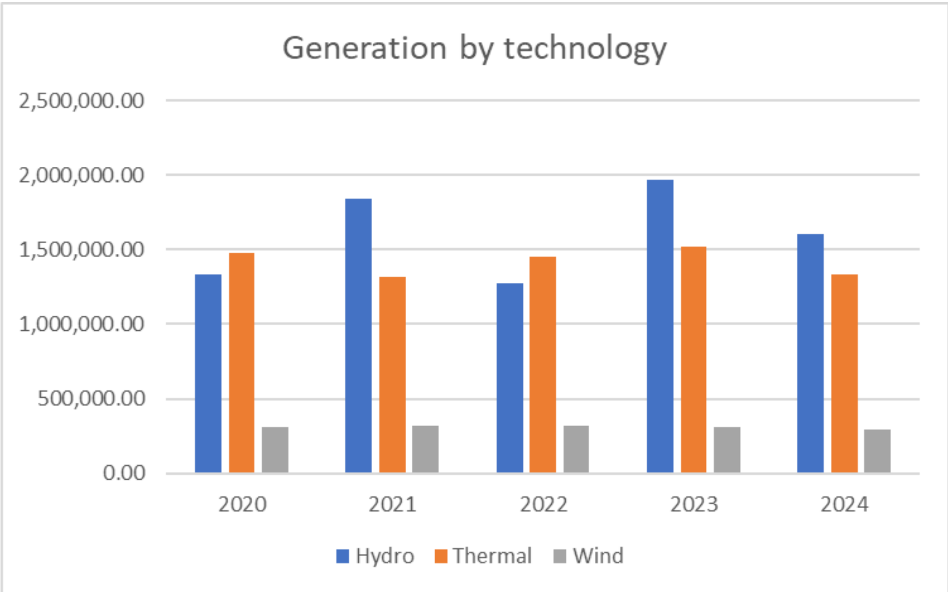


Figure 4-5: Generation of the Montenegrin EPS by power plant type in the period 2020-2024

Having in mind a high percentage of annual generation from hydropower plants, we can conclude that the Montenegrin EPS has been in deficit mainly in summer months having poor hydrology and high consumption, especially in Podgorica and at the seaside.

Due to favourable weather conditions, the generation of HPP Piva and HPP Perućica was considerably higher in the period 2023-2024 in comparison with the past two years (2021-2022. On the other hand, generation of TPP Pljevlja was practically constant and only slight variations can be observed from year to year, which is a consequence of the period of overhaul of the power plant. WPP Krnovo and WPP Možura certainly contribute to the electricity surplus. Their share in total generation in 2024 was about 9.2%.

4.4 Geographic overview of total available power by points in the system free for the connection of new users (ΔGTC)

This chapter outlines the Grid Transfer Capacity (GTC). This capacity represents the maximum allowed power of exchange at the connection point, which does not require further development of the system in order to permanently preserve the transmission parameters guaranteed by the Transmission Grid Code.

For the actual network model, the calculation uses a representative model of the Montenegrin electric power system, prepared for congestion forecasts for a day in advance and combined with other models of the synchronous area of continental Europe. The following assumptions is taken into account:

- The model reflects the state of the system from March to April last year, on weekdays.
- It includes the usual topology and switching state of elements of the Montenegrin system.
- The initial utilisation of Montenegrin hydropower plants gives flexibility to the model for potential capacity increase (ΔC).

The methodology boils down to determining various parameters at each connection point as:

Initial scenario

The exchange power at the connection point in the base case (BC) is determined in both directions individually:

- Generation power (BCG): Power to generate in the base case.
- Consumption power (BCL): Power for consumption in the base case.

Previously occupied capacity

The previously occupied capacity at the connection point is determined individually for generation (AACG) and load (AACL) for both the maximum and minimum exchange scenarios where:

- AACG(L)max: is the maximum previously occupied generation (consumption) capacity, based on the highest average hourly generation in the last 12 months.
- AACG(L)min: is the minimum previously occupied generation (consumption) capacity, based on the lowest average hourly generation in the last 12 months

The potential increase in capacity at the connection point (ΔC) is calculated for both generation (ΔCG) and load (ΔCL) with a step of 5 MW, with a modelled virtual machine at the connection point, respecting the N-1 security criteria.

The maximum theoretical connection power for generation (GTCG) and load (GTCL) is calculated as follows:

$$GTCG = BCG - BCL + \Delta CG$$
$$GTCL = BCL - BCG + \Delta CL$$

The remaining transmission capacity for generation (RTCG) and consumption (RTCL) is calculated as follows:

RTCG(L)= GTCG(L) - TRMG(L) - AACGmax(Lmax) + AACLmin(Gmin), where:

- GTCG(L): is the maximum available generation (consumption) capacity of connection power.
- TRMG(L): is the reliability margin for power flow calculations (generation or consumption).

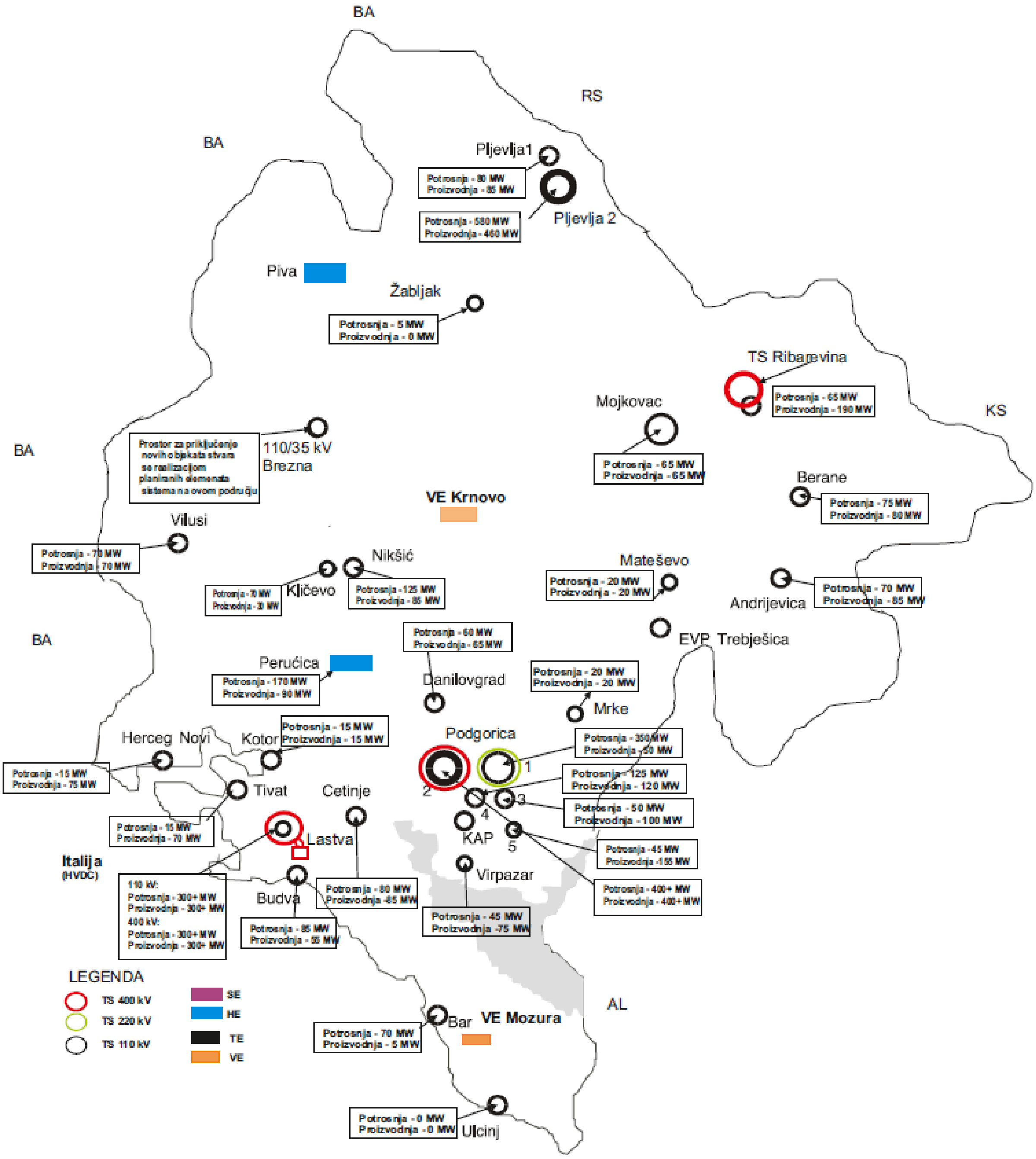


Figure 4-6: Geographic overview of the total available power by points in the system free for the connection of new users

Table 4-2: Overview of the available connection power by points in the CGES system

Connection point	Direction	BC	AAC min	AAC max	ΔC	GTC	TRM	RTC	RTCr
Bar	*Consumption*	30	8	40	40	70	10	**20**	**20**
	Generation	0	0	0	80	50	10	**48**	**40**
Budva	*Consumption*	20	11	76	65	85	10	**-1**	**-10**
	Generation	0	0	0	75	55	10	**56**	**50**
Cetinje	*Consumption*	10	3	21.5	70	80	10	**48.5**	**40**
	Generation	0	0	0	95	85	10	**78**	**70**
Danilovgrad	*Consumption*	9	0.75	13.7	75	84	10	**60.3**	**60**
	Generation	0	0	0	85	76	10	**67**	**60**
Herceg Novi	*Consumption*	16	2.8	45	0	16	10	**-39**	**-40**
	Generation	0	0	0	90	74	10	**66.8**	**60**
Tivat	*Consumption*	15	2	35	0	15	10	**-30**	**-30**
	Generation	0	0	0	85	70	10	**62**	**60**
Kotor	*Consumption*	14	3.5	28	0	14	10	**-24**	**-30**
	Generation	0	0	0	0	-14	10	**-21**	**-30**
Ulcinj	*Consumption*	12	2.5	38	0	12	10	**-36**	**-40**
	Generation	0	0	0	0	-12	10	**-20**	**-20**
Lastva	*Consumption*	0.4	0.3	0.5	310	310.4	10	**299.9**	**290**
	Generation	0	0	0	340	340	10	**330**	**320**
Podgorica 1	*Consumption*	51	9	62	310	361	10	**289**	**280**
	Generation	0	0	0	100	49	10	**48**	**40**
Podgorica 2	*Consumption*	0	0	0	400	400	10	**390**	**390**
	Generation	0	0	0	400	400	10	**390**	**390**
Podgorica 3	*Consumption*	13.5	6.5	41.2	35	48.5	10	**-2.7**	**-10**
	Generation	0	0	0	110	97	10	**93**	**90**
Podgorica 4	*Consumption*	16.5	7.5	53.2	110	126.5	10	**63.3**	**60**
	Generation	0	0	0	145	129	10	**126**	**120**
Podgorica 5	*Consumption*	9.5	4	32	35	44.5	10	**2.5**	**0**
	Generation	0	0	0	165	156	10	**150**	**140**
Vilusi	*Consumption*	0.5	0.2	1.45	70	70.5	10	**59.05**	**50**
	Generation	0	0	0	70	70	10	**60**	**50**
Nikšić 2	*Consumption*	27.5	8.5	34	100	127.5	10	**83.5**	**80**
	Generation	0	0	0	110	83	10	**81**	**80**
Perućica	*Consumption*	0	0	0	205	170	10	**160**	**160**
	Generation	35	0	307	55	90	10	**-227**	**-230**
Brezna	*Consumption*	0.5	0.2	9	120	121	10	**101.5**	**100**
	Generation	0	0	0	120	120	10	**110**	**100**
Mojkovac	*Consumption*	4.5	1.7	11.7	60	64.5	10	**42.8**	**40**
	Generation	0	0	0	70	66	10	**57**	**50**
Andrijevica	*Consumption*	3.5	0.5	6.2	65	68.5	10	**52.3**	**50**
	Generation	0	0	0	90	87	10	**77**	**70**
Berane	*Consumption*	9.35	0.75	16.7	65	74.35	10	**47.65**	**40**
	Generation	0	0	0	90	81	10	**71**	**70**
Ribarevine	*Consumption*	16.5	3.5	17.8	50	66.5	10	**38.7**	**30**
	Generation	0	0	0	205	189	10	**182**	**180**
Pljevlja 1	*Consumption*	16.8	5.8	24.2	65	81.8	10	**47.6**	**40**
	Generation	0	0	0	100	83	10	**79**	**70**
Pljevlja 2	*Consumption*	0	0	0	800	580	10	**570**	**570**
	Generation	220	0	220	240	460	10	**230**	**230**
Virpazar	*Consumption*	4.4	1.95	19.2	40	44.4	10	**15.2**	**10**
	Generation	0	0	0	80	76	10	**68**	**60**
Mrke	*Consumption*	0.5	0.5	1	20	20	10	**9.5**	**0**
	Generation	0.5	0.5	1	20	20	10	**10**	**0**
Mateševo	*Consumption*	0.5	0.5	1	20	20	10	**9.5**	**0**
	Generation	0.5	0.5	1	20	20	10	**10**	**0**
Žabljak	*Consumption*	5	2	8	0	5	10	**-13**	**-20**
	Generation	0	0	0	0	-5	10	**-13**	**-20**

4.5 Overview of electricity transmission infrastructure

This chapter shows the state of the transmission network of Montenegro, its age, possibility of extension, as well as the future status of certain facilities from the aspect of abandoning some solutions (it primarily refers to facilities the revitalisation of which is in progress).

For each transmission system element are given its main features, necessary for further analysis.

The current topology of the transmission system (late 2024) is shown in the Figure 4-7.

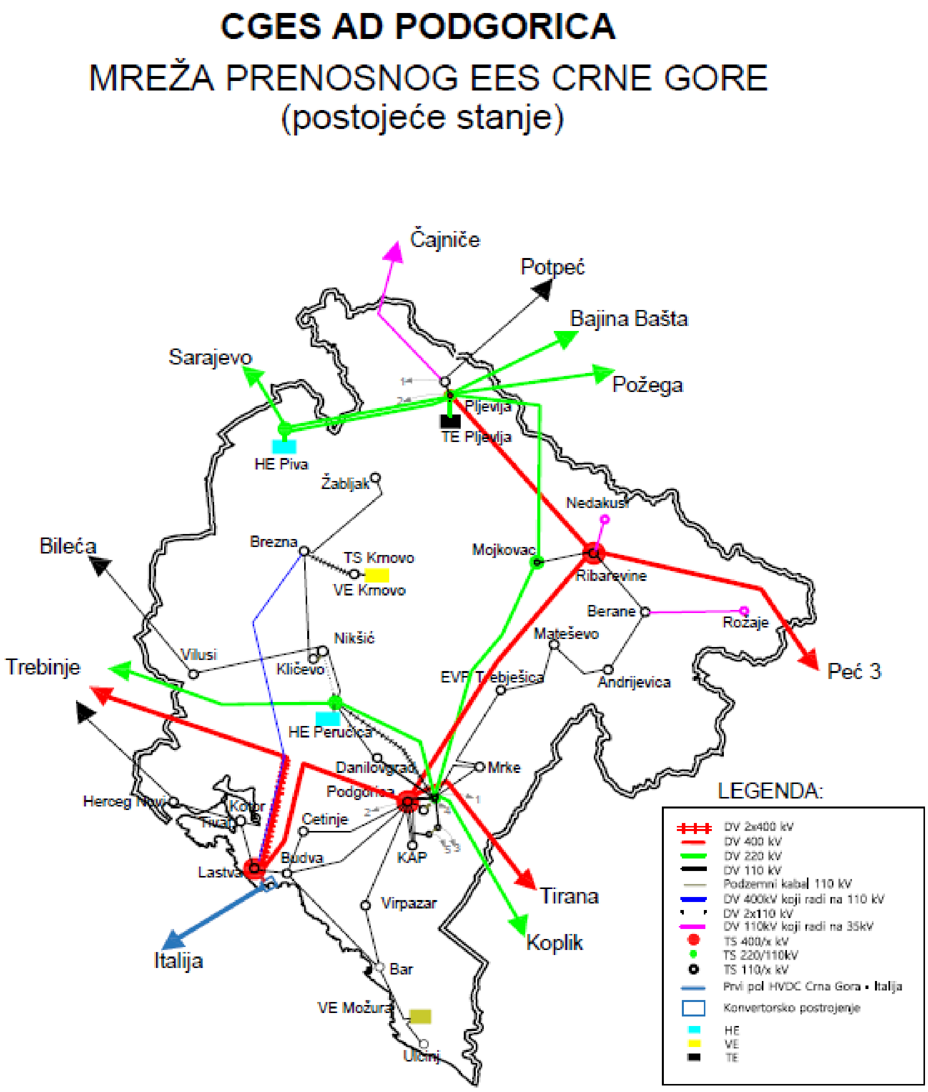


Figure 4-7: Transmission network of CGES

4.5.1 Overhead lines

Within the transmission system there are overhead lines of voltage level 110, 220 and 400 kV, as well as 110 kV lines that currently operate at 35 kV voltage. All overhead lines are made of Al/Fe material, except overhead lines 110 kV Vilusi-Nikšić, Vilusi Bileća and Vilusi-Vilusi KT that are made of material Cu 120 mm^2. Most of them are 110 kV overhead lines, which at the same time are the ones with the highest load regardless of time of day or year. In the course of 2024, the first implementation of the high-temperature composite conductor with a thermal limit of 946 A at a maximum continuous operating temperature of 180°C was carried out on OHL 110 kV Podgorica 1 - Danilovgrad - Perućica.

As stated, 110 kV OHLs currently operating at 35 kV voltage are also operational in the transmission network, of which there are four in total (OHL 110 (35) kV Pljevlja 1 - Čajniče, OHL 110 (35) kV Pljevlja 1 - Žabljak, OHL 110 (35) kV Berane - Rožaje, OHL 110 (35) kV Ribarevine - Nedakusi). About 50% of total capacities of overhead lines consists of 100 kV overhead lines, of which more than half are overhead line with section Al-Fe150/25 mm^2 with capacity of 470A (89 MVA). Most of these overhead lines was constructed in the coastal area of Montenegro whereby, due to increased load (particularly in the future) they automatically impose themselves as first candidates for reconstruction (replacement).

Here is important to note that during replacement of overhead line wires, of the same type but higher transmission capacity, it will have to be replaced also towers and complete suspension equipment (as well as equipment in switchgears), which practically means construction of a new overhead line. The advantage of this approach is that the existing routes will be used to the fullest extent. The list of lines is given in the tables below (Table 4-3 and Table 4-4).

Figure 4-8 – Lengths of overhead lines in the transmission network

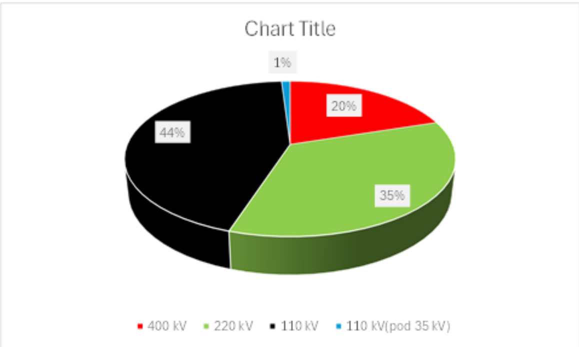


Figure 4-9 – Capacities of overhead lines in the transmission network

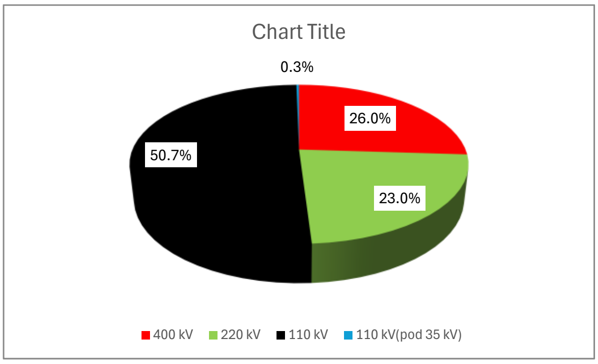


Table 4-3: Data on overhead lines of voltage level 400, 220 and 110 kV of the transmission system of CGES

Voltage level (kV)	No.	OHL	Circuit	Length		material	Cross-section	R		X		B		Sn	In
				in MNE	total			in MNE	total	in MNE	total	in MNE	total		
				(km)			(mm²/phase)	(ohm/phase)		(ohm/phase)		(µF/phase)		(MVA)	(A)
400	1	Lastva - Trebinje	1	67.0	95	Al-Fe	(2x490/65)-5	1.80516	2.62836	20.9374	30.4854	0.658836	0.959282	1330.2	1920
	2	Lastva - Podgorica 2	1	59.5	59.5	Al-Fe	(2x490/65)-5	2.51958	2.51958	29.2237	29.2237	0.91958	0.91958	1330.2	1920
	3	Ribarevine - Podgorica 2	1	85.1	85.1	Al-Fe	(2x490/65)-5	2.51958	2.51958	29.2237	29.2237	0.91958	0.91958	1330.2	1920
	4	Ribarevine – Pljevlja	1	54.8	54.8	Al-Fe	(2x490/65)-5	1.61112	1.61112	18.6868	18.6868	0.588016	0.588016	1330.2	1920
	5	Ribarevine - Peć 3	1	53.1	81.1	Al-Fe	(2x490/65)-5	1.56114	1.911	18.1071	43.6821	0.569775	1.374542	1330.2	1920
	6	Podgorica 2 - Tirana 2	1	29.3	156	Al-Fe	(2x490/65)-5	0.8614	4.586	9.991	53.196	0.317578	1.673915	1330.2	1920
	7	Čevo - Brezna	1	54	50	Al-Fe	(2x490/65)-5	1.5876	1.5876	18.144	18.144	0.579726	0.579726	1330.2	1920
220	1	Pljevlja 2 - HPP Piva 264	1	50.1	50.1	Al-Fe	490/65	2.8884	2.8884	21.2646	21.2646	0.423244	0.423244	381.1	1000
	2	Pljevlja 2 - HPP Piva 265	2	49.7	49.7	Al-Fe	490/65	2.8768	2.8768	21.1792	21.1792	0.421544	0.421544	381.1	1000
	3	Piva - Lukavica (Buk Bijela)	1	11.0	25	Al-Fe	490/65	1.3572	1.45	9.9918	10.675	0.198874	0.212472	381.1	1000
	4	Pljevlja 2 – Požega	1	14.1	92	Al-Fe	360/57	1.128	7.36	6.1476	40.112	0.116692	0.761397	274.4	720
	5	Podgorica 1 - HPP Perućica	1	34.1	34.1	Al-Fe	360/57	2.728	2.728	14.8676	14.8676	0.282214	0.282214	274.4	720
	6	HPP Perućica – Trebinje	1	42.5	63.2	Al-Fe	360/57	3.4	5.056	18.53	27.5552	0.351732	0.523047	274.4	720
	7	Podgorica 1 – Mojkovac	1	72.3	72.3	Al-Fe	360/57	5.816	5.816	31.6972	31.6972	0.601669	0.601669	274.4	720
	8	Mojkovac - Pljevlja 2	1	81.6	81.6	Al-Fe	360/57	6.48	6.48	35.316	35.316	0.670361	0.670361	274.4	720
	9	Bajina Bašta - Pljevlja 2	1	15.7	97.2	Al-Fe	360/57	1.256	7.776	6.8452	42.3792	0.129934	0.804433	274.4	720
	10	Podgorica 1 - Koplik	1	21	65.6	Al-Fe	360/57	1.68	3.0224	9.156	16.427	0.172549	0.322785	274.4	720
110	1	Podgorica 1 - HPP Perućica	1	32.6	32.6	Al-Fe	240/40	3.9446	3.9446	13.0726	13.0726	0.295742	0.295742	122.9	645
	2	Podgorica 1 - HPP Perućica	2	32.6	32.6	Al-Fe	240/40	3.9446	3.9446	13.0726	13.0726	0.295742	0.295742	122.9	645
	3	Podgorica 1 – Danilovgrad	1	17.6	17.6	Al-HVCRC	217.1/28	4.29264	4.292642.60656	4.1712	4.1712	0.08585	0.08585	180	946
	4	Podgorica 1 - Podgorica 2	1	5.8	5.8	Al-Fe	(2x240/40)-5	0.35148	0.35148	1.8328	1.8328	0.067386	0.067386	245.8	1290
	5	Podgorica 1 - Podgorica 2	2	5.9	5.9	Al-Fe	(2x240/40)-5	0.35754	0.35754	1.8644	1.8644	0.068548	0.068548	245.8	1290
	6	Podgorica 2 - Podgorica 4	1	3.5	3.5	Al-Fe	240/40	0.4235	0.4235	1.4035	1.4035	0.031751	0.031751	122.9	645
	7	Podgorica 1 - Podgorica 3	1	3.9	3.9	Al-Fe	240/40	0.4719	0.4719	1.5639	1.5639	0.03538	0.03538	122.9	645
	8	DV 110 kV Podgorica - Mrke, line 1	1	7.47	7.47	Al-Fe	150/25	1.43424	1.43424	3.11499	3.11499	0.06470828	0.06470828	89.5	470
	9	DV 110 kV Podgorica - Mrke, line 2	1	8.2	8.2	Al-Fe	150/25	1.5744	1.5744	3.4194	3.4194	0.071031847	0.071031847	89.5	470
	10	DV 110 kV Mrke - Traction power substation (TPSS) Trebješica	1	29.47	29.47	Al-Fe	150/25	5.65824	5.65824	12.28899	12.28899	0.255281529	0.255281529	89.5	470
	11	Podgorica 2 - Virpazar	1	30.0	30.0	Al-Fe	150/25	5.51	5.51	11.967	11.967	0.248485	0.248485	89.5	470
	12	Virpazar - Bar	1	16.4	16.4	Al-Fe	150/25	3.283	3.283	7.13	7.13	0.148052	0.148052	89.5	470
	13	Podgorica 2 - Budva	1	36	36	Al-Fe	150/25	7.296	7.296	15.846	15.846	0.329005	0.329005	89.5	470

Table 4-4 (continuation): Data on overhead lines of voltage level 400, 220 and 110 kV of the transmission system of CGES

Voltage level (kV)	No.	OHL	Circuit	Length (km)		material	Cross-section (mm²/phase)	R (ohm/phase)		X (ohm/phase)		B (µS/phase)		Sn (MVA)	In (A)
				In MNE	total			in MNE	total	in MNE	total	in MNE	total		
110	14	Podgorica 2 - Cetinje	1	31.7	31.7	Al-Fe	240/40	3.835	3.835	12.711	12.711	0.287577	0.287577	122.9	645
	15	Bar - Možura	1	17.0	17.0	Al-Fe	150/25	3.2832	3.2832	7.1307	7.1307	0.148127389	0.148127389	89.5	470
	16	Možura - Ulcinj	1	7.1	7.1	Al-Fe	150/25	1.344	1.344	2.919	2.919	0.060636943	0.060636943	89.5	470
	17	Bar - Budva	1	33.4	33.4	Al-Fe	150/25	6.4128	6.4128	13.9278	13.9278	0.289178	0.289178	89.5	470
	18	Budva - Cetinje	1	11.5	11.5	Al-Fe	150/25	2.400	2.400	5.2125	5.2125	0.108225	0.108225	89.5	470
	19	Budva - Lastva	1	6.0	6.0	Al-Fe	150/25	1.1520	1.1520	2.5022	2.5022	0.051970	0.051970	89.5	470
	20	Lastva - Tivat	1	11.9	11.9	Al-Fe	150/25	2.2848	2.2848	4.9622	4.9622	0.103082	0.103080	89.5	470
	21	Tivat - Herceg Novi	1	20.7	20.7	Al-Fe	150/25	3.9744	3.9744	8.6319	8.6319	0.179221	0.179221	89.5	470
	22	Herceg Novi - Trebinje	1	15.6	30.8	Al-Fe	150/25	2.976	5.9136	6.4635	12.8436	0.134199	0.266667	89.5	470
	23	Danilovgrad - HPP Perućica	1	17.1	17.1	Al-HVCRC	217.1/28	4.171	4.171	4.0527	4.0527	0.08341	0.08341	180	946
	24	HPP Perućica - Nikšić	1	12.8	12.8	Al-Fe	240/40	1.5488	1.5488	5.1328	5.1328	0.116119	0.116119	122.9	645
	25	HPP Perućica - Nikšić	2	12.8	12.8	Al-Fe	240/40	1.5488	1.5488	5.1328	5.1328	0.116119	0.116119	122.9	645
	26	HPP Perućica - Nikšić	3	13.5	13.5	Al-Fe	240/40	1.6335	1.6335	5.4135	5.4135	0.12247	0.12247	122.9	645
	27	Nikšić - Vilusi KT	1	37.4	37.4	Cu	120	5.797	5.797	16.3064	16.3064	0.333334	0.333334	89.4	470
	28	Vilusi KT - Bileća	1	13.8	17.7	Cu	120	2.139	2.7435	6.0168	7.7172	0.122995	0.157754	89.4	470
	29	Vilusi KT - Vilusi	1	0.5	0.5	Al-Fe	150/25	0.096	0.096	0.2085	0.2085	0.004329	0.004329	89.5	470
	30	OHL 110 kV TPSS Trebješica - Mateševo	1	12	12	Al-Fe	150/25	2.304	2.304	5.004	5.004	0.103949045	0.103949045	89.5	470
	31	OHL 110 kV Mateševo - Andrijevica	1	21.66	21.66	Al-Fe	150/25	4.15872	4.15872	9.03222	9.03222	0.187628025	0.187628025	89.5	470
	32	Andrijevica - Berane	1	17.1	17.1	Al-Fe	150/25	3.436	3.436	7.464	7.464	0.155233	0.155233	89.5	470
	33	Berane - Ribarevine	1	21.1	21.1	Al-Fe	150/25	4.0512	4.0512	8.7987	8.7987	0.182684	0.182684	89.5	470
	34	Ribarevine - Mojkovac	1	14.0	14.0	Al-Fe	150/25	2.688	2.688	5.838	5.838	0.121212	0.121212	89.5	470
	35	Pljevlja 1 - Pljevlja 2	1	2.8	2.8	Al-Fe	240/40	0.3388	0.3388	1.122	1.122	0.024242	0.024242	122.9	645
	36	Pljevlja 1 - Potpeć	1	8.2	28.3	Al-Fe	150/25	1.5744	5.4336	3.4194	11.8011	0.070996	0.245022	89.5	470
	37	Podgorica 2 - KAP	1	8.1	8.1	Al-Fe	(2x240/40)-5	0.49086	0.49086	2.5596	2.5596	0.094108	0.094108	245.8	1290
	38	Podgorica 2 - KAP	2	8	8	Al-Fe	(2x240/40)-5	0.4848	0.4848	2.528	2.528	0.092946	0.092946	245.8	1290
	39	Podgorica 2 – Podgorica 5	1	11.7	11.7	Al-Fe	240/40	1.4399	1.4399	4.7719	4.7719	0.1080247	0.1080247	122.9	645
	40	Kličevo - Nikšić	1	3.7	3.7	A2XS(FL)2Y	3x(1x1000) Al	0.09922	0.09922	0.363	0.363	0.73527	0.73527	141	740
	41	Podgorica 3 - Podgorica 5	1	3.0	3.0	A2XS(FL)2Y	3x(1x1000) Al	0.08954	0.08954	0.33033	0.33033	0.668451	0.668451	141	740
	42	Tivat - Kotor	1	5.9	5.9	Al-Fe	240/40	0.7139	0.7139	2.3659	2.3659	0.053558	0.053558	122.9	645
	43	Brezna – Kličevo	1	32.0	32.0	Al-Fe	240/40	3.533200	3.533200	11.709170	11.709170	0.265171	0.265171	122.9	645
	44	OHL+KB 110 kV Podgorica 1 - Podgorica 4	1	5.15	5.15	Al-Fe	240/40	3.533200	3.533200	11.709170	11.709170	0.265171	0.265171	122.9	645

4.5.2 Transformers 400, 220 and 110 kV

The following substations are currently in operation in the EPS of Montenegro:

- one SS 400/220/110 kV (SS Pljevlja 2),
- one SS 400/110 kV (SS Podgorica 2),
- two SSs 400/110/35 kV (SS Ribarevine and SS Lastva),
- one 220 kV Piva distribution facility,
- three SSs 220/110/35 kV (SS Podgorica 1 and SS Mojkovac),
- sixteen SSs 110/35 kV (SS Herceg Novi, SS Tivat, SS Budva, SS Bar, SS Ulcinj, SS Virpazar, SS Nikšić, SS Vilusi, SS Danilovgrad, SS Pljevlja 1, SS Cetinje, SS Berane, SS Andrijevica, SS Kotor, SS Žabljak and SS Brezna),
- two SSs 110/20 kV: SS Mrke and SS Mateševo,
- four SS 110/10 kV: SS Kličevo, SS Podgorica 3, SS Podgorica 4 and SS Podgorica 5.

The largest SS is 400/220/110 kV SS Pljevlja 2 (2x400 MVA + 1x125 MVA). On 400 kV voltage level it is connected to SS Ribarevine, and on 220 kV voltage level with HPP Piva and TPP Pljevlja, and with SS 220/110 kV/35 kV Mojkovac, as well as the electric power system of Serbia (SS Bajina Bašta and SS Požega). SS 110/35 kV Pljevlja 1 is supplied through transformation 220/110 kV.

The next substation with installed power of transformation of 600 MVA (2x300 MVA, one of which was replaced in 2021) is SS 400/110 kV Podgorica 2, as a part of the most important supply node in the EPS of Montenegro.

It is connected to SS Ribarevine, SS Lastva and SS Tirana in Albania at 400 kV voltage level. In addition, it is connected to SS 220/110 kV Podgorica 1 as well as to SS 110/35 kV Virpazar and SS 110/35 kV Budva via two 110 kV overhead lines. It supplies SS Podgorica 4, SS Podgorica 5, SS Cetinje and KAP via 110 kV connections.

SS Lastva was commissioned in 2019 with installed power of 2x300 MVA and represents an important hub for supplying the coastal part of Montenegro. Over 400 kV voltage level is connected with one connection to SS Podgorica 2 and the other to SS Trebinje (BiH). At 110 kV voltage level it is connected to SS Tivat and SS Budva (OHL 110 kV Budva - Tivat was diverted to SS Lastva by in/out principle). With two short 400 kV connections it is connected to the converter plant (TERNA) and further via 500 kV HVDC to Italy (one cable pole of 600 MW capacity).

Distribution consumers in Montenegro are supplied through substations of 110/35 kV and 110/10 kV. Two transformers are installed in the most of switchgears, and very often of different installed powers.

All transformers are three-winding, where the third winding is a compensation one.

The list of transformers is given in the Table Table 4-5.

Table 4-5: Data on transformers of the transmission system of CGES

Facility	Transmission ratio (kV/kV)	Mark	Nominal power (MVA)	Level of regulation (+/-) %	Connection	Manufacturer	Year of		uk 1-2	uk 1-3	uk 2-3	Pfe	Pcu	R	X	In1	In2	In3
							Manufacture	Installation	(%)	(%)	(%)	(kW)	(kW)	(Ω)	(Ω)	(A)	(A)	(A)
Pljevlja 2	400/231/31.5	**T1**	400	5	YNaOd5	Rade Končar	1982	1991	11.93	13.37	9.72	127.1	594.5	0.59	47.2	577	1000	1833
		T2	400	5	YNaOd5	Rade Končar	1984	1991	11.8	13.27	9.88	131.8	615.5	0.62	47.2	577	1000	1833
Podgorica 2	400/115/10.5	**T2**	300	8x1.25	YNaOd5	CHINT	2020	2021	12.53	31.16	16.38	64.57	538.69	1.1	65.33	433.3	1506.1	5482
		T1	300	8x1.25	YNaOd5	CHINT	2015	2016	12.34	31.16	16.34	71.69	539.29	0.96	65.82	433	1506	5482
Ribarevine	400/115/10.5	**T1**	150	+10%, -8%	Yy0d5	Siemens	2010	2010	12.22	23.88	8.8	49.11	339.41	1.1	130.4	216.5	753.1	2749.3
Lastva	400/115/10.5	**T1**	300	8x1.25	YNaOd5	CHINT	2020	2021	12.44	31.16	16.38	64.73	533.4	0.96	65.82	433	1506.1	5482
	400/115/10.5	**T2**	300	8x1.25	YNaOd5	CHINT	2016	2017	12.37	30.99	16.34	72.63	541.12	0.96	65.82	433.3	1506.1	5482
Podgorica 1	220/115/10.5	**T1**	150	12x1.25	YNaOd5	Končar-Siemens	2012	2012	10.64	11.24	6.36	41	282	0.61	32.9	393.6	753	2749.3
	220/115/10.5	**T2**	150	12x1.25	YNaOd5	Rade Končar	1972	1973	10.22	13.13	8.66	52.46	428.2	0.92	32.9	394	754	2750
Mojkovac	220/115/10.5	**T2**	150	12x1.25	YNaOd5	Elta	1975	1977	10.53	11.73	7.43	59.4	371.08	0.8	33.97	393.7	753	2749
HE Perucica	220/110/6.3	**T1**	125	6x2	Yy0d5	SSSR	1978	1981	10.1	15.2	9.55	80.2	295	0.91	40.7	313	595	3000
Pljevlja 2	230/115/6.3	**T3**	125	6x2	YNa0d5	SSSR	1979	1984	10.51	19.7	31.6	80.2	295	0.91	40.7	313	595	577

Podgorica 1	110/36.5/10.5	T4	63	10x1.5	YNynOd5	ETRA	2005	2015	10.44			36	178	0.54	20	330.7	989.7	1154.7
		T5	63	10x1.5	YNynO(d5)	ETRA	2005	2005	10.32	-	-	37.36	179.97	0.55	19.82	330.7	989.7	1154.7
Podgorica 3	110/10.5/10.5	T2	40	10x1.5	YNynOd5	Končar D&ST	2013	2013	11.04			19.32	114.3	0.86	33.39	210	2199.4	428.6
		T1	31.5	12x1.33	YNynOd5	Minel	2001	2001	10.41	5.77	1.6	25.59	165.61	2.13	39.98	166	1732	578
Podgorica 4	110/10.5/10.5	T1	40	10x1.5	YNynOd5	ETRA	2005	2008	10.57	-	-	27.04	113.93	0.86	31.97	209.9	2199.4	742.3
		T2	40	10x1.5	YNynOd5	ETRA	2005	2008	10.6	-	-	27.95	113.66	0.86	32.06	209.9	2199.4	742.3
Danilovgrad	110 / 36.5/(10.5)	T1	20	10x1.5	YNynO(d5)	Energoinvest	1986	1986	10.7			21.09	101.25	3.06	64.73	104.9	314	367
Nikšić		T2	63	10x1.5	YNynOd5	ETRA	2009	2009	10.27	-	-	39.01	184.29	0.56	19.72	330.7	989.7	1154.7
		T1	40	10x1.5	YNynOd5	ETRA	2015	2015	10.48			24.58	113.24	0.86	31.71	209.9	628.4	742.3
		T3	63	10x1.5	YNynOd5	Rade Končar	1979	1979	11.03	11.1	6.74	54.9	302.89	0.92	21.14	330.7	989.7	1924.5
		T4	63	10x1.5	YNynOd5	ETRA	2020	2020	11.59			34.94	204.135	0.56	19.72	330.7	989.7	1154.7
Herceg Novi		T1	40	10x1.5	YNynO(d5)	ETRA	2004	2005	10.14	11.1	9.89	27.38	114.03	0.86	30.67	209.9	628.4	742.3
		T2	40	10x1.5	YNynO(d5)	ETRA	2005	2005	10.12	11.09	9.89	27.64	114.42	0.86	30.61	209.9	628.4	742.3
Tivat		T1	20	10x1.5	YyOd5	Minel	1981	1981	10.43	-	-	21.27	116.63	3.53	63.1	105	314.2	357.8
		T2	63	10x1.5	YNynOd5	ETRA	2011	2011	10.3	-	-	32.77	190.81	0.58	19.78	330.7	989.7	1154.7
Budva		T1	63	10x1.5	YNynO(d5)	Končar DST	2016	2023	11.196			28.59	161.7	0.92	21.14	330.7	989.7	1154.7
		T2	63	10x1.5	YNynOd5	ETRA	2009	2009	10.21	-	-	39.26	184.25	0.56	19.6	330.7	989.7	1154.7
Bar		T1	40	10x1.5	YNynO(d5)	ETRA	2004	2005	10.1	11.1	9.89	26.99	114.1	0.86	30.55	209.9	628.4	742.3
		T2	40	10x1.5	YNynO(d5)	ETRA	2005	2005	10.06	11.09	9.88	26.41	113.93	0.86	30.55	209.9	628.4	742.3
Ulcinj		T1	31.5	10x1.5	YNynO(d5)	Minel	1979	2015	10.43	-	-	27.71	125.76	2.13	39.85	165.3	494.9	333.3
		T2	40	10x1.5	YNynO(d5)	ETRA	2004	2005	10.08	-	-	27.18	114.16	0.86	30.49	209.9	628.4	742.3
Cetinje		T1	20	10x1.5	YNynO(d5)	Elta	1977	1979	10.76	-	-	20.48	99.08	3.01	65.09	84	251.4	170
		T2	31.5	10x1.5	YNynO(d5)	Minel	2001	2001	10.3	-	-	24.96	152.07	1.85	62.31	165	495	577
Pljevlja 1		T1	20	10x1.5	YNynO(d5)	Minel	1981	1987	10.38	-	-	20.19	113.99	3.45	62.79	105	314.2	357.4
		T2	40	10x1.5	YNynO(d5)	ETRA	2004	2005	10.12	-	-	26.9	114.29	0.86	30.61	209.9	628.4	742.3
Ribarevine		T1	20	10x1.5	YNynO(d5)	Elin-Minel	1977/1990	1983	10.95			15.07	141.97	3.1	66.24	105	314	367
		T2	20	10x1.5	YNynO(d5)	Minel	1997	1999	10.43	-	-	19.92	102.83	3.11	63.1	105	314	357.4
Mojkovac		T1	20	10x1.5	YNynO(d5)	Minel	1981/2007	2012	10.4	-	-	20.1	118	3.75	64.37	105	314	357.4
		T3	20	10x1.5	YNynO(d5)	ABB	2015	2015	10.82			14.98	76.04	2.3	65.44	105	314.2	366.6
Berane		T1	20	10x1.5	YNynO(d5)	Rade Končar	1963	1964	10.9	8.9	5.3	43.26	114.33	3.46	65.94	105	314	357.4
		T2	20	10x1.5	YNynO(d5)	Elta-Minel	1964	1964/80	10.58	5.77	1.79	26.08	108.93	3.3	64	105	314.2	366.6
Andrijevica		T1	10	10x1.5	YNynO(d5)	Rade Končar	1961	1988	10.98	4.85	1.18	21.98	63.88	7.73	132.86	52.5	157	275
		T2	20	10x1.5	YNynO(d5)	ETRA	2009	2011	10.58	-	-	12.18	77.06	2.33	64	105	314.2	362.9
Vilusi		T1	20	10x1.5	YNyn0d5	Rade Končar	1987	2024	11.05	-	-	25.2	146.2			105	314.2	366.6
Podgorica 5	110/10.5/10.5	T1	31.5	10x1.5	YNynOd5	Energoinv.	1988	88/2010	11.43	-	-	28.03	145.5	1.77	43.9	165	1732	577.3
	110/10.5/10.5	T2	31.5	10x1.5	YNynOd5	Energoinv.	1988	88//2010	11.5	-	-	28.5	144	1.76	44.17	165	1732	577.3
Virpazar	110/36.5/10.5	T1	20	10x1.5	YNynOd5	Elta	1977	88/2009	10.93	-	-	19.62	102.8	3.1	66.12	84	251.4	170
	110/36.5/10.5	T2	20	10x1.5	YNynOd5	Rade Končar	1990	99/2021	11.05	-	-	29.7	137.5	2.33	64	104.97	314.2	362.9

Kotor	110/36.5/10.5	T2	20	10x1.5	YNynOd5	Končar D&ST	2020	2020	10.83			12.96	78.91	2.38	10.31	105	314.2	211.7
	110/36.5/10.5	T1	20	10x1.5	YNynOd5	ABB	2015	2015	10.74			14.96	75.23	2.27	64.96	105	314.2	366.6
Kličevo	110/10.5/10.5	T1	31.5	10x1.5	YNynOd5	ABB	2015	2015	10.75			27.751	185.29	2.26	41.23	165.3	1732	577.35
	110/10.5/10.5	T2	31.5	10x1.5	YNynOd5	ABB	2015	2015	10.63			27.529	184.734	2.25	40.78	165.3	1732	577.35
Brezna	110/35/10,5	T1	20	10x1.5	YNyn0(d)	SGB	2016	2016	10.95			10.448	77.443	2.34	66.23	105	329.9	211.6
Krnovo	110/33	T1	60	10x1.5	YNyn0(d)	SGB	2016	2016	10.8			25.253	161.691	0.54	21.78	314.9	1049.7	634.9
	110/33	T2	60	10x1.5	YNyn0(d)	SGB	2016	2016	10.89			24.689	162.1	0.54	21.96	314.9	1049.7	634.9
Lastva	110/36,75/10,5	T3	20	10x1,5	YNynOd5	Končar D&ST	2016	2018	10.81			16.65	109.4	3.31	10.29	105	314.2	211.8
Mateševo	110/21/10,5	T1	20	10x1,5	YNynOd5	Končar D&ST	2020	2022	14.94			10.1	116.75	3.53	90.27	105	549.9	211.8
	110/21/10,6	T2	20	10x1,5	YNynOd6	Končar D&ST	2020	2022	14.94			10.1	116.75	3.58	90.51	105	549.9	211.8
Mrke	110/21/10,5	T1	20	10x1,5	YNynOd5	Comem	2020	2022	14.5			10.7	104	3.14	87.64	105	549.9	366.8
	110/21/10,5	T2	20	10x1,5	YNynOd6	Comem	2020	2022	14.5			10.76	103.7	3.14	87.7	105	549.9	366.8
Žabljak	110/36.5/10.5	T1	20	10x1.5	YNynOd5	ETRA	2023	2023	10.44			14.45	79.27	2.4	63.1	105	314.2	367
	110/36.5/10.5	T2	20	10x1.5	YNynOd5	ETRA	2023	2023	10.45			14.37	79.56	2.41	63.16	105	314.2	367

4.6 Overview of the need for remedial actions on the existing elements during the period 2026-2032 assuming that there will be no changes in the needs of system users during the specified period

The area of Montenegro is powered through a relatively well-built transmission system network (especially 110 kV lines), but the problem of secure and high-quality power supply to certain parts is significantly pronounced during the summer months. The basic parameter that characterizes the state of the existing transmission system network, especially the part of network through which the Montenegrin coastal area is supplied, is the age of the transmission system facilities, i.e. the equipment installed therein, and therefore obsolescence and depreciation of the same.

Criterion (N-1), when concerning power supply from the transmission system, is not satisfied during the summer season on the Montenegrin coast, because in case of failure of any of 110 kV overhead lines that supply the coastal area, with peak load, there is overloads on other lines, whereby the most pronounced problem of lack of criterion (N-1) refers to the area of Ulcinj and Kotor.

Stresses of the overhead line equipment from overvoltages caused by lightning impulse are very pronounced due to the karst terrain in the central and southern parts of Montenegro due to which, most commonly, insulators are damaged, then somewhat less protective and conductive ropes. These failures do not, however, have a lasting impact on the general state of overhead lines, as they are immediately eliminated by replacing the insulator by connecting it, or by replacing conductors.

As mentioned in the previous chapters, distribution consumers are supplied from 16 substations 110/35kV and four substations 110/10 kV, with total installed transformation power of 1298.5 MVA. The substations are constructed with two transformer units (for distribution consumers) except for Danilovgrad, Vilusi and Brezna where one transformer unit is installed. In the previous period, with the aim of improving the quality and improvement of network operation, in parallel with the replacement of transformers, it was also replaced a part of the HV equipment, protection and control equipment, technical and operational characteristics of which were proved to meet no requirements of secure operation.

In order to provide reliable and secure power supply to certain areas, and based on consumption trends and the condition of individual transformers, it is necessary to replace certain existing transformers with transformers of a larger unit, i.e. units of the same power in facilities where only the technical characteristics of the existing transformers are questionable, namely:

- Both transformers in SS Bar (40 MVA transformers need to be replaced with 63 MVA transformers);
- Both transformers in SS Tivat (63 MVA and 20 MVA transformers need to be replaced with new 40 MVA transformers);
- Both transformers in SS Pljevlja 2 (two units of 400 MVA each need to be replaced with new units);
- One transformer in SS Podgorica 1 (one unit of 150 MVA should be replaced with a new unit of the same power);
- One transformer in SS Mojkovac 1 (one unit of 150 MVA should be replaced with a new unit of the same power);
- One transformer in SS Danilovgrad (currently only one 20 MVA unit is operational, and due to the increased load there is a need to install another 20 MVA unit);
- One transformer in SS Berane (it is necessary to replace the 20 MVA unit with a new one because the last tests showed that it was weakened);

- One transformer in SS Herceg Novi (the transformer of 40 MVA needs to be replaced with a transformer with a higher installed capacity of 63 MVA, bearing in mind the requirement of CEDIS to increase the connection power, and the current load of the transformers that are operational in the SS in question).

Bearing in mind the time required for the procurement of transformers, and the importance of these elements in order to ensure the safe operation of the system, there is a need to create operational reserves in the coming period.

The following table contains a list of required remedial actions on the existing elements during the planning period:

Table 4-6: Overview of required remedial actions on the existing CGES elements

REQUIRED REMEDIAL ACTIONS ON THE EXISTING ELEMENTS, THE IMPLEMENTATION OF WHICH IS PLANNED TO BEGIN DURING THE PERIOD 2026-2032, OR THE IMPLEMENTATION OF WHICH BEGAN BEFORE THE SPECIFIED PERIOD		
NO.	**ID NO.**	**NAME OF INVESTMENT**
1	IPR009	Reconstruction of OHL 110 kV Budva - Lastva
2	IPR010	Reconstruction of OHL 110 kV Lastva - Tivat – phase II
3	IPR115	Reconstruction and extension of plant 220/110 kV at SS Perućica
4	IPR072	Reconstruction of OHL 110 kV Nikšić - Bileća
5	IPR109	Reconstruction of OHL 110 kV Podgorica 1 - TPSS Trebješica - Andrijevica
6	IPR110	Reconductoring OHL 220 kV Trebinje (BiH) - Perućica - Podgorica - Koplik (AL)
7	IPR089	Reconstruction of OHL 110 kV Podgorica - Danilovgrad - Perućica
8	IPR118	Revitalisation of 110 kV overhead lines
9	IPR125	Extension of SS Podgorica 2 with 110/10 kV transformation
10	IPR126	Reconstruction of OHL 110 kV Bar - Možura - Ulcinj – reconductoring
11	IPR127	Reconstruction of OHL 110 kV Bar - Budva – reconductoring
12	IPR128	Reconstruction of OHL 110 kV Podgorica 2 - Virpazar – reconductoring

5 Identifying needs

5.1 Consumption forecast

The basic problem of forecasting consumption on the transmission network is the fact that at the time of the preparation of the Updated Development Plan, there is no official document that reflects the latest changes in the energy market of Europe and Montenegro itself. The NECP is currently in the preparation phase, while the Energy Development Strategy of Montenegro is a document that is no longer current because it does not consider the requirements set by the EU in order to reduce the emission of harmful gases and implementation of a greater number of renewable sources.

Meanwhile, Montenegro started applying the so-called "green agenda", which can be seen from the large number of application for the connection of renewable sources, both to the transmission and distribution system.

Accordingly, the consumption forecast used for the analyses in the Updated Plan was based on several official sources, whereby the process consisted of the following steps:

- The hourly consumption values of Montenegro in the future, by 2032, were taken from ENTSO-E ERAA2023 (ERAA 2024 and ERAA 2025 are currently being prepared, but have not yet been officially adopted);
- Hourly consumption by distribution areas of Montenegro from the past (previous 3 years) was scaled according to the percentage increase from ERAA2023 for the period by 2032;
- To the total, hourly consumption of the distribution areas, the constant consumption of large consumers supplied by the transmission network users (Uniprom KAP, Željeznica, Željezara) was added.
- The total energy consumption of electricity by 2023 was estimated by summing up the hourly electricity at the level of the year, obtained in the previous points.
- For certain SSs, where consumption is not expected to increase in the coming period, a zero rate of increase was maintained (constant consumption in average years).

Figure 5-1 represents the peak load growth forecast for Montenegro for the analysed years and is aligned with the growth percentage from the ENTSO-E database (used in ERAA2023).

The overall increase in electricity consumption in Montenegro, which includes consumers connected to the 110 kV voltage level, as well as the tourist complexes Porto Montenegro and Luštica, is shown in the figure Figure 5-2, while the consumption forecast by individual TS is shown in the table (Table 5-1).

It should be noted that the existing substations will be unloaded by constructing new ones, with the fact that a load redistribution plan will be made with CEDIS.

As for the characteristic winter maximum mode, the following can be concluded:

- An average annual growth of 1.3% per year was recorded in the period 2023-2024 (after a decline due to the decommissioning of KAP during 2021-2022);
- In the period 2025-2032, the average annual growth of peak load is lower than 1.35% due to the entry into operation of substations for powering a highway infrastructure on the Bar-Podgorica section, thereby the given growth reflects a consumption growth on key 110/x kV nodes.

As for the characteristic summer maximum mode, the following can be concluded:

- A slight increase in peak load with an annual increase of 1.73% in the period 2023 - 2025 as a result of the return of tourism on the coast to the level before the COVID pandemic, but also due to an increase in consumption due to greater use of cooling devices;
- In the period 2026-2032, the average annual growth of peak load is 1.4%, provided that it is necessary in this case to pay attention to the tourist season that has a considerable impact on the summer peak load, which is expected to possibly exceed the winter peak.

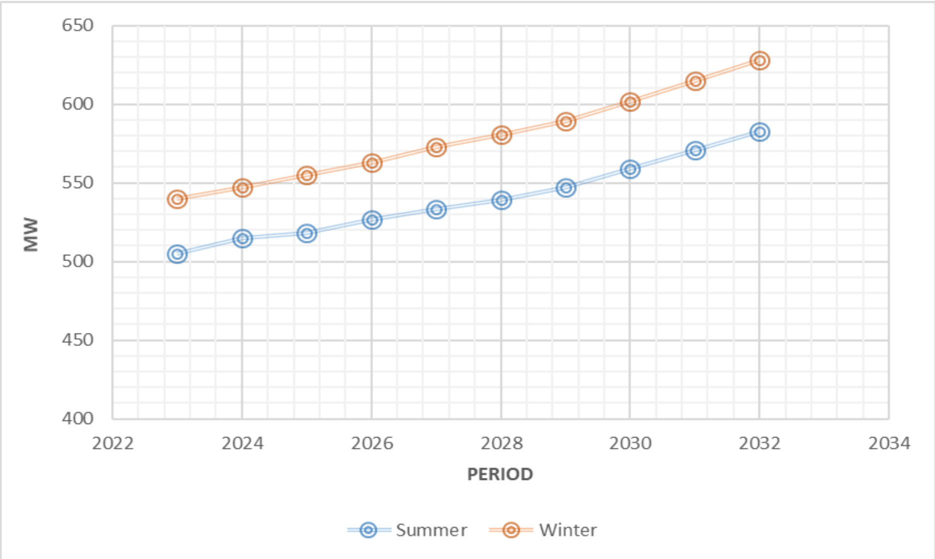


Figure 5-1: Peak power growth in EPS of Montenegro 2023-2032

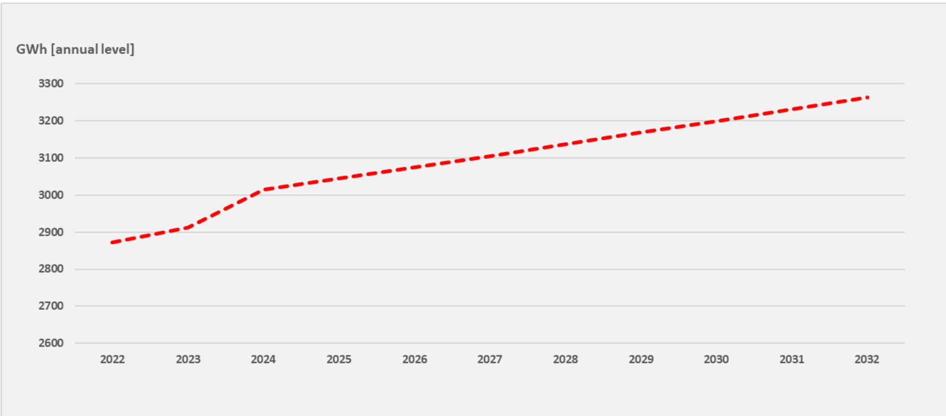


Figure 5-2: Net consumption growth in the EPS of Montenegro 2023-2032

Table 5-1: Electricity consumption forecast for 110/X kV nodes (CEDIS energy takeover points from the transmission system) and forecasted peak active and reactive loads for the horizon years 2026 and 2032

Electric power facility	2024						2026						2032					
	Winter			Summer			Winter			Summer			Winter			Summer		
	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)	W_a (MWh)	P_{max} (MW)	Q (MVar)
SS Andrijevica	2,380.90	4.98	2.08	6,681.86	5.62	2.25	17,845.43	6.53	1.93	15,229.79	6.29	2.25	17,845.43	6.60	2.13	15,229.79	6.41	2.30
SS Bar	116,732.52	52.83	14.65	127,943.63	59.05	15.75	119,550.91	54.11	15.00	131,032.70	60.47	16.13	123,906.59	56.08	16.11	135,806.71	62.68	17.32
SS Berane	46,202.26	21.14	7.69	44,154.20	16.99	4.90	46,572.62	21.30	7.76	44,508.14	17.13	4.94	47,133.73	21.56	8.01	45,044.38	17.34	5.10
SS Budva	141,280.50	55.93	1.90	180,511.26	80.23	1.57	145,264.05	57.51	1.90	185,600.95	82.49	1.57	151,450.95	59.96	1.93	193,505.84	86.01	1.59
SS Cetinje	37,324.71	17.64	7.34	22,532.84	19.79	4.89	38,074.94	18.00	7.40	22,985.76	20.19	4.93	39,228.65	18.54	7.64	23,682.25	20.80	5.09
SS Tivat	86,414.78	33.14	22.99	89,005.66	41.50	23.57	88,676.16	34.00	23.64	91,334.85	42.59	24.23	92,179.69	35.35	25.65	94,943.42	44.27	26.29
SS Herceg Novi	103,145.77	38.37	6.82	113,817.14	50.83	6.22	105,427.46	39.21	6.99	116,334.89	51.96	6.38	108,944.97	40.52	7.43	120,216.33	53.69	6.78
SS Danilovgrad	33,514.26	14.00	4.30	30,459.01	16.49	5.21	34,391.29	14.37	4.41	31,256.09	16.92	5.35	35,750.06	14.94	4.76	32,491.00	17.59	5.77
SS Podgorica1	166,095.65	64.77	12.66	152,365.08	73.63	13.46	172,805.92	67.39	12.94	158,520.63	76.60	13.76	183,383.02	71.52	13.83	168,223.36	81.29	14.70
SS Podgorica3	110,321.66	43.78	2.62	100,231.02	44.73	3.38	113,208.67	44.93	2.57	102,853.96	45.90	3.31	117,681.45	46.70	2.65	106,917.64	47.72	3.42
SS Podgorica4	131,924.42	51.53	15.50	111,513.16	45.59	11.50	136,716.44	53.40	15.69	115,563.76	47.24	11.65	144,232.81	56.34	16.28	121,917.21	49.84	12.08
SS Podgorica5	93,718.46	37.13	11.30	81,433.29	34.56	7.92	96,551.10	38.25	21.67	83,894.61	35.61	8.12	100,961.39	40.00	22.82	87,726.78	37.23	7.82
SS Mojkovac	17,973.89	8.47	20.82	17,511.81	8.20	16.55	17,973.89	8.47	21.67	17,511.81	8.20	17.22	17,973.89	8.47	24.21	17,511.81	8.20	19.24
SS Nikšić	87,800.64	30.78	15.79	63,340.53	25.17	12.98	88,680.84	31.08	16.20	63,975.52	25.42	13.32	90,017.72	31.55	17.49	64,939.96	25.81	14.38
SS Kličevo	37,364.91	13.98	19.88	25,586.31	11.01	15.12	37,965.14	14.21	20.60	25,997.33	11.18	15.66	38,883.62	14.55	22.79	26,626.27	11.45	17.33
SS Kotor	60,422.69	26.78	9.10	64,490.87	28.58	6.65	62,003.89	27.48	9.81	66,178.53	29.33	7.16	64,453.62	28.57	10.69	68,793.20	30.48	7.81
SS Pljevlja	55,185.04	64.77	7.76	47,225.80	16.86	8.26	56,294.26	67.39	11.94	48,175.04	17.19	10.70	58,000.03	71.52	9.26	49,634.79	17.72	9.35
SS Ribarevine	54,638.64	19.47	6.32	48,699.11	16.76	6.78	55,076.62	19.63	6.48	49,089.48	16.89	6.96	55,740.19	19.86	7.00	49,680.91	17.10	7.51
SS Brezna	3,779.96	6.40	2.13	4,514.58	5.98	0.89	3,779.96	6.40	2.17	4,514.58	5.98	0.90	3,779.96	6.40	2.28	4,514.58	5.98	12.08
SS Ulcinj	52,617.66	24.60	8.74	76,079.09	43.96	11.58	54,743.41	25.59	9.10	79,152.69	45.74	12.05	58,094.15	27.16	10.16	83,997.47	48.54	13.46
SS Vilusi	2,962.26	1.32	0.51	3,504.61	1.26	0.34	2,997.91	1.33	0.51	3,546.79	1.27	0.35	3,052.20	1.36	0.53	3,611.01	1.30	0.36
SS Virpazar	21,175.50	15.39	4.33	27,727.45	12.21	3.66	21,430.37	15.58	4.37	28,061.18	12.36	3.69	21,818.43	15.86	4.49	28,569.32	12.58	3.80
SS Lastva	2,366.02	0.77	0.73	2,298.90	0.77	0.74	2,404.65	0.79	0.75	2,359.06	0.79	0.75	2,396.78	0.78	0.74	2,328.78	0.78	0.75
SS Žabljak	10,335.85	6.51	6.19	10,247.40	4.79	4.55	10,495.38	6.68	6.35	10,515.56	4.91	4.67	10,470.21	6.60	6.27	10,380.61	4.85	4.61

5.1.1 Distribution system development needs

Within this chapter, an analysis of the connection of new SSs 110/x kV, whose time schedules of construction are the subject of coordination between CGES and CEDIS, was performed.

In accordance with the time schedules, it is not foreseen that any of the facilities, i.e. substations 110/x kV will be commissioned in 2026.

When it comes to the period 2027-2032, as can be seen from Table 5-2, the assessment is that it is technically feasible to implement SS 110/35 kV Luštica, SS 110/10 kV Podgorica 7, SS 110/35 kV Buljarica, SS 110/10 kV Bečići and SS 110/x kV Podgorica 9.

The construction of other SSs will be planned depending on the consumption growth and its geographical distribution.

Table 5-2: New SSs 110/x kV in the period 2027-2032

Facility	Installed power of transformer	Transmission ratio of transformer
	(MVA)	(kV/kV)
SS 110/35 kV Luštica	2x40 MVA	110/35
SS 110/10 kV Podgorica 7	2x31.5 (40) MVA	110/10
SS 110/35 kV Buljarica	2x40 MVA (subject of analysis)	110/35
SS 110/10 kV Bečići	2x40 MVA (subject of analysis)	110/10
SS 110/x kV Podgorica 9	subject of analysis	110/x kV

5.2 Generation forecast

The construction of new generation facilities in the EPS Montenegro as well as the reality of their implementation should be observed while considering the following facts:

- large untapped hydropower potential,
- expansion of renewable energy construction in the region,
- implementation of the project of connecting the systems of Montenegro and Italy via submarine DC cable, and thus connecting the electricity markets of Southeast Europe and Italy.

Considering the abovementioned, it is quite realistic to expect a significant number of new generation facilities in Montenegro, especially after the commissioning of DC cable (December 2019). Accordingly, one of the tasks of this document is to give directions of the electricity transmission system development in terms of generation. The starting point for planning the construction of new transmission capacities is the Energy Development Strategy of Montenegro, and official documents obtained from the competent Ministry of Montenegro in accordance with currently available information on the existing status of each project.

The connection of new power plants is defined according to already developed and adopted studies and analyses, by adopting sustainable solutions, and serve to achieve goals for further development of the power system and cause minimum investment costs.

The following table (Table 5-3), shows a list of new generation facilities submitted by relevant institutions in Montenegro (EPCG and the Ministry of Energy).

Table 5-3: List of generation facilities by 2026

CGES by 2026			
Large hydropower plants			
Facility	Installed power [MW]	Planned annual generation [GWh]	Commissioning year
Wind power plants			
Facility	Installed power [MW]	Planned annual generation [GWh]	Commissioning year
WPP Gvozd I	54.6	150	2025
Solar power plants			
Facility	Installed power [MW]	Planned annual generation [GWh]	Commissioning year
SPP Krupac	50	60-70	2026

Table 5-4: List of generation facilities in the period 2027-2032 (EPCG)[3]

CGES 2023-2032			
Large hydropower plants			
Facility	Installed power [MW]	Planned annual generation [GWh]	Commissioning year
HPP Perućica - Unit A8	58.5	50	2027
HPP Komarnica	171.9	213	2032
HPP Kruševo	82	170	2033
Wind power plants			
Facility	Installed power [MW]	Planned annual generation [GWh]	Commissioning year
WPP Gvozd II	20-25	60-70	2027
Solar power plants			
Facility	Installed power [MW]	Planned annual generation [GWh]	Commissioning year

[3] For those power plants for which connection studies (possibility analysis) were not done, the power plants were connected according to the results from…

SPP Velje Brdo[4]	165.2	-	2027
SPP Vilusi I	30	45	2027
SPP Slano	50	80-90	2027
SPP Željezara	80[5]	100	TBD
SPP Tuzi	135.9	344.775	2027

Small hydropower plants are modelled according to the principle of equivalent tank, while solar panels have been made equivalent through negative consumption.

Based on the data obtained from EPCG, the thermal power plants used in the modelling are as follows:

Rehabilitacija/revitalizacija postojećih				
Objekat	Instalisana snaga (MW)			Godina ulaska u pogon rehabilitovane jedinice
	2018	2021 - 2023	2023 - 2032	
TE Pljevlja - G1	225	225	225	

The construction of a second block has not been envisaged in the EPCG plan, so the analyses will take into account only one block is constantly in operation.

When it comes to new power plants by the end of the last year of the period to which the Updated Plan refers, all power plants for which CGES received an official request for an opinion on the connection possibility and for which analyses of the connection possibility were conducted were modelled (Addendum 11.4)[6]:

- Solar power plants with installed capacities of 3352 MW;
- Wind power plants with installed capacities of 720 MW.

5.3 Cross-border projects

This chapter outlines a brief overview of new projects of transmission system operators of neighbouring countries (including HOPS - Transmission System Operator of Croatia), which may have an impact on changes in power flows in the region and security of the transmission system of Montenegro. Information on these data is taken from the latest version of TYNDP 2024 ENTSO-E, i.e. national development plans.

The following subchapters provide lists of CGES-led projects, which are on the ENTSO-TYNDP and PECI/PMI lists.

5.3.1.1 Projects on the ENTSO-E TYNDP list

The following projects relating to the CGES activities are on the ENTSO-E project list:

- OHL 400 kV Pljevlja – Bajina Bašta (RS) – Višegrad (BA) – Trans-Balkan Corridor,
- HVDC Montenegro – Italy II pole line (600 MW),

[4] Bearing in mind that the data were collected in the period until the planning documents for the area were changed, the power plant was not analysed in the list of new sources.

[5] According to recent data from November 2024, the power plant's capacity is 30 MW.

[6] WPP Gvozd, together with SPP Krupac, was analysed in the regulatory period for 2026.

- OHL 400 kV Lastva – Pljevlja.

OHL 400 kV Pljevlja - Bajina Bašta (RS) - Višegrad (BA) is included in a large investment project called Trans-Balkan Corridor stretching from central Serbia (SS Kragujevac 2 and SS Kraljevo 3) and western Serbia (SS Obrenovac and SS Bajina Bašta) all the way to SS Višegrad in Bosnia and Herzegovina and SS Lastva (via SS Pljevlja) in Montenegro. The project aims to increase both transmission capacity within the transmission system of Montenegro and transmission capacity at the borders between these countries. This project is closely associated with the Italy-Montenegro and Central Balkan Corridor projects.

The second pole line (600 MW), or the interconnection project of Italy and Montenegro, includes a new HVDC submarine cable between Villanova (Italy) and Lastva (Montenegro) and DC converter stations. The second HVDC module (600 MW) of the Italy-Montenegro interconnection project is strictly correlated with the Trans-Balkan Corridor, thus significantly contributing to the use of transmission capacity between Italy and the countries of Southeast Europe.

OHL 400 kV Pljevlja - Lastva is in the phase of completion of works.

Table 5-5: ENTSO-E TYNDP project list

Broj projekta	Ime projekta	Zemlje	Očekivana godina ulaska u pogon	Status ID 1 : Razmatra se, 2 :U toku procesa planiranja 3 : U toku izdavanje dozvola, 4 : Izgradnja u toku	Da li je projekat u 5. PCI listi?		Porast kapaciteta A-B (MW)	Porast kapaciteta B-A (MW)
28	**Italy-Montenegro**	**IT ;ME**	**2027**	**4**	**False**	**ITCS-ME00**	**600**	**600**
144	Mid Continental East corridor	RO ;RS	2029	3	False	RO00-RS00 HU00-RO00	844 617	600 335
227	**Transbalkan Corridor**	**BA ;ME ;RS**	**2027**	**3**	**False**	**BA00-RS00 ME00-RS00**	**1200 240**	**1200 840**
243	New 400 kV interconnection line between Serbia and Croatia	HR ;RS	2038	1	False	HR00-RS00	746	306
341	North CSE Corridor	RO ;RS	2029	2	False	RO00-RS00	680	720
342	Central Balkan Corridor	BG ;RS	2034	2	False	BG00-RS00	490	270
343	CSE1 New	BA ;HR	2035	2	False	BA00-HR00	644	298
350	South Balkan Corridor	AL ;MK	2026	4	False	AL00-MK00	500	500
1074	Pannonian Corridor	HU ;RS	2030	2	True	HU00-RS00	500	500
1183	New interconnection line 400 kV Greece - Albania	AL ;GR	2030	2	False	AL00-GR00	200	200

5.3.1.2 Projects on the PECI/PMI list

Within the PECI list, there are projects to increase the capacity of the existing 220 kV overhead line Trebinje (BA) - Perućica and the construction of OHL 2x400 kV Pljevlja - Bajina Bašta - Višegrad.

5.3.1.3 Review of development plans of neighbouring countries

This chapter outlines a brief overview of new projects of transmission system operators of neighbouring countries (including HOPS - Transmission System Operator of Croatia), which may have an impact on changes in power flows in the region and security of the transmission system of Montenegro. Information on these data is taken from the latest version of TYNDP 2024 ENTSO-E, i.e. the national development plans

Albania:

- SS 400/220 kV Vau Dejes near the existing 220/110 kV, the commissioning is expected by 2030,
- OHL 400 kV Rrashbul - Fier, the commissioning is expected by 2030.
- OHL 400 kV Thesprotia (GR) - Fier (AL), the commissioning is expected by 2030.
- OHL 400 kV Elbasan (AL) - Ohrid (MK).

- Reconstruction of 220 kV Podgorica - Koplik, replacement of the conductor with a special wire of higher capacity.

Of these five projects, it is certain that the construction of SS 400/220 kV Vau Dejes, construction of the 400 kV overhead line towards Greece and the reconstruction of the 220 KV overhead line will have a significant impact on increasing transit through the EPS of Montenegro.

Bosnia and Herzegovina:

- **OHL 400 kV Bajina Bašta (RS) - Višegrad**, according to the current development plan (Long-Term Transmission System Development Plan 2021-2030) dated December 2017, the commissioning of this overhead line is expected in 2025, but according to available data from TYNDP 2024, the expected year has been shifted to 2027.
- **OHL 400 kV Višegrad - Bistrica (RS) - Pljevlja (ME)**, according to the current development plan (Long-Term Transmission System Development Plan 2021-2030) dated December 2017, the commissioning of this overhead line is expected in 2025, however, according to available data from TYNDP 2024, the expected year has been shifted to 2027.
- OHL 400 kV Banja Luka (BiH) - Lika (HR), a new 400 kV interconnection between HR and BiH, depending on the agreement of the two parties.

In addition to the above transmission network facilities that may have an impact on the transmission network of Montenegro, it should be noted that the Indicative Plan for Development of Production Facilities of BiH 2025 - 2034 includes the construction of HPP Dabar with connecting lines, located in Eastern Herzegovina (according to official data, it will be commissioned in 2027). The power plant will be connected to OHL 220 kV Trebinje - Mostar, but it will most likely not be completed before 2027.

In addition to HPP Dabar, SPP Trebinje 2 (48.7 MW) and SPP Nevesinje (570 MW) are expected to be commissioned in 2027.

Due to their electrical proximity to the Montenegrin power system, the generation of these power plants is expected to affect the flow of power on the border Montenegro - Bosnia and Herzegovina.

Croatia period 2023-2032 (draft plan):

- **OHL 400 kV Banja Luka (BA) - Lika**, new 400 kV interconnection between HR and BiH.
- **OHL 400 kV Brinje - Lika**, 400 kV overhead line that replaces the section of the existing OHL 220 kV Brinje - Konjsko.
- **OHL 400 kV Lika - Velebit**, 400 kV overhead line that replaces the section of the existing OHL 220 kV Brinje - Konjsko.
- **Cirkovce (SI) - Heviz (HU), Žerjavinec (HR)** (New 400 kV interconnection between HR and SI, and HR and HU).
- **OHL 400 kV Velebit - Konjsko**, 400 kV overhead line that replaces the section of the existing OHL 220 kV Brinje - Konjsko.
- **OHL 400 kV TPP Tuzla (BA) - Đakovo**.
- **OHL 400 kV TPP Tuzla (BA) - Gradačac (BA) - Đakovo**.

- **OHL 400 kV Ernestinovo - Sombor (RS)**, new 400 kV interconnection between HR and Serbia, the commissioning is expected in **2035**.

Of the listed projects within the responsibility of HOPS, there is not a single project that can directly affect the Montenegrin power system.

Italy period 2020-2031:

The transmission network of the Italian Transmission System Operator (TERNA) has no significant impact on the CGES transmission system, due to the fact that they are connected by HVDC cable, which can be treated as consumption with regard to the EPS of Montenegro. Among the most significant projects, which are planned by the Italian transmission network operator, the following reinforcements stand out:

- **HVDC 500 kV Lastva (ME) - Villanova (IT)**, the second pole of the HVDC cable, whose year of completion has not yet been precisely defined.
- **HVDC 500 kV Sicily (IT) - Tunis**, HVDC 600 MW.
- **OHL 400 kV Codrongianos (IT) - Lucciana (Corsica, FR) - Suvereto (IT), currently known as SACOI 3.**
- **HVDC Salgareda (IT) - Divača (SI)**, 1000 MW.

Depending on the electricity deficit/surplus in Western Europe, the increased exchange at the Italy - Western Europe border is expected to affect the load on the ME - IT HVDC cable.

Kosovo:

- **SS 400/220/110kV Prizren 4,** new SS connected according to input/output to OHL 400 kV Kosovo B - Tirana (AL).

Serbia:

- Interconnection double-circuit **OHL 400 kV Pančevo - Resica (RO)**, which has been completed on the Serbian side and whose commissioning is planned after the completion of the works on the Romanian side (currently, due to the works on the Romanian side, it operates under 110 kV).
- Interconnection double-circuit **OHL 400 kV Leskovac - Bobov Dol (BG)**, the commissioning planned after 2030.
- **OHL 2x400 kV HPP Đerdap 1 - Portile de Fier (RO)**, after 2029.
- Double-circuit **OHL 400 kV Obrenovac - Bajina Bašta**, with upgrading the voltage level in SS Bajina Bašta to 400 kV. According to the development plan (Transmission System Development Plan of the Republic of Serbia 2023-2032) dated June 2023, the commissioning is expected in 2026.
- Interconnection line between Serbia, Montenegro and BiH. In the first phase, an overhead line will be constructed where both systems will be equipped from Bajina Bašta (RS) to the bifurcation towards BiH, and then only one equipped system to Pljevlja (by 2028). In the second phase, another system will be equipped, depending on the implementation of the RHE Bistrica (RS) project.
- **Pannonian Corridor**, first phase (planned year **2028/2032**) consisting of a) Section 1: new OHL 2x400 kV SS Subotica 3 - Šandorfalva and b) Section 2: new OHL 2x400 kV SS Sombor 3 - SS Novi

Sad 3; the second phase (planned year 2030) consisting of Section 3: new OHL 2x400 kV SS Sremska Mitrovica 2 - SS Beograd 50.

- **Project "Belgrade 2025"**, which consists of: New SS 400/110 kV Beograd 50 with an extension and new OHL 2x400 kV SS Beograd 50 - connection switchgear (SG) Čibuk. The project completion deadline is **2028**.
- **Central-Balkan Corridor**, whose Section 1: OHL 2x400 kV SS Jagodina 4 - SG 400 kV Požarevac is planned for **2030**. Other sections are planned after 2030.
- **Reconstruction of SS 220/110 kV Požega** and upgrading to 400 kV voltage level **after 2030**.

EMS took into consideration another project, and that is OHL 110 kV Tutin - state border (SS Rožaje (ME)).

Each of these projects can potentially lead to an increase in exchanges at HVDC ME - IT, thus their modelling and analysis of power flows in the Montenegrin power system should be taken into account in the calculation of NTCs at the above borders.

6 System analyses

System analyses within the subject Plan were performed according to the recommendations from the Transmission Grid Planning Rules [4], with certain changes in terms of adjusting the needs and capabilities of CGES:

- Dynamic stability analyses were performed for 2026, as the target year of the regulatory framework, but also as a year by which the parameters of individual generation facilities can be determined with sufficient accuracy, which are crucial for creating dynamic power system models.
- Analysis of general indicators of electricity supply quality are analyses performed at the operational level by the 25th of the month for the previous month, as well as at the annual level (Article 7 of the Rules on Minimum Quality Requirements of Electricity Delivery and Supply **Error! Reference source not found.**). They have not been specifically processed within the plan in question.

6.1 Cross-section in 2024

6.1.1 Analysis of power flows and system elements loads

Within this chapter, two critical mode are analysed:

- Maximum transit mode (in order to consider the system load); and
- Minimum load mode (in order to consider voltage-reactive problems).

High transits are characterised by the full HVDC capacity and high import from the Albanian system. We note that energy comes from the EPS of Bosnia and Herzegovina as a consequence of strong generation node in Herzegovina (TPP Gacko, HPP Trebinje, HPP Dubrovnik), and import to the Albanian system, with CGES being a significant transit country for electricity. The topological structure of the 400 kV network in that part of the region is practically such that there is a 400 kV connection between Trebinje (BA) and Tirana (AL), over the 400 kV network of Montenegro.

The full topology analysis was performed and the results show that the most loaded element is OHL 110 kV Budva - Lastva which is loaded with 128% of its thermal limit (470 A, Al/Fe 150/25 mm^2).

Due to the high load, longitudinal sectioning is carried out at SS Budva.

6.1.2 Analyses of voltage-reactive conditions

In the period of low loads, higher voltages are observed mainly in the vicinity of generation facilities and in parts of lightly loaded network of 220 kV and 400 kV voltage level, which results in reactive energy generation and additional voltage increase. The problem is primarily noticed in SS Lastva, when voltages are above the allowed values at 400 kV voltage level (the voltage value for the minimum load of the transmission network goes up to 439 kV).

Generally speaking about voltage-reactive problems, high voltages are observed in all 400 and 220 kV nodes of the transmission networks of Montenegro and Bosnia and Herzegovina.

6.1.3 Analysis of short-circuit currents

Short-circuit current calculation was made for the winter maximum mode. In the given mode, in the system of Montenegro and the surrounding systems, the largest number of power plants is in operation, which gives the maximum values of the short-circuit current.

The short-circuit current calculations were made in accordance with IEC 60909 international standard, whereby for the calculation of the maximum value of short-circuit current, the coefficient for increasing the voltage by nodes is assumed to be 1.1.

A detailed calculation of short-circuit currents (at all voltage levels in the transmission network, as well as on the low-voltage busbars in the facilities belonging to CGES to which users are connected) was made through a separate study that provided measures for reducing them [13].

The highest expected values in SS Podgorica 1 and Podgorica 2 are:

2024

SS Podgorica 1: I_{3pks} - 24,992 A **I_{1pks} - 28,775 A**

SS Podgorica 2: I_{3pks} - 26,065 A **I_{1pks} - 29,449 A**

6.1.4 Dynamic system stability analysis

The dynamic stability test was performed by analysing transient stability. The transient stability analysis is performed by analysing the angle of the generator rotor for major disturbances.

Frequency stability analyses are performed for systems that are not well-connected, where an outage of some of the links could lead to isolated system operation, thus leading to a significant reduction/increase in frequency below/above the allowable values. Given the good interconnectivity between the Montenegrin system and its neighbours, such analyses did not need to be done in this study.

Dynamic analysis models were created on the basis of models from individual studies ([12], [19].

Fault simulations were carried out for all major elements of the transmission system, including overhead lines that connect power plants with the rest of the transmission system. The fault time was 100 ms, after which the fault was cleared by switching off the element affected by the fault.

In all cases, the responses showed that the system was stable, or that the system, after disturbance, reached a new stationary state without any additional or cascading outages.

Besides, the calculation of critical clearing time (CCT) was performed within the transient stability analysis. Analyses of the most critical cases were performed within the simulations needed to determine the critical fault clearance time because the faults observed on the busbars are such that the clearance of faults implies tripping the busbars and all converging branches. The cases of actions of the second degree of distant protection in adjacent nodes were practically simulated.

6.1.4.1 Simulation of faults in the selected tie power lines

This chapter outlines the results of simulation of faults on selected tie power lines. A fault was simulated on the side of the power plant for 100 ms, after which the fault was cleared by the distant protection or by switching off the overhead line.

Simulations of the following faults are shown for the winter maximum mode:

- short circuit at the initial end of the 220 kV overhead line Pljevlja - Mojkovac and outage of the overhead line;
- short circuit at the initial end of the 220 kV overhead line Piva - Pljevlja (2) and outage of the overhead line;
- short circuit at the initial end of the 110 kV overhead line Perućica - Podgorica 1 (1) and outage of the overhead line.

Simulations of the following faults are shown for the summer maximum mode:

- short circuit at the initial end of the 220 kV overhead line Pljevlja - Mojkovac and outage of the overhead line;
- short circuit at the initial end of the 220 kV overhead line Piva - Sarajevo 20 (B&H) and outage of the overhead line;
- short circuit at the initial end of the 110 kV overhead line Perućica - Danilovgrad and outage of the overhead line.

Generator responses to the observed faults are shown in figures in the Chapter 11.2.

6.1.4.2 Calculation of critical clearing time

The critical clearing time (CCT), compared to the real critical clearing time, provides a good estimate of the transient stability reserve in the Montenegrin system.

The critical clearing time was determined by simulating the faults causing the node and all incidental branches to fail. Thus, the most critical situations were simulated, where there was no response from distant protection in the first degree (stuck breaker contacts, no response of protective devices, etc.), but the distant protection in adjacent nodes was triggered in the second or third degree switching off the tie lines.

In addition, cases of transient faults in the busbars were examined, i.e. faults where they disappear (e.g. arc suppression) before action of protection.

Calculations were made for 2024, for which there were available dynamic models of neighbouring systems.

The calculation results are shown in the following table.

Table 6-1: Critical clearing time (CCT) in non-production nodes

Fault in node	Un [kV]	Description of simulation	Winter maximum CCT [ms]	Summer maximum CCT [ms]	Adopted CCT [ms]
SS Podgorica 2	400	Fault cleared by busbar tripping	550	680	550
		Transient fault	550	680	550
SS Lastva	400	Fault cleared by busbar tripping	550	690	550
		Transient fault	530	680	530
SS Pljevlja	400	Fault cleared by busbar tripping	530	470	470
		Transient fault	520	430	430
SS Ribarevine	400	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Mojkovac	220	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Podgorica 1	220	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000

SS Perućica	220	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Pljevlja	110	Fault cleared by busbar tripping	660	1 000	660
		Transient fault	670	1 000	670

Such faults, along with busbar tripping, were not simulated for the nodes to which power plant units are connected (220 kV busbars in HPP Piva and SS Pljevlja 2, as well as 110 kV busbars in HPP Perućica), because the tripping of the busbars would automatically mean switching off power units from the network.

Accordingly, in order to estimate the transient stability reserve, three-phase short circuits were simulated at the ends of all 400 kV and 220 kV overhead lines (faults in plants on the territory of Montenegro were analysed for the interconnective overhead lines) and 110 kV overhead lines connected to HPP Perućica. The critical clearing time was calculated for both observed modes, and the lower values were taken as the final value.

The results showed that the lowest values of the critical clearing time were obtained for the faults in the branches converging on the busbars to which the power units are also connected, more precisely for the faults on the power plant side. The most critical values were obtained for the faults in the 220 kV lines converging on the SS Pljevlja 2 for which the critical clearing time was about 240 ms, as well as for the faults in the 110 kV lines converging on HPP Perućica for which the critical clearing time was about 220 ms.

Table 6-2: Critical clearing time (CCT) of overhead lines

Overhead line	Un [kV]	Fault in the mode	Winter max CCT [ms]	Summer max CCT [ms]	**CCT [ms]**
Podgorica 2 - Tirana (AL)	400	Podgorica 2	530	630	**530**
Podgorica 2- Lastva	400	Podgorica 2	520	640	**520**
Lastva - Trebinje (BiH)	400	Podgorica 2	520	640	**520**
Ribarevine - Peć (KS)	400	Ribarevine	> 1000	> 1000	**> 1000**
Pljevlja - Ribarevine	400	Pljevlja	510	440	**440**
		Ribarevine	> 1000	> 1000	**> 1000**
Podgorica 2 - Ribarevine	400	Podgorica 2	520	630	**520**
		Ribarevine	> 1000	> 1000	**> 1000**
Pljevlja - Požega (RS)	220	Pljevlja	250	250	**250**
Podgorica 1 - Koplik (AL)	220	Podgorica 1	> 1000	> 1000	**> 1000**
Piva - Sarajevo 20 (BiH)	220	Piva	330	300	**300**
Perućica - Trebinje (BiH)	220	Perućica	> 1000	> 1000	**> 1000**
Pljevlja - Bajina Bašta (RS)	220	Pljevlja	250	250	**250**
Perućica - Podgorica 1	220	Perućica	> 1000	> 1000	**> 1000**
		Podgorica 1	> 1000	> 1000	**> 1000**
Piva - Pljevlja (1)	220	Piva	360	320	**320**
		Pljevlja	250	250	**250**
Piva - Pljevlja (2)	220	Piva	360	320	**320**
		Pljevlja	240	240	**240**
Mojkovac - Podgorica 1	220	Mojkovac	> 1000	> 1000	**> 1000**
		Podgorica 1	> 1000	> 1000	**> 1000**
Mojkovac - Pljevlja	220	Mojkovac	> 1000	> 1000	**> 1000**
		Pljevlja	240	240	**240**
Pljevlja (1) - Pljevlja (2)	110	Pljevlja (1)	650	> 1000	**650**
Pljevlja (2) - Zamršten (RS)	110	Pljevlja (2)	590	790	**590**
Danilovgrad - Perućica (A)	110	Perućica (A)	220	270	**220**
Perućica (A) - Nikšić (1)	110	Perućica (A)	220	270	**220**
Perućica (A) - Nikšić (2)	110	Perućica (A)	220	270	**220**
Perućica (B) - Nikšić (3)	110	Perućica (B)	220	270	**220**
Perućica (B) - Podgorica 1 (1)	110	Perućica (B)	220	270	**220**
Perućica (B) - Podgorica 1 (2)	110	Perućica (B)	220	275	**220**

6.1.5 Analysis of electricity losses

The analysis of losses was carried out on the basis of data collected during 2024.

The following table shows the losses in 2024.

Table 6-3: Losses in the transmission network of Montenegro during 2024

Energy [MWh] / Year	2023	2024
Energy at the entrance to the transmission system	8,832,816	8,979,134
Generation at the power plant gate	3,804,456	3,232,174.32
Total losses in the transmission system	146,228	143,227
Total consumption [MWh]	2,912,631	3,014,714
Ratio of losses and total energy [%]	1.65	1.59

The value of losses depends on several factors, including the large transit going through the Montenegrin transmission system towards the Albanian, and through the submarine cable towards the Italian power system, as well as the specific layout of generation facilities and consumer centres in Montenegro.

The rate of losses shows the dependence of the same on the total energy entering and leaving the system, so that we can see a trend of their reduction compared to the period before 2024.

6.1.6 Analysis of transmission capacity and congestions

Individual outages of elements of the transmission system of Montenegro in the modelled mode of maximum transit (including import from Italy via the HVDC cable up to 600 MW) lead to overload within the Montenegrin system and thus to the disturbance of the normal operating mode of the EPS of Montenegro.

In the analysis of N-1 security, a large number of overloads of elements over 100% is observed, primarily in the 220 kV network. It should be noted that due to the large overload of OHL 110 kV Budva - Lastva must be disconnected in normal topology.

Analyses of cascading outages and simulations of faults with protection relay activation have revealed the following critical situations from the security of the EPS of Montenegro:

Outage of OHL 400 kV **Trebinje (BA) - Lastva**, leads to the overload mode of the entire 220 kV section of Trebinje (BA) - HPP Perućica - Podgorica 1 - Vau Dejes (AL).

Outage of OHL 400 kV **Lastva - Podgorica 2** leads to the overload mode of the overhead line 110 kV between Herceg Novi - Tivat, as well as OHL 110 kV Tivat - Lastva.

Outage of OHL 400 kV **Podgorica 2 - Tirana** (AL), leads to the overload mode of the entire 220 kV section of Trebinje (BA) - HPP Perućica - Podgorica 1 - Vau Dejes (AL), as well as some 110 kV lines on the direction Trebinje (BiH) - Lastva. In this case, due to the overload, level II of overload protection is activated on OHL Podgorica 1 - Vau Dejes and its automatic disconnection after 20 seconds occurs. After this disconnection, the system resumes its normal operation.

The problem of parallel operation of 400 kV and 110 kV is solved by the radial mode of the 110 kV network or by using automation. The problem of the 110 kV network should be viewed from the aspect of sufficient reserve in capacity to be able to supply the consumer area even after failure of one of the relevant elements.

Table 6-3: Analysis of the N-1 security criterion of transmission system of the EPS of Montenegro

PRVI ISPAD	PREOPTEREĆEN ELEMENT	Termička Granica (MVA)/(A)	Tok po Elementu (MVA)/(A)	Zaštita od preopterećenja (A) I Stepen / II Stepen	Strujno Opterećenje (%)
400kV DV Trebinje (BA) - Lastva	220kV DV Trebinje (BA) - HE Perućica-VauDejes	274.4 / 790	321.5 / 843.7	720 / 940	106.8
	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	147.8 / 817.4	468/-	174
	110kV DV Herceg Novi - Tivat	89.5 / 470	107.4 / 584.4	- / -	124.4
	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	123.7 / 634.2	- / -	135
		/	/	/	/
400kV DV Lastva - Podgorica 2	110kV DV Trebinje (BA) - Herceg Novi	106.2 / 557	89.5 / 715.2	468/-	128.3
		89.5 / 470	93.7 / 491.8	468/-	104.7
		89.5 / 470	100 / 524.7	468/-	111.7
	110kV DV Budva - Lastva	89.5 / 470	200.2 / 1025	- / -	218.2
400kV DV Podgorica 2 - Tirana	220 kV DV Podgorica 1 - Vau Dejes	274.4 / 720	305.8 / 802.2	720 / 900	111.4
	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	93.5 / 490.9	468/-	104.5
	110kV DV Budva - Lastva	89.5 / 470	92.5 / 485.3	450 / 500	103.3
	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	99 / 519.5	468/-	110.6
220kV DV Trebinje (BA) - HE Perucica	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	104.6 / 549.1	468/-	116.9
	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	108.1 / 567	468/-	120.7
	110kV DV Trebinje (BA) - Herceg Novi	89.5 / 470	113.6 / 596.1	468/-	126.9
110kV DV Bar - Budva	110kV DV Bar - Virpazar	91.5 / 480	113.8 / 597.4	480 / 600	124.4
	110kV DV Podgorica 2 - Virpazar	99.1 / 520	123.6 / 648.6	520 / 600	124.7

6.1.7 Analysis of general indicators of quality electricity delivery

In order to encourage transmission system operators to achieve and maintain the level of general and individual indicators of minimum quality of electricity supply, the Agency Board has established Rules on Minimum Quality Requirements of Electricity Delivery and Supply (**Error! Reference source not found.**), which specify minimum quality of electricity delivery and supply, which is based on the following criteria:

- quality of services,
- uninterruptible power supply,
- quality of electricity voltage.

The most important indicator of the quality of transmission system operation is AIT (average interruption time) which provides information on the average power supply interruption time for customers, parts of distribution systems and closed distribution systems connected to the transmission system, expressed in minutes per year. In terms of transmission system operation, it is desirable that the values of AIT parameters be as low as possible.

With regard to the number of transient failures of overhead lines, it must be emphasized that the size of this parameter depends on a large number of factors, and that this trend does not necessarily occur due to poor condition of system elements, but may be due to climatic conditions such as thunderbolt near the overhead line in the year in question. Such phenomena, widely recognized as risky for adequate operation of the transmission system, are not sufficiently predictable, which lead to a short-term reduction in the insulation level of equipment, and, consequently, to more favourable conditions for transient failures.

The values of the average annual power supply interruption for 2024 are presented in the following diagram:

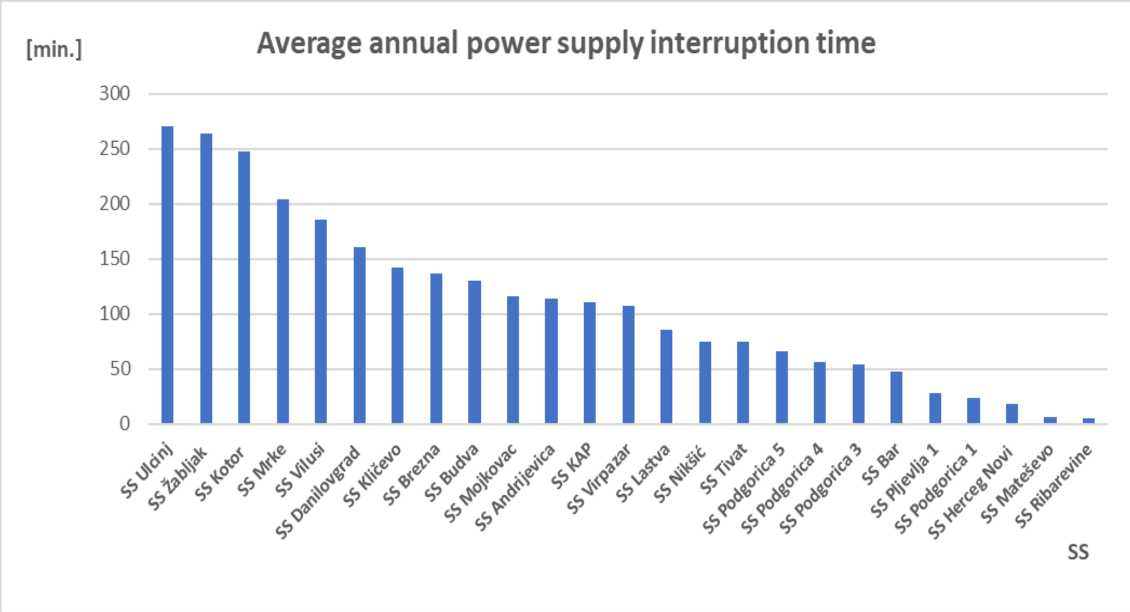


Figure 6-1: Average interruption time in 2024

From the diagram it can be seen that SS Ulcinj and SS Žabljak had the longest average period of interruption of about 270 minutes, with the longest interruption recorded in April at SS Ulcinj. It should be noted that at both substations, the reason for this interruption time is that during the time in question, works were carried out that required a voltage-free state of the transmission network for longer intervals, and that the power supply is provided from the distribution network.

As for other substations, the longest interruption periods were recorded in SS Vilusi and SS Kotor, which is also a consequence of planned works.

When it comes to unplanned power interruptions, the longest interruptions were recorded in SS Kotor for 143 hours per year and SS Vilusi for 197 hours per year.

6.1.8 Situation in 2024 - Conclusion:

Generally, having analysed current state of network, regardless of operational modes, the following problems should be solved:

1. More reliable power supply to the coastal area of Montenegro, in particular Herceg Novi, Kotor and Ulcinj (connected via single line to the transmission network), which are practically one-sidedly supplied from the system of Montenegro (from the other side Herceg Novi is supplied with power from the system of Bosnia and Herzegovina).
2. During the operation of the HVDC ME-IT cable, problems were noted in the mode when Italy exports to Southeast Europe. The direction of the exchange on the HVDC cable from Italy causes the 110 kV network in the coastal part of Montenegro (on the stretch from Lastva to Budva and Bar) to be extremely loaded, so it is necessary to perform the longitudinal sectioning of busbars in SS Budva. Therefore, it is necessary to plan the reconstruction of the 110 kV network on the mentioned stretch, i.e. overhead lines 110 kV Lastva - Budva, Bar - Budva and Bar - Možura - Ulcinj.
3. Following the shutdown of the Aluminium Smelter Mostar (BiH), poor hydrological situation in the region (it is often the case that few generating units in the region are connected), as well as limited possibilities of the transmission system operators in the region when it comes to reactive energy

management led to voltage increase across all transmission networks in the region of interest of CGES operation, especially at the 400 kV voltage level. It is necessary to install a shunt reactor with a 250 MVAr capacity in SS Lastva for greater flexibility and engagement of the device (for fixed shunts, an order is given for switching the device on or off, while the variable shunts set the desired degree depending on need – investment in progress.

4. SS Kotor has one-sided supply from the transmission system (from SS Tivat), so at least one connection has to be provided, in order to meet the N-1 security criterion. Another connection planned and proposed in the Plan and which solves this problem is OHL 110 kV Lastva - Kotor.
5. Constant suppressing of generation capacity from HPP Perućica towards SS Podgorica 1 through 110 kV overhead lines HPP Perućica - Podgorica 1 (double-circuit on the same towers) and HPP Perućica - Danilovgrad - Podgorica 1 (Al/Fe 470A, cross-section 150/25 mm2), which are loaded with over 50% of its thermal limit in full network topology and availability of all elements of transmission system. This is caused because only a small portion of energy generated in HPP Perućica goes through TR 220/110 HPP Perućica into the 220 kV network. Construction of OHL 110 kV Vilusi - Herceg Novi and reconstruction of OHL 110 kV Perućica - Danilovgrad - Podgorica will solve this overload problem, with the fact that it should be noted that the reconstruction of the mentioned overhead line is almost completed and it remains to replace the protective wire in the course of 2025.
6. All OHLs 110 kV in the coastal area of Montenegro are old with conductors 150/25 mm2 and thermal limit of 470 A (89MVA). Since the towers are designed to bear wires of the existing cross-section, it is not possible to replace only the existing wires with the wires of larger cross-section, but the existing towers will have to be replaced as well by towers that can bear wires of larger cross-section. Construction of SS Luštica, increase of the existing line capacities, as well as the construction of OHL 110 kV Vilusi - Herceg Novi and Kotor - Tivat, with the already installed in SS Lastva, will completely solve this problem.
7. It is necessary to solve the problem of T-junction in SS Vilusi, including reconstruction of the substation with associated overhead lines (overhead lines Cu 120 mm2 transmission capacity 76MVA) as envisaged through the construction project OHL 110 kV Vilusi - Herceg Novi
8. The analysis of power losses in the selected modes has shown that the level of losses depends on the transit of electricity, which should be taken in consideration now when HVDC Montenegro-Italy is in operation. All losses resulting from the transit of electricity to other transmission system operators will be recovered by the ENTSO-E ITC mechanism, the member of which is CGES. It is not expected that the total losses in relation to the available energy exceed 1.8-2.1%.
9. Regarding the values of short-circuit currents in the transmission network, they are separately elaborated through the study Analysis of short-circuit currents in the transmission network of Montenegro [13], but it is definitely necessary to take measures to reduce them, as a last resort through the installation of low-ohm resistors.

6.2 Cross-section in 2026

Analyses for 2026 - market simulation results

This chapter, inter alia, analyses development of the electricity market from the point of the price zone coupling of certain regions of Europe.

Basic analyses within this study rely on the data from:

- ENTSO database;
- PEMDDB (2020-Expected Progress, 2030-Vision 1),
- ERAA 2023.

Growth rates for the realistic scenario for most countries are calculated according to annual consumption in 2024 and forecasted consumption for year 2032. The growth rates so determined were applied to the medium-sized load from 2024 and thus the consumption was determined for years 2026 and 2032.

The main indicator of the behaviour of the electricity market is the trend of prices on the so-called Whole Sail Market, as shown in the figure (average monthly prices obtained after simulating the behaviour of the electricity market). It is important to note that the simulations imply an ideal electricity market, as assumed by the ENTSO-E CBA methodology.

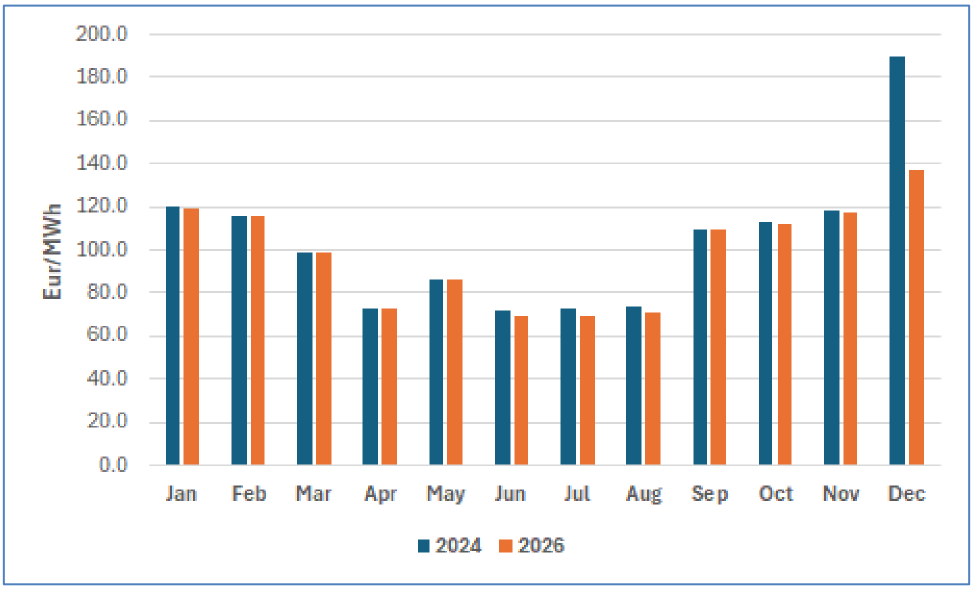


Figure 6-2: Market analyses results for Montenegro in 2026

Figure 6-2 shows the basic results of market analyses for 2024 and 2026. The average annual marginal price for 2024 was around 103.4 €/MWh, while the expected price for 2026 is slightly lower and is estimated at 98.1 €/MWh.

Market results were used to create network models of the Southeast Europe region for maximum winter and maximum summer mode.

6.2.1 Analysis of power flows and system elements loads

The implementation of the following development projects is underway, the completion and commissioning of which is expected in the next regulatory period (possibly with some delay) and which are considered in the transmission network model for 2026[7]:

- OHL 400 kV Lastva (Čevo) - Pljevlja;
- OHL 110 kV Brezna - Žabljak - Pljevlja (currently, the overhead line 400 kV from Lastva to Žabljak is operating at 110 kV voltage with connection to SS Brezna.);
- Installation of variable shunt reactor 250 MVAr in SS Lastva;

Based on the input data obtained from the relevant institutions in the coming period, the following generation facilities are expected (analysed in market and network analyses)[8]:

- **WPP Gvozd 54.6 MW** – connection of new 110 kV OHLs to the existing SS 110/33 kV Krnovo and SS 110/35kV Nikšić;
- **SPP Krupac 50 MW** – connection to the 110 kV SG Trubjela, which is connected according to the in/out principle to OHL 110 kV Nikšić - Vilusi. This Plan envisages the construction of SS 400/110 kV Trubjela in the period by 2032, with the fact that the power plant in question could be connected to the 110 kV network with certain operational restrictions[9] (given the fact that the investor has not yet signed a connection agreement with CGES, this Plan does not prejudge the final connection solution);

Power flows and voltage profiles in the Montenegrin transmission grid have shown the following:

- for the winter maximum mode:
  - OHL 220 kV Pljevlja (ME) - Bajina Bašta (RS), loaded with 97% of its thermal limit;
  - OHL 110 kV Kličevo - Brezna loaded with 91% of its thermal limit (directly resulting from the installed capacities of generation facilities) as a result of utilization of WPP Krnovo and small hydropower plants, whereby the energy from these generation facilities is naturally transferred in the direction of Kličevo or towards the centre of consumption;
  - OHL 110 kV Herceg Novi (ME) - SS Trebinje (BA) loaded with 81% of its thermal limit.
- for the summer maximum mode:
  - OHL 220 kV Pljevlja (ME) - Bajina Bašta (RS) loaded with 88% of its thermal limit;
  - OHL 110 kV Kličevo - Brezna loaded with 91% of its thermal limit;
  - OHL 110 kV Herceg Novi (ME) - SS Trebinje (BA) loaded with 85% of its thermal limit.

6.2.2 Analysis of voltage-reactive conditions

In the period of low loads, as well as for 2024 and 2026, higher voltages are observed mainly in the vicinity of generation facilities and in parts of lightly loaded network of 220 and 400 kV voltage level, which results in reactive energy generation and additional voltage increase. The problem is primarily noticed in SS

[7] Approved by the Agency [1], but does not prejudge the year of commissioning.

[8] Except for WPP Gvozd, connection method of which was elaborated in a special Connection Study, the connection methods of new generation facilities are informative and will be treated in special studies, after receiving official connection applications.

[9] According to Article 164 of the Energy Law of Montenegro (Official Gazette of Montenegro, no. 28/2025).

Lastva, when voltages are above the allowed values at 400 kV voltage level. The installation of a variable shunt reactor in SS Lastva should bring the voltage within the allowed limits, but it also depends on the neighbouring systems and their voltage regulation.

The completion of installation of variable shunt reactor 250 MVAr in SS Lastva is planned during 2026, but the need for its installation has been seen through other analyses and studies [20].

Generally speaking about voltage-reactive problems, high voltages are observed in all 400 and 220 kV nodes of the transmission networks of Montenegro and Bosnia and Herzegovina.

6.2.3 Analysis of short-circuit currents

An increase in the short-circuit current values is obvious in almost all transformer stations. The most vulnerable one is SS Podgorica 1 with extremely high values in 2026 and 2032.

The highest expected values of short-circuit currents are in SS Podgorica 1 and SS Podgorica 2 and amount to:

2026

SS Podgorica 1: I_{3pks} - 27,660 A **I_{1pks} - 30,321 A**

SS Podgorica 2: I_{3pks} - 31,725 A **I_{1pks} - 33,835 A**

Bearing in mind that the primary equipment was replaced in SS Podgorica 2 (40 kA), the stated value of the short-circuit current in SS Podgorica 2 is not considered critical.

6.2.4 Dynamic system stability analysis

The dynamic stability test was performed by analysing transient stability. The transient stability analysis is performed by analysing the angle of the generator rotor for major disturbances.

Frequency stability analyses are performed for systems that are not well-connected, where an outage of some of the links could lead to isolated system operation, thus leading to a significant reduction/increase in frequency below/above the allowable values. Given the good interconnectivity between the Montenegrin system and its neighbours, such analyses did not need to be done in this study.

Likewise, voltage stability is separately tested for systems where voltage may collapse, most often as a result of high energy transit. Such analyses have already been done in the Defence Plan (the results of the latest Defence Plan showed that the Montenegrin power system did not face problems of voltage instability and voltage collapse, and that voltage may collapse only due to large imports of the Montenegrin power system which significantly exceeds the current needs of the system and the available transmission capacities on the border overhead lines towards the neighbours [12]).

Dynamic analysis models were created based on models from individual studies [12], [19] and then updated according to the proposed CGES development plan by 2026.

The analysis of transient stability was performed in accordance with the requirement of CGES on the operating conditions of the system in disturbed operating modes from the Transmission Grid Code (**Error! Reference source not found.**). Three-phase short-circuits (so-called metal short-circuits) were simulated on the busbar side (in the case of lines, short-circuits were simulated on the output/input gantry, and in the case of transformers, short-circuits were simulated on the conductive insulators at the entry to the transformers).

Fault simulations were carried out for all major elements of the transmission system, including overhead lines that connect power plants with the rest of the transmission system. The fault time was 100 ms, after which the fault was cleared by switching off the element affected by the fault.

In all cases, the responses showed that the system was stable, or that the system, after disturbance, reached a new stationary state without any additional or cascading outages.

Besides, the calculation of critical clearing time (CCT) was performed within the transient stability analysis. Analyses of the most critical cases were performed within the simulations needed to determine the critical fault clearance time because the faults observed on the busbars are such that the clearance of faults implies tripping the busbars and all converging branches. The cases of actions of the second degree of distant protection in adjacent nodes were practically simulated.

6.2.4.1 Simulation of faults in the selected tie power lines

A fault was simulated on the side of the power plant for 100 ms, after which the fault was cleared by the distant protection or by switching off the overhead line.

Simulations of the following faults are shown for the winter maximum modes:

- short circuit at the initial end of the 220 kV overhead line Pljevlja - Mojkovac and outage of the overhead line;
- short circuit at the initial end of the 220 kV overhead line Piva - Pljevlja (2) and outage of the overhead line;
- short circuit at the initial end of the 110 kV overhead line Perućica - Podgorica 1 (1) and outage of the overhead line.

Simulations of the following faults are shown for the summer maximum modes:

- short circuit at the initial end of the 220 kV overhead line Pljevlja - Mojkovac and outage of the overhead line;
- short circuit at the initial end of the 220 kV overhead line Piva - Sarajevo 20 (B&H) and outage of the overhead line;
- short circuit at the initial end of the 110 kV overhead line Perućica - Danilovgrad and outage of the overhead line.

Generator responses to the observed faults are shown in Figures in the Chapter 11.2.

6.2.4.2 Calculation of critical clearing time

Compared to the real critical clearing time, the CCT provides a good estimate of the transient stability reserve in the Montenegrin system.

The critical clearing time was determined by simulating the faults causing the node and all incidental branches to fail. Thus, the most critical situations were simulated, where there was no response from distant protection in the first degree (stuck breaker contacts, no response of protective devices, etc.), but the distant protection in adjacent nodes was triggered in the second or third degree switching off the tie lines.

In addition, cases of transient faults in the busbars were examined, i.e. faults where they disappear (e.g. arc suppression) before action of protection.

Calculations were made for 2026, for which there were available dynamic models of neighbouring systems.

The calculation results are shown in the following table.

Table 6-4: Critical clearing time (CCT) in non-production nodes

Fault in node	Un [kV]	Description of simulation	Winter maximum CCT [ms]	Summer maximum CCT [ms]	Adopted CCT [ms]
SS Podgorica 2	400	Fault cleared by busbar tripping	570	680	570
		Transient fault	560	680	560
SS Lastva	400	Fault cleared by busbar tripping	560	690	560
		Transient fault	540	680	540
SS Pljevlja	400	Fault cleared by busbar tripping	540	480	480
		Transient fault	520	440	440
SS Ribarevine	400	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Mojkovac	220	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Podgorica 1	220	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Perućica	220	Fault cleared by busbar tripping	> 1 000	> 1 000	> 1 000
		Transient fault	> 1 000	> 1 000	> 1 000
SS Pljevlja	110	Fault cleared by busbar tripping	660	1 000	660
		Transient fault	670	1 000	670

Such faults, along with busbar tripping, were not simulated for the nodes to which power plant units are connected (220 kV busbars in HPP Piva and SS Pljevlja 2, as well as 110 kV busbars in HPP Perućica), because the tripping of the busbars would automatically mean switching off power units from the network.

Accordingly, in order to estimate the transient stability reserve, three-phase short circuits were simulated at the ends of all 400 kV and 220 kV overhead lines (faults in plants on the territory of Montenegro were analysed for the interconnective overhead lines) and 110 kV overhead lines connected to HPP Perućica. The critical clearing time was calculated for both observed modes, and the lower values were taken as the final value (Table 6-5).

The results showed that the lowest values of the critical clearing time were obtained for the faults in the branches converging on the busbars to which the power units are also connected, more precisely for the faults on the power plant side. The most critical values were obtained for the faults in the 220 kV lines converging on the SS Pljevlja 2 for which the critical clearing time was about 250 ms, as well as for the faults in the 110 kV lines converging on HPP Perućica for which the critical clearing time was about 220 ms.

Table 6-5: Critical clearing time (CCT) of overhead lines

Overhead line	Un [kV]	Fault in the node	Winter max CCT [ms]	Summer max CCT [ms]	**CCT [ms]**
Podgorica 2 - Tirana (AL)	400	Podgorica 2	535	635	**535**
Podgorica 2- Lastva	400	Podgorica 2	525	645	**525**
Lastva - Trebinje (BiH)	400	Podgorica 2	525	645	**525**
Ribarevine - Peć (KS)	400	Ribarevine	> 1000	> 1000	**> 1000**
Pljevlja - Ribarevine	400	Pljevlja	515	440	**440**
		Ribarevine	> 1000	> 1000	**> 1000**
Podgorica 2 - Ribarevine	400	Podgorica 2	525	635	**525**
		Ribarevine	> 1000	> 1000	**> 1000**
Pljevlja - Požega (RS)	220	Pljevlja	250	250	**250**
Podgorica 1 - Koplik (AL)	220	Podgorica 1	> 1000	> 1000	**> 1000**
Piva - Sarajevo 20 (BiH)	220	Piva	330	305	**305**
Perućica - Trebinje (BiH)	220	Perućica	> 1000	> 1000	**> 1000**
Pljevlja - Bajina Bašta (RS)	220	Pljevlja	250	250	**250**
Perućica - Podgorica 1	220	Perućica	> 1000	> 1000	**> 1000**
		Podgorica 1	> 1000	> 1000	**> 1000**
Piva - Pljevlja (1)	220	Piva	360	320	**320**
		Pljevlja	250	250	**250**
Piva - Pljevlja (2)	220	Piva	360	325	**325**
		Pljevlja	250	250	**250**
Mojkovac - Podgorica 1	220	Mojkovac	> 1000	> 1000	**> 1000**
		Podgorica 1	> 1000	> 1000	**> 1000**
Mojkovac - Pljevlja	220	Mojkovac	> 1000	> 1000	**> 1000**
		Pljevlja	250	250	**250**
Pljevlja (1) - Pljevlja (2)	110	Pljevlja (1)	660	> 1 000	**660**
Pljevlja (2) - Zamršten (RS)	110	Pljevlja (2)	600	795	**600**
Danilovgrad - Perućica (A)	110	Perućica (A)	220	275	**220**
Perućica (A) - Nikšić (1)	110	Perućica (A)	220	275	**220**
Perućica (A) - Nikšić (2)	110	Perućica (A)	220	275	**220**
Perućica (B) - Nikšić (3)	110	Perućica (B)	220	275	**220**
Perućica (B) - Podgorica 1 (1)	110	Perućica (B)	220	275	**220**
Perućica (B) - Podgorica 1 (2)	110	Perućica (B)	220	275	**220**

6.2.5 Analysis of electricity losses

The analysis of losses was elaborated through the analysis and comparison of losses in 2026 in the analysed modes (winter and summer maximum), compared to calculated losses in 2024. Consumption compared to 2024 has increased by 1.2%.

The following table shows the power losses in 2026, while the total losses on the transmission network are calculated in relation to the total energy entering the system.

Table 6-6: Ratio between the power of losses and consumption for the characteristic hours in 2026[10]

Summer 2026				Winter 2026			
Generation	Consumption	Losses*		Generation	Consumption	Losses*	
MW	MW	MW	%	MW	MW	MW	%
400	463	14.22	3.0	871	425	15.1	3.55

*** including also the HVDC (as consumption of 600 MW), the capacity of consumption is 1060 MW in summer and 1402 MW in winter, so losses amount to 1.35% and 1.47%, respectively**

Total losses in the EPS of Montenegro amount to about 15.1 MW for the winter and 14.22 MW for the summer mode, which amounts to 3.55%, and 3.0%, respectively, compared to the total consumption of Montenegro.

Making comparison with losses from 2024, It can be said that a slight decrease in losses in the transmission network is expected, which is mainly the result of the expected same electricity transits.

The losses caused by transit will be compensated through the ITC mechanism within the ENTSO-E calculation of costs for loss coverage (ENTSO-E Inter TSOs Compensation Mechanism) so that the level of losses caused by internal transits will remain at approximately same level, while the construction of new elements of the transmission system and new generation capacities could reduce them.

Loss calculation based on 8,760 hour models for 2026 has shown that losses are at the level of 2014 and amount to 150,541.7 MWh[11].

6.2.6 Transmission capacity and congestion analysis

With regard to the import of electricity from the direction of Italy, 110 kV overhead lines from Budva are critically loaded because SS Lastva at the 400 kV voltage level behaves as a 600 MW power generator (or less, depending on the exchange programme on the cable) and directly pushes energy to the 100 kV grid, thereby loading the direction to SS Budva and further to the maximum limit (this topic is separately elaborated through the CGES Defence Plan).

As a solution to the identified problems, the following reconstructions, operational measures and construction of transmission elements are proposed (Table 6-7):

[10] The costs of losses incurred by cross-border transits are reimbursed from the ITC mechanism.
[11] Including losses on 110/x kV transformers.

Table 6-7: Analysis of reinforcements and elimination of identified uncertainties in the transmission network of Montenegro

2026				
Element outage/network problem	**Overloaded element**	**Load [%]**	**Load relief measure**	**Development measure**
Import from Italy on 600 MW HVDC (Base case)	**OHL 110 kV Budva - Bar**	**137**	**Busbar sectioning in SS Budva**	**Reconstruction of OHL 110 kV Budva - Bar - Ulcinj**
OHL 110 kV Bar - WPP Možura	**Consumption outage in SS Ulcinj and WPP Krnovo**	**-**	**-**	**Construction of another 110 kV link from SS Ulcinj to SS Virpazar or construction of 110 kV Ulcinj – Velika plaža - Velipojë (AL)**
OHL 110 kV Kotor - Tivat	**Outage of part of consumption in SS Kotor**	**-**	**-**	**Construction of OHL 110 kV Lastva - Kotor**
OHL 400 kV Trebinje (BA) - Lastva (ME)	**Herceg Novi (ME) - Trebinje (BA) Herceg Novi - Tivat**	**130**	**Change of grid switching state in the area of Herceg Novi**	**Reconstruction of OHL 110 kV Lastva - Tivat Construction of 110 kV OHL Lastva - Kotor**
High grid voltages in the Lastva region	**Voltages over 420 kV**	**-**	**-**	**Installation of variable shunt reactor 250 MVAr in SS Lastva (expected in 2026)**

6.2.7 Analysis of general indicators of quality electricity delivery

In order to improve the quality electricity delivery and supply, which is based on the Rules (**Error! Reference source not found.**), in the regulatory period by 2026, CGES will continue with the implementation or begin a series of activities to build new and reconstruct old elements of the transmission network that will provide a high degree of reliability of certain elements of the transmission system, and above all:

- Construction of OHL 110 kV Žabljak - Pljevlja;
- Construction of OHL 110 kV Krnovo - Gvozd - Nikšić;
- Reconstruction of OHL 110 kV Lastva - Tivat.

Taking into account the previously mentioned reinforcements and reconstructions, a significant reduction in the number of outages and unavailability of certain elements of the transmission network is expected, primarily:

- SS Kotor;
- SS Budva;
- SS Žabljak;
- SS Ulcinj;
- SS Bar;
- SS Vilusi and
- SS Danilovgrad.

With regard to other facilities of the high-voltage network, the reduction of undelivered electricity can be expected after the implementation of a number of measures, in terms of reinforcement and reconstruction of the transmission network in the period after 2026.

For 2026, the expected values of AIT (taking into account the experiences with existing SSs that are either bidirectionally supplied or reconstructed) are presented in the following diagram:

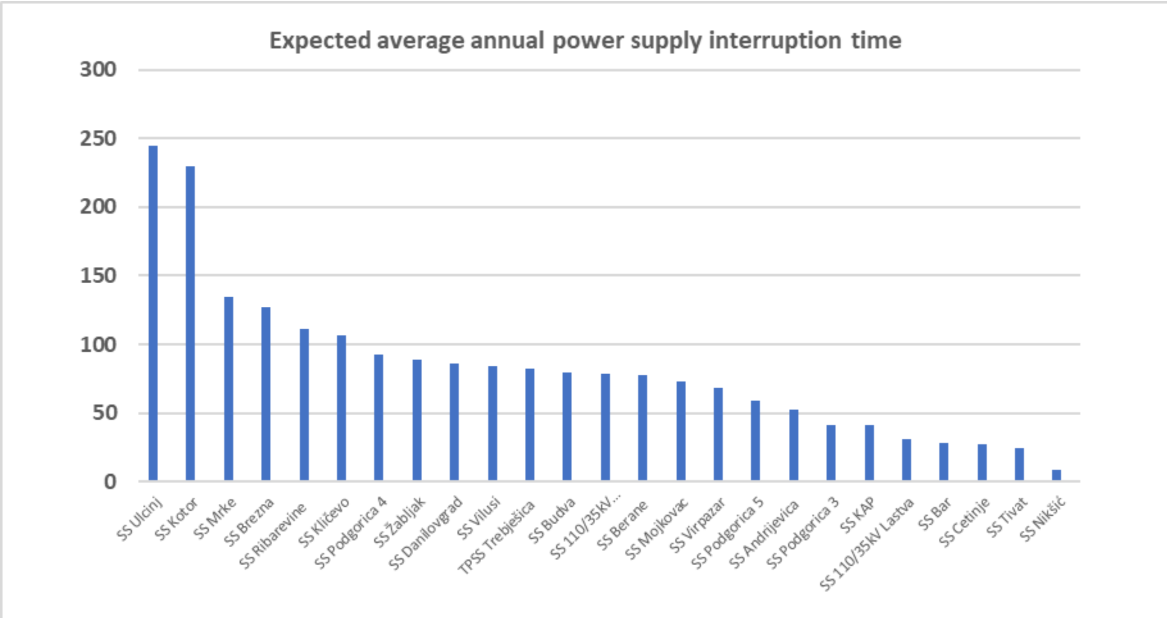


Figure 6-3: Average interruption time in 2026

It is very important to emphasise that the size of the reliability parameters of individual elements depends also on other impacts, primarily climatic conditions, such as thunderstorms, high/low temperatures that are risky for adequate operation of the transmission system and not sufficiently predictable leading to short-term reduction of the insulation level of equipment and more favourable conditions for the occurrence of transient failures.

6.3 Analyses for 2032

Market simulation results – 2032

Figure 6-4 shows the basic results of market analyses for 2032. The average annual marginal price on the Montenegrin market is between 54 €/MWh and 103 €/MWh, with an average annual price of 100.8 €/MWh. The maximum expected transit (as a result of commercial exchanges at the border) is around 1500 MW/hour (import and export imply energy that entered /left the system). Market results were used to create network models of the Southeast Europe region

Figure 6-5 shows a comparison of the impact of the construction of the proposed infrastructure in 2032 compared to the predicted level of construction for 2024 and 2026 with the same level of RES as in the final year of the Plan.

It has been observed that with the high degree of construction of renewables, it is necessary to envisage also the construction of transmission infrastructure that would enable the placement of energy in neighbouring systems, as well as the procurement of the energy in hours of low generation in the EPS of Montenegro.

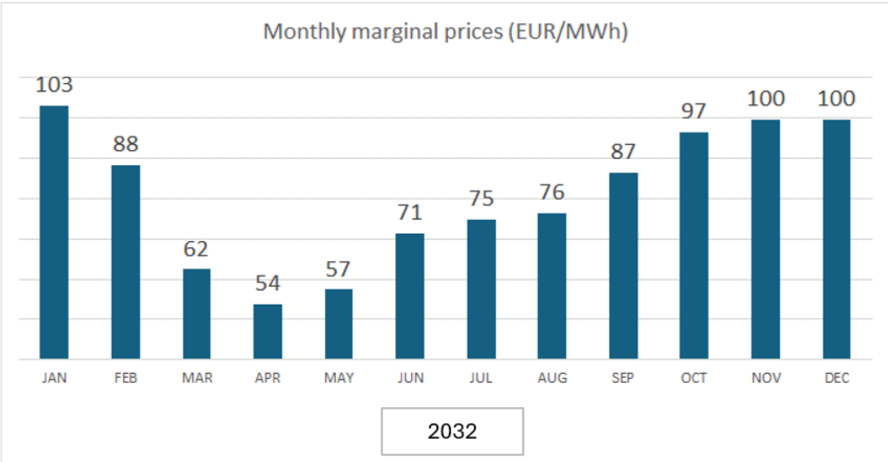


Figure 6-4: Market analyses results for Montenegro in 2032

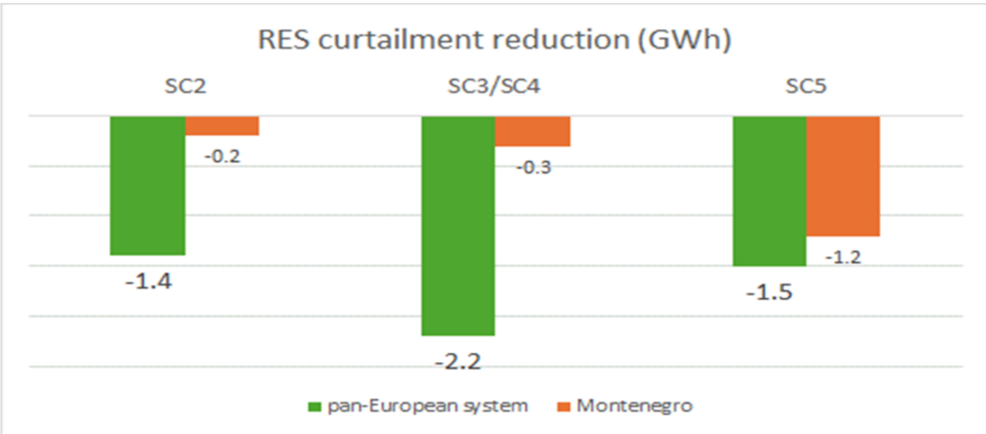


Figure 6-5: Reduction of RES "diffusion" after infrastructure construction in 2032

By analysing commercial exchanges along the borders of Montenegro, it can be concluded as follows:

- ✓ Bosnia and Herzegovina: the dominant direction of trade from B&H to Montenegro, which is largely due to the export of B&H towards the cable and the Italian market, and to a lesser extent from own import needs of Montenegro, due to the cable capacity increase compared to 2025, the imports from Bosnia and Herzegovina increased by almost 0.5 TWh.
- ✓ Serbia: the dominant direction of exchange is towards Montenegro.
- ✓ Kosovo: the dominant direction of exchange is towards Montenegro which, as in the case of B&H, originates from exports through Montenegro to Italy, and to a lesser extent due to own needs of Montenegro. Despite the change in cable capacity, the expected export is at a similar level as in 2025.
- ✓ Italy: the dominant direction of exchange is towards Italy, caused by import needs and higher prices in Italy compared to the region of Southeast Europe. The increase in exports through cable increases by about 28%, i.e. 2.5 TWh compared to 2026. This is enabled by higher imports from the B&H price zone, lower exports to Albania, but also surpluses in the generation in Montenegro in relation to domestic needs.
- ✓ Albania: the dominant direction of exchange is still from Montenegro to Albania, as a result of the export transit to Greece and Albania, however, this export is reduced by about 360 GWh, as most of electricity due to higher prices goes to Italy. If Greece implements plans for high implementation of solar energy, it is expected that in the summer periods the direction will be towards Montenegro, or Central Europe.

6.3.1 Analysis of power flows and system elements loads

Based on the input data obtained from the relevant institutions (primarily EPCG), the following generation facilities are expected in the coming period (analysed in market and network analyses):

- **HPP Perućica -** Unit A8 58.5 MW;
- **WPP Gvozd II** - 25 MW connection to WPP Gvozd I,
- **HPP Komarnica 171.9 MW** - connection to SS Brezna 400/110 kV;
- **HPP Kruševo 120 MW** - connection to OHL 400 kV Sarajevo 20 (BA) - Brezna[12];
- **SPP Vilusi** - 30 MW connected to SS 220/110 kV Vilusi;
- **SPP Slano** - 50 MW connected to SS 220/110 kV Vilusi;
- **SPP Tuzi** - 135.9 MW connected to OHL 400 kV Podgorica - Tirana;
- **SPP Željezara** - 30 MW connected to the connection point of Željezara Nikšić.

It should be noted that the updated development plan in question did not specifically deal with the issue of connecting power plants for which no study (analysis of possibility) of connection was done (WPP Gvozd II, SPP Vilusi, SPP Slano), so for them the location and method of connection was adopted based previously accepted studies that dealt with this issue (**Error! Reference source not found.**).

In addition to the abovementioned power plants, the market and market model for 2032 also included power plants for which CGES conducted study (analysis of possibility) of connection, based on received requests from potential investors. The list of these power plants is in the Annex 11.4).

Bearing in mind the locations of the power plants for which connections are requested, several connection points, which were determined in order to reduce connection costs and maintain a high level of security of the EPS of Montenegro, were proposed.

[12] If a decision on a new ME-BA interconnection is adopted.

Of the distributive ones, the following SSs were modelled:

- **SS 110/10 kV Bečići** - connected according to the in/out principle to OHL 110 kV Budva - Bar;
- **SS 110/35 kV Buljarica** - connected according to the in/out principle to OHL 110 kV Bečići - Bar;
- **SS 110/10 kV Podgorica 7** - cutting of the line Podgorica 2 - Podgorica 5;
- **SS 110/35 kV Podgorica 9** - according to the in/out principle to OHL 110 kV Podgorica 1 - Podgorica 2 (II line).

In order to connect a large number of renewable sources, as well as the placement of energy from them, the following reinforcements (construction) of the transmission infrastructure are proposed:

- Construction of OHL 400 kV Brezna - Pivska planina - Sarajevo with SS 400/220 kV Pivska planina;
- Reconductoring OHL 220 kV Trebinje (B&H) - Perućica - Podgorica - Koplik (AL);
- SG 400 kV Čevo and connection 400 kV overhead lines (3 x in-out);
- SS 220/110 kV Vilusi with connection to network;
- Reconstruction of OHL 110 kV Nikšić - Bileća;
- SS 400/110 kV Trubjela with connection to network;
- SS 400/110 kV Kolašin with connection to network;
- Construction of OHL 110 kV Vilusi - Herceg Novi;
- Reconstruction of OHL 110 kV Podgorica - TPSS Trebješica - Andrijevica;
- Reconstruction and extension of plant 220/110 kV at SS Perućica;
- Construction of OHL 110 kV Virpazar - Ulcinj;
- Construction of OHL 110 kV Lastva - Kotor;
- Construction of 110 kV connection Ulcinj - Velika plaža - Velipojë with SS 110/35 kV Velika plaža.

Of the other elements that are expected to be in operation after 2032, but whose construction should start by the end of the planning period, the most important are:

- Extension of SS Podgorica 2 with transformation 110/10 kV;
- Construction of SS 110/35 kV Kolašin (Drijenak) and construction of OHL 110 kV Kolašin - Mateševo;
- Construction of SS 110/x kV Bijela;
- Construction of SS 110/10 kV Podgorica 6;
- Construction of SS 110/10 kV Podgorica 8;
- Construction of SS 110/35 kV Tuzi and connection 110 kV Tuzi - Golubovci;
- Construction of SS 110/35 kV Golubovci and connection 110 kV Podgorica 5 - Golubovci - Virpazar;
- Reconstruction of OHL 110 kV Bar - Budva – reconductoring;
- Reconstruction of OHL 110 kV Podgorica 2 - Virpazar – reconductoring;
- Reconstruction of OHL 110 kV Bar - Možura - Ulcinj – reconductoring;
- Construction of OHL 400 kV Čevo - Brezna (line II);
- Installation of synchronous condenser.

Based on all collected data, a market and network model was created, on which analyses of the system's benefit and security were made for the final year of the planning period. Figure 11-12 shows only those elements whose commissioning is envisaged by the expected time schedule by 2032.

6.3.2 Analysis of voltage-reactive conditions

In the period of low loads, as well as for 2026, higher voltages are noted mainly in the vicinity of generation facilities and parts of the lightly loaded network of 220 and 400 kV voltage levels, which results in reactive energy generation and additional voltage increase. The problem is primarily noted in SS Lastva when voltages are above the allowed values at the 400 kV voltage level. After the completion of the project of installation of a variable shunt reactor in SS Lastva, it is to be expected that the voltages will be brought within the allowed limits, but this also depends on the neighbouring systems and their voltage regulation.

Depending on the implementation of RES and the time schedule of their connection to the transmission network of Montenegro, it will be necessary to conduct a special study for the installation of a second reactor. The problem of high voltages in the mentioned region will certainly be dealt with through the study of the connection of new sources for those candidates who apply for connection after the acquisition of equipment, that is, the preparation of the final design of the power plant.

Generally speaking about voltage-reactive problems, high voltages are noted in all 400 and 220 kV hubs of the transmission network of Montenegro and Bosnia and Herzegovina.

6.3.3 Analysis of short-circuit currents

As for the previous two timeframes, the highest expected values of short-circuit currents are in SS Podgorica 1 and SS Podgorica 2 and amount to:

2032

SS Podgorica 1: I_{3pks} - 31,331 A **I_{1pks} - 35,914 A**

SS Podgorica 2: I_{3pks} - 32,244 A **I_{1pks} - 36,045 A**

Bearing in mind that the primary equipment was replaced in SS Podgorica 2 (40 kA), the stated value of the short-circuit current in SS Podgorica 2 is not considered critical.

Bearing in mind all of the above, it is recommended to propose in one of the detailed analyses a solution that will limit the values of short-circuit currents throughout the transmission network.

The following solutions may be proposed:

- network sectioning at the 110 kV voltage level,
- installation of low ohm resistance in order to reduce short-circuit currents,
- replacement of equipment where feasible and profitable,
- estimation of the probability of failures occurring at the moment of utilization of all (or a large number) generation units in Montenegro and the surrounding area.

Detailed values of short-circuit currents are shown in the Addendum 11.2.

6.3.4 Dynamic system stability analysis

Having in mind that there are currently no reliable models of Southeast European systems for dynamic analysis (SECI dynamic models for 2030 are under development at the time of preparing this Plan), this chapter provides only a qualitative overview of the expected parameters of transient stability.

Having in mind that new interconnections to Bosnia and Herzegovina and Serbia are expected to be put into operation in the period from 2025 to 2032, it is realistic to expect that the values of dynamic indicators of stability of the Montenegrin power system will be higher than in 2025. This is supported by the fact that all conventional sources in the Montenegrin power system, the southern part of Bosnia and Herzegovina and the Albanian power system (primarily all hydropower plants which are in operation in 2025) are in operation in 2032, which significantly affects faster clearing time of the affected element.

The lowest values of the critical clearing time were obtained for the faults in the branches converging on the busbars to which the power units are also connected, more precisely for the faults on the power plant side. The most critical values were obtained for the faults in the 220 kV lines converging on the SS Pljevlja 2 for which the critical clearing time was about 250 ms in 2025, where higher values can be expected in 2032 due to the new interconnection to Bosnia and Herzegovina and Serbia, i.e. lower critical values.

With regard to the faults in the 110 kV lines converging on HPP Perućica for which the critical clearing time was about 220 ms in 2025, it can be expected that in the worst case the values will remain at the same level.

6.3.5 Analysis of electricity losses

The analysis of losses was elaborated through the analysis and comparison of losses in 2032 in the analysed modes (winter and summer maximum), compared to calculated losses in 2026. It should be noted that the increase in consumption includes the entry into operation of tourist complexes Luštica, Porto Montenegro, Highway, etc. The forecast of the increase in the peak load of transformer stations (excluding "direct consumers") is about 1.5% annually.

The following table shows the losses in 2032 calculated in the analysed modes.

Table 6-8: Ratio between the power of losses and consumption for the characteristic hours in 2032[13]

Summer 2032					Winter 2032				
Generation	Consumption	Export	Losses*		Generation	Consumption	Export	Losses*	
MW	MW	MW	MW	%	MW	MW	MW	MW	%
3594	498	3198	64	1.73%	992	604	2658	43	1.32%

*** calculated compared to the total available power in the system**

Total losses in the EPS of Montenegro amount to about 43 MW for the winter and 64 MW for the summer mode, which amounts to 1.32% and 1.73%, respectively, compared to the total available energy in the system of Montenegro.

Making comparison with the losses from 2026, losses are at approximately the same level, and as with the case of power transit over the 600 MW cable, here the losses caused by the increase in transit to 1200 MW will be also compensated through the ITC mechanism within the ENTSO-E calculation of costs for covering losses (Inter TSO Compensation Mechanism), and will not affect the increase in the costs of CGES' operation.

The calculation of losses based on 8760 hour models for 2032 showed that a significant increase in losses can be expected compared to 2026, as a result of several factors, the most important of which are the commissioning of the second pole of the HVDC and a large number of generation facilities. In any case, all losses caused by international deliveries of electricity are compensated from a special fund (ENTSO-E ITC mechanism).

6.3.6 Transmission capacity and congestion analysis

Security analyses were made for the development of a transmission network for a high degree of connection of renewable sources and with all necessary reinforcements to enable their connection.

Of all the reported increases in 2032, the most important for the purposes of connecting renewables are:

[13] The costs of losses incurred by cross-border transits are reimbursed from the ITC mechanism.

1. Reconstruction of OHL 220 kV Trebinje (BA) - Perućica - Podgorica - Koplik (AL) and replacing the wire with one with a higher capacity;
2. SS 400/110/35 kV Brezna – commissioning in 2028 (connection of power of approximately 320 MW);
3. OHL 400 kV Pljevlja - Bajina Bašta (RS) commissioning in 2028 (connection of power of approximately 350 MW)[14];
4. SG Čevo – commissioning in 2027 (connection of power of approximately 1100 MW);
5. SS 220/110 kV Vilusi – commissioning in 2028 (connection of power of approximately 200 MW);
6. SS 400/110 kV Trubjela – commissioning in 2029 (connection of power of approximately 330 MW).

In the analysis of N-1 security for winter and summer mode, overloads of over 100% of two elements in the transmission network of the Montenegrin EPS are noted. These are 110 kV OHL Trebinje (BA) - Herceg Novi and Herceg Novi - Tivat, during the outage of 400 kV overhead line Trebinje (BA) - Lastva.

The problem of the mentioned overload is a consequence of the operation of these overhead lines in parallel, i.e. 110 kV connection Lastva - Tivat - Herceg Novi - Trebinje (BA) and 400 kV connection Lastva - Trebinje (BA) and is resolved by changing the switching state in the 110 kV network.

At the same time, the high level of load of the 400 kV OHL from or towards the direction of Trebinje contributes to the fact that a good part of the energy, in case of its outage, "spills over" to the 110 kV network and leads to overload from the direction of Trebinje.

For the rest of the network of CGES, it can be stated that it meets the security criteria envisaged by the Transmission Grid Code of CGES **Error! Reference source not found.**, provided that all proposed solutions in the previous period are implemented by 2032.

As a solution to the identified problems, the following reconstructions, operational measures and construction of transmission elements are proposed (Table 6-9) by 2032.

Table 6-9: Analysis of reinforcements and elimination of identified uncertainties in the transmission network of Montenegro

2032				
Element outage/ network problem	**Overloaded element**	**Load [%]**	**Load relief measure**	**Development measure**
Import from Italy on HVDC 1200 MW (Base case)[15]	**OHL 220 kV Pljevlja - Bajina Bašta (RS)[16]**	**267**	**Reduction of the exchange power on the HVDC**	**400 kV Brezna - Sarajevo 20 (BA), in addition to upgrading the 220 kV Pljevlja - Bajina Bašta (RS) overhead line to 400 kV.**
TR 1 40 MVA in SS Ulcinj	**TR 2 31.5 MVA in SS Ulcinj**	**118**	**Consumption reduction**	**Increasing the capacity of transformers in SS Ulcinj**
400 kV Trebinje (BA) - Lastva (ME)	**Herceg Novi (ME) - Trebinje (BA) Herceg Novi - Tivat**	**110**		**Construction of 110 kV OHL Vilusi - Herceg Novi**

[14] In base topology, it operates at 220 kV.

[15] In line with ENTSO-E TYNDP 2024, commissioning of the second pole of HVDC ME-IT is postponed beyond 2027.

[16] Planned in previous plans and international studies to be completed by 2028.

Of the above projects, in order to couple the electricity market and connect renewable sources, two new potential interconnections stand out, towards Bosnia and Herzegovina and Albania:

- 400 kV Brezna - Sarajevo 20 (BA).

The degree of implementation of new interconnections towards neighbouring systems depends on the possibility to implement them at a given moment and thus enable increased exchange of electricity through the electricity system of Montenegro, primarily for the needs of import/export, but also to couple the electricity markets of the Southeast Europe region, enabling increased benefits to consumers and producers of electricity.

The connection from Montenegro towards Serbia depends on the pace of construction and reconstruction of the existing infrastructure in the western part of Serbia, i.e. the construction of hundreds of kilometres of the new 400 kV network in the next 5 years, which is envisaged by the Development Plan of EMS (Transmission System Operator of Serbia).

According to the latest information, EMS has started activities on the implementation of Section IV of the Trans-Balkan Corridor, but for its implementation, it is necessary to complete Section III 400 kV Obrenovac (RS) - Bajina Bašta (RS).

On the other hand, significant new infrastructure has been built on the territory of Montenegro, which is ready for full utilisation and connection to neighbouring systems, primarily for the purpose of implementing Section IV of the Trans-Balkan Corridor, i.e. the connection towards Serbia.

The second 400 kV interconnection from the systems of Montenegro and Bosnia and Herzegovina would enable the elimination of congestion on the border with BiH (conditionally also towards Serbia, due to the electrical connection of these three systems). This operation mode should further encourage the full use of energy potentials of Montenegro, Bosnia and Herzegovina, but also other neighbouring systems for which a strong connection with the Italian electricity market should offer a reliable investment signal and guarantee the profitability of investments in electricity generation.

- OHL 110 kV Velika plaža (with construction of OHL 110 kV Ulcinj - Velika plaža and reconstruction of SS Velika plaža to 110 kV) - Dajc (AL)

The position of Albania and Montenegro in Southeast Europe provides favourable conditions for it to act as a region of "electricity channelling" (from Italy/Montenegro to Central Europe and vice versa), which requires new requirements for constructing a stable and secure transmission network.

Further development of the South East Europe (SEE) regional electricity market in accordance with the Energy Community Treaty and the expected opening of local electricity markets in both countries, with the need to meet the EC’s targets for RES implementation in Montenegro (ME) and Albania (AL), which further implies the need to further strengthen internal and interconnection links.

The geographical characteristics of Montenegro and Albania, as well as the energy policy of diversification of conventional electricity sources and the revised legal framework of both countries paved the way for the construction and connection of an increasing number of renewable energy plants (wind and photovoltaic energy).

There are many new private investors who have expressed interest in implementing new RES projects near the border between the two countries, with the intention of exporting generation to the rest of Southeast Europe, i.e. the Italian electricity market.

The geographical overview of the region of interest is given in the Figure 6.4.

The project includes the construction of a new 110 kV connection between Montenegro and Albania (with a capacity of 245 MVA), including the construction of the necessary substations 110/x kV Kosmac (AL) and SS Velika plaža. The diagram is shown in the following figure:

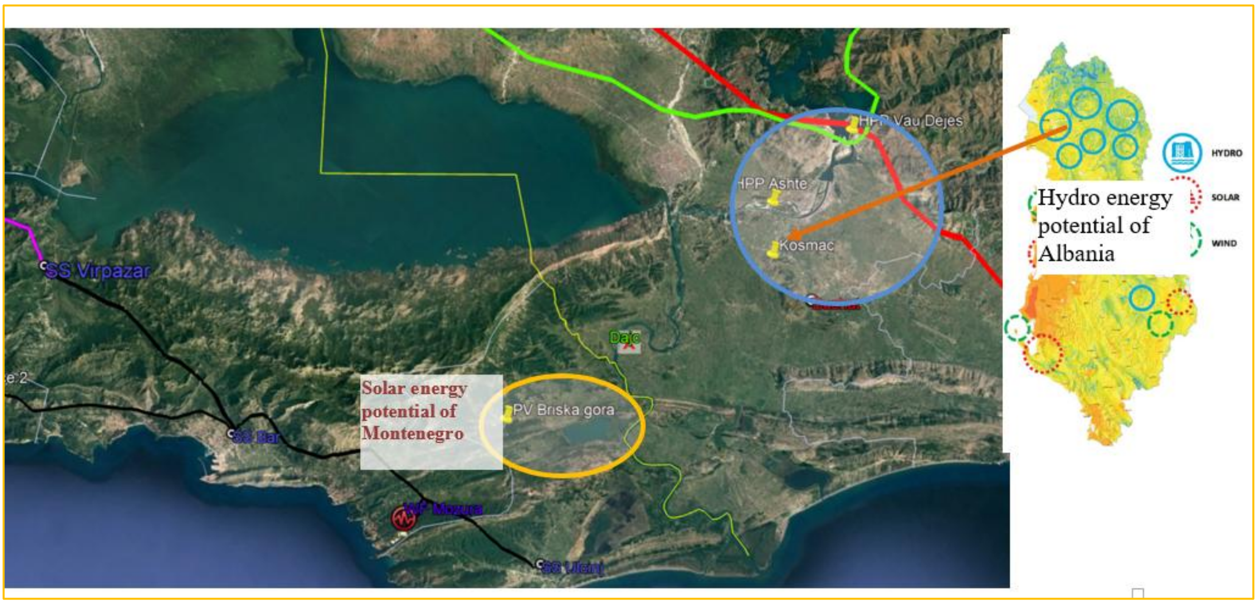


Figure 6-6: Geographical overview of the region between Montenegro and Albania with RES capacities

Having in mind the following facts:

- the average age of 220 kV overhead lines and transformers 220/110 kV will be 56 years in 2032,
- the reliability of the 220 kV transmission system has been already significantly reduced,
- parallel operation of 400 and 220 kV networks connecting virtually the same parts of the system and representing constraints in the transit of energy through the transmission system of Montenegro reducing cross-border transmission capacities,
- almost certain upgrade of 220 kV network in western Serbia to the 400 kV voltage level (previous plans predicted by 2030, but this is no longer realistic and for now it is not specifically addressed in the EMS plans).

it is necessary to give recommendations and guidelines for the future of the 220 kV network in Montenegro, or to answer the question of whether and how it is possible to abandon the 220 kV network. The issue of the possible abandonment of the 220 kV network is very complex and requires detailed analysis of the various characteristic conditions of the network to detect possible problems that can arise, and therefore, one scenario of possible abandonment of the 220 kV network in phases is given below. The gradual abandonment of the 220 kV voltage level would be performed in phases in accordance with the time schedule of the possibility of disconnection and termination of operation of the 220 kV interconnection overhead lines (agreement with neighbouring transmission system operators), as well as the time schedule of the construction of certain transmission system elements , which has a significant impact on the implementation of the entire project.

The whole project requires a more detailed analysis, but it should be emphasised that in the characteristic modes for 2032, no major network problems were identified in the case of the above-described abandonment of the 220 kV network, except for the aforementioned reinforcements in the 110 kV network in the direction of Bijelo Polje - Mojkovac unless another 400 kV overhead line in this direction that would connect SS Pljevlja towards Serbia and SS Podgorica 1 towards Albania is constructed.

Bearing in mind that through its plan, CGES envisages an increase in capacity on the 220 kV stretch from Trebinje (BiH) to Albania, as well as the procurement of a 220/110 kV transformer in Perućica, this imposes the necessity of assessing the need for and methods of abandoning the 220 kV voltage level through special studies and analyses.

The perspective of the construction of new interconnections towards Bosnia and Herzegovina and Albania (in light of strengthening links towards neighbouring systems):

- ✓ New 400 kV interconnection Montenegro - Albania. Namely, according to the transmission system development plan, after 2030, OST plans to build a 400/220 kV transformation that would be connected to 400 kV overhead line Podgorica - Tirana, in the section between Tirana and Vau Dejes (in SS Komen, 21 km from Vau Dejes). Based on limited information related to the current initiative, the following can be analysed: to remove 220 kV overhead line Podgorica-Koplik-Vau Dejes and instead of it construct a new 400 kV overhead line, or a similar combination.
- ✓ New 400 kV interconnection Montenegro - Bosnia and Herzegovina. Considering that the studies conducted in the past few years have shown that the expected direction of capacity import to Montenegro is from Bosnia and Herzegovina, because this system is the first neighbouring system with the expected energy surplus as long as 2016, it was logical to assume that their capacity surplus will be transferred to Montenegro towards the HVDC cable. One of the proposals for the analysis is a new interconnection overhead line that would connect one of the existing 400 kV switchyards, or the future switchyard 400 kV Brezna in Montenegro, with the neighbouring connection point 400 kV (existing or planned) in BiH, where SS Sarajevo 20 (BiH) is the most logical option. The integration of this overhead line would require the dismantling of the 220 kV section of the overhead line Piva - Sarajevo 20 and the use of the 400 kV section from the location in BiH where the construction of HPP Buk Bijela was previously planned.

6.3.7 Analysis of general indicators of quality electricity delivery

With regard to indicators of the quality electricity delivery by 2032, a significant reduction in the number is expected as a result of the reconstruction, revitalisation and construction of a number of transmission capacities, primarily:

- Construction of OHL 110 kV Vilusi - Herceg Novi;
- Construction of SS 110/10 kV Bečići;
- SS 400/110/35 kV Brezna;
- Construction of OHL 400 kV Pljevlja 2 - Bajina Bašta - Višegrad;
- Construction of OHL 110 kV Virpazar - Ulcinj;
- Construction of a series of transformer stations in the area of Podgorica and the coastal part of Montenegro.

Taking into account the previously mentioned reinforcements and reconstructions, a significant reduction in the number of outages and unavailability of certain elements of the transmission network is expected, primarily:

- SS Brezna;
- SS Podgorica 3;
- SS Podgorica 5;
- SS Kličevo.

For 2032, the expected values of AIT (taking into account experiences with existing SSs that are either bidirectionally supplied or reconstructed) are presented in the following diagram:

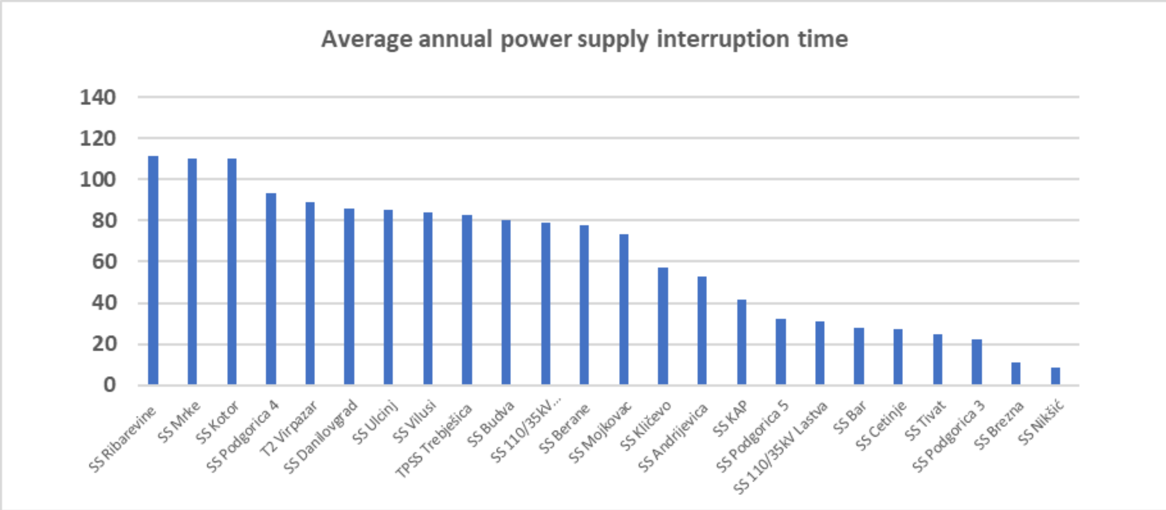


Figure 6-7: Average interruption time in 2032

Of course, one should refrain from assessing the condition of the network for 10 years and possible unplanned and sudden failures due to causes beyond the control of CGES' Maintenance Department.

7 Necessary investments in the period 2026-2032

7.1 Overview of necessary new system elements and remedial actions on existing elements

CGES Investment Plan for 2026 contains significant projects for the development of the electricity transmission system, aimed at providing safer, more reliable and better quality electricity transmission services, as well as providing conditions for the connection of new generation facilities.

Pursuant to Article 10 of the Rules for Planning, the investments presented in the Investment Plan for 2026 can be divided into investments in the construction of new or remedial actions on existing electricity transmission infrastructure, investments in telecommunications and control infrastructure, investments resulting from the need to replace elements whose service life has endangered their safe operation, investments so-called smart grid projects aimed at optimal operation of the transmission system, as well as investments implemented by other investors, for which an infrastructure purchase programme has been prepared, and investments from the group "other" that contribute to the improvement of the CGES core activity. In addition, in accordance with Article 10 of the Rules for Planning, the Investment Plan in question contains funds intended for the implementation of investments that cannot be foreseen in the year of submission of the application for approval of the investment plan, i.e. investments whose implementation may become necessary during the planning period due to unforeseen circumstances (Contingency Plan).

Part of the investments within the Plan has been already included in previous CGES plans and the Agency's decisions. Table 7-1 je contains the list of necessary investments in the planning period by 2032.

Table 7-1: Overview of necessary new transmission network elements and remedial actions on existing ones

INVESTMENTS THE IMPLEMENTATION OF WHICH IS PLANNED TO BEGIN DURING THE PERIOD 2026-2032, OR THE IMPLEMENTATION OF WHICH BEGAN BEFORE THE SPECIFIED PERIOD			
NO.	**ID NO.**	**NAME OF INVESTMENT**	**NEW ELEMENTS OR REMEDIAL ACTIONS ON EXISTING ELEMENTS**
1	IPI009	Construction of OHL 400 kV OHL Pljevlja 2 - Bajina Bašta - Višegrad	New element
2	IPI058	Installation of variable shunt reactor 250 MVAr in SS Lastva	New element
3	IPI019	Construction of SS 400/110/35 kV Brezna – II phase	New element
4	IPI017	Construction of OHL 110 kV Lastva - Kotor	New element
5	IPR009	Reconstruction of OHL 110 kV Budva - Lastva	Remedial action on existing elements
6	IPR010	Reconstruction of OHL 110 kV Lastva - Tivat – II phase	Remedial action on existing elements

7	IPI061	Construction of OHL 400 kV Brezna - Pivska planina - Sarajevo with SS 400/220 kV Pivska planina	New element
8	IPI062	Construction of 110 kV connection Ulcinj - Velika plaža - Velipojë with SS 110/35 kV Velika plaža	New element
9	IPR115	Reconstruction and extension of 220/110 kV plant at SS Perućica	Remedial action on existing elements
10	IPR072	Reconstruction of OHL 110 kV Nikšić - Bileća	Remedial action on existing elements
11	IPI015	Construction of OHL 110 kV Virpazar - Ulcinj	New element
12	IPR109	Reconstruction of OHL 110 kV Podgorica 1 - TPSS Trebješica - Andrijevica	Remedial action on existing elements
13	IPR110	Reconductoring OHL 220 kV Trebinje (BiH) - Perućica - Podgorica - Koplik (AL)	Remedial action on existing elements
14	IPI030	Construction of SS 110/35 kV Luštica and connection to 110 kV network	New element
15	IPI060	Construction of SS 110/10 kV Bečići	New element
16	IPI055	Construction of SS 110/10 kV Podgorica 7 and its connection to 110 kV network	New element
17	IPI056	Construction of SS 110/35 kV Buljarica and its connection to 110 kV network	New element
18	IPI070	Construction of SS 110/x kV Podgorica 9 with connection to 110 kV network	New element
19	IPR089	Reconstruction of OHL 110 kV Podgorica - Danilovgrad - Perućica	Remedial action on existing elements
20	IPI016	Construction of OHL 110 kV Vilusi - Herceg Novi	New element
21	IPR116	Procurement of power transformers	New element
22	IPR118	Revitalisation of 110 kV overhead lines	Remedial action on existing elements
23	IPR125	Extension of SS Podgorica 2 with 110/10 kV transformation	Remedial action on existing elements
24	IPI014	Construction of SS 110/35 kV Kolašin (Drijenak) and construction of OHL 110 kV Kolašin - Mateševo	New element
25	IPI071	Construction of SS 110/x kV Bijela and connection to transmission network	New element
26	IPI072	Construction of SS 110/10 kV Podgorica 6 and connection to transmission network	New element

27	IPI073	Construction of SS 110/10 kV Podgorica 8 and connection to transmission network	New element
28	IPI075	Construction of SS 110/35 kV Golubovci and connection 110 kV Podgorica 5 - Golubovci - Virpazar	New element
29	IPI074	Construction of SS 110/35 kV Tuzi and connection 110 kV Tuzi - Golubovci	New element
30	IPR126	Reconstruction of OHL 110 kV Bar - Možura - Ulcinj – reconductoring	Remedial action on existing elements
31	IPR127	Reconstruction of OHL 110 kV Bar - Budva – reconductoring	Remedial action on existing elements
32	IPR128	Reconstruction of OHL 110 kV Podgorica 2 - Virpazar – reconductoring	Remedial action on existing elements
33	IPI078	Construction of OHL 400 kV Čevo - Brezna (line II)	New element
34	IPR129	Installation of synchronous condenser	New element

7.2 Overview of unnecessary remedial actions on existing elements during the planning period

The planned new project for the construction of the 110/10 kV Bečići substation, as well as the installation of busbar breaker in SS Budva as a quick solution (completed), created preconditions for abandoning the expensive investment in the 110 kV busbar reconstruction in Budva (GIS design), which was included in the previous plans.

Table 7-2: Overview of investments in existing elements being postponed

NO.	Investments in remedial actions on existing elements being postponed	Investments due to which remedial actions on existing elements are postponed
1	Reconstruction of busbars in SS 110/35 kV Budva	Construction of SS 110/10 kV Bečići

7.3 Overview of other electricity transmission system investment needs

All investments that are not treated by subchapters 7.1 and 7.2, and which are forecasted in the Investment Plan for 2026, can be classified in one of the following categories: control infrastructure, telecommunications infrastructure, smart grid projects, i.e. smart networks whose objective is the optimal operation of the transmission system, investments implemented by other investors and for which an infrastructure purchase programme was developed, as well as investments in the group "other" that contribute to the improvement of the core activity of CGES.

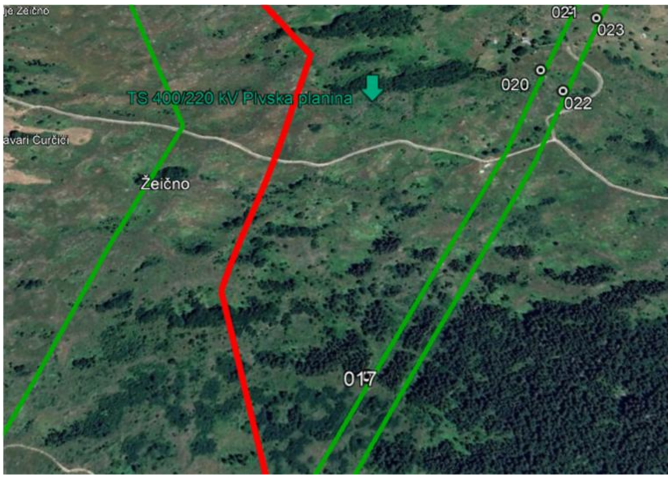
Certain funds are envisaged for the implementation of investments that could not be foreseen at the time of the preparation of the plan for 2026, i.e. for unforeseen interventions in the period in question, so in addition to the above, we can also talk about the category of unforeseen investments, which by their nature also represent investments in the transmission system.

8 Techno-economic analyses

8.1 Construction of new transmission system elements or remedial actions on existing transmission system elements that change the nominal power

Below are techno-economic analyses for the construction of new transmission system elements or remedial actions on existing transmission system elements that change the nominal power, and which were not approved in the previous approval procedures of the Energy and Water Regulatory or whose technical scope was changed compared to the already approved scope of investment.

<u>Construction of OHL 400 kV Brezna - Pivska planina - Sarajevo with SS 400/220 kV Pivska planina</u>

<table>
<tr><th>NAME OF INVESTMENT</th><th>GEOGRAPHICAL LOCATION</th></tr>
<tr><td>Construction of OHL 400 kV Brezna - Pivska planina - Sarajevo with SS 400/220 kV Pivska planina</td><td rowspan="5">
</td></tr>
<tr><td>INVESTMENT IDENTIFICATION NUMBER</td></tr>
<tr><td>IPI061</td></tr>
<tr><td>DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]</td></tr>
<tr><td>A significant new infrastructure has been built in Montenegro, which is ready for full-scale utilisation and connection to neighbouring systems, primarily for the implementation of Section IV of the Trans-Balkan Corridor.
The new 400 kV interconnection between the systems of Montenegro and Bosnia and Herzegovina would eliminate congestion at the border with Bosnia and Herzegovina (conditionally also towards Serbia, due to the electrical connection between the three systems). This operational mode should further encourage the full utilisation of the energy potential of Montenegro, Bosnia and Herzegovina, and other neighbouring systems, for which a strong connection to the Italian electricity market should provide a reliable investment signal and guarantee the profitability of investments in electricity generation.
The project includes the construction of the following sections:</td></tr>
</table>

• *OHL 400 kV Brezna (ME) - Pivska planina (ME) - Sarajevo 20 (BiH);* • *SS 400/220 kV Pivska planina;* • *OHL 220 kV Pivska planina - HPP Piva.* *The objective of the project is to improve the transmission network in the northwestern region of Montenegro in order to improve the stability of the network, enable the connection of RES and upgrade the interconnection with B&H. The project will support cross-border electricity trade, creating a favourable environment for the development of RES projects in the region.* *The new connection between Montenegro and Bosnia and Herzegovina will further eliminate the possibility of congestions at this border, supporting open access to a larger electricity market in the region and with the EU. The project will also directly reduce network losses and provide a connection with the future HPP Kruševo and improve the connection with HPP Piva.*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 3 - Security of uninterrupted electricity trade in the region* *Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	4,200,000.00.
K1.1 Energy cost savings [*€/year*]	1,650,000 €. Reduced use of energy sources (Thermal Power Plant Pljevlja) by importing energy in certain hours, when the price of electricity on the market is higher in Europe, and the generation of the Pljevlja thermal unit is reduced. Benefit is contained in SEW.
K1.2 Gas emissions cost savings	2,550,000 €.

[*€/year*]	Based on the reduction in the engagement of the thermal unit, CO2 emissions are also reduced. Contained in SEW.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	26,600.00 t/year. 718,200.00 €/year. This factor was estimated based on EU experience because it does not refer to CO2 emissions from K1, but rather to the difference in the price of CO2 emissions and the ETS price (in the EU, 78-81€/t CO2 at the beginning of October 2025). Given that the price used is 105 €/t for CO2, the difference is 24-27€/t.
K3 RES integration [*MW*] or [*MWh/year*]	650 MW.
K4 Non-CO_2 emissions [*t/year*]	Nox CO Sox 123 24 436
K5 Network losses [*MWh/year*]	7,700.00.
K6 Adequacy [*MWh/year*]	No impact.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	4.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	Currently, it is technically unfeasible to measure the impact, but it is expected to have an impact after the adoption of separate laws and the elaboration of the methodology within ENTSO-E. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). Generally speaking, the project has an impact on increasing the benefits of improving transient stability in terms of the ability of the system to remain synchronised and stable after major, sudden disturbances. The greater the number of transmission elements, the more stable the system can be in case of major disturbances. When it comes to voltage stability, it enables stable voltage conditions in SS Brezna.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. Frequency stability is defined as the electric power system's ability to maintain a stable frequency within the nominal range, both in conditions of constant deviations between generation and consumption, and after serious system

	disturbances that lead to a significant imbalance between generation and consumption. According to this definition, even in future scenarios, frequency stability is generally not expected to be a serious problem during normal disturbances, but rather during severe events, such as system separations, especially in situations with high power flows in the AC system and low inertia.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely. In addition, the point of the Bosnia and Herzegovina - Sarajevo 20 system does not have generation capacities that would provide voltage stability when the system is restored.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	No impact.
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	5.
EXPENSES	
T1 CAPEX [*€*]	70,065,000.00
T2 OPEX [*€/year*]	525,000.00 (In accordance with the generally accepted methodology of CIGRE, the expected maintenance costs grow according to the "S" curve from 0.7% of investment costs at the beginning of the facility's life to 2.2% of investment costs at an average time interval of 25 years of facility utilisation. In accordance with the aforesaid, the value of Opex was taken as the average value of operating costs of 1.5% of the investment value of the facility)

Comparison of variants for the planned connection with Bosnia and Herzegovina::

NAME OF INVESTMENT	*Construction of interconnection 400 kV Montenegro - Bosnia and Herzegovina*	
EVALUATION	**Construction of OHL 400 kV Brezna - Pivska planina - Sarajevo with SS 400/220 kV Pivska planina**	**Construction of OHL 400 kV Brezna - Gacko**
TECHNICAL DESCRIPTION OF VARIANT [it is recommended to be up to 100 words]	**Significant new infrastructure has been built on the territory of Montenegro, which is ready for full-scale operation and connection to neighbouring systems, primarily for the purpose of implementing Section IV of the Trans-Balkan Corridor.** **The new interconnection 400 kV from the system of Montenegro and Bosnia and Herzegovina would enable the elimination of congestion at the border with Bosnia and Herzegovina.** **This type of operation mode should additionally encourage the full utilisation of the energy potentials of Montenegro and Bosnia and Herzegovina.** **The project includes the construction of the following sections:** **• OHL 400 kV Brezna (ME) - Pivska planina (ME) - Sarajevo 20 (BiH)** **• SS 400/220 kV Pivska planina** **• OHL 220 kV Pivska planina - HPP Piva.** **The new connection between Montenegro and Bosnia and Herzegovina will further eliminate the possibility of congestion at this border, supporting open access to a larger electricity market in the region and with the EU. The project will ensure a connection with the future hydroelectric power plant**	**Significant new infrastructure has been built on the territory of Montenegro, which is ready for full-scale operation and connection to neighbouring systems, primarily for the purpose of implementing Section IV of the Trans-Balkan Corridor.** **The new interconnection 400 kV from the system of Montenegro and Bosnia and Herzegovina would enable the elimination of congestion at the border with Bosnia and Herzegovina.** **This type of operation mode should additionally encourage higher utilisation of the energy potentials of Montenegro and Bosnia and Herzegovina.** **The project includes the construction of the following sections:** **• OHL 400 kV Brezna (ME) - Gacko (BiH)** **The new connection between Montenegro and Bosnia and Herzegovina will further eliminate the possibility of congestion at this border, supporting open access to a larger electricity market in the region and with the EU.**

	Kruševo and improve the connection with HPP Piva.	
VARIANT MEETS THE TECHNICAL CRITERIA PRESCRIBED BY THE TRANSMISSION GRID CODE [YES/NO]	**YES**	**YES**
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO WHOSE ACHIEVEMENT THE INVESTMENT CONTRIBUTES	**Objective 1 - Elimination of observed uncertainties in the past period** **Objective 2 - National system security** **Objective 3 - Security of uninterrupted electricity trade in the region** **Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth** **Objective 6 - Coupling the European electricity market**	**Objective 1 - Elimination of observed uncertainties in the past period** **Objective 2 - National system security** **Objective 3 - Security of uninterrupted electricity trade in the region** **Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth** **Objective 6 - Coupling the European electricity market**
K1 [€]	**4,200,000**	**1,750,000**
K3 [MWh/year]	**940,447**	**590,000**
K5 [MWh/year]	**7,700**	**4,400**
K6 [MWh/year]	**0**	**0**
K9 [€]	**0**	**0**
K11 [rating scale]	**5**	**3**
CAPEX [€]	**70,065,000.00**	**22,000,000.00**
OPEX [€/year]	**1,050,975.00**	**330,000.00**
VARIANT RANKING	**1**	**2**

Related to the comparison of the variants for the investment in question IPI061, comprehensively, as a result of significantly greater benefits (coefficients K1, K3, K5), and taking into account the critical routes of overhead lines in BiH through the protected area and the decision of the transmission network operator of BiH to take into account the Brezna - Sarajevo 20 variant as more acceptable for its system, **variant 1 is shown to be more favourable**, although it has a higher investment value than variant 2. Variant 1 would also enable the connection of HPP Kruševo to the EPS of Montenegro, which additionally makes it much more acceptable for Montenegrin society as a whole. This assessment is also based on detailed technical, system and economic arguments, which are presented below.

1. Technical and system reasons

* SS Pivska planina enables the integration of the existing 220 kV lines of HPP Piva – HPP Pljevlja and HPP Piva – Sarajevo 20 into the new 400/220 kV transmission node. This makes use of the existing infrastructure and reduces the need to construct new routes, with a significant increase in transmission reliability.

* With the introduction of the new 400/220 kV substation, the 220 kV network of northwestern Montenegro is directly connected to the 400 kV system, which the Brezna – Gacko variant does not provide.

* The project creates a new strong node in the transmission network, which improves voltage stability, reduces losses and unloads existing corridors (especially in the region of Pljevlja and Piva).

* Stability and security analyses (N-1 criterion) show that variant no. 1 with the construction of SS Pivska planina reduces overloads on part of the BiH network (Trebinje – Mostar 3), while not causing new critical modes.

2. Economic and strategic reasons

* Within the ENTSO-E methodology (CBA), variant no. 1 shows a greater positive impact on social and economic wealth, security of supply and integration of renewable energy sources.

* The connection of future generation facilities (HPP Kruševo, wind power plants and solar power plants in the north of Montenegro) is possible directly to SS Pivska planina, which increases the flexibility and development potential of the network.

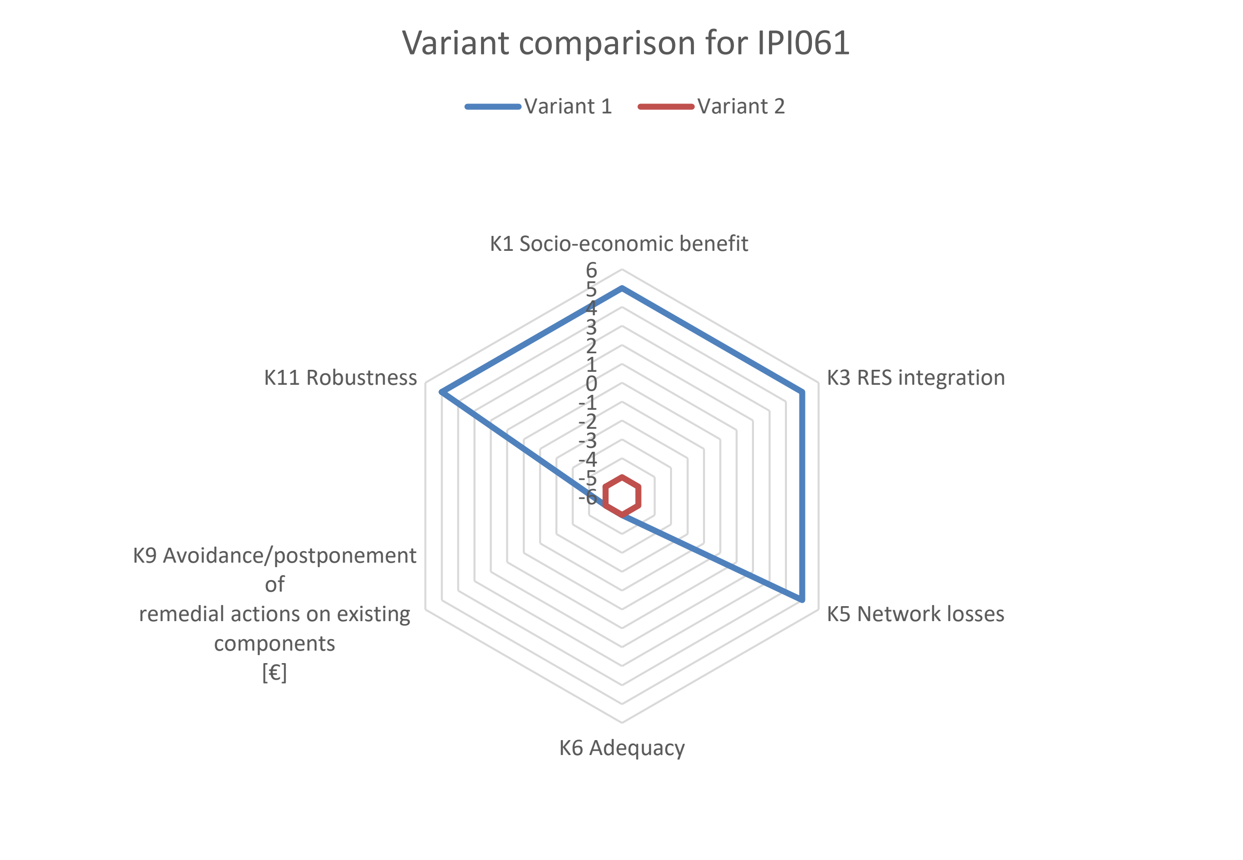
* Compared to the variant Brezna – Gacko, variant no. 1 achieves significant regional benefits thanks to the increase in transmission capacity (GTC) towards BiH, Serbia and Kosovo.

3. Conclusion

The variant of the 400 kV connection via SS Pivska planina represents a technically optimal and economically justifiable solution. It ensures the creation of a new 400/220 kV node in the northwestern part of Montenegro, increases the security, stability and flexibility of the electric power system, and enables the long-term development and integration of new renewable sources.

Compared to the Brezna – Gacko variant, the option with the construction of SS 400/220 kV Pivska planina brings wider regional benefits and is a strategically correct choice for CGES and the electric power system of Montenegro.

Variant comparison radar chart



Note: As only two variants are compared, and bearing in mind that in variant 2 all the coefficients of interest are such that they are assigned the value "-5" on the radar diagram, these are the final values on the illustration of interest "-6" and "6" so that the diagram for variant no. 2 is also visible.

Construction of 110 kV connection Ulcinj - Velika plaža - Velipojë with SS 110/35 kV Velika plaža

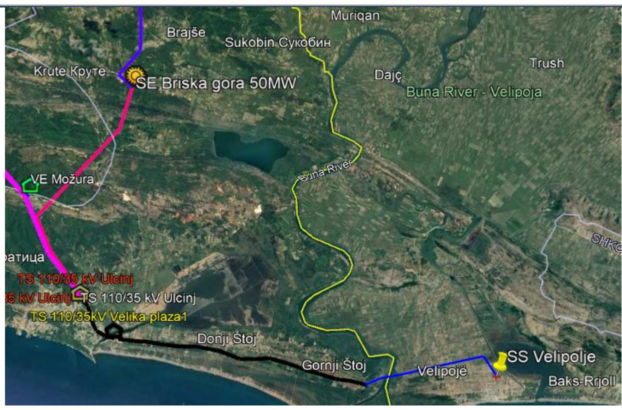
NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Construction of 110 kV connection Ulcinj - Velika plaža - Velipojë with SS 110/35 kV Velika plaža	
INVESTMENT IDENTIFICATION NUMBER	
IPI062	

DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]

In order to ensure the security of power supply to the southern part of Montenegro, connect renewable energy sources in the Ulcinj region, and link with the neighbouring Albanian transmission system, there is a need to construct a new 110 kV line Ulcinj 2 (SS 110/35 kV Velika plaža) - Velipojë with the construction of SS 110/35 kV Velika plaža. One of the objectives of constructing this line and SS Velika plaža is to ensure increased cross-border electricity exchange between Albania and Montenegro. The project in question will enable the integration of renewable electricity sources at the border areas of the two countries, and enable the further development of the tourism industry. In order to enable connection to the existing local network, the construction of the following facilities is planned:

- *New 110/35 kV substation in the Municipality of Ulcinj (reconstruction of the existing 35/10 kV Velika plaža substation and upgrading it to the 110 kV voltage level);*
- *Line 110 kV Ulcinj - Velika plaža – Velipojë (AL), with a transmission capacity of 245 MVA.*

The mentioned new SS 110/35 kV Velika plaža would be connected on one side to the existing SS 110 kV Ulcinj, and on the other side to the planned SS Velipojë in Albania.



☒ **Project** ☐ **Programme**

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security
Objective 3 - Security of uninterrupted electricity trade in the region
Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth

BENEFITS	
K1 Social and economic wealth [*€/year*]	685,200.00.
K1.1 Energy cost savings [*€/year*]	265,000€/year.
K1.2 Gas emissions cost savings [*€/year*]	200,200€/year. Based on the reduction in the engagement of the thermal unit, CO2 emissions are also reduced. Contained in SEW.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	340 t/year, 9,180€/year. This factor was estimated based on EU experience because it does not refer to CO2 emissions from K1, but rather to the difference in the price of CO2 emissions and the ETS price (in the EU, 78-81€/t CO2 at the beginning of October 2025). Given that the price used is 105 €/t for CO2, the difference is 24-27€/t.
K3 RES integration [*MW*] or [*MWh/year*]	50 MW.
K4 Non-CO_2 emissions [*t/year*]	Nox CO SOx 2 1 0
K5 Network losses [*MWh/year*]	6,480.00.
K6 Adequacy [*MWh/year*]	333,6.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	2.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	There is no impact, but it can be expected after the legislation on the use of balancing services in accordance with EU rules and access to one of the balancing platforms, when an assessment (calculation) will be made. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has a little impact on increasing the benefits of improving transient stability in terms of the ability of the system to remain synchronised and stable after major, sudden disturbances. In any case, it supports the stability of the Ulcinj area in the event of a water outage from Ulcinj to Bar and keeps the WPP Možura in synchronism.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. Frequency stability is defined as the electric power system's ability to maintain a stable frequency within the nominal

	range, both in conditions of constant deviations between generation and consumption, and after serious system disturbances that lead to a significant imbalance between generation and consumption. According to this definition, even in future scenarios, frequency stability is generally not expected to be a serious problem during normal disturbances, but rather during severe events, such as system separations, especially in situations with high power flows in the AC system and low inertia.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely. In addition, the point of the Albanian system with which the Montenegrin system is connected does not have conventional generation capacities that would provide voltage stability when the system is restored.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems).
K9 Avoidance/postponement of remedial actions on existing components [*€*]	No impact.
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	4.
EXPENSES	
T1 CAPEX [*€*]	35,000,000.00
T2 OPEX [*€/year*]	525,000.00 (In accordance with the generally accepted methodology of CIGRE, the expected maintenance costs grow according to the "S" curve from 0.7% of investment costs at the beginning of the facility's life to 2.2% of

	investment costs at an average time interval of 25 years of facility utilisation. In accordance with the aforesaid, the value of Opex was taken as the average value of operating costs of 1.5% of the investment value of the facility)

Comparison of variants for the planned connection with Albania:

NAME OF INVESTMENT	*Construction of interconnection 110 kV Montenegro - Albania*	
E V A L U A T I O N	**Construction of 110 kV connection Ulcinj - Velika plaža - Velipojë with SS 110/35 kV Velika plaža**	**Construction of OHL 110 kV Virpazar - Velipojë**
TECHNICAL DESCRIPTION OF VARIANT [it is recommended to be up to 100 words]	**In order to ensure the security of power supply to the southern part of Montenegro, the connection of renewable sources in the region of Ulcinj, as well as the connection with the neighbouring Albanian transmission system, a need appeared for the construction of a new line 110 kV Ulcinj - SS 110/35 kV Velika plaža - Velipojë (Albania) with the construction of SS 110/35 kV Velika plaža.** **The project in question will enable the integration of renewable electricity sources in the border areas of the two countries, and enable the further development of the tourism industry.** **The construction of the following facilities is planned:** • **New substation 110/35 kV in the Municipality of Ulcinj (reconstruction of the existing SS 35/10 kV Velika plaža and its upgrade to 110 kV voltage level)** • **Line 110 kV line Ulcinj - Velika plaža - Velipojë (AL), with a transmission capacity of 245 MVA.** **The mentioned new SS 110/35 kV Velika plaža would be connected on one side to the existing SS 110 kV Ulcinj, and on the other side to the planned SS Velipojë in Albania.**	**In order to ensure the security of power supply to the southern part of Montenegro, the connection of renewable sources in the region of Ulcinj, as well as the connection with the neighbouring Albanian transmission system, a need appeared for the construction of a new line 110 kV Virpazar - Velipojë (Albania). The project in question will enable the integration of renewable electricity sources in the border areas of the two countries, and enable the further development of the tourism industry.** **The construction of the following facilities is planned:** • **Line 110 kV Virpazar - Velipojë (AL), with a transmission capacity of MVA.**

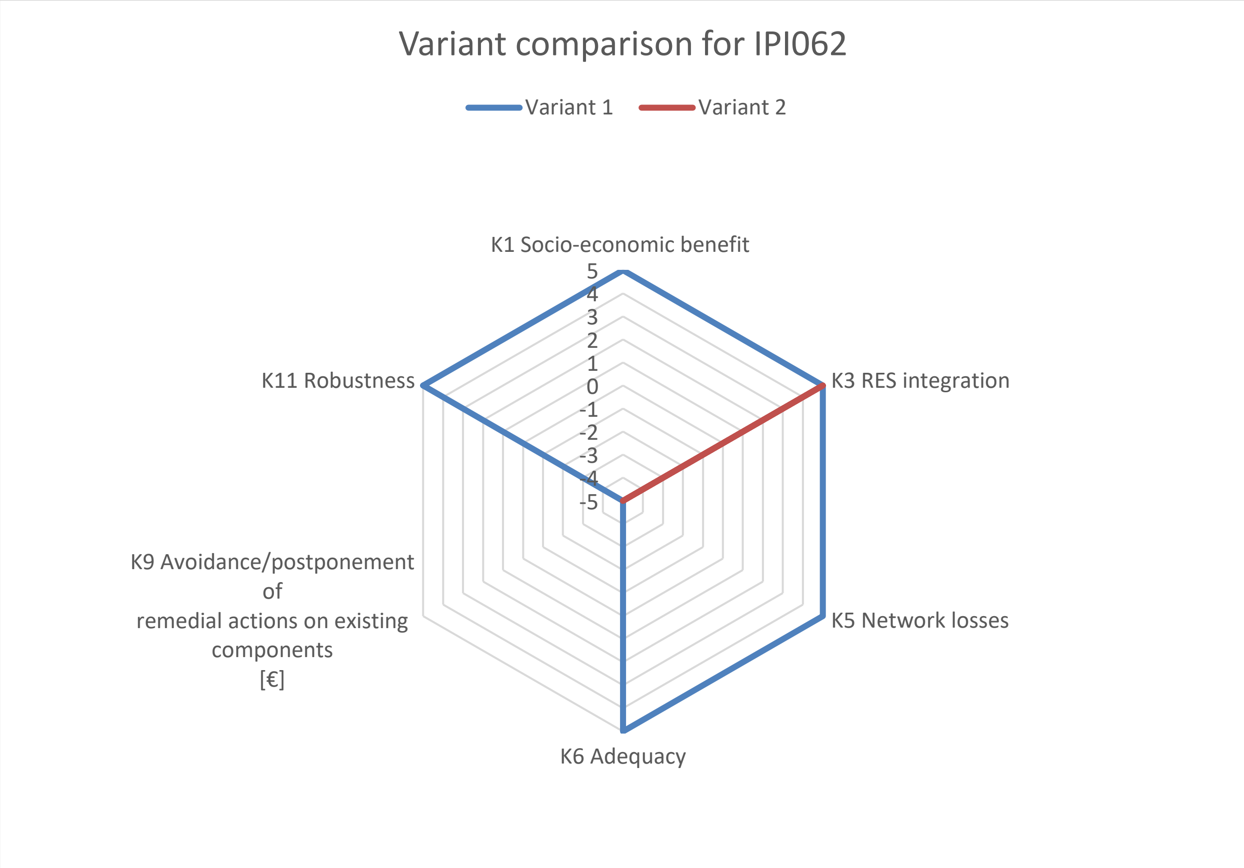
VARIANT MEETS THE TECHNICAL CRITERIA PRESCRIBED BY THE TRANSMISSION GRID CODE [YES/NO]	**YES**	**YES**
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO WHOSE ACHIEVEMENT THE INVESTMENT CONTRIBUTES[17]	**Objective 1 - Elimination of observed uncertainties in the past period** **Objective 2 - National system security** **Objective 3 - Security of uninterrupted electricity trade in the region** **Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth**	**Objective 1 - Elimination of observed uncertainties in the past period** **Objective 2 - National system security** **Objective 3 - Security of uninterrupted electricity trade in the region** **Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth**
K1 [€]	**685,200**	**564,000**
K3 [MWh/year]	**78,000**	**78,000**
K5 [MWh/year]	**6,480**	**3,850**
K6 [MWh/year]	**333,6**	**124.8**
K9 [€]	**0**	**0**
K11 [rating scale]	**4**	**3**
CAPEX [€]	**35,000,000**	**36,230,000**
OPEX [€/year]	**525,000**	**543,450**
VARIANT RANKING	**1**	**2**

By comparing the previously indicated variants, it can be concluded that variant no. 1 is more favourable because all the parameters of interest are higher, and additionally its

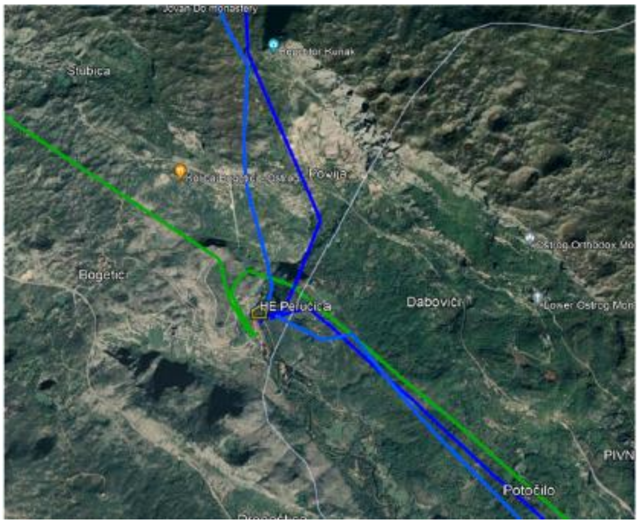
[17] Specify in detail which of the objectives defined in Chapter 3.2 of this plan contributes to a particular variant.

investment value compared to variant no. 2 lower. Related to this interconnection, it is important to emphasise that the connection point on the Albanian side was previously defined by the Albanian transmission system operator (OST) - the new SS 110/x kV Velipojë. Bearing in mind the planned position of SS Velipojë, the only two options that were imposed as logical, and related to the connection point on the Montenegrin side, were SS Ulcinj and SS Virpazar. Since the corridors for the interconnection line for both variants are in the coastal area, cable connection is planned because the solution with the construction of an overhead line would not be feasible.

Variant comparison radar chart



Reconstruction and extension of 220/110 kV plant at SS Perućica

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconstruction and extension of 220/110 kV plant at SS Perućica	
INVESTMENT IDENTIFICATION NUMBER	
IPR115	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
HPP Perućica was constructed in 1960 and connected to the transmission system at a 110 kV voltage level. With the development of the system and industry (primarily the construction of Željezara in Nikšić), the need arose to extend the 110 kV plant by constructing a 110/220 kV transformation and a 220 kV plant (110/220 kV, 125 MVA transformer was installed). As a constructed	

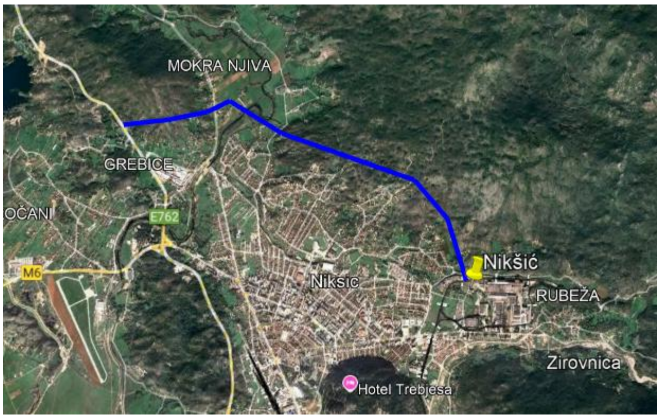
facility, HPP Perućica is connected to the rest of the power system via six 110 kV overhead lines, while at the 220 kV voltage level, it is connected to Podgorica and Trebinje via overhead lines. Such constructed system has been in operation for over 50 years. Due to the long period of operation and obsolescence, despite regular maintenance of the installed equipment according to the manufacturer's instructions, it is necessary to reconstruct and extend the 220/110 kV plant. *The project of reconstruction and extension of HPP 220/110 kV Perućica aims at the complete replacement of outdated HV equipment in the 110 kV plant (6 overhead line and one coupling bay) and 220 kV (2 overhead line, one coupling and one transformer bay) in the plant of HPP Perućica. The 110 kV and 220 kV busbars will also be replaced.* *The 110 kV plant will be extended by one 110 kV overhead line bay and one 110 kV transformer bay, which will be connected to the new 220 kV transformer bay via a 110 kV cable connection.* *The existing 110/220 kV autotransformer will be replaced, and another new autotransformer will be installed, with a total power of 2x200 MVA.* *In addition to the replacement of HV equipment, a completely new protection and control system will be made, where the protection, control and metering cabinets will be located in the relay houses in the plant, a total of 5 relay houses in the 110 kV plant and 3 relay houses in the 220 kV plant.* *In order to completely separate the two companies CGES and EPCG, a new power control building and an independent power supply system for auxiliary consumption will be constructed.* *The implementation of this project will achieve securer, more reliable and better power supply to consumers, reduce losses, and create conditions for the future connection of renewable energy sources that gravitate to the micro-location of SS Perućica.*	
☒ **Project** ☐ **Programme**	

(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 3 - Security of uninterrupted electricity trade in the region* *Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth* *Objective 6 - Coupling the European electricity market*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	508,000,00.
K1.1 Energy cost savings [*€/year*]	128,500€/year. In order for the system to meet the energy needs, the generation from TPP Pljevlja is increased in certain hours. With the increase in the capacity of SS Perućica, the use of energy sources (TPP Pljevlja) is reduced, so that in certain hours, when the price of electricity on the market is higher in Europe, energy is imported, and the generation of the Pljevlja thermal unit is reduced. Contained in SEW.
K1.2 Gas emissions cost savings [*€/year*]	379,500€/year. Based on the reduced generation from TPP Pljevlja, CO2 emissions are also reduced. Contained in SEW.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	11,000.00 t/year, 297 000€/year. This factor was estimated based on EU experience because it does not refer to CO2 emissions from K1, but rather to the difference in the price of CO2 emissions and the ETS price (in the EU, 78-81€/t CO2 at the beginning of October 2025). Given that the price used is 105 €/t for CO2, the difference is 24-27€/t.
K3 RES integration [*MW*] or [*MWh/year*]	250 MW.
K4 Non-CO_2 emissions [*t/year*]	Nox CO SOx 19.5 0 0
K5 Network losses [*MWh/year*]	20,410 MWh.
K6 Adequacy [*MWh/year*]	No impact.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities	No impact.

[it is recommended to be up to 200 words]	This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has an impact on increasing the benefits of improving transient stability in terms of the ability of the system to remain synchronised and stable after major, sudden disturbances, such as a 220/110 kV transformer outage (if only one transformer remains), as well as improving voltage conditions through voltage regulation.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. Frequency stability is defined as the electric power system's ability to maintain a stable frequency within the nominal range, both in conditions of constant deviations between generation and consumption, and after serious system disturbances that lead to a significant imbalance between generation and consumption. According to this definition, even in future scenarios, frequency stability is generally not expected to be a serious problem during normal disturbances, but rather during severe events, such as system separations, especially in situations with high power flows in the AC system and low inertia.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout because there are 7 hydro units in HPP Perućica (and one more in the implementation phase).
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	The project has an impact on voltage and reactive power control because through the installation of two transformers, the voltage-reactive conditions in the network of Montenegro can be better controlled in the region of their installation (but not further because the voltage is a quantity that depends on the conditions in the local network).
K9 Avoidance/postponement of remedial actions on existing components [*€*]	No impact.
K10 Changing needs for redispatching [*€/year*]	No impact.

K11 Robustness [*rating scale*]	4.
EXPENSES	
T1 CAPEX [€]	25,230,000.00
T2 OPEX [*€/year*]	378,450.00 (In accordance with the generally accepted methodology of CIGRE, the expected maintenance costs grow according to the "S" curve from 0.7% of investment costs at the beginning of the facility's life to 2.2% of investment costs at an average time interval of 25 years of facility utilisation. In accordance with the aforesaid, the value of Opex was taken as the average value of operating costs of 1.5% of the investment value of the facility)

Reconstruction of OHL 110 kV Nikšić - Bileća

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconstruction of OHL 110 kV Nikšić - Bileća	
INVESTMENT IDENTIFICATION NUMBER	
IPR072	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The overhead line Nikšić - Bileća was commissioned in 1956, and its components (towers, conductors, earth wire, jointing and suspension equipment) are in poor technical condition, which is why it is necessary to reconstruct the entire overhead line. Initially, work was planned on the tension bay between tower no. 150 and tower no. 159, but due to the poor condition of the overhead line, the scope of work was extended to include the full reconstruction of the OHL. The planned reconstruction entails replacing all towers and installing conductors with 240/40 mm² section to eliminate frequent faults, such as conductor breaks, which result in tower failures and increased power supply interruptions. In addition to the aforementioned, it is necessary to take into account the application for connection of about 200 MW of renewable sources in the	

region that gravitates to the OHL in question, which results in the need for the reconstruction of SS Vilusi and the line on the stretch from Bileća to Nikšić, in order to raise the level of security of the system and create conditions for the smooth operation of renewable electricity sources.	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 3 - Security of uninterrupted electricity trade in the region* *Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth* *Objective 7 - Strategic directions for environmental protection improvement and development*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	750,000.00 €/year.
K1.1 Energy cost savings [*€/year*]	208,000€/year.
K1.2 Gas emissions cost savings [*€/year*]	542,500.00 €/year. By reducing the generation at TPP Pljevlja, the total amount of CO2 in the system of Montenegro is reduced.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	7,500.00 t/year. 209,250.00 €/year. This factor was estimated based on EU experience because it does not refer to CO2 emissions from K1, but rather to the difference in the price of CO2 emissions and the ETS price (in the EU, 78-81€/t CO2 at the beginning of October 2025). Given that the price used is 105 €/t for CO2, the difference is 24-27€/t.
K3 RES integration [*MW*] or [*MWh/year*]	304,500.00 MWh/year.
K4 Non-CO_2 emissions [*t/year*]	Nox CO SOx 29 5 37
K5 Network losses [*MWh/year*]	No impact.
K6 Adequacy [*MWh/year*]	No impact.
K7 Flexibility	

K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has a small impact only on improvements in transient stability in the case of line outages from SS Nikšić. It has a smaller positive impact on voltage stability.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. Frequency stability is defined as the electric power system's ability to maintain a stable frequency within the nominal range, both in conditions of constant deviations between generation and consumption, and after serious system disturbances that lead to a significant imbalance between generation and consumption. According to this definition, even in future scenarios, frequency stability is generally not expected to be a serious problem during normal disturbances, but rather during severe events, such as system separations, especially in situations with high power flows in the AC system and low inertia.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components	No impact.

[€]	
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	2.
EXPENSES	
T1 CAPEX [€]	11,650,000.00
T2 OPEX [*€/year*]	174,750.00 (In accordance with the generally accepted methodology of CIGRE, the expected maintenance costs grow according to the "S" curve from 0.7% of investment costs at the beginning of the facility's life to 2.2% of investment costs at an average time interval of 25 years of facility utilisation. In accordance with the aforesaid, the value of Opex was taken as the average value of operating costs of 1.5% of the investment value of the facility)

Reconstruction of OHL 110 kV Podgorica 1 - TPSS Trebješica - Andrijevica

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconstruction of OHL 110 kV Podgorica 1 - TPSS Trebješica - Andrijevica	
INVESTMENT IDENTIFICATION NUMBER	
IPR109	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The overhead line 110 kV Podgorica 1 - TPSS Trebješica - Andrijevica has been in operation since 1960, and its condition reflects years of operation and the fact that it passes through terrain with demanding and harsh climatic conditions. Given the age and operational condition of the overhead line, it is necessary to reconstruct it, particularly considering the importance of the line for providing power supply to consumers – TPSS Trebješica, the highway (SS Mateševo), and the fact that the line ensures safe power supply to the north-eastern part of Montenegro (Andrijevica, Plav, and Gusinje) by meeting the N-1 security criterion.	

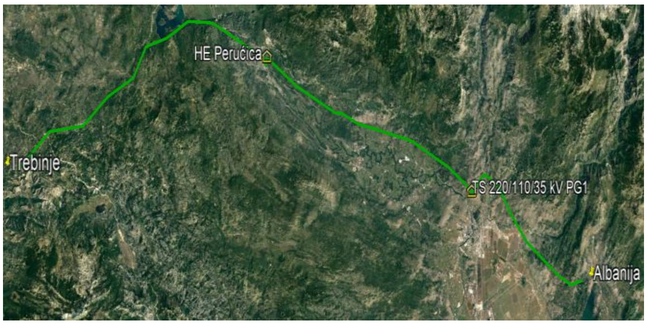
Due to the overall condition of the transmission line, the reconstruction must include a complete replacement of conductors, earth wire, insulation, suspension and jointing equipment, and the construction of new towers. This involves replacing the existing conductors and installing the 240/40 mm² conductors and a complete replacement of the towers. The detailed scope of the reconstruction would be defined through technical documentation.	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 4 - Proper planning to minimise capital investments in the transmission network*	

BENEFITS	
K1 Social and economic wealth [*€/year*]	2,600,000€/year.
K1.1 Energy cost savings [*€/year*]	1,850,000€/year.
K1.2 Gas emissions cost savings [*€/year*]	500,000€/year.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	6,530.00 t/year. 176.310,00 €/year. This factor was estimated based on EU experience because it does not refer to CO2 emissions from K1, but rather to the difference in the price of CO2 emissions and the ETS price (in the EU, 78-81€/t CO2 at the beginning of October 2025). Given that the price used is 105 €/t for CO2, the difference is 24-27€/t.
K3 RES integration [*MW*] or [*MWh/year*]	No impact.
K4 Non-CO_2 emissions [*t/year*]	Nox CO SOx 17 2 16
K5 Network losses [*MWh/year*]	6,596.00.
K6 Adequacy [*MWh/year*]	No impact.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.

K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has a small impact only on improvements in transient stability in the case of line outages from SS Podgorica. It has a smaller positive impact on voltage stability.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. Frequency stability is defined as the electric power system's ability to maintain a stable frequency within the nominal range, both in conditions of constant deviations between generation and consumption, and after serious system disturbances that lead to a significant imbalance between generation and consumption. According to this definition, even in future scenarios, frequency stability is generally not expected to be a serious problem during normal disturbances, but rather during severe events, such as system separations, especially in situations with high power flows in the AC system and low inertia.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	No impact.

K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	8.
EXPENSES	
T1 CAPEX [*€*]	15,500,000.00
T2 OPEX [*€/year*]	232,500.00 (In accordance with the generally accepted methodology of CIGRE, the expected maintenance costs grow according to the "S" curve from 0.7% of investment costs at the beginning of the facility's life to 2.2% of investment costs at an average time interval of 25 years of facility utilisation. In accordance with the aforesaid, the value of Opex was taken as the average value of operating costs of 1.5% of the investment value of the facility)

Reconductoring OHL 220 kV Trebinje (BiH) - Perućica - Podgorica - Koplik (AL)

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconductoring OHL 220 kV Trebinje (BiH) - Perućica - Podgorica - Koplik (AL)	
INVESTMENT IDENTIFICATION NUMBER	
IPR110	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The overhead line 220 kV Trebinje (B&H) - Perućica - Podgorica - Koplik (Albania) was commissioned in stages, with the first section from Trebinje to Podgorica commissioned in 1965, and the section from Podgorica to Koplik (Albania) in 1972. The section from Trebinje to HPP Perućica and Podgorica was revitalised in 1981. *Its current condition reflects long-term operation and the fact that it passes through terrain with challenging and harsh climatic conditions. The throughput of the overhead line (720 A) has been surpassed due to increased requests for the construction of new capacities (from renewable sources, primarily solar, but also hydro potential).*	

Considering the need to connect renewable energy sources in Montenegro, the capacity limitations of the conductors, their age and operational condition, it is necessary to reconstruct the overhead line. The reconstruction, mainly due to insufficient capacity, will involve the complete replacement of conductors, earth wires, insulation, and suspension and jointing equipment. Since it is not possible to install standard higher-capacity conductors on the existing towers due to their structural characteristics, it will be necessary to replace the existing conductors with special design conductors that are capable of handling 1500 A of transmission capacity, while in terms of mechanical characteristics they will not increase the load on the towers beyond the load for which the towers were originally designed. *The detailed scope of the reconstruction will be defined in the design documentation.* *The project also envisages an examination of the condition of the existing foundations and towers, and if it turns out that their technical characteristics are satisfactory, the implementation of the rest of the abovementioned activities will continue.* *In addition to the above, project implementation is of particular importance, especially for the connection of RES in the region of Vilusi and Perućica.* *Since only one part of the OHL, that is, investment in question is on the PECI list, the project is divided into three LOTs in order to enable their separate consideration (monitoring) in relation to the mentioned status:* *1. LOT 1 – OHL 220 kV Trebinje (BiH) - Perućica – budget 6.5 million €* *2. LOT 2 – OHL 220 kV Perućica - Podgorica – budget 5.3 million €* *3. LOT 3 – OHL 220 kV Podgorica - Koplik (AL) – budget 3.2 million €.*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	

Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 3 - Security of uninterrupted electricity trade in the region* *Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	4,835,000.00 €/year.
K1.1 Energy cost savings [*€/year*]	1,110,000.00 €/year.
K1.2 Gas emissions cost savings [*€/year*]	2,525,000 €/year. Contained in SEW.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	1,309.00 t/year. 35,343 €/year. It does not refer to CO2 emissions from K1, but rather to the difference in the price of CO2 emissions and the ETS price (in the EU, 78-81€/t CO2 at the beginning of October 2025). Given that the price used is 105 €/t for CO2, the difference is 24-27€/t.
K3 RES integration [*MW*] or [*MWh/year*]	250 MW.
K4 Non-CO_2 emissions [*t/year*]	Nox CO SOx 0 1 3
K5 Network losses [*MWh/year*]	0. There is no effect of replacing the wire. The wire itself reduces losses for the same power flow, but at the same time the transmitted power increases and the losses remain practically the same.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs. On the other hand, the project could help adequacy in the future by contributing to the increase of cross-border capacity.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either.

K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has a small impact only on improvements in transient and voltage stability in case of outages of the 400 kV line Podgorica - Albania, because part of the load from/to Albania will be transferred to this line.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. Frequency stability is defined as the electric power system's ability to maintain a stable frequency within the nominal range, both in conditions of constant deviations between generation and consumption, and after serious system disturbances that lead to a significant imbalance between generation and consumption. According to this definition, even in future scenarios, frequency stability is generally not expected to be a serious problem during normal disturbances, but rather during severe events, such as system separations, especially in situations with high power flows in the AC system and low inertia.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	0.
K10 Changing needs for redispatching [*€/year*]	0.
K11 Robustness [*rating scale*]	4.

EXPENSES	
T1 CAPEX [€]	15,000,000.00
T2 OPEX [*€/year*]	225,000.00

Construction of SS 110/x kV Podgorica 9 with connection to 110 kV network

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Construction of SS 110/x kV Podgorica 9 with connection to 110 kV network	
INVESTMENT IDENTIFICATION NUMBER	
IPI070	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The project of construction of SS Podgorica 9 and its connection to the 110 kV transmission network needs to be implemented in order to ensure the securest and most reliable power supply to consumers in the suburban part of Podgorica, at the Velje brdo location, where, in accordance with current plans, a large residential and business complex is planned. Project implementation includes the construction of SS 110/x kV Podgorica 9 in a technology that will be determined subsequently (conditional on the location, spatial assumptions, i.e. the possibility of solving property-legal issues, geological features, a sustainable solution for fitting), the transformation power defined through feasibility studies and technical documentation, which will be part of the project, and its connection to OHL Podgorica 1 - Podgorica 2.	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period	

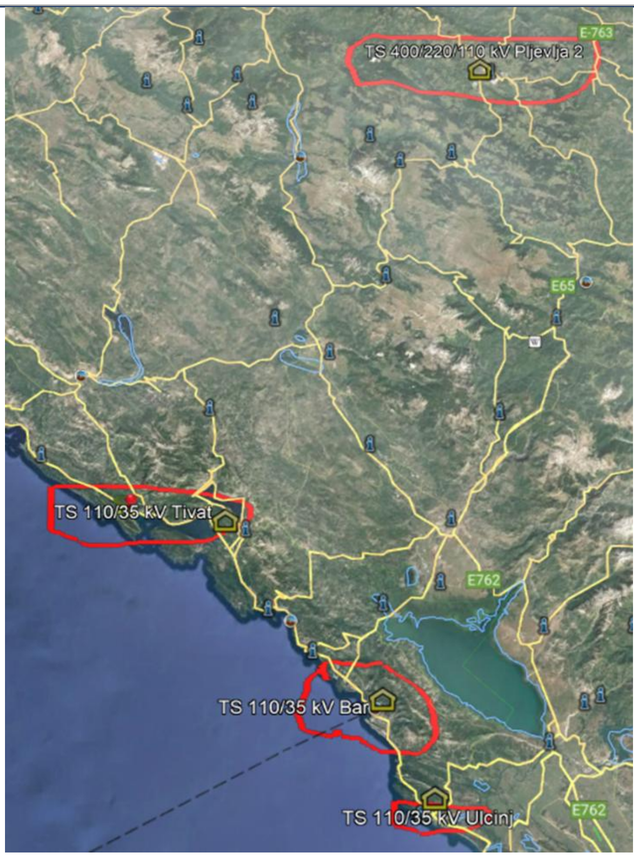
Objective 2 - National system security *Objective 7 - Strategic directions for environmental protection improvement and development*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	240.000,00.
K1.1 Energy cost savings [*€/year*]	80,000.
K1.2 Gas emissions cost savings [*€/year*]	95,000.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	300.00 t/year. 31,500€/year.
K3 RES integration [*MW*] or [*MWh/year*]	2 MW. It enables the integration of solar panels on roofs.
K4 Non-CO_2 emissions [*t/year*]	No impact. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	No impact.
K6 Adequacy [*MWh/year*]	No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on system stability because the existing line is practically cut and connected to SS Podgorica 9.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services	0.

[*€/year*] and [it is recommended to be up to 200 words]	No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [€]	1,300,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [€]	12,000,000.00
T2 OPEX [*€/year*]	180,000.00

Procurement of power transformers

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Procurement of power transformers	
INVESTMENT IDENTIFICATION NUMBER	
IPR116	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	

Continuous load growth in coastal municipalities, as well as the natural aging of transformers, create the need for the acquisition of new transformer units, but also for the creation of an operational reserve. With this project, the procurement and installation of seven 110/35 kV transformers and two 400/220/33 kV transformers has been planned. Two power transformers 110/35 kV, 63 MVA will be installed in SS Bar instead of the existing transformers with a power of 40 MVA, one of which will be installed in SS Ulcinj, and the other will be placed in operational reserve. The third power transformer 110/35 kV, 63 MVA will be installed in SS Herceg Novi instead of the existing transformer 40 MVA, and due to the request of CEDIS to increase the installed power. The 40 MVA transformer from SS Herceg Novi will be placed in operational reserve. Two new 110/35 kV, 40 MVA power transformers will be installed in SS 110/35 kV Tivat. The existing 63 MVA transformer from SS Tivat will be placed in operational reserve. One 110/35 kV transformer with a power of 20 MVA will be installed in SS Danilovgrad, with the aim of meeting the growing consumption and ensuring N-1 security criterion, while another transformer of the same transmission ratio and power will be installed instead of the transformer in SS Berane, which was assessed as weakened by the last tests.
Two 400/220/33 kV, 400 MVA power transformers will be installed instead of the existing transformers, which are over 40 years old, in SS 400/220/110 kV Pljevlja 2. The project also includes the transportation of dismantled transformers and any necessary civil works that may arise from the need to adapt the transformer oil tanks.



☒ Project ☐ Programme

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security

Objective 4 - Proper planning to minimise capital investments in the transmission network	
BENEFITS	
K1 Social and economic wealth [*€/year*]	624,000.00
K1.1 Energy cost savings [*€/year*]	300,000
K1.2 Gas emissions cost savings [*€/year*]	324,000
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	1,900.00 t/year. 199,500€/year.
K3 RES integration [*MW*] or [*MWh/year*]	1,200 MWh/year.
K4 Non-CO_2 emissions [*t/year*]	There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	20,410.00. Savings in losses on an annual basis compared to the scenario when the system would operate without power transformers 400/110 kV, 400/220 kV and 220/110 kV.
K6 Adequacy [*MWh/year*]	No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has no impact on the stability of the system because practically no new overhead lines are commissioned, but the existing topology is maintained.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain

	synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	No impact.
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	4.
EXPENSES	
T1 CAPEX [*€*]	25,700,000.00
T2 OPEX [*€/year*]	385,500.00

<u>Extension of SS Podgorica 2 with 110/10 kV transformation</u>

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Extension of SS Podgorica 2 with 110/10 kV transformation	
INVESTMENT IDENTIFICATION NUMBER	
IPR125	

DESCRIPTION OF TECHNICAL SOLUTION
[it is recommended to be up to 200 words]

The project of extension of SS Podgorica 2 through the introduction of 110/10 kV transformation needs to be implemented in order to ensure the securest and most reliable power supply to consumers in the city part of Podgorica - the part of the city across the river Morača. Namely, in the last few years, this part of the city has been characterised by intensive construction activity with a large number of commercial and residential complexes that are dominantly supplied from SS 110/10 kV Podgorica 4, whose load is very high and the increase in the power of transformation creates problems of short-circuit currents on the distribution side. In addition, the development plans of the city envisage construction in the part of the city between the two mentioned substations - Sadine, which is why it is necessary to plan the transformation in question in SS Podgorica 2.
The implementation of the project includes the extension of SS Podgorica 2 with two transformers of power 31.5-40MVA, depending on the needs of consumers and the development plans of this part of the city.

☒ **Project** ☐ **Programme**

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

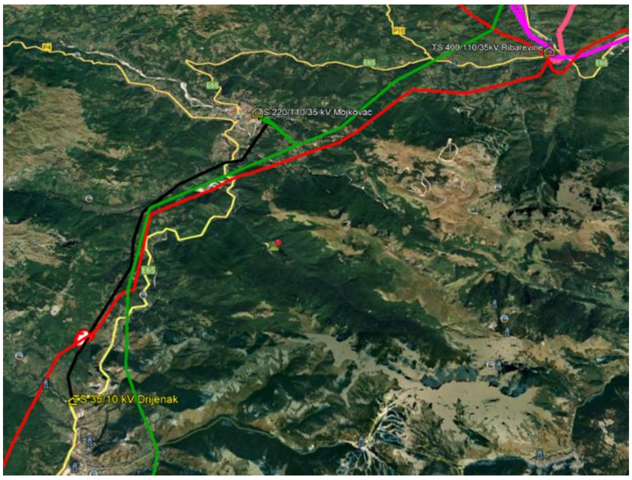
Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security
Objective 7 - Strategic directions for environmental protection improvement and development

BENEFITS	
K1 Social and economic wealth [*€/year*]	240.000,00.
K1.1 Energy cost savings [*€/year*]	115,000.
K1.2 Gas emissions cost savings [*€/year*]	88,000.
K2 Change in CO_2 emissions	300.00 t/year.

[*t/year*] **and** [*€/year*]	31,500€/year.
K3 RES integration [*MW*] or [*MWh/year*]	2 MW. It enables the integration of solar panels on roofs.
K4 Non-CO_2 emissions [*t/year*]	There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	No impact.
K6 Adequacy [*MWh/year*]	No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has no impact on the stability of the system because practically no new overhead lines are commissioned, but the existing topology is maintained.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume,

[it is recommended to be up to 200 words]	at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [€]	1,250,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [€]	5,000,000.00
T2 OPEX [*€/year*]	75,000.00

Construction of SS 110/35 kV Kolašin (Drijenak) and construction of OHL 110 kV Kolašin - Mateševo

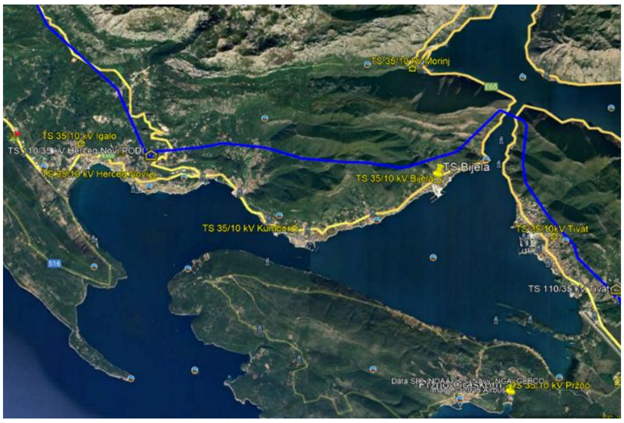
NAME OF INVESTMENT	**GEOGRAPHICAL LOCATION**
Construction of SS 110/35 kV Kolašin (Drijenak) and construction of OHL 110 kV Kolašin - Mateševo	
INVESTMENT IDENTIFICATION NUMBER	
IPI014	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The current situation in the area of Kolašin is such that the distribution network is supplied via the overhead line 110 kV Mojkovac - Kolašin (Drijenak) which operates under 35 kV voltage from one and via the overhead line 35 kV Kolašin (Breza) - Ptič - Bioče - Ubli - Podgorica 1 which is disconnected in the normal switching state. The overhead line 110 kV Mojkovac - Kolašin was constructed as 110 kV, including the section at the entrance to SS	

Mojkovac, which was constructed in 2012 during the resolution of the disposition of 110 kV overhead lines in front of SS Mojkovac to free up space for the construction of a new 220 kV connection overhead line. *As according to the existing development plans there are significant tourist capacities in the vicinity of Kolašin and, according to the adopted planning documents, a significant increase in consumption is expected in this area, all conducted analyses have shown that it is necessary to construct a new SS 110/35 kV in the area of Kolašin, and the location of the existing SS 35/10 kV Drijenak, to which the overhead line 110(35) kV Mojkovac - Kolašin is connected, was assessed as the most favourable location (also from the aspect of connection to the transmission network). At the same time, OHL 110 kV Mojkovac - Kolašin, which now operates at 35 kV, would also be put into operation under the 110 kV voltage level, with its previous reconstruction/revitalisation. In addition to the above, and with the aim of connection, it is also necessary to reconstruct SS Mojkovac (construction and equipping of the Kolašin overhead line bay).*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 7 - Strategic directions for environmental protection improvement and development*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	There is no impact on the change in the price of electricity in the system of Montenegro.
K1.1 Energy cost savings [*€/year*]	0. It does not have an impact on the reduction of engagement of thermal units.
K1.2 Gas emissions cost savings [*€/year*]	0.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	0.

	It does not have an impact on the reduction of engagement of thermal units.
K3 RES integration [*MW*] or [*MWh/year*]	0. No impact on the connection of RES.
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	No impact.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). It has no impact on the stability of the system because practically no new overhead lines are commissioned, but the existing topology is maintained.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.

K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	1,100,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [*€*]	20,000,000.00
T2 OPEX [*€/year*]	300,000.00

<u>Construction of SS 110/x kV Bijela and connection to transmission network</u>

NAME OF INVESTMENT	**GEOGRAPHICAL LOCATION**
Construction of SS 110/x kV Bijela and connection to transmission network	
INVESTMENT IDENTIFICATION NUMBER	
IPI071	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The project of construction of SS Bijela and its connection to the 110 kV transmission network needs to be implemented in order to ensure the securest and most reliable power supply to consumers in the area of the coastal part of Montenegro and settlements that gravitate towards it due to the growth of economic activity and the expected increase in the	

number of inhabitants, thus increase in consumption. *Project implementation includes the construction of SS 110/x kV Bijela in a technology that will be determined subsequently (conditional on the location, spatial assumptions, i.e. the possibility of solving property-legal issues, geological features, a sustainable solution for fitting), the transformation power defined through feasibility studies and technical documentation, which will be part of the project, and its connection according to the in/out principle to OHL 110 kV Herceg Novi - Tivat.*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 7 - Strategic directions for environmental protection improvement and development*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	120,000.00. Simulation done with the integration of 5 MW of solar energy (on roofs).
K1.1 Energy cost savings [*€/year*]	50,000.
K1.2 Gas emissions cost savings [*€/year*]	60,000.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	150 t/year. 16,000.00 €/year.
K3 RES integration [*MW*] or [*MWh/year*]	5 MW. Mainly through the distribution network (on the ground or on the roofs).
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	0. No impact.
K6 Adequacy [*MWh/year*]	No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.

K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on system stability because the existing line is practically cut and connected to SS Bijela.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	0. No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [€]	1,950,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for	0.

redispatching [*€/year*]	No impact
K11 Robustness [*rating scale*]	8.
EXPENSES	
T1 CAPEX [*€*]	10,000,000.00
T2 OPEX [*€/year*]	150,000,.00

Construction of SS 110/10 kV Podgorica 6 and connection to transmission network

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Construction of SS 110/10 kV Podgorica 6 and connection to transmission network	
INVESTMENT IDENTIFICATION NUMBER	
IPI072	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The project of construction of SS Podgorica 6 and its connection to the 110 kV transmission network needs to be implemented in order to ensure the securest and most reliable power supply to consumers in the centre of Podgorica due to the growth of economic activity and the expected increase in the number of inhabitants, thus increase in consumption. *Project implementation includes the construction of SS 110/10 kV Podgorica 6 in a technology that will be determined subsequently (conditional on the location, spatial assumptions, i.e. the possibility of solving property-legal issues, geological features, a sustainable solution for fitting), the transformation power defined through feasibility studies and technical documentation, which will be part of the project, and its connection via cable lines towards SS Podgorica 3 and SS Podgorica 4.*	
☒ **Project** ☐ **Programme**	

(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 7 - Strategic directions for environmental protection improvement and development*	

BENEFITS	
K1 Social and economic wealth [*€/year*]	0. Only supplying consumption in the city centre.
K1.1 Energy cost savings [*€/year*]	0.
K1.2 Gas emissions cost savings [*€/year*]	0.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	0. No impact.
K3 RES integration [*MW*] or [*MWh/year*]	0. No impact.
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	0. No impact.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	0. No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0).

	No impact on system stability because the existing line is practically cut and connected to SS Podgorica 6.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	1,200,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	No impact.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [*€*]	20,000,000.00
T2 OPEX [*€/year*]	300,000.00

Construction of SS 110/10 kV Podgorica 8 and connection to transmission network

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION

Construction of SS 110/10 kV Podgorica 8 and connection to transmission network

INVESTMENT IDENTIFICATION NUMBER

IPI073

DESCRIPTION OF TECHNICAL SOLUTION
[it is recommended to be up to 200 words]

The project of construction of SS Podgorica 8 and its connection to the 110 kV transmission network needs to be implemented in order to ensure the securest and most reliable power supply to consumers in the area of the part of Podgorica - Zlatica and the settlements that gravitate towards it due to the growth of economic activity and the expected increase in the number of inhabitants, thus increase in consumption.

Project implementation includes the construction of SS 110/10 kV Podgorica 8 in a technology that will be determined subsequently (conditional on the location, spatial assumptions, i.e. the possibility of solving property-legal issues, geological features, a sustainable solution for fitting), the transformation power defined through feasibility studies and technical documentation, which will be part of the project, and its connection according to the in-out principle to OHL 110 kV Podgorica 1 - Podgorica 3.

☒ **Project** ☐ **Programme**

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security
Objective 7 - Strategic directions for environmental protection improvement and development

BENEFITS

K1 Social and economic wealth [*€/year*]	240,000.00. Simulation done with the integration of 2 MW of solar energy (on roofs).

K1.1 Energy cost savings [*€/year*]	98,000.
K1.2 Gas emissions cost savings [*€/year*]	124,000.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	300 t/year. 31,500.00 €/year.
K3 RES integration [*MW*] or [*MWh/year*]	2 MW. Estimated quantity on roofs or in general at the distribution level.
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	0. No impact, with and without the project, the total annual losses remain unchanged on the transmission network.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on system stability because the existing line is practically cut and connected to SS Podgorica 8.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services.

	The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	1,250,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	0.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [*€*]	10,000,000.00
T2 OPEX [*€/year*]	150,000.00

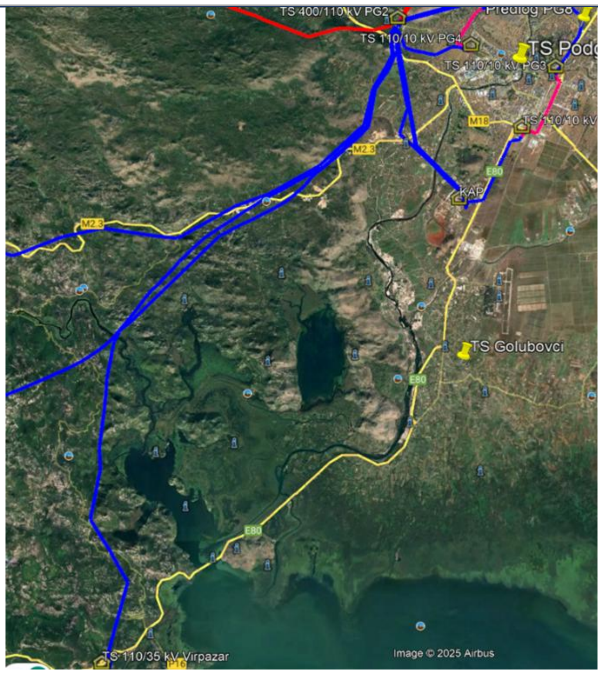
Construction of SS 110/35 kV Golubovci and connection 110 kV Podgorica 5 - Golubovci - Virpazar

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Construction of SS 110/35 kV Golubovci and connection 110 kV Podgorica 5 - Golubovci - Virpazar	
INVESTMENT IDENTIFICATION NUMBER	
IPI075	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The project of construction of SS Golubovci and its connection to the 110 kV transmission network needs to be implemented in order to	

ensure the securest and most reliable power supply to consumers in the area of the Municipality of Zeta and the settlements that gravitate towards it due to the growth of economic activity and the expected increase in the number of inhabitants, thus increase in consumption.

Project implementation includes the construction of SS 110/35 kV Golubovci in a technology that will be determined subsequently (conditional on the location, spatial assumptions, i.e. the possibility of solving property-legal issues, geological features, a sustainable solution for fitting), the transformation power defined through feasibility studies and technical documentation, which will be part of the project, and its connection according to the in-out principle to OHL 110 kV Podgorica 5 - Virpazar.

The construction of connection 110 kV Podgorica 5 - Golubovci - Virpazar is also a project that increases the transmission capacity towards the coast (towards Bar). Namely, all the analyses that were done in the previous period showed the necessity of increasing transmission capacities between the consumption area of the Capital City and the southern part of the coast, that is, the municipalities of Bar and Ulcinj.



☒ Project ☐ Programme

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security
Objective 7 - Strategic directions for environmental protection improvement and development

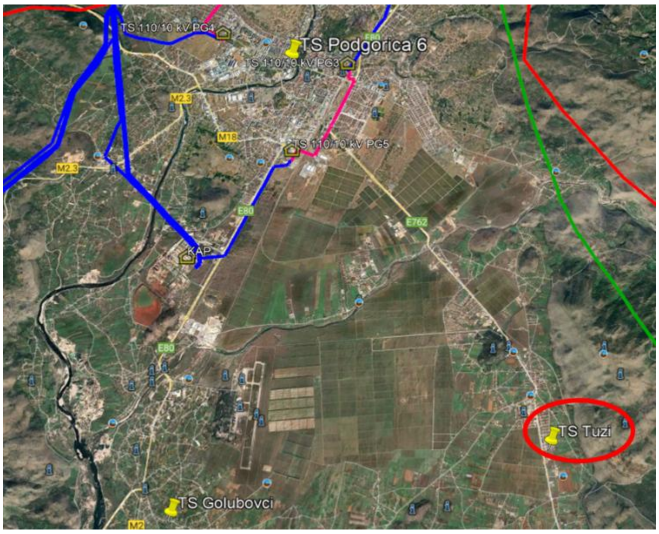
BENEFITS

K1 Social and economic wealth [*€/year*]	0. No impact on the change in the price of electricity for consumers and producers.
K1.1 Energy cost savings [*€/year*]	0.
K1.2 Gas emissions cost savings [*€/year*]	0.

K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	0. No impact as a consequence.
K3 RES integration [*MW*] or [*MWh/year*]	0. No impact.
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	1,880.00 MWh/year.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on system stability because the existing line is practically cut and connected to SS Golubovci.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services	No impact.

[it is recommended to be up to 200 words]	Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [€]	1,200,000.00. It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [€]	25,000,000.00
T2 OPEX [*€/year*]	375,000.00

Construction of SS 110/35 kV Tuzi and connection 110 kV Tuzi - Golubovci

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Construction of SS 110/35 kV Tuzi and connection 110 kV Tuzi - Golubovci	
INVESTMENT IDENTIFICATION NUMBER	
IPI074	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The project of construction of SS Tuzi and its connection to the 110 kV transmission network needs to be implemented in order to ensure the securest and most reliable power supply to consumers in the area of the Municipality of Tuzi and the settlements that gravitate towards it due to the growth of economic activity and the expected	

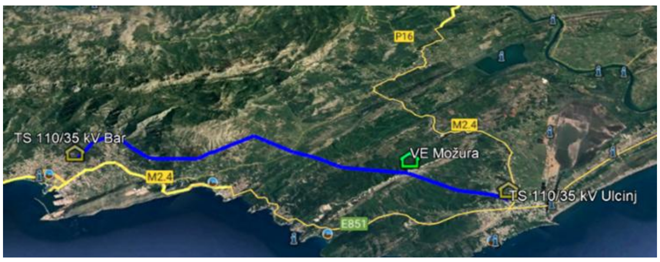
increase in the number of inhabitants, thus increase in consumption. *Project implementation includes the construction of SS 110/35 kV Tuzi in a technology that will be determined subsequently (conditional on the location, spatial assumptions, i.e. the possibility of solving property-legal issues, geological features, a sustainable solution for fitting), the transformation power defined through feasibility studies and technical documentation, which will be part of the project, and its connection to SS Golubovci by constructing the connection 110 kV Tuzi – Golubovci.* *Bidirectional power supply will be provided by upgrading the existing line 110(35) kV Podgorica 1 - Tuzi, which currently operates at 35 kV voltage, to 110 kV voltage level.*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 7 - Strategic directions for environmental protection improvement and development*	

BENEFITS	
K1 Social and economic wealth [*€/year*]	576,000.00. The calculation was made based on a certain number of requests for the connection of solar power plants on rooftops.
K1.1 Energy cost savings [*€/year*]	250,000.
K1.2 Gas emissions cost savings [*€/year*]	145,000.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	175 t/year 17,500.00 €/year.
K3 RES integration [*MW*] or [*MWh/year*]	5 MW. Mainly through the distribution network (on the ground or on the roofs).
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	0. Reduction in the distribution network.

K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on system stability because the existing line is practically cut and connected to SS Tuzi.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of	1,450,000.00.

remedial actions on existing components [€]	It is estimated that the construction of the SS in question with connection lines would reduce investments in the distribution network and increase power supply security.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	6.
EXPENSES	
T1 CAPEX [€]	20,000,000.00
T2 OPEX [*€/year*]	300,000.00

Reconstruction of OHL 110 kV Bar - Možura - Ulcinj – reconductoring

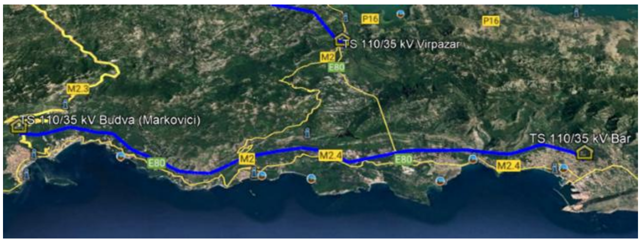
NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconstruction of OHL 110 kV Bar - Možura - Ulcinj – reconductoring	
INVESTMENT IDENTIFICATION NUMBER	
IPR126	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The overhead line 110 kV Bar - Ulcinj has been in operation since 1963. The overhead line has a total length of 23.7 km. The conductor is ACSR 150/25 mm^2, and due to its age and years of operation in a heavy load mode, frequent faults appear. The reconstruction of OHL Bar - Možura - Ulcinj envisages the construction of new towers on new foundations, thus replacing jointing equipment, suspension equipment, insulation and wires. The project will achieve an increase in throughput capacity on this stretch, which will follow the growing trend of consumer needs, but also create conditions for further connection of RES and evacuation of generated energy, while ensuring security, reliability and quality of supply.	
☒ **Project** ☐ **Programme**	

(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 4 - Proper planning to minimise capital investments in the transmission network* *Objective 7 - Strategic directions for environmental protection improvement and development*	
BENEFITS	
K1 Social and economic wealth [*€/year*]	750,000€/year.
K1.1 Energy cost savings [*€/year*]	475,000€/year,
K1.2 Gas emissions cost savings [*€/year*]	245,000€/year.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	450.00 t/year. 47,200€/year.
K3 RES integration [*MW*] or [*MWh/year*]	30 MW
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	No impact
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	

K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on the voltage and frequency stability of the system because the existing line is practically reinforced, but transient stability is increased through the characteristics of the reconstructed line and the reconductoring.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	0. The project does not affect the postponement of interventions on other elements because it does not affect the increase in system security through the postponement of other investments or reconstructions. The benefit is modelled as a one-time benefit. Regardless of maintenance plans or the state of other elements in the system, the construction of this project does not have an impact on the intervention on other elements because the maintenance of other elements is carried out on time and according to a precisely determined sequence.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	3.
EXPENSES	

T1 CAPEX [€]	11,000,000.00
T2 OPEX [*€/year*]	165,000.00

Reconstruction of OHL 110 kV Bar - Budva – reconductoring

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconstruction of OHL 110 kV Bar - Budva – reconductoring	
INVESTMENT IDENTIFICATION NUMBER	
IPR127	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The overhead line 110 kV Bar - Budva has been in operation since 1963. The overhead line has a total length of 33.4 km. The conductor is ACSR 150/25 mm^2, and due to its age and years of operation in a heavy load mode, frequent faults appear. *The reconstruction of OHL Bar – Budva envisages the construction of new towers on new foundations, thus replacing jointing equipment, suspension equipment, insulation and wires. The project will achieve an increase in throughput capacity on this stretch, which will follow the growing trend of consumer needs, but also create conditions for further connection of RES and evacuation of generated energy, while ensuring security, reliability and quality of supply.*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 4 - Proper planning to minimise capital investments in the transmission network*	

Objective 7 - Strategic directions for environmental protection improvement and development	
BENEFITS	
K1 Social and economic wealth [*€/year*]	475,000. The assumption is that the line capacity increases by about 30 MW, which is how much more RES can be connected.
K1.1 Energy cost savings [*€/year*]	175,000.
K1.2 Gas emissions cost savings [*€/year*]	225,000.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	350.0 t/year. 36,750€/year.
K3 RES integration [*MW*] or [*MWh/year*]	30 MW.
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	No impact.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on the voltage and frequency stability of the system because the existing line is practically reinforced, but transient stability is increased through the characteristics of the reconstructed line and the reconductoring.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain

	synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	0.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	3.
EXPENSES	
T1 CAPEX [*€*]	11,000,000.00
T2 OPEX [*€/year*]	165,000.00

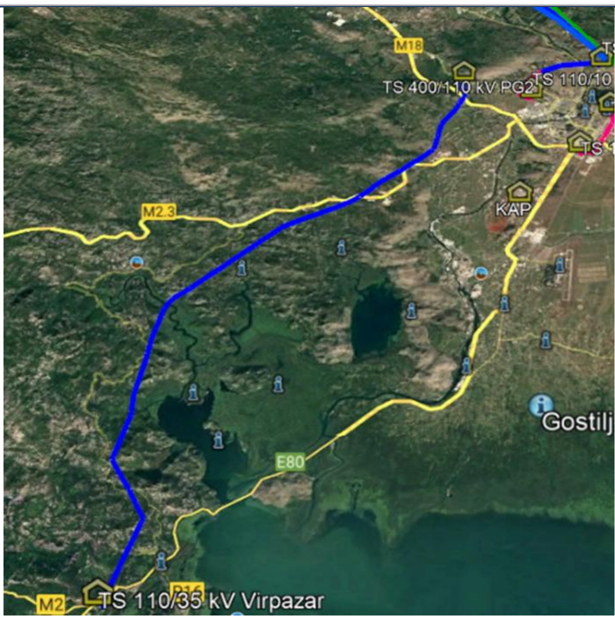
Reconstruction of OHL 110 kV Podgorica 2 - Virpazar – reconductoring

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Reconstruction of OHL 110 kV Podgorica 2 - Virpazar – reconductoring	
INVESTMENT IDENTIFICATION NUMBER	
IPR128	

DESCRIPTION OF TECHNICAL SOLUTION
[it is recommended to be up to 200 words]

The overhead line 110 kV Podgorica 2 - Virpazar has been in operation since 1961. The overhead line has a total length of 30 km. The conductor is ACSR 150/25 mm^2, and because of to poor technical condition due to age due to its age and years of operation in a heavy load mode, and the occurrence of frequent failures, conductors, jointing and suspension equipment were replaced in 2023. Considering the trend of increasing consumption, the need to create conditions for the sale of energy from future RES, while ensuring security, reliability and quality of supply, it is necessary to reconductor this overhead line.

Project implementation includes the complete replacement of conductors (procurement and installation of a special wire with a higher capacity), jointing and suspension equipment.



☒ **Project** ☐ **Programme**

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security
Objective 4 - Proper planning to minimise capital investments in the transmission network
Objective 7 - Strategic directions for environmental protection improvement and development

BENEFITS	
K1 Social and economic wealth [*€/year*]	120,000€/year. Benefit calculated as the value of energy not supplied at the level of 34 MWh/year at a price of 4,000€/MWh (value from ERAA2023 and market model).
K1.1 Energy cost savings [*€/year*]	0. No impact.
K1.2 Gas emissions cost savings [*€/year*]	0. No impact.
K2 Change in CO_2 emissions	0.

[*t/year*] **and** [*€/year*]	No impact.
K3 RES integration [*MW*] or [*MWh/year*]	0.
K4 Non-CO_2 emissions [*t/year*]	0. There are no changes in the emission of "non-CO2" gases.
K5 Network losses [*MWh/year*]	No impact.
K6 Adequacy [*MWh/year*]	34 MWh/year. Based on the data on the substation remaining in a voltage-free state of 107 min/year and the average consumption for 2024, it is estimated that the reconstruction of this line would reduce the voltage-free state to zero, that is, the area would save 10 MWh/year. It should be added that this indicator does not apply to the entire system of Montenegro (according to ENTSO-E CBA), but only to the local level of Virpazar.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Transient stability (++), Voltage stability (++), Frequency stability (0). No impact on the voltage and frequency stability of the system because the existing line is practically reinforced, but transient stability is increased through the characteristics of the reconstructed line and the reconductoring.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but,

	taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [€]	0. The project does not affect the postponement of interventions on other elements because it does not affect the increase in system security through the postponement of other investments or reconstructions. The benefit is modelled as a one-time benefit. Regardless of maintenance plans or the state of other elements in the system, the construction of this project does not have an impact on the intervention on other elements because the maintenance of other elements is carried out on time and according to a precisely determined sequence.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	3.
EXPENSES	
T1 CAPEX [€]	8,000,000.00
T2 OPEX [*€/year*]	120,000.00

Construction of OHL 400 kV Čevo - Brezna (line II)

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Construction of OHL 400 kV Čevo - Brezna (line II)	
INVESTMENT IDENTIFICATION NUMBER	
IPI078	
DESCRIPTION OF TECHNICAL SOLUTION	

[it is recommended to be up to 200 words]

The project of construction of OHL 400 kV Čevo - Brezna (line II) needs to be implemented in order to ensure the connection of several renewable sources in the Čevo region.
During the preparation of connection studies, the analyses showed that there are several critical situations where the energy generated in the solar power plants connected to SG Čevo cannot be placed in the system of Montenegro, nor can it be exported outside of it without generation restrictions in the EPS of Montenegro.
In addition, the project supports the integration of European electricity markets, thus enabling increased cross-border trade and competition among electricity suppliers through better integration of renewable energy sources.

☒ **Project** ☐ **Programme**

(explain why it is a programme – it is recommended to be up to 200 words)

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT

Objective 1 - Elimination of observed uncertainties in the past period
Objective 2 - National system security
Objective 3 - Security of uninterrupted electricity trade in the region
Objective 5 - Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth
Objective 6 - Coupling the European electricity market

BENEFITS

K1 Social and economic wealth [*€/year*]	12,500,000.00.
K1.1 Energy cost savings [*€/year*]	7,650,000€/year.
K1.2 Gas emissions cost savings [*€/year*]	4,850,000€/year.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	456,000.00 t/year.
K3 RES integration [*MW*] or [*MWh/year*]	300 MW.
K4 Non-CO_2 emissions	Nox CO SOx

[*t/year*]	6 9 6 The results are the exit from the market programme package as a change in the generation portfolio that enables the project and the entry of renewable sources into operation.
K5 Network losses [*MWh/year*]	3,830.00.
K6 Adequacy [*MWh/year*]	0. No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	Generally speaking, the project has an impact on increasing the benefits of improving transient stability in terms of the ability of the system to remain synchronised and stable after major, sudden disturbances. The greater the number of transmission elements, the more stable the system can be in case of major disturbances.
K8.2 Frequency stability [it is recommended to be up to 200 words]	No impact. According to the definition of frequency stability, it is not expected that the project can affect frequency stability during disturbances, because the rest of the system (Montenegro and interconnections) will remain synchronised, i.e. this project has no impact on system separations.
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. This indicator is not defined by grid rules through system services, that is, there is no methodology for billing these services. The project may have an impact on the restoration of the Montenegrin system in the event of a total blackout, but, taking into account the good connectivity of the Montenegrin system, such a scenario is unlikely.

K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [€]	0. The project does not affect the postponement of interventions on other elements because it does not affect the increase in system security through the postponement of other investments or reconstructions. The benefit is modelled as a one-time benefit. Regardless of maintenance plans or the state of other elements in the system, the construction of this project does not have an impact on the intervention on other elements because the maintenance of other elements is carried out on time and according to a precisely determined sequence.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	4.
EXPENSES	
T1 CAPEX [€]	20,000,000.00
T2 OPEX [*€/year*]	300,000.00

Comparison of variants for the construction of OHL 400 kV Čevo - Brezna (line II):

NAME OF INVESTMENT	*Construction of OHL 400 kV Čevo - Brezna (line II)*	
EVALUATION	**Construction of OHL 400 kV Čevo - Brezna (line II)**	**Construction of OHL 400 kV Brezna - Gacko**
TECHNICAL DESCRIPTION OF VARIANT	**The project of construction of OHL 400 kV Čevo - Brezna (line II) needs to be implemented to ensure the connection of several renewable sources in the Čevo region.**	**Significant new infrastructure has been built on the territory of Montenegro, which is ready for full-scale operation and connection to neighbouring**

[it is recommended to be up to 100 words]	**During the preparation of connection studies, analyses showed that there are several critical situations where the energy generated in the solar power plants connected to the SG Čevo cannot be placed in the system of Montenegro, nor can it be exported outside of it without generation restrictions in the EPS of Montenegro.** **In addition, the project supports the integration of European electricity markets, thus enabling increased cross-border trade and competition among electricity suppliers through better integration of renewable energy sources.** **The project involves the construction of a single-circuit line from the future SG Čevo to the 400/110/35 kV SS Brezna.**	**systems, primarily for the purpose of implementing Section IV of the Trans-Balkan Corridor.** **The new 400 kV interconnection from the system of Montenegro and Bosnia and Herzegovina would enable the elimination of congestion at the border with Bosnia and Herzegovina.** **This type of operation mode should additionally encourage greater utilisation of the energy potentials of Montenegro and Bosnia and Herzegovina.** **The project includes the construction of the following sections:** **• OHL 400 kV Brezna (ME) – Gacko (BiH)** **The new connection between Montenegro and Bosnia and Herzegovina will further eliminate the possibility of congestion at this border, supporting open access to a larger electricity market in the region and with the EU.**
VARIANT MEETS THE TECHNICAL CRITERIA PRESCRIBED BY THE TRANSMISSION GRID CODE [YES/NO]	**YES**	**YES**

OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO WHOSE ACHIEVEMENT THE INVESTMENT CONTRIBUTES[18]	**Objective 1 Elimination of observed uncertainties in the past period** **Objective 2 National system security** **Objective 3 Security of uninterrupted electricity trade in the region** **Objective 5 Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth** **Objective 6 Coupling the European electricity market**	**Objective 1 Elimination of observed uncertainties in the past period** **Objective 2 National system security** **Objective 3 Security of uninterrupted electricity trade in the region** **Objective 5 Proper planning aimed at connecting renewable electricity sources and increasing social and economic wealth** **Objective 6 Coupling the European electricity market**
K1 [€]	**12,500,000**	**1,750,000**
K3 [MWh/year]	**435,000**	**59,000**
K5 [MWh/year]	**3,830**	**4,400**
K6 [MWh/year]	**0**	**0**
K9 [€]	**0**	**0**
K11 [rating scale]	**4**	**3**
CAPEX [€]	**20,000,000**	**22,000,000**
OPEX [€/year]	**300,000**	**330,000**

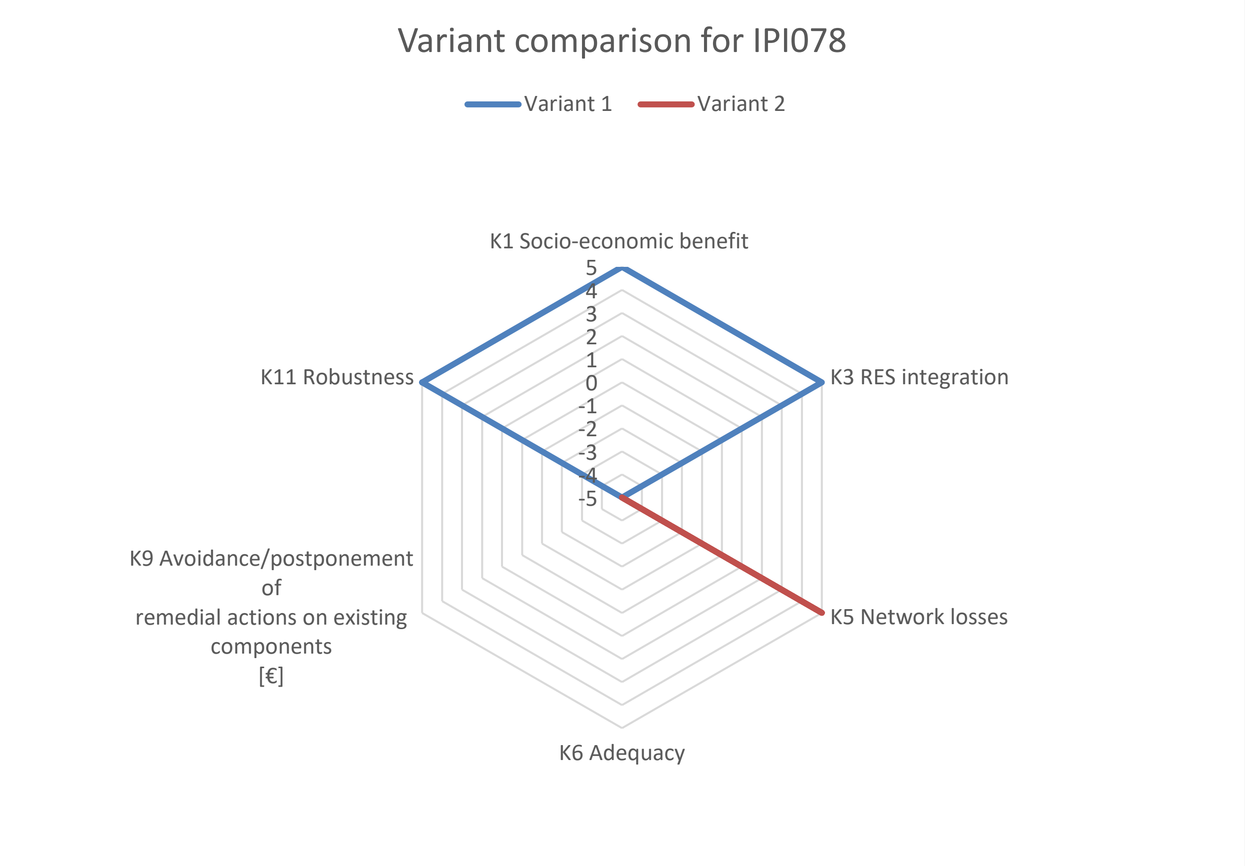
18 Specify in detail which of the objectives defined in Chapter 3.2 of this plan contributes to a particular variant.

VARIANT RANKING	1	2

Based on the number of increased requests for connection in the Čevo region, an analysis of power flows in the "N-1" system security mode was performed. In every analysis, the outage of the 400 kV connection to Trebinje (BiH) was critical. In order to remove uncertainty in the system, the need for another connection from SS Brezna (in addition to the already planned interconnection to Sarajevo (BiH)) was imposed. Based on the topological structure of the transmission network of Montenegro and Bosnia Herzegovina, there were only 2 possibilities, to construct another interconnection to Gacko in BiH (of course, with the prior agreement of Bosnia and Herzegovina) or another line to Čevo.

By comparing the variants, it can be seen that OHL 400 kV Čevo - Brezna is a slightly smaller investment, and that it provides greater benefits in all parameters, except for losses, from which the conclusion was imposed that variant 1 is more favourable.

Variant comparison radar chart:



Installation of synchronous condenser

NAME OF INVESTMENT	GEOGRAPHICAL LOCATION
Installation of synchronous condenser	
INVESTMENT IDENTIFICATION NUMBER	
IPR129	
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]	
The installation of synchronous condenser is one of the projects that are necessary for the secure operation of the transmission system in the future, which will be characterised by the dominance of distributed generation facilities from energy obtained from renewable sources, which are connected to the network via devices based on power electronics.	

Synchronous condenser is a rotating machine that does not serve to convert electrical energy into mechanical energy or vice versa, but whose task is to provide an increase in the short-circuit current of the system, an increase in the system inertia, provide the necessary reactive energy and enable passage through a fault even in the case of extremely low voltages in the network. *The importance of the synchronous condenser is particularly recognised in systems that, like ours, are connected to HVDC links via so-called line-commutated converters that require a strong network for secure and reliable operation.* *The scope of the project has not been fully defined at the moment, so the specification itself, which includes the power of the synchronous machine, flywheel and other equipment, will depend on the time schedule of the decommissioning of the thermal power plant and the integration of renewable sources.*	
☒ **Project** ☐ **Programme**	
(explain why it is a programme – it is recommended to be up to 200 words)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 2 - National system security* *Objective 4 - Proper planning to minimise capital investments in the transmission network* *Objective 7 - Strategic directions for environmental protection improvement and development*	

BENEFITS	
K1 Social and economic wealth [*€/year*]	400,000.00.
K1.1 Energy cost savings [*€/year*]	Contained in SEW.
K1.2 Gas emissions cost savings [*€/year*]	Contained in SEW.
K2 Change in CO_2 emissions [*t/year*] **and** [*€/year*]	2,520.00 t/year.
K3 RES integration [*MW*] or [*MWh/year*]	Contained in K1.

K4 Non-CO_2 emissions [*t/year*]	No impact.
K5 Network losses [*MWh/year*]	32,000.00.
K6 Adequacy [*MWh/year*]	No impact. With and without the project, no energy not supplied was recorded, which means that the Montenegrin system has enough generation and transmission capacities to import electricity for consumption needs.
K7 Flexibility	
K7.1 Exchange of balance energy [*rating scale*]	No impact.
K7.2 Exchange of balance capacities [it is recommended to be up to 200 words]	No impact. This indicator refers to the increase in the volume of energy exchange for balancing across cross-zonal borders. The impossibility of defining a single and universal methodology stems from a large number of variables that are related to this indicator, so it was not addressed in ENTSO-E TYNDP 2024 either. The project will not have an impact on the exchange of balancing capacities in the future either.
K8 Stability	
K8.1 Qualitative indicator [*rating scale*]	It has an impact in case of lack of inertia of the system (in moments when there are no synchronous machines on the network) and keeps the system stable in case of major disturbances.
K8.2 Frequency stability [it is recommended to be up to 200 words]	The project may have an impact on the stability of the system of Montenegro in the event that there is not enough inertia of the system (after decommissioning TPP Pljevlja), so that in the event of certain disturbances, there may be a cascading outage of individual overhead lines and isolated operation of the system of Montenegro. The second option is to adopt the binding application of "grid forming" inverters in the Montenegrin system (ENTSO-E is still working on the grid code and rules on maintaining system inertia).
K8.3 Black start services [*€/year*] and [it is recommended to be up to 200 words]	0. No impact. It is not envisaged to start the system, but to maintain its stability.
K8.4 Voltage/reactive power control services [it is recommended to be up to 200 words]	No impact. Typically, these services are contracted or imposed by the transmission system operator in a certain minimum volume, at precisely defined locations in the network, using existing flexible units on the market, to ensure that the voltage quality remains within the limits necessary for system security. Alternatively, these services can be provided by investments in passive elements (capacitors/reactors) or

	active elements (electronic devices such as STATCOM, systems), which is not the case with this project.
K9 Avoidance/postponement of remedial actions on existing components [*€*]	0. No impact. The project does not affect the postponement of interventions on other elements because it does not affect the increase in system security through the postponement of other investments or reconstructions. The benefit is modelled as a one-time benefit. Regardless of maintenance plans or the state of other elements in the system, the construction of this project does not have an impact on the intervention on other elements because the maintenance of other elements is carried out on time and according to a precisely determined sequence.
K10 Changing needs for redispatching [*€/year*]	0. No impact.
K11 Robustness [*rating scale*]	4.
EXPENSES	
T1 CAPEX [*€*]	40,000,000.00
T2 OPEX [*€/year*]	600,000.00

8.2 Remedial actions on existing transmission system elements that do not change the nominal power

NAME OF INVESTMENT

Revitalisation of 110 kV overhead lines

INVESTMENT IDENTIFICATION NUMBER

IPR118

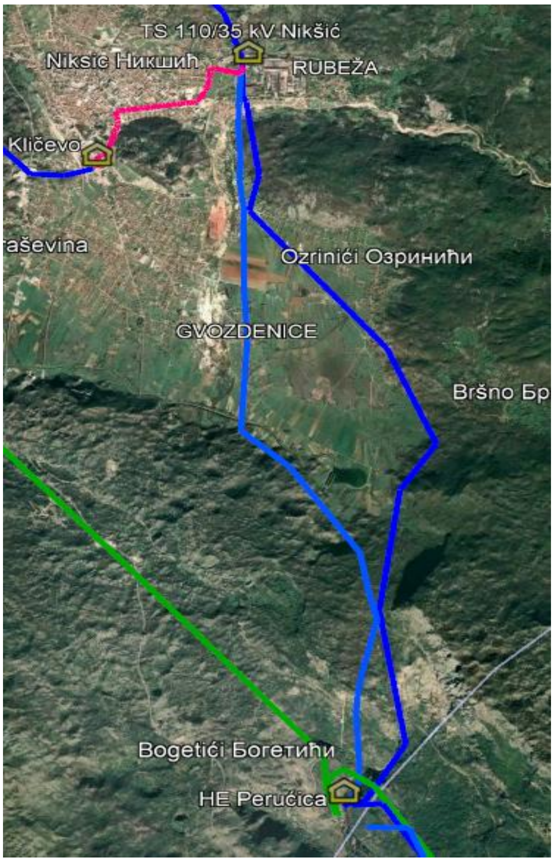
DESCRIPTION OF TECHNICAL SOLUTION [it is recommended to be up to 200 words]

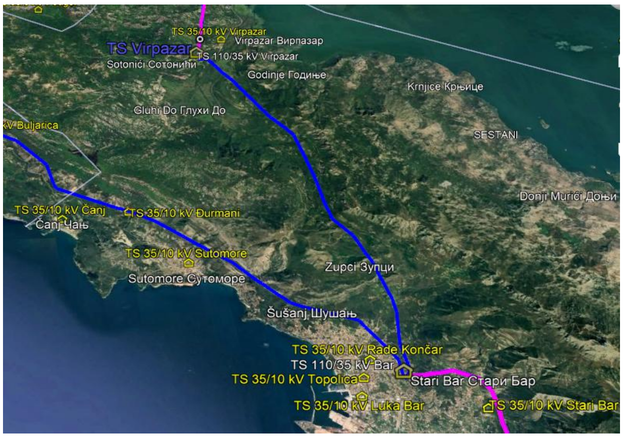
The overhead line 110 kV Virpazar - Bar has been in operation since 1961. During its operational period, only jointing and suspension equipment on the tension towers and some insulator strings were replaced. The as-built design of this line has revealed several deficiencies, such as corrosion and deterioration of certain suspension equipment components. During their utilisation life, the conductors have suffered numerous damages due to frequent outages and, primarily, have lost their elastic properties, due to which it is necessary to replace them in order to improve the operational reliability of the overhead line.

The revitalisation of OHL 110 kV Virpazar - Bar involves the procurement of Al/Fe 150/25 mm² conductors, the procurement of jointing and suspension equipment, the procurement of glass insulators, and the execution of works on the installation of the equipment. In addition to equipment replacement, painting of the towers, from tower no. 112 to tower no. 163, is also planned.

The overhead line 110 kV Perućica - Nikšić Line 3 was commissioned in 1958. Due to its long operational life and deterioration, it is necessary to replace the jointing and

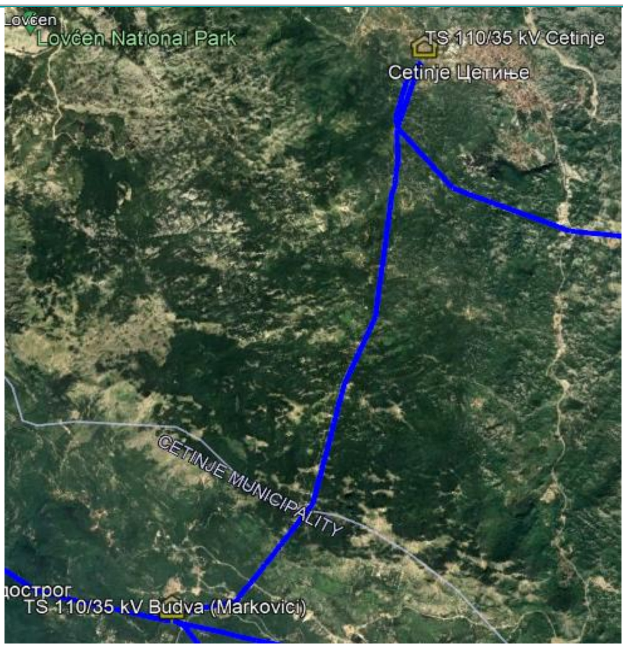
GEOGRAPHICAL LOCATION*

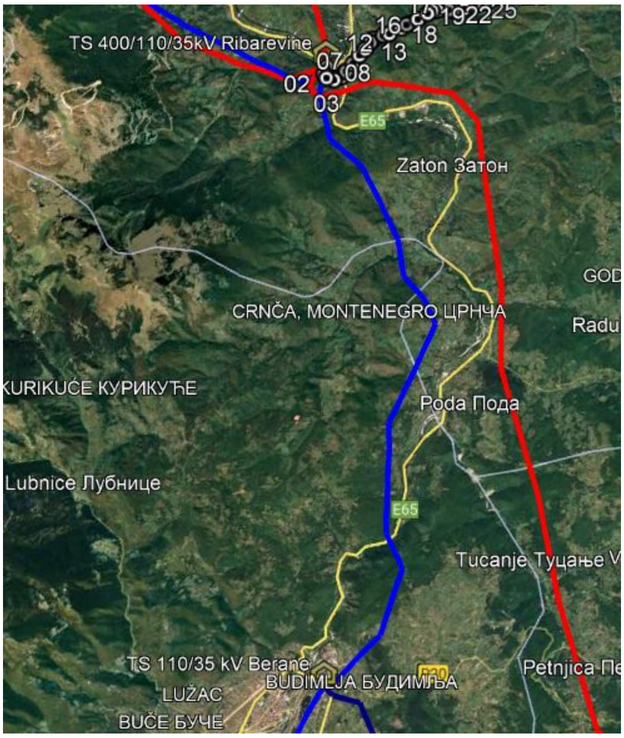




suspension equipment, phase conductors, and porcelain insulators. The revitalisation of OHL 110 kV Perućica - Nikšić line III implies the procurement of Al/Fe 240/40 mm² conductors, the procurement of jointing and suspension equipment, the procurement of glass insulators, and the execution of works on the installation of the equipment.

The as-built design for OHL 110 kV Budva - Cetinje anticipates the installation of completely new insulation in accordance with current regulations to increase operational security. In addition, given that the suspension equipment is movable and has been in operation for 46 years, deterioration from swinging, coupled with corrosion, is anticipated, underscoring the necessity for its replacement along the entire overhead line. The same conclusion applies to the condition of the conductor and its operational life. In order to increase the security of people and property and enhance the reliability and security of electricity transmission along this line (to reduce the risk of back flashovers that cause outages and damage to suspension equipment and conductors), it is recommended to renew the earth electrodes on towers where technical conditions are met and which are located in areas accessible to people (near houses, asphalt roads, vineyards, olive groves, arable land, gravel roads, etc.). An analysis of the line route has identified 20 tower locations where earth electrodes should be renewed given that a higher number of outages of this line (transient faults), have also been recorded through SGM. The project has also identified the presence of corrosion, to varying degrees, at all tower locations. It is obvious that advanced corrosion could become a weak point in the steel lattice structure at all tower locations, and thus the anti-corrosion protection is





planned for all towers along the overhead line.

The revitalisation of OHL 110 kV Budva - Cetinje implies the procurement of Al/Fe 150/25 mm² conductors, the procurement of jointing and suspension equipment, the procurement of glass insulators, and the execution of works on the installation of the mentioned equipment. In addition, the procurement of necessary materials and the execution of works on the anti-corrosion protection on all towers are planned, along with the excavation, replacement of existing earth electrodes, connection of newly installed earth electrodes to the tower structures, backfilling and measurement of earth electrode resistance on 20 towers.

With the project of the current condition of OHL 110 kV Ribarevine - Mojkovac, in order to increase operational security, it is recommended to install completely new insulation in accordance with current regulations. In addition, taking into account that the suspension equipment is mobile and has been in operation for over 50 years, it is to be expected that it will wear out due to swinging, which, along with the appearance of corrosion, indicates the need to replace it on the entire overhead line. The same statement is made regarding the condition of the conductor and its useful life. The revitalisation of OHL 110 kV Ribarevine - Mojkovac includes the procurement of Al/Fe 150/25 mm2 conductors, the procurement of jointing and suspension equipment and the procurement of glass insulators, as well as the execution of works on the installation of the mentioned equipment.

As OHL 110 kV Berane - Ribarevine and OHL 110 kV Ribarevine - Mojkovac used to form a single OHL 110 kV Mojkovac - Berane, the operational life of the

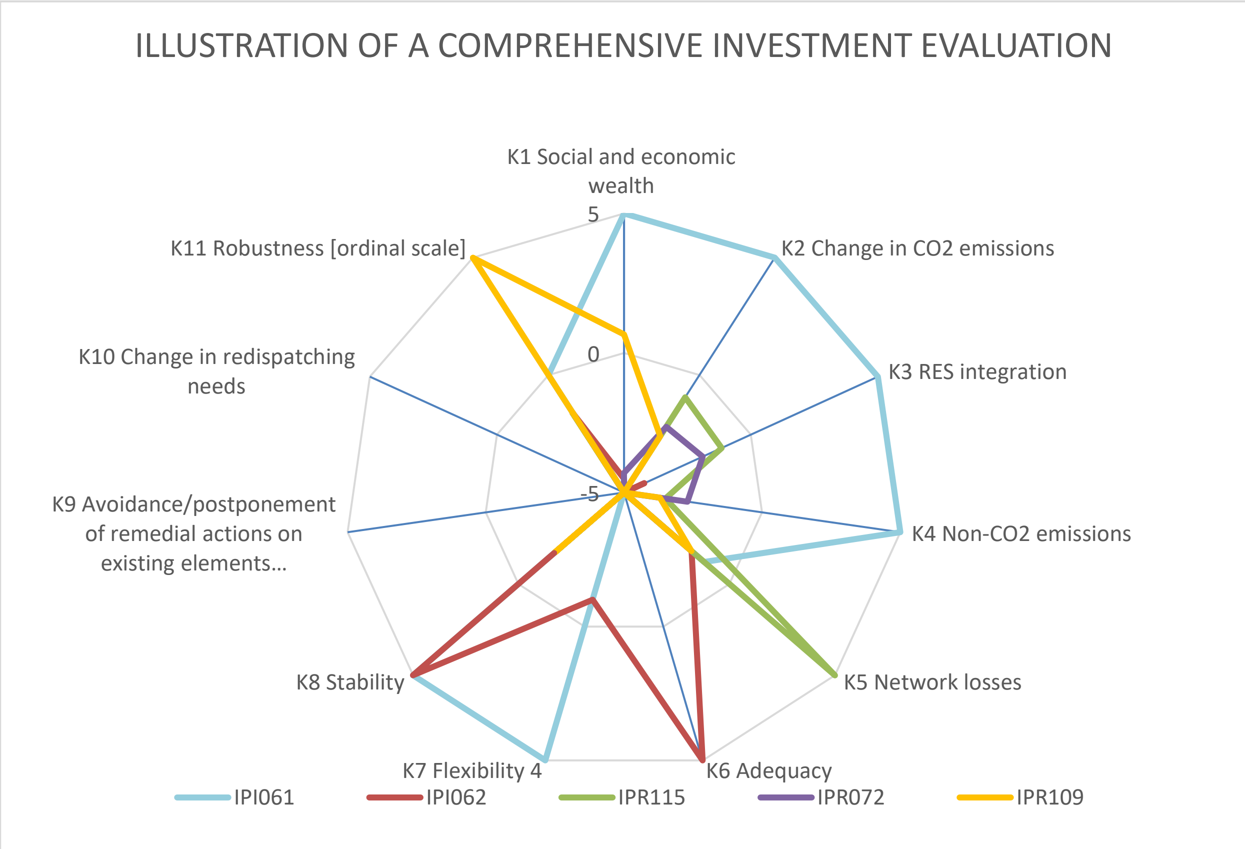
equipment on one and the other line is identical, both lines pass through a similar terrain configuration, with similar defects recorded during its operational period. For this reason, it is necessary to carry out the revitalisation of OHL 110 kV Berane - Ribarevine in an identical way. It includes the procurement of Al/Fe 150/25 mm2 conductors, the procurement of jointing and suspension equipment and the procurement of glass insulators, as well as the execution of works on the installation of the mentioned equipment.	
START OF CONSTRUCTION / **END OF CONSTRUCTION**	
2025 / *2030*	
☒ Project ☐ Programme	
(explain why it is a programme – it is recommended to be up to 200 words)	
INVESTMENT CATEGORY	
Remedial action on the existing electricity transmission infrastructure (without changing the transmission capacity)	
OBJECTIVE(S) OF THE DEVELOPMENT PLAN TO BE ACHIEVED BY INVESTMENT	
Objective 1 - Elimination of observed uncertainties in the past period *Objective 4 - Proper planning to minimise capital investments in the transmission network* *Objective 7 - Strategic directions for environmental protection improvement and development*	

BENEFITS	
K1 Avoided operating expenses [*€/year*]	100,000.00.
K2 Link to other investments (approved/completed) [it is recommended to be up to 200 words]	- IPD029 - Development of technical documentation.
K3 Fulfilment of legal obligations [it is recommended to be up to 200 words]	Energy Law (Official Gazette of Montenegro, no. 28/2025) Article 87 paragraph 1: The electricity transmission system operator shall "ensure long-term system capacity to meet the realistic requirements for electricity transmission, i.e. ensure the operation, maintenance, improvement and

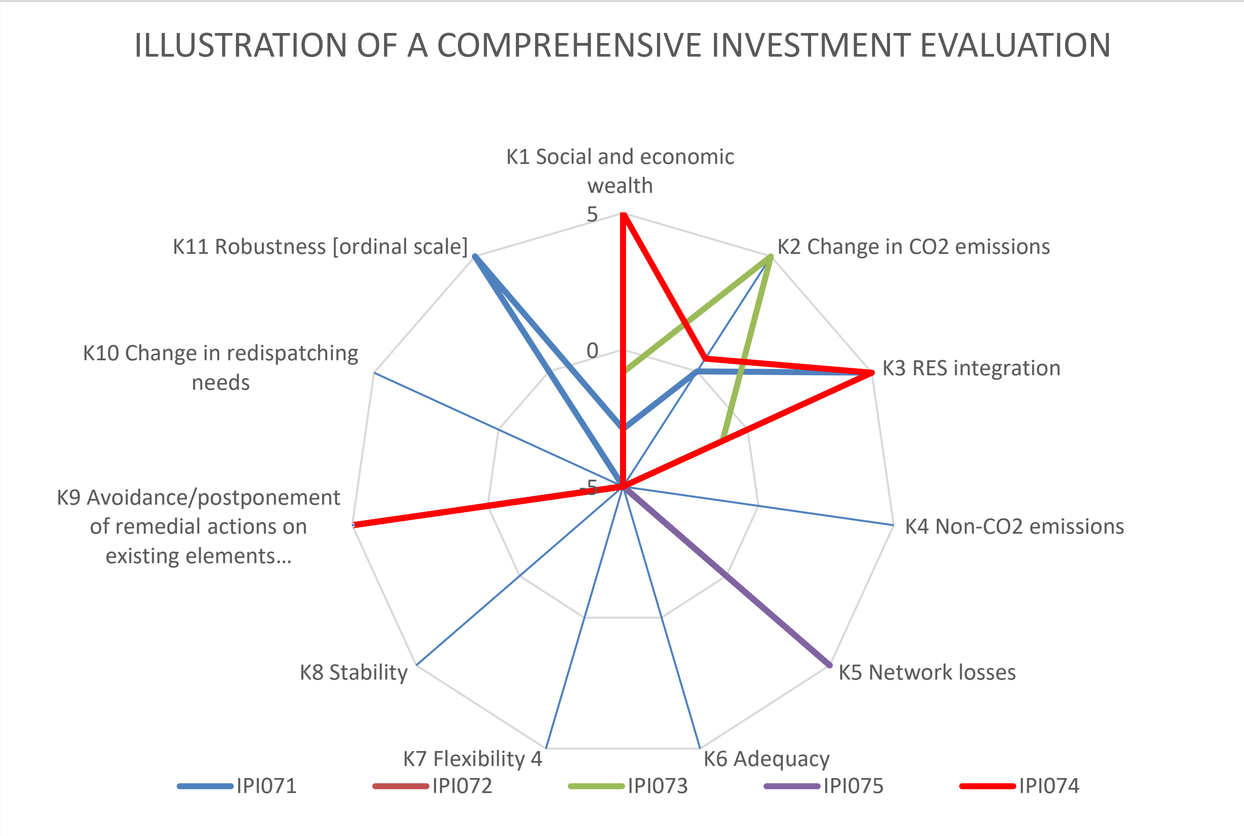
	development of the electricity transmission system with the aim of reliability, security and efficiency, all in compliance with the environmental protection requirements" - point 1, "contribute to security of supply through adequate transmission capacity and system availability" - point 3 and "ensure the security of electric power system operation" - point 16.
K4 Fulfilment of obligations from international agreements [it is recommended to be up to 200 words]	-
EXPENSES	
T1 CAPEX [€]	2,570,000.00
T2 OPEX [*€/year*]	4,000.00

9 Illustration of a comprehensive investment evaluation

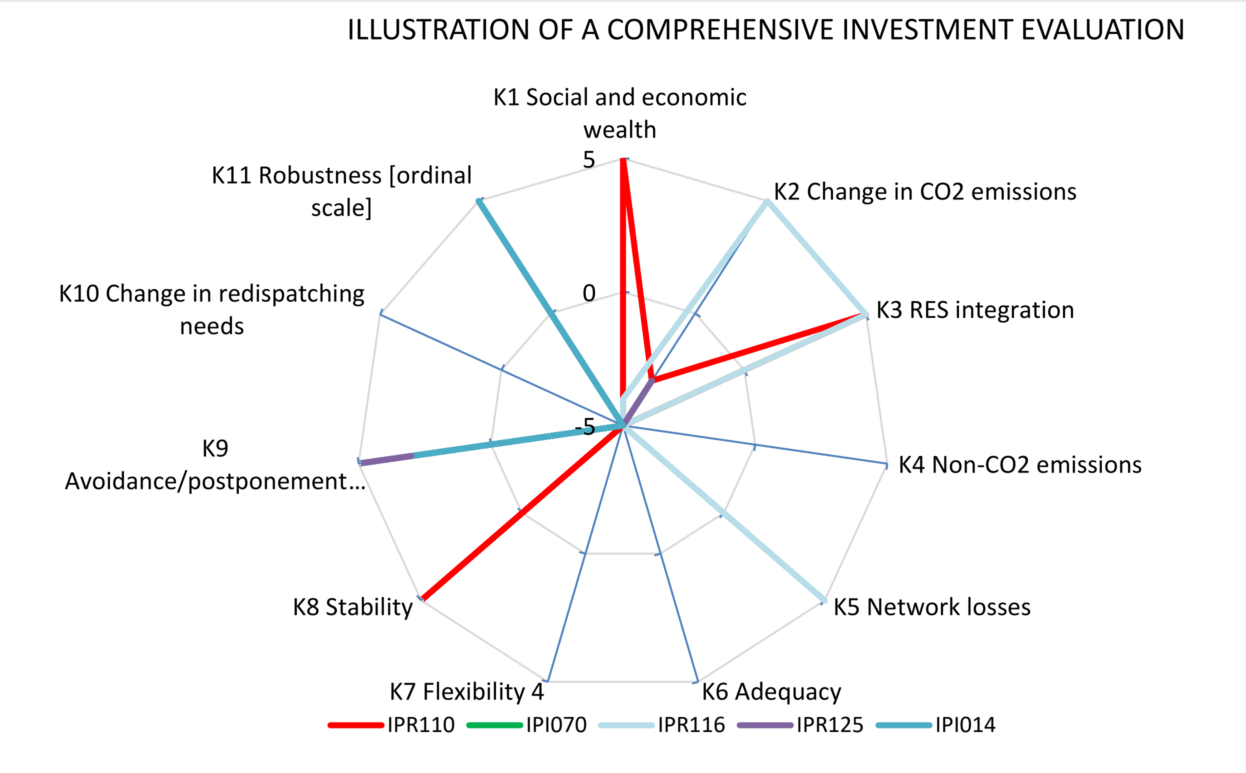
9.1 Construction of OHL 400 kV Brezna - Pivska planina - Sarajevo with SS 400/220 kV Pivska planina (IPI061), Construction of 110 kV connection Ulcinj - Velika plaža - Velipojë with SS 110/35 kV Velika plaža (IPI062), Reconstruction and extension of 220/110 kV plant at SS Perućica (IPR115), Reconstruction of OHL 110 kV Nikšić - Bileća (IPR072) and Reconstruction of OHL 110 kV Podgorica 1 - TPSS Trebješica - Andrijevica (IPR109)



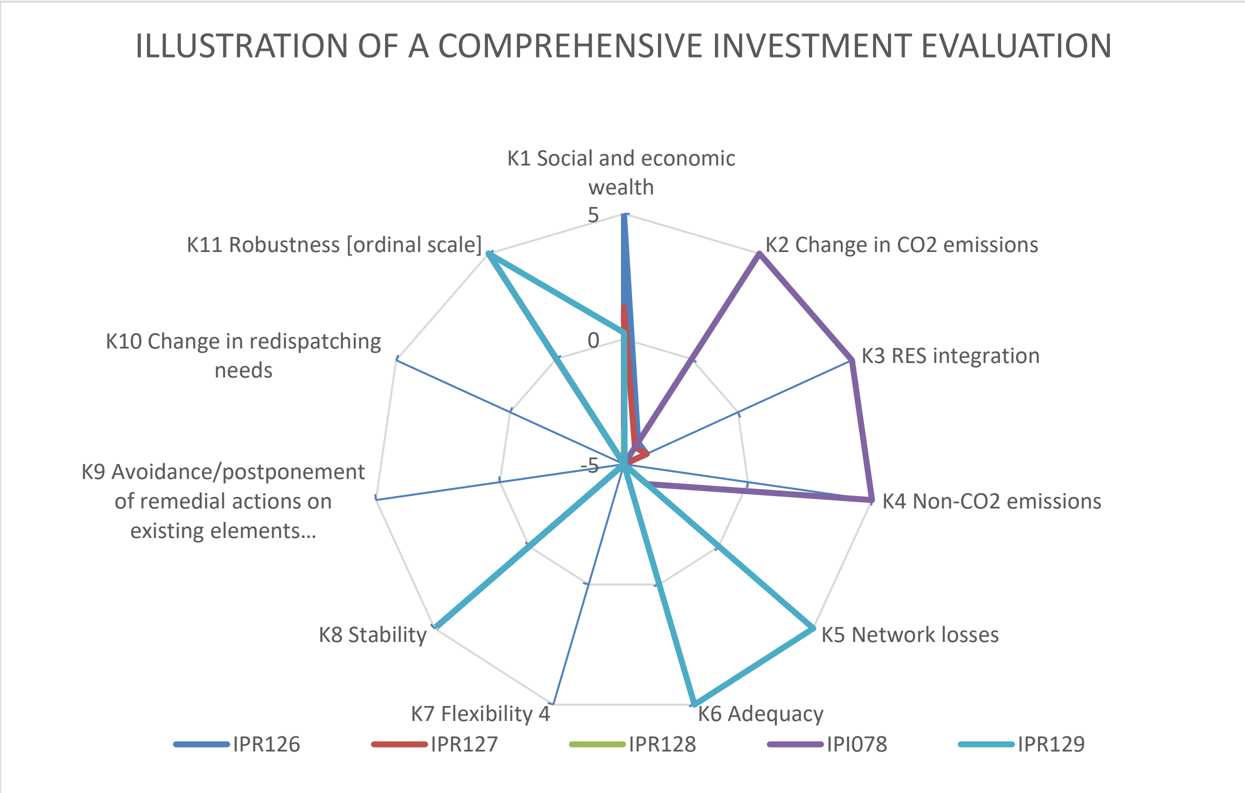
9.2 Construction of SS 110/x kV Bijela and connection to transmission network (IPI071), Construction of SS 110/10 kV Podgorica 6 and connection to transmission network (IPI072), Construction of SS 110/10 kV Podgorica 8 and connection to transmission network (IPI073), Construction of SS 110/35 kV Golubovci and connection 110 kV Podgorica 5 - Golubovci - Virpazar (IPI075) and Construction of SS 110/35 kV Tuzi and connection 110 kV Tuzi - Golubovci (IPI074)



9.3 Reconductoring OHL 220 kV Trebinje (BiH) - Perućica - Podgorica - Koplik (AL) (IPR110), Construction of SS 110/x kV Podgorica 9 with connection to 110 kV network (IPI070), Procurement of power transformers (IPR116), Extension of SS Podgorica 2 with 110/10 kV transformation (IPR125) and Construction of SS 110/35 kV Kolašin (Drijenak) and construction of OHL 110 kV Kolašin - Mateševo (IPI014)



9.4 Reconstruction of OHL 110 kV Bar - Možura - Ulcinj – reconductoring (IPR126), Reconstruction of OHL 110 kV Bar - Budva – reconductoring (IPR127), Reconstruction of OHL 110 kV Podgorica 2 - Virpazar – reconductoring (IPR128), Construction of OHL 400 kV Čevo - Brezna (line II) (IPI078) and Installation of synchronous condenser (IPR129)



Prepared by:	Proposed by:
Director of Development and Investment Sector:	Executive Director:
Dragan Perunović, BScEE	Ivan Asanović, BScEE

10 Literature and input data

[1] Transmission System Development Plan of Montenegro 2023-2032, December 2022
[2] Energy Law of Montenegro (Official Gazette of Montenegro, no. 28/2025)
[3] Transmission Grid Code (Official Gazette of Montenegro, no. 149/22 of 29 December 2022)
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[13] Calculation of short-circuit currents in the transmission network of Montenegro for the period 2020-2029 and measures for their reduction, June 2019/January 2020
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11 Addendum

11.1 Simulation of faults in the selected tie power lines

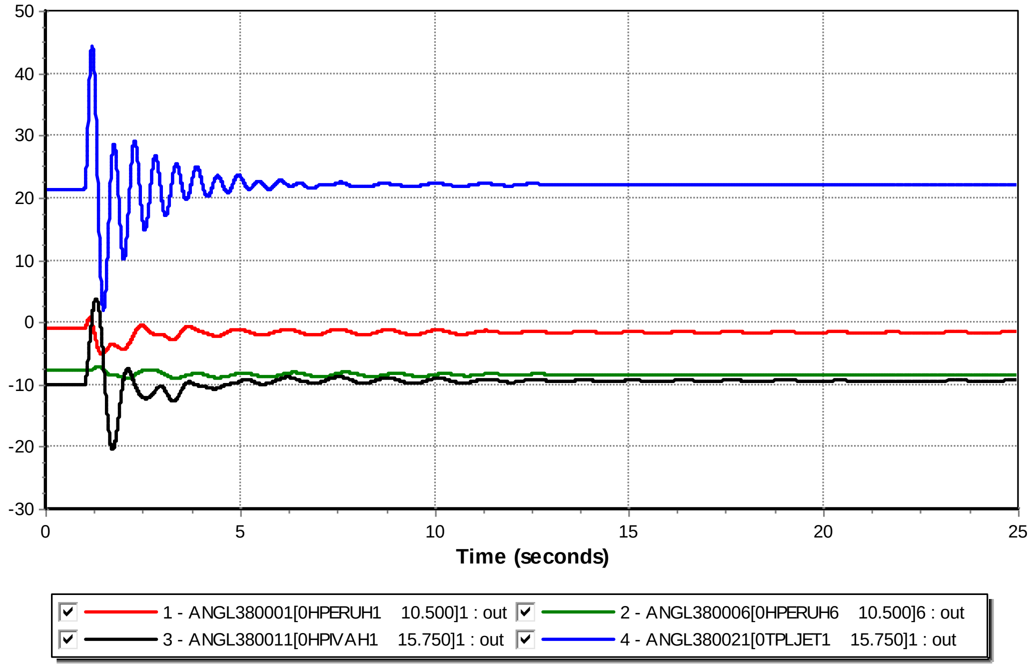

Figure 11-1: Generator angles in case of failure and outage of 220 kV OHL Pljevlja - Mojkovac, winter maximum mode in 2024

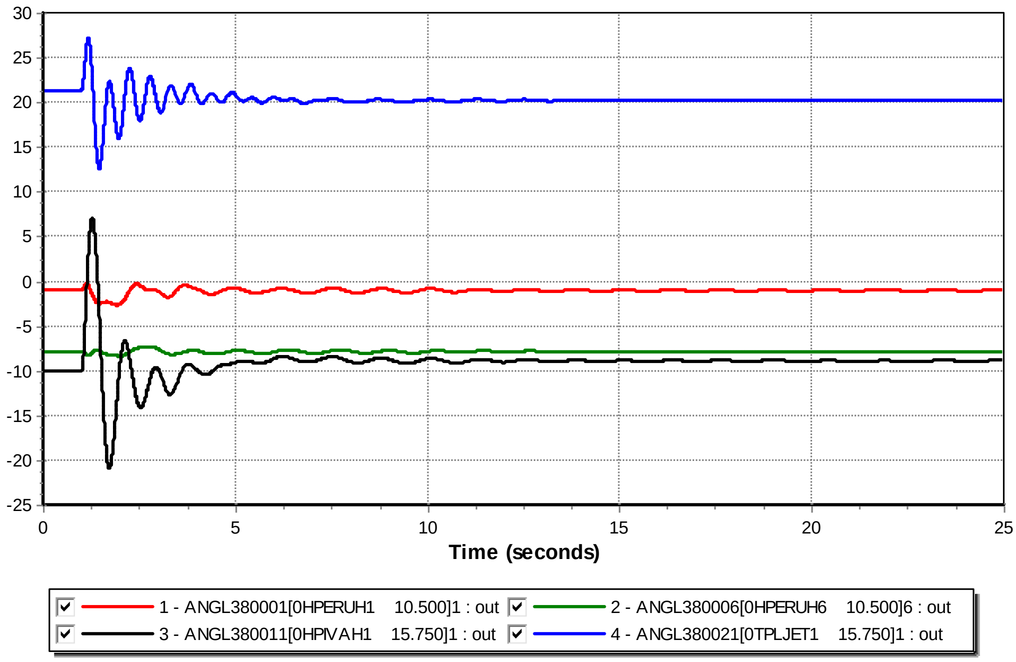

Figure 11-2: Generator angles in case of failure and outage of 220 kV OHL Pljevlja - Piva, winter maximum mode in 2024

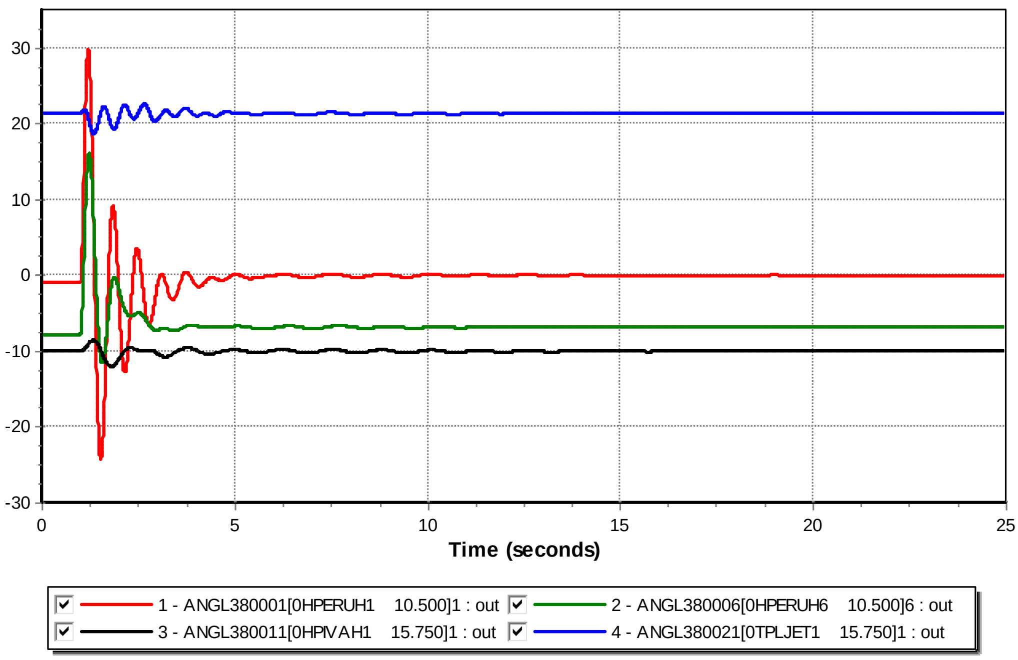

Figure 11-3: Generator angles in case of failure and outage of 110 kV OHL Perućica - Podgorica 1 (1), winter maximum mode in 2024

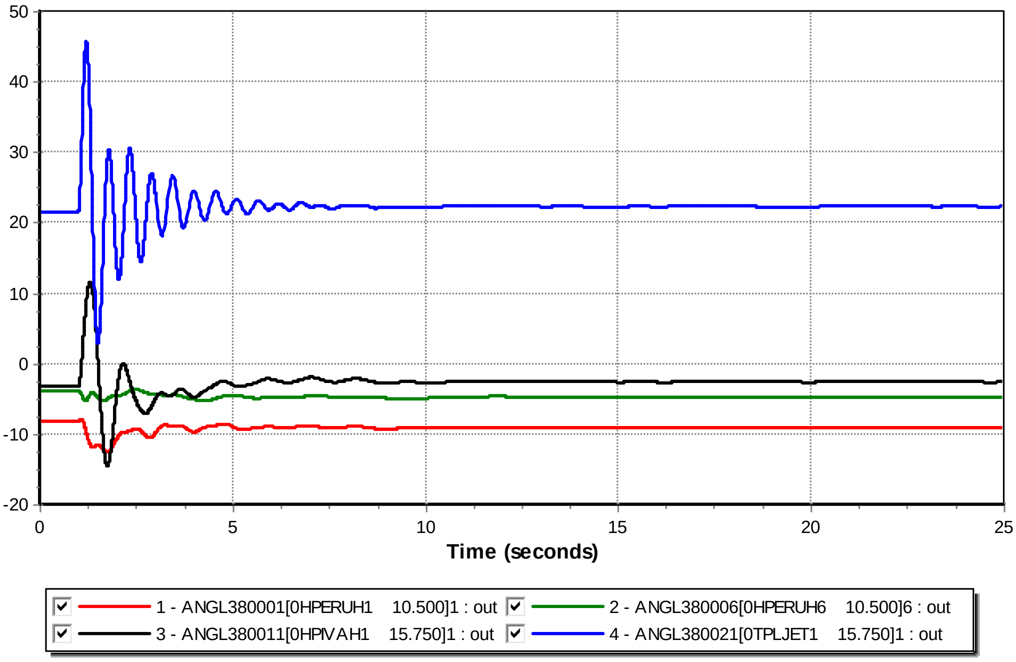

Figure 11-4: Generator angles in case of failure and outage of 220 kV OHL Pljevlja - Mojkovac, summer maximum mode in 2024

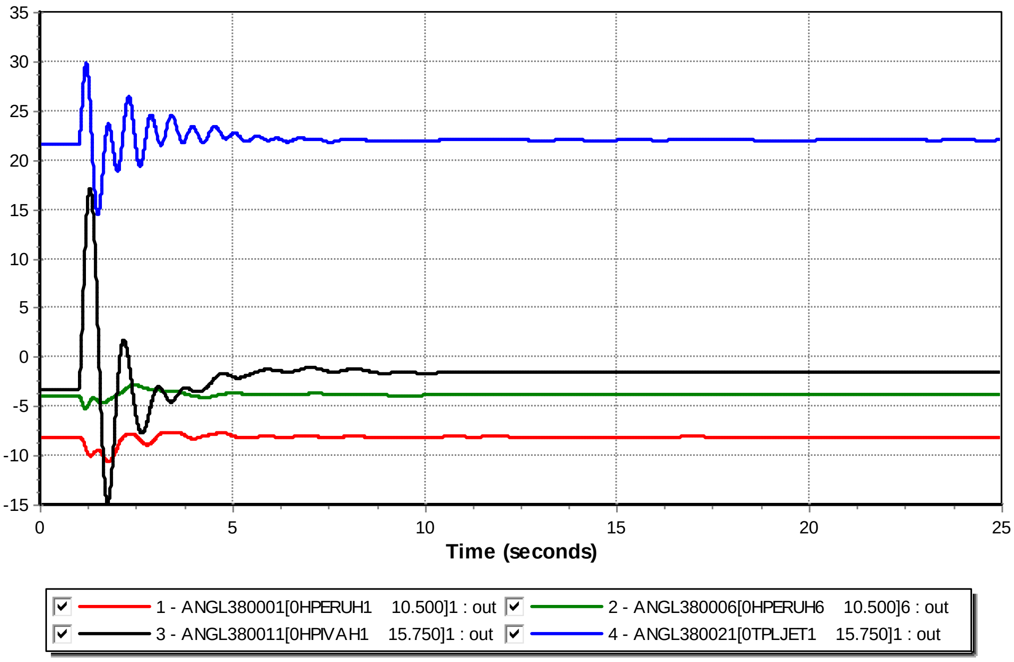

Figure 11-5: Generator angles in case of failure and outage of 220 kV OHL Piva - Sarajevo 20 (BiH), summer maximum mode in 2024

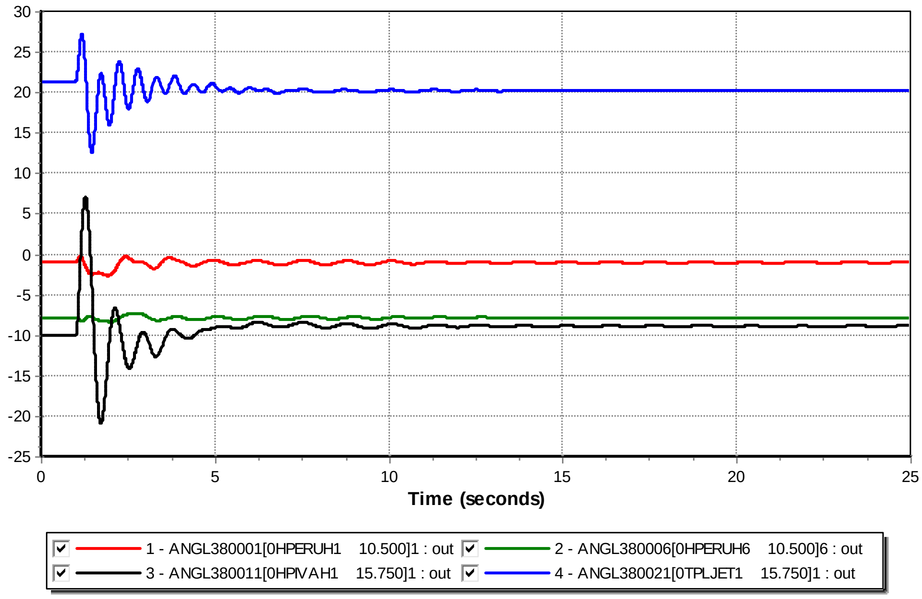

Figure 11-6: Generator angles in case of failure and outage of 220 kV OHL Pljevlja - Piva, winter maximum mode in 2026

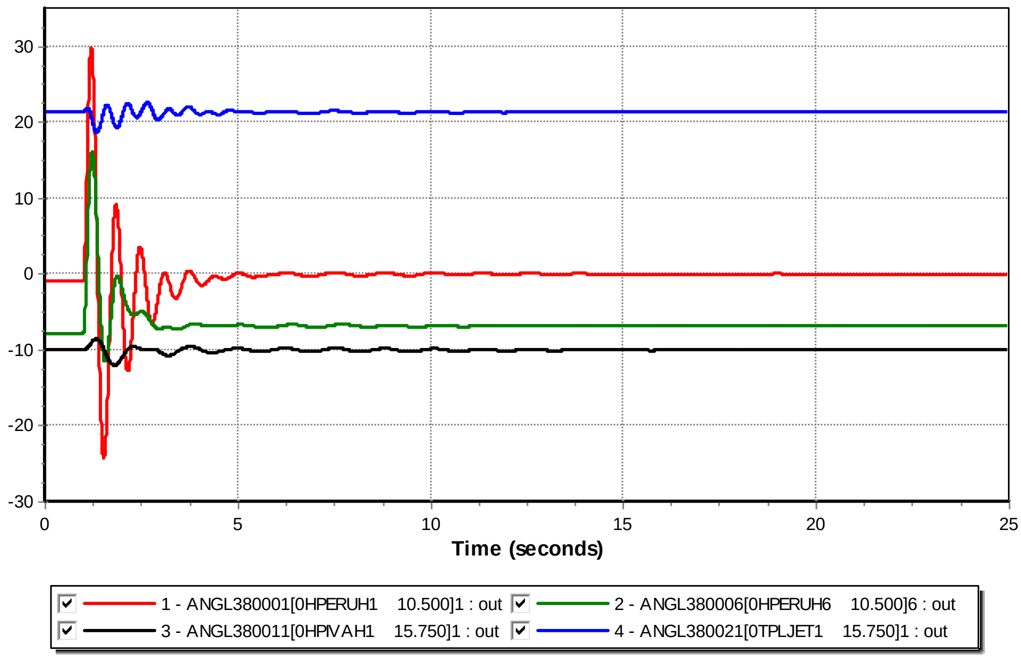

Figure 11-7: Generator angles in case of failure and outage of 110 kV OHL Perućica - Podgorica 1 (1), winter maximum mode in 2026

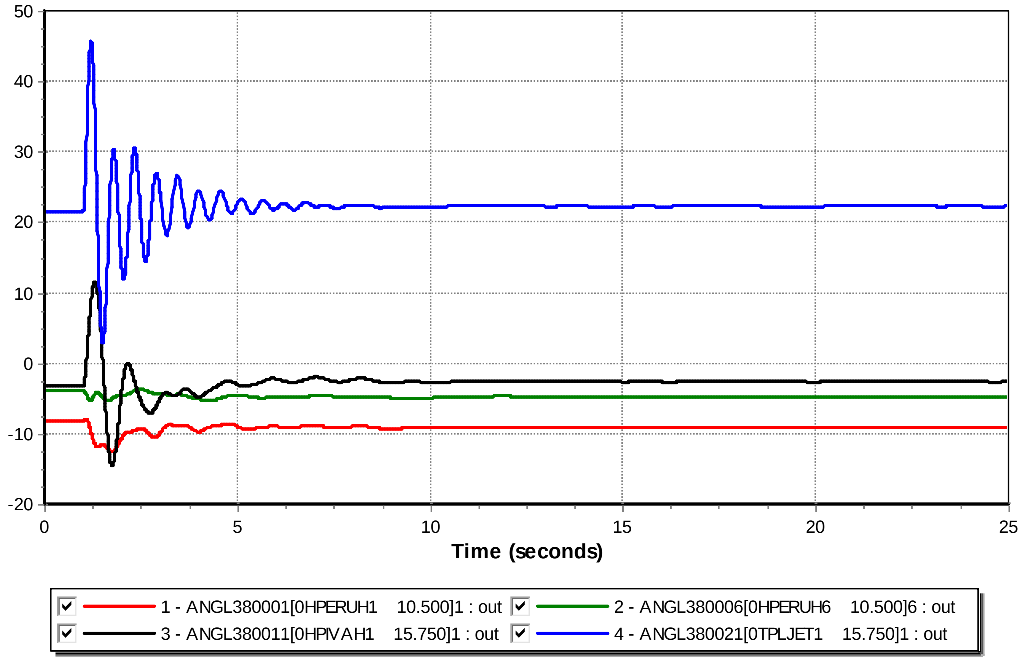

Figure 11-8: Generator angles in case of failure and outage of 220 kV OHL Pljevlja - Mojkovac, summer maximum mode in 2026

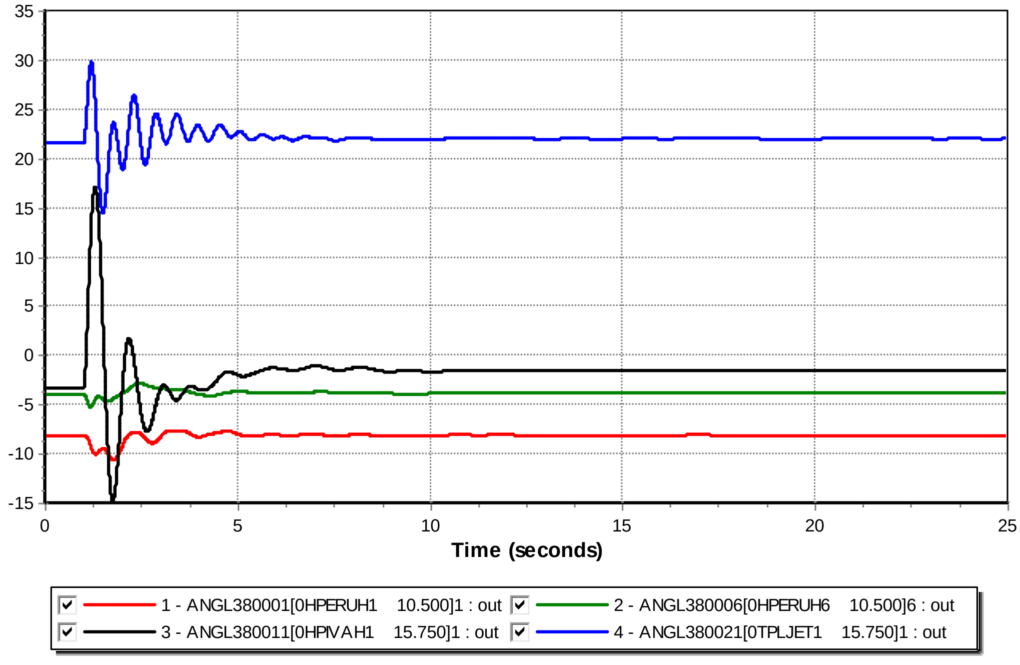

Figure 11-9: Generator angles in case of failure and outage of 220 kV OHL Piva - Sarajevo 20 (BiH), summer maximum mode in 2026

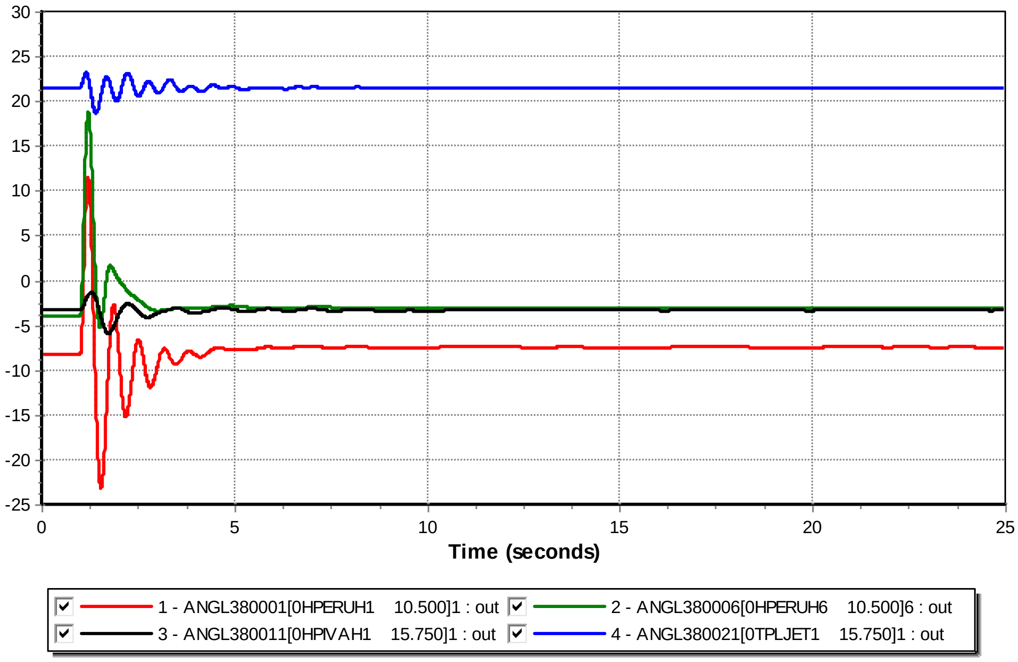

Figure 11-10: Generator angles in case of failure and outage of 110 kV OHL Perućica - Danilovgrad, summer maximum mode in 2026

11.2 Calculation of short-circuit current values

Table 11-1: Short-circuit current values in 2024

Node name		SHORT-CIRCUIT CURRENT VALUE 2024				
		Three-phase			Single-phase	
NAME	KV	MVA	KA	ANGLE	KA	ANGLE
ČEVO	400					
PLJEVLJA2	400	7.2	10.4	-85.12	9.8	-83.06
BREZNA	400					
PODGORICA2	400	8.6	12.4	-84.76	11.8	-83.10
LASTVA	400	6.9	9.9	-84.08	10.0	-83.93
RIBAREVINE	400	8.2	11.9	-84.92	10.6	-82.46
TRUBJELA	400					
KOLAŠIN	400					
PLJEVLJA2	220	8.1	21.2	-85.74	22.7	-85.57
PODGORICA1	220	4.7	12.2	-82.66	11.4	-82.41
VILUSI	220	0				
PERUĆICA	220	3.6	9.5	-82.49	8.1	-82.19
ANDRIJEVICA	110	0.9	4.7	-69.75	1.3	-71.19
BAR	110	1	5.3	-68.85	5.6	-71.52
BEČIĆI	110					
BERANE	110	1	5.5	-72.30	1.6	-73.19
BIJELA	110					
BREZNA	110	0.8	4.0	-72.32	3.4	-73.97
BUDVA	110	1.6	8.6	-71.63	9.1	-73.17
BULJARICA	110					
CETINJE	110	1.4	7.6	-73.02	7.4	-74.63
DANILOVGRAD	110	2	10.6	-72.70	8.4	-71.06
GVOZD WPP	110	0				
H.NOVI	110	1.1	5.9	-69.30	6.1	-72.74
KAP	110	3.3	17.6	-82.61	15.4	-81.62
KLIČEVO	110	2.1	11.2	-77.46	11.6	-77.88
KOLAŠIN	110	0				
KOTOR	110	1	5.2	-69.35	5.5	-72.11
LASTVA	110	3.7	19.2	-82.45	21.5	-83.00
KRNOVO WPP	110	0.7	3.6	-73.23	3.9	-75.55
LUŠTICA	110					
MATEŠEVO	110	0.9	4.8	-67.59	3.1	-67.88
MOJKOVAC	110	1.6	8.6	-81.71	9.5	-81.65
MOŽURA WPP	110	0.8	4.0	-70.51	4.4	-72.65
MRKE	110	2.2	11.5	-71.41	8.5	-69.84
NIKŠIĆ	110	2.4	12.7	-78.03	13.9	-78.72
NIKŠIĆ STEEL MILL	110	2.4	12.7	-78.43	13.9	-79.21
PERUĆICA	110	3.4	18.0	-79.89	21.4	-80.85
PLJEVLJA1	110	1.4	7.1	-81.42	2.5	-82.22
PLJEVLJA2	110	1.5	7.7	-80.91	9.2	-82.14
PODGORICA1	110	4.8	25.0	-83.39	28.8	-83.23
PODGORICA2	110	5.3	27.7	-84.29	31.7	-83.88
PODGORICA3	110	3.4	17.9	-80.89	18.4	-80.43
PODGORICA4	110	4.3	22.6	-78.01	22.3	-77.33
PODGORICA5	110	3.3	17.2	-80.83	17.3	-80.43
PODGORICA6	110					
PODGORICA7	110					
PODGORICA8	110					
PODGORICA9	110					
RIBAREVINE	110	2.3	11.9	-84.92	10.6	-82.46
TIVAT	110	1.2	6.2	-69.25	6.9	-72.04
TREBJEŠICA	110	1	5.2	-68.73	3.7	-68.03
TRUBJELA	110					
TUZI	110					
ULCINJ	110	0.6	3.4	-67.22	3.7	-70.74
VELIKA PLAŽA	110	1.6				
VILUSI	110	1.2	6.2	-87.22	5.1	-86.77
VIRPAZAR	110	1.1	6.0	-69.35	5.7	-71.08
ŽABLJAK	110	1.4	7.3	-73.01	6.5	-75.34

Table 11-2: Short-circuit current values in 2026

Node name		SHORT-CIRCUIT CURRENT VALUE 2026				
		Three-phase			Single-phase	
NAME	KV	MVA	KA	ANGLE	KA	ANGLE
ČEVO	400					
PLJEVLJA2	400	7.6	11.0	-85.12	10.4	-83.06
BREZNA	400					
PODGORICA2	400	7.6	11.0	-83.69	11.3	-82.54
LASTVA	400	6.9	9.9	-81.99	10.0	-81.81
RIBAREVINE	400	8.4	12.1	-84.94	11.0	-82.19
TRUBJELA	400					
KOLAŠIN	400					
PLJEVLJA2	220	8.1	21.2	-85.74	22.7	-85.57
PODGORICA1	220	4.8	12.7	-82.49	11.7	-82.41
VILUSI	220	0				
PERUĆICA	220	3.7	9.8	-82.49	8.4	-82.19
ANDRIJEVICA	110	0.9	4.7	-68.98	3.9	-70.96
BAR	110	2.7	14.2	-70.57	7.6	-73.69
BEČIĆI	110					
BERANE	110	1.1	5.5	-71.43	4.9	-72.92
BIJELA	110					
BREZNA	110	1.5	8.1	-88.25	7.4	-88.05
BUDVA	110	3.2	16.8	-75.83	16.5	-77.14
BULJARICA	110					
CETINJE	110	1.9	10.2	-72.50	9.0	-75.32
DANILOVGRAD	110	2.1	11.3	-71.10	8.7	-70.49
GVOZD WPP	110	1.6	8.2	-72.28	8.2	-76.30
H.NOVI	110	1.4	7.6	-72.28	7.3	-76.30
KAP	110	3.6	18.8	-80.81	16.3	-80.70
KLIČEVO	110	2.6	13.4	-76.05	13.4	-77.02
KOLAŠIN	110	0				
KOTOR	110	2.7	14.2	-77.49	13.9	-77.73
LASTVA	110	3.8	20.2	-81.51	23.3	-82.48
KRNOVO WPP	110	1.5	7.9	-81.51	8.1	-82.48
LUŠTICA	110					
MATEŠEVO	110	1	5.0	-67.59	3.5	-67.88
MOJKOVAC	110	1.6	8.6	-81.56	9.5	-81.46
MOŽURA WPP	110	0.8	4.0	-68.91	4.4	-71.82
MRKE	110	2.2	11.5	-71.41	8.5	-69.84
NIKŠIĆ	110	2.9	15.2	-76.84	16.2	-78.33
NIKŠIĆ STEEL MILL	110	2.9	15.2	-76.84	16.2	-78.33
PERUĆICA	110	3.8	20.0	-79.89	23.2	-80.85
PLJEVLJA1	110	1.7	8.8	-79.31	8.8	-80.49
PLJEVLJA2	110	1.7	9.0	-80.91	9.2	-82.14
PODGORICA1	110	5.3	27.7	-80.26	31.7	-80.64
PODGORICA2	110	5.8	30.3	-81.33	33.8	-81.73
PODGORICA3	110	3.6	19.0	-78.20	19.4	-78.62
PODGORICA4	110	4.3	22.9	-78.01	22.6	-77.33
PODGORICA5	110	3.5	18.3	-78.29	18.3	-78.81
PODGORICA6	110					
PODGORICA7	110					
PODGORICA8	110					
PODGORICA9	110					
RIBAREVINE	110	1.9	9.8	-82.63	10.8	-82.87
TIVAT	110	2.6	13.5	-75.72	13.5	-76.70
TREBJEŠICA	110	1	5.3	-67.61	3.7	-67.67
TRUBJELA	110					
TUZI	110					
ULCINJ	110	0.7	3.5	-70.06	3.8	-73.69
VELIKA PLAŽA	110	1.6	8.6	-87.22	9.5	-86.77
VILUSI	110	1.2	6.3	-87.22	5.2	-86.77
VIRPAZAR	110	1.7	9.0	-68.84	7.9	-71.28
ŽABLJAK	110	1.4	7.5	-73.01	6.6	-75.34

Table 11-3: Short-circuit current values in 2032

Node name		SHORT-CIRCUIT CURRENT VALUE 2032				
		Three-phase			Single-phase	
NAME	KV	MVA	KA	ANGLE	KA	ANGLE
ČEVO	400	13.7	19.8	-81.84	20.3	-81.66
PLJEVLJA2	400	12.1	17.5	-84.03	15.5	-82.32
BREZNA	400	12	17.2	-83.56	17.9	-83.29
PODGORICA2	400	11.6	16.7	-82.62	17	-81.8
LASTVA	400	11.1	16.1	-80.94	17	-81.08
RIBAREVINE	400	11.1	16	-83.85	13.6	-81.46
TRUBJELA	400	10.4	15.1	-83.41	13.6	-82.91
KOLAŠIN	400	9.5	13.8	-83.94	12.6	-82.27
PLJEVLJA2	220	7	18.5	-84.64	20.1	-84.81
PODGORICA1	220	4.8	12.7	-81.43	11.6	-81.67
VILUSI	220	3.7	9.8	-81.59	7.5	-82.03
PERUĆICA	220	3.7	9.6	-81.43	8.2	-81.46
ANDRIJEVICA	110	0.9	4.6	-68.09	3.8	-70.33
BAR	110	1.3	6.9	-69.66	7.1	-73.03
BEČIĆI	110	2.9	15.1	-73.96	11.1	-76.09
BERANE	110	1	5.4	-70.51	4.8	-72.27
BIJELA	110	2.3	12.4	-71.27	9.9	-75.44
BREZNA	110	5.1	26.8	-87.12	30.8	-87.26
BUDVA	110	3.2	16.7	-74.86	15.6	-76.45
BULJARICA	110	2.9	14.9	-73.92	10.9	-76.8
CETINJE	110	1.9	10.1	-71.57	9.1	-74.65
DANILOVGRAD	110	2.1	11.1	-70.19	8.6	-69.86
GVOZD WPP	110	1.6	8.2	-71.35	8.2	-75.62
H.NOVI	110	2.3	12.1	-71.35	9.7	-75.62
KAP	110	3.7	19.4	-79.77	16.2	-79.98
KLIČEVO	110	2.6	13.5	-75.07	13.1	-76.33
KOLAŠIN	110	1.68	8.85	-74.75	9.6	-76.02
KOTOR	110	3	15.9	-76.5	14.9	-77.04
LASTVA	110	4.4	23.3	-80.46	26.5	-81.74
KRNOVO WPP	110	1.5	7.9	-80.46	8.1	-81.74
LUŠTICA	110	2.88	15.1	-80.48	14.8	-81.74
MATEŠEVO	110	0.9	4.9	-66.72	3.4	-67.27
MOJKOVAC	110	1.6	8.2	-80.51	8.9	-80.73
MOŽURA WPP	110	1.1	5.8	-68.03	6.1	-71.18
MRKE	110	2.2	11.4	-70.49	8.3	-69.22
NIKŠIĆ	110	2.9	15.4	-75.85	16	-77.63
NIKŠIĆ STEEL MILL	110	2.9	15.4	-75.85	16	-77.63
PERUĆICA	110	3.9	20.4	-78.86	23.5	-80.13
PLJEVLJA1	110	1.5	8.1	-78.29	8.3	-79.77
PLJEVLJA2	110	1.6	8.3	-79.87	8.5	-81.41
PODGORICA1	110	5.6	29.3	-79.23	32.8	-79.92
PODGORICA2	110	5.9	31	-80.29	34.1	-81
PODGORICA3	110	3.7	19.6	-77.2	20	-77.92
PODGORICA4	110	4.6	23.9	-77.01	23.4	-76.64
PODGORICA5	110	3.6	18.8	-77.29	18.8	-78.11
PODGORICA6	110	3.88	20.4	-77.31	21.7	-78.22
PODGORICA7	110	3.32	17.45	-76.31	16.43	-77.22
PODGORICA8	110	4.6	24.5	-79.23	25.1	-79.92
PODGORICA9	110	5.6	29.8	-79.23	31.8	-79.92
RIBAREVINE	110	1.8	9.6	-81.57	10.6	-82.13
TIVAT	110	3	15.5	-74.75	14.8	-76.02
TREBJEŠICA	110	1	5.2	-66.74	3.6	-67.07
TRUBJELA	110	3.8	19.9	-87.41	21.9	-87.45
TUZI	110	1.5	7.9	-72.93	6.5	-74.6
ULCINJ	110	1.4	7.2	-69.16	7.1	-73.03
VELIKA PLAŽA	110	1.4	7.2	-69.66	7.5	-70.03
VILUSI	110	1.3	6.608	-86.1	9.5	-86
VIRPAZAR	110	1.3	7	-67.96	6.3	-70.64
ŽABLJAK	110	0.9	4.8	-72.07	4.5	-74.67

11.3 Power flows and voltage conditions

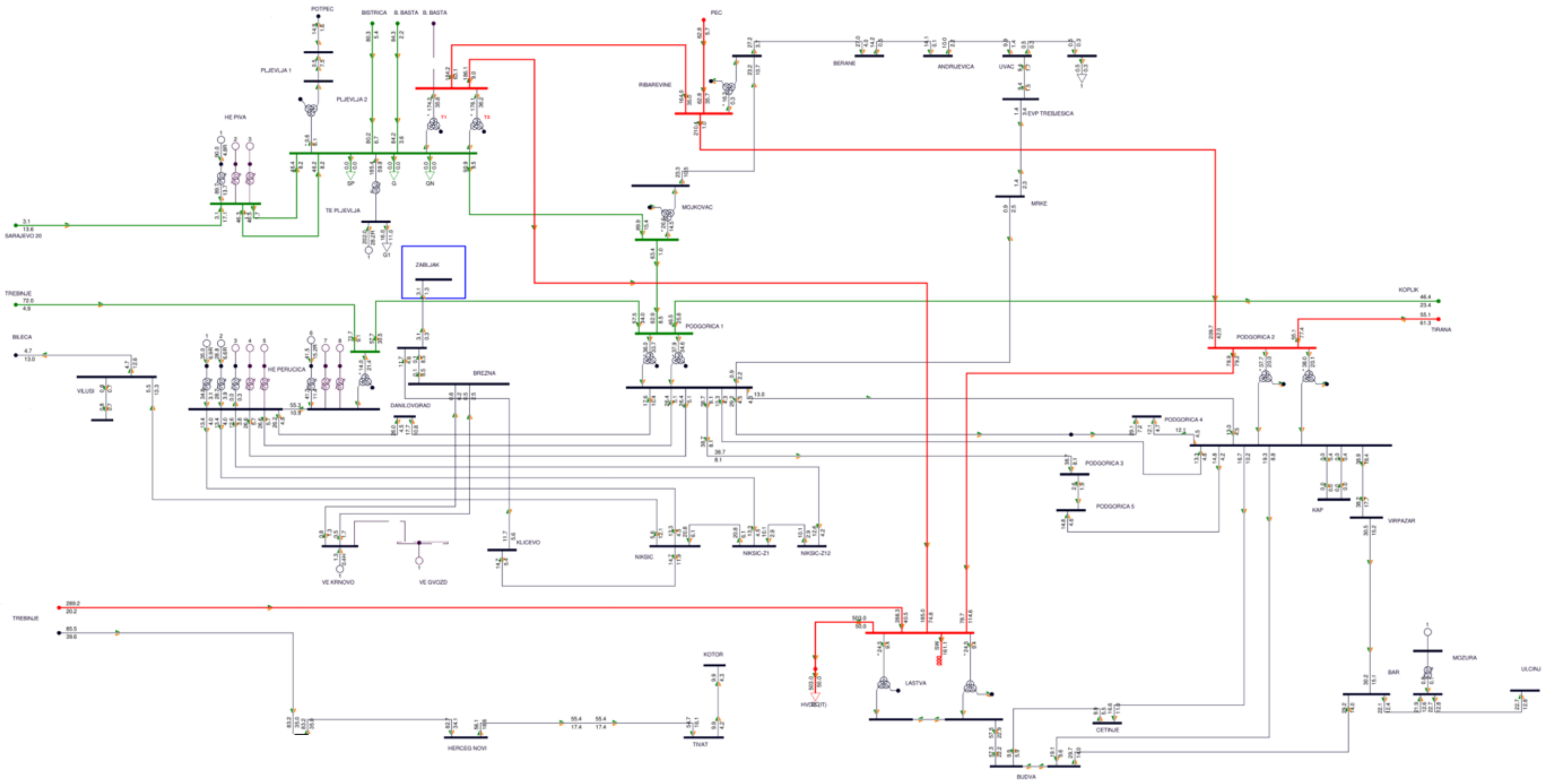

Figure 11-11: Transmission network topology for 2026

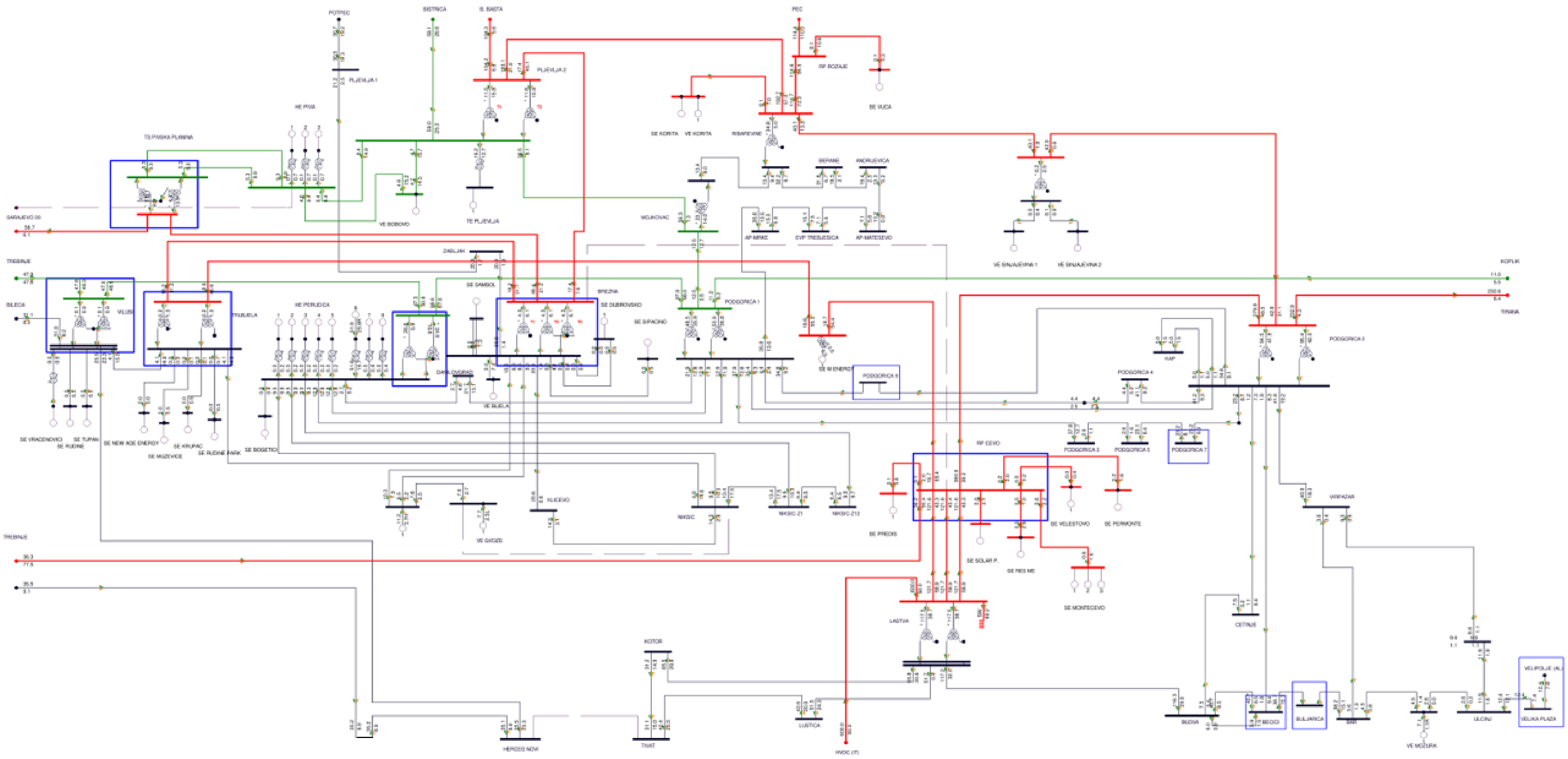

Figure 11-12: Transmission network topology for 2032

11.4 Power plants for which an application for connection was received and connection possibility analysis was conducted

No.	Power plant	Power plant type	Municipality	Installed power
1.	M ENERGY	SPP	Cetinje and Nikšić	385 MW
2.	MONTEČEVO	SPP	Cetinje	400 MW
3.	Prediš	SPP	Cetinje	215 MW
4.	SOLAR POWER	SPP	Cetinje	170 MW
5.	Korita	SPP	Bijelo Polje	240 MW
6.	Dubrovsko	SPP	Šavnik	I phase – 40 MW and II phase – 155 MW
7.	RES MONTENEGRO	SPP	Cetinje	506 MW
8.	Vraćenovići	SPP	Nikšić	87,5 MW
9.	Bijela	WPP	Šavnik	118,8 MW
10.	QAIR MONTENEGRO-RUDINE	SPP	Nikšić	50.13 MW
11.	EPCG (A8)	HPP	Nikšić	58,5 MW
12.	“Nebojša” (Bobovo)	WPP	Pljevlja	120 MW
13.	Bogetići	SPP	Nikšić	18 MW
14.	Sinjajevina I	WPP	Kolašin	118.8 MW
15.	Vuča	SPP	Rožaje	122 MW
16.	Permonte	SPP	Cetinje	100 MW
17.	Rudine energy park	SPP	Nikšić	140 MW
18.	Šipačno II	SPP	Nikšić	164 MW
19.	Velestovo	SPP	Nikšić	50 MW
20.	Krupac (Stuba)	SPP	Nikšić	49.96 MW
21.	New Age Energy III	SPP	Nikšić	68 MW
22.	Vjetro park Korita	WPP	Bijelo Polje	72.6 MW
23.	Lika	SPP	Ulcinj	12 MW
24.	Krstac (Muževice)	SPP	Nikšić	80 MW
25.	Sinjajevina II	WPP	Kolašin	290.4 MW
26.	Petrovići	SPP	Nikšić	50 MW
27.	Somina (Samsol)	SPP	Nikšić	180 MW
28.	Tupan	SPP	Nikšić	70 MW