Master Plan of Energy Networks for the Adriatic-Ionian Region

Study 1 –

POWER NETWORKS AND MARKET FOR A GREEN ADRIATIC-IONIAN REGION

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Summary

1 Flagship project – overall goal and expected impact

The Energy Networks Sub-Group of EUSAIR Pillar 2 – Connecting the Region identified three Flagship Projects for embedding in the frameworks of 2021-2027 European cooperation and cohesion funds, namely:

- F1 - Power networks and market for a green Adriatic-Ionian region: The goal is at expanding and interconnecting national power systems, creating power market coupling while exploring opportunities for large-scale deployment of low-carbon energy sources and grid digitalisation;
- F2 - Integrated natural gas corridors and market for a green Adriatic-Ionian region: The goal is at expanding and interconnecting national gas systems promoting security of gas supplies while exploiting opportunities for gas storage and counterflows towards an efficient gas trading hub; and
- F3 - Development and operation of logistics for direct LNG use as a clean fuel for the Adriatic-Ionian region: The development of small-scale direct LNG use is contributing to a more secure, competitive and sustainable energy system through the Adriatic-Ionian Region.

The Flagships Projects were approved by the EUSAIR Governing Board on 10/06/2020. For each of these three Flagship Projects, a feasibility study is foreseen to be conducted to analyse in detail and evaluate its potential for enactment and contribution to EUSAIR Member States programmes and commitments towards the year 2030 and beyond. The feasibility studies are an integral part of the Master Plan.

One of the specific objectives for Pillar 2 is to achieve a well-interconnected and well-functioning internal energy market supporting the three energy policy objectives of the EU – competitiveness, security of supply and sustainability.

In this regard, electricity is foreseen to have an increasing role and share in all the national energy systems through the Adriatic-Ionian Region as one of the drivers in the energy transition towards a low-carbon economy. Electricity is envisaged to be produced by a variety of sources and facilities while renewable energies are expected to become a key component. It is in the interest of all EUSAIR Member States to interconnect their power grids, as a means to optimise the deployment of low-carbon power generation, to maintain grid stability and security while expanding the use of intermittent and diversified power sources. Electricity storage, digitalisation of the power grid and smart grids will offer further opportunities for reducing costs and improving the service. Electricity market integration, market coupling would become possible should investments in new power infrastructure become a reality.

For attaining the goals set for F1 - Power networks and market for a green Adriatic-Ionian region, the following actions contributing to the overall flagship to be taken within national boundaries/at the national level are foreseen:

- **Transbalkan Electricity Corridor.** The Transbalkan Electricity Corridor is a cluster of projects consisting in new power transmission lines, their reinforcements to allow electricity trade, improve grid stability and the large-scale deployment of source. This action is of interest to the following EUSAIR Countries: Bosnia and Herzegovina, Croatia, Montenegro, and Serbia.

- **Power market coupling and integration**. This action encompasses creation of a wholesale power market for the Adriatic-Ionian Region according to a number of steps including harmonisation of electricity transmission tariffs, progressive market coupling, power purchase agreements and use of blockchain to facilitate electricity trading. The action is of interest to all EUSAIR Countries.
- **Digitalisation of the power system, smart grids, deployment of renewable energy sources**. According to the Clean Energy for All Europeans package and several National Energy and Climate Plans (NECPs) developed by EUSAIR countries, priority should be given to the clean energy transition. In this context new collaborative projects are envisioned.

The following Chapter 2 - Proposed actions and projects – will give an overview of the three F1 actions listed above. A detailed insight into the measures foreseen will be provided, and the effects of these measures within the period of the Master Plan will be elaborated.

2 Proposed actions and projects

2.1 Trans-Balkan Electricity Corridor

The Trans-Balkan Electricity Corridor is considered nationally and regionally significant and one of the Flagship projects under the EU's Economic and Investment Plan for the Western Balkans. Construction of the Corridor is supported by the Western Balkans Investment Framework (WBIF). The Corridor contributes to the establishment of a regional power network connecting the electricity transmission systems (ETS) of Bosnia and Herzegovina, Montenegro and Serbia (non-EU EUSAIR countries) with EU countries, both EUSAIR (Croatia, Italy), and non-EUSAIR countries (Hungary, Romania), through 400 kV overhead lines or submarine cables.

The map of the Trans-Balkan Electricity Corridor (further on referred to as "the Corridor") is presented in the following figure.

Figure 1. Trans-Balkan electricity corridor

The route of the corridor is presented in more detail in the following figure.

Figure 2. Route of the Trans-Balkan electricity corridor

Construction of the Corridor encompasses construction of 400 kV overhead lines (OHLs) in Serbia, Bosnia and Herzegovina, and Montenegro, as well as construction of the interconnection towards Italy under the Adriatic Sea (Lastva (MNE) – Villanova (ITA)).

2.1.a Sections of the Trans-Balkan Electricity Corridor in Serbia

As for the related investments in the **Serbian electricity transmission** which are parts of the Corridor, these include:

- Construction of a new 400 kV section Kragujevac – Kraljevo,
- Upgrading the sections Obrenovac – Bajina Bašta and Bajina Bašta – Višegrad (Bosnia and Herzegovina), and to the border with Montenegro to 400 kV.

By constructing/upgrading these OHLs, only low to moderate social and environmental impacts are foreseen, since the OHLs are planned to use the existing transmission corridors wherever possible, or be in close proximity to the existing corridors. The most important benefits of the Corridor are in replacing the outdated (and hence susceptible to system failures, with significant O&M costs) 220 kV network.

Construction of the Corridor in Serbia is foreseen in two phases.

As depicted in Figure 1 above and in Figure 3, **Phase 1** in Serbia encompasses construction of four sections of the Corridor:

- Section 1: double-circuit 400 kV interconnecting line between Serbia and Romania,
- Section 2: 400 kV OHL TS Kragujevac – TS Kraljevo 3, together with increasing of voltage level in TS Kraljevo 3 to 400 kV,
- Section 3: new double-circuit 400 kV OHL TS Obrenovac – TS Bajina Bašta and reconstruction of the presently operating TS Obrenovac and TS Bajina Bašta, resulting in increased voltage level of Western Serbia transmission grid to 400 kV between TS Obrenovac and TS Bajina Bašta, and
- Section 4: double-circuit 400 kV interconnection between Serbia, Montenegro, and Bosnia and Herzegovina.

Figure 3. The route and the sections of the Trans-Balkan electricity corridor in Serbia – Phase 1

The following table summarizes the lengths of the sections, construction status, as well as needed investments.

Section	Route	Length [km]	Investment [EUR]	Status
Section 1	Romania (Resita) - Serbia (Pančevo)	68	n/a	Completed and commissioned in 2017
Section 2	TS Kragujevac 2 - TS Kraljevo 3, with voltage level upgrade in TS Kraljevo 3 to 400 kV	60	29,600,000	Completed and commissioned in 2022
Section 3	TS Obrenovac - TS Bajina Bašta, with voltage level upgrade of TS Bajina Basta to 400 kV	109	89,778,400	Design/permitting stage, financing secured, tender preparation
Section 4	Interconnection to Montenegro and Bosnia & Herzegovina (TS Bajina Bašta - TS Pljevlja (MNE) - TS Višegrad (BiH))	84	40,800,000	Design/permitting stage; to be completed by 2027
Total		**321**	**154,000,000**	Please see note below
.				
KfW loan			82,800,000	
EU grant/WBIF			31,200,000	
Serbia			40,000,000	

Note: The figures in the table originate from different sources. Total/KfW loan/WBIF/Serbia contributions originate from https://www.euzatebe.rs/rs/projekti/transbalkanski-elektroenergetski-koridor. Cost data for sections originate from WBIF records (https://www.wbif.eu/project/PRJ-SRB-ENE-007) and ENTSO-E (https://tyndp2022-project-platform.azurewebsites.net/projectsheets/transmission/227).

Table 1. Trans-Balkan electricity corridor – Serbia – Phase 1 – sections, construction status, investments and financing

Financing of construction for Section 3 has been secured, as follows.

Source	Type of contribution	WBIF reference	Amount [EUR]
KfW	Loan	-	40,000,000
WBIF	Grant	TA-SER-26	500,000
WBIF	Grant	WB14-SRB-ENE-01	804,000
WBIF	Grant	WB-IG04-SRB-ENE-01	13,101,800
Beneficiary Contribution	Own Contribution	-	4,370,000
KfW	Loan	-	24,500,000
Anticipated WBIF INV Grant	External Grant	-	6,252,600
KfW	External Grant		250,000
		Total	**89,778,400**
		Total Grants	20,908,400
		Total Loans	64,500,000

Table 2. Trans-Balkan electricity corridor – Serbia – Phase 1 – Section 3 – Financing plan

In October 2022, the contract for consulting services for the construction of the TS's and the OHL was signed with period of execution October 2022 – August 2027 under KfW Development Bank financing rules. Construction of Section 3 is scheduled to start in August 2023, and commissioning is foreseen for August 2027.

On 23/01/2023, Serbia (represented by the Minister of Mining and Energy, the Minister of European Integration and the Director of the TSO "Elektromreža Srbije") has signed a donation agreement with KfW (represented by the Director of KfW Belgrade office), for construction of Section 4 of the Corridor. The donation agreement's worth is 8.5 million EUR. There are some unharmonized data on the expected start and completion of construction[1]. Completion of Section 4 is officially foreseen for the year 2027, however it will probably be delayed.

Further details on the status of Section 3 and Section 4 of the Corridor are presented in Section 5 of the Master Plan.

All planned investments under Phase 1 have been envisaged by the respective planning documentation of EMS at national level (Ten-Year Transmission System Development Plan of the Republic of Serbia), respective Regional Investment Plans (RegIP) and ENTSO-E pan-European ten-year development plan (TYNDP - Ten Year Network Development Plan).

Phase 2 of the Corridor in Serbia consists of transmission infrastructure which is in the development or pre-investment stage at the moment. This phase consists of the following sections:

[1] MEI - Aktuelnosti - Donacija EU 8,5 miliona evra za Transbalkanski koridor ka CG i BiH – completion of Section 3 in 2027, Agreement on donation for fourth section of Trans-Balkan Corridor signed (srbija.gov.rs) – start of construction in 2026, upon completion of Section 3.

- Section 1 – North CSE (Continental South-East) corridor:
    - TS 400/110 kV Belgrade West,
    - OHL 400 kV Belgrade West – Wind Farm (WF) Čibuk 1,
    - Extension of 400 kV interconnection with Romania (Đerdap – Porţile De Fier),
- Section 2 – Central Balkan corridor:
    - OHL 400 kV Bajina Bašta – Kraljevo,
    - OHL 400 kV Kraljevo – Kruševac,
    - OHL 400 kV Kruševac – Niš, including upgrade of voltage level in TS Kruševac to 400 kV,
    - 400 kV interconnecting line Niš – Sofia West,
- Section 3 – 400 kV interconnecting line between Serbia and Croatia, and
- Section 4 – OHL 400 kV TS Jagodina 4 – TS Požarevac.

The sections of Phase 2 are presented in Figure 4.

Figure 4. The route and the sections of the Trans-Balkan electricity corridor in Serbia – Phase 2

2.1.b Sections of the Trans-Balkan Electricity Corridor in Montenegro

Construction of the Corridor in Montenegro is foreseen in two phases:

- **Trans-Balkan Electricity Corridor - Grid Section in Montenegro - Part I** (completed in 2023):

- Lot 1: Construction of TS 400/110/35 kV Lastva and extension of existing TS 400/220/110 kV Pljevlja;
- Lot 2: Construction of OHL 400 kV Lastva-Čevo:
  - construction of the double circuit line 2x400 kV Lastva-Trebinje
  - construction of the double circuit line 2x400 kV Lastva-Pljevlja (section Lastva-Čevo),
  - construction of the single circuit line 400 kV Lastva-Podgorica (section Lastva-Čevo);
- Lot 3: Construction of OHL Čevo-Pljevlja:
  - construction of the 400 kV Lastva-Pljevlja line (section Čevo-Pljevlja) which is partly double circuit, and
  - construction of OHL 2x400 kV Pljevlja-Border with Serbia.

The project also includes replacement of high voltage equipment in substations, as well as reconstruction of protection system in transmission network and construction of TS 110/35 kV Brezna.

- **Trans-Balkan Electricity Corridor - Grid Section in Montenegro - Part II**:
  - Component 1: Replacement of high voltage (HV) equipment and other equipment in several HV substations,
  - Component 2: Reconstruction of control and protection systems and the integration of several existing substations into SCADA communication,
  - Component 3: Replacement of the existing 220 kV OHL with new 400 kV OHL from Pljevlja 2 to the border with Serbia, and extension of the 400 kV switchyard in substation Pljevlja 2; and
  - Component 4: Integration of TS 110/35 kV Brezna and associated transmission line into the public transmission grid.

The route of the Corridor in Montenegro is presented in Figure 5.

Figure 5. Route of the Corridor in Montenegro

The status of individual sections is summarized in **Errore. L'autoriferimento non è valido per un segnalibro.**.

Section	Route	Length [km]	Investment [EUR]	Status
Part I				
Lot 1	Construction of TS 400/110/35 kV Lastva and extension of existing TS 400/220/110 kV Pljevlja	-	129,390,000	Completed and commissioned
Lot 2	Construction of OHL 400 kV Lastva-Čevo	220		
Lot 3	Construction of OHL Čevo-Pljevlja			
Total		**220**	**129,390,000**	
Financing - Part I				
KfW loan			25,000,000	
EBRD loan			60,000,000	
EU grant/WBIF			27,390,000	
Montenegro			17,000,000	
Part II				
Component 1	Replacement of HV equipment and other equipment in several HV substations	-	n/a	Completed and commissioned
Component 2	Reconstruction of control and protection systems and the integration of several existing substations into SCADA communication	-	n/a	Completed and commissioned
Component 3	Replacement of the existing 220 kV OHL with new 400 kV OHL Pljevlja 2 - border with Serbia + extension of the 400 kV switchyard in TS Pljevlja 2	15.7	13,200,000	On hold due to delayed adoption of the spatial plan, and conflict of the OHL route with the mining area at the entry to TS Pljevlja 2
Component 4	Integration of TS 110/35 kV Brezna and associated transmission line into the public transmission grid	-	n/a	Completed and commissioned
Total		**n/a**	**24,500,000**	
Financing - Part II				
KfW loan			24,500,000	

Note: Part I costs originate from WBIF (https://www.wbif.eu/project/PRJ-MNE-ENE-001?downloadpdf=project). Interconnection costs (Part II - Component 3) originate from the Energy Community (https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL01c.html). Overall Part II costs originate from CGES (https://www.cges.me/en/projects/trans-balkan-electricity-corridor-i-grid-section-in-montenegro-part-ii/about-project).

Table 3. Trans-Balkan electricity corridor – Montenegro – sections, construction status, investments and financing

In January 2018, the Government of Montenegro adopted the Decision on the preparation of the detailed spatial plan for the corridor of the double-circuit 400 kV OHL TS Pljevlja 2 – Bajina Bašta (Serbia), for the section on Montenegrin territory. The detailed spatial plan was drafted, and the Strategic Environmental Impact Assessment (SEIA) report for the spatial plan was prepared. Both documents were put to public consultations, which were held during the period 11/01/2019 – 21/02-2019. The detailed spatial plan was publicly presented in the Pljevlja municipality on 06/02/2019.

Upon receiving the report on the public consultations held, a proposal of the detailed spatial plan was prepared, which received consents of all line institutions. The SEIA report also received consent from the Agency for protection of the nature and the environment on 10/05/2019.

At the session held on 26/12/2019, the Government of Montenegro adopted the Proposal of the Decision on adoption of the detailed spatial plan for the OHL for the Montenegrin section, and sent the Decision to the Montenegrin Assembly for adoption.

The Assembly of Montenegro has not discussed the spatial plan and has not reached a decision on approval on the spatial plan. Meanwhile, in February 2023 the Montenegrin Electricity Transmission System CGES approached the Ministry of Ecology, Spatial Planning and Urban Planning to initiate the adoption of the spatial plan. Since the Assembly of Montenegro had not discussed the spatial plan for the OHL and had not approved it, and since the Law on Spatial Planning and Construction was amended[2] moving the approval process for the spatial plan from the Assembly to the Government, on 16/03/2023 the Government of Montenegro reached the following conclusions:

- To task the Ministry of Ecology, Spatial Planning and Urban Planning to re-send the Proposal of the Detailed spatial plan to institutions for consent, and
- To task the Ministry of Ecology, Spatial Planning and Urban Planning to submit the Proposal of the Detailed spatial plan, after it receives all consents, to the Government for discussion and approval.

Further to the above, a conflict has been noted between the route of the 400 kV OHL and mining area at the entrance of the TS Pljevlja 2. A sustainable technical solution for the issue is expected to be reached through the Preliminary Design.

2.1.c Section of the Trans-Balkan Electricity Corridor in Bosnia and Herzegovina

The length of the foreseen OHL section of the Corridor in Bosnia and Herzegovina (BiH) is 17.18 km, and the OHL would lead from Višegrad to the border with Serbia, near the village of Vardište, which will be a hub, connecting the main OHL (interconnections of Serbia with BiH and Montenegro + OHL towards Kraljevo foreseen in Phase 2 in Serbia). This project is in the design/permitting stage, i.e. route survey (geodetic) was done in 2020, and geological survey activities on the route are in progress.

[2] Official Gazette of Montenegro, OG MNE 64/17, 44/18/, 63/18, 82/20, 86/22, 4/23.

2.1.d Interconnection Montenegro-Italy under the Adriatic Sea

MONITA 2 – Doubling of Existing HVDC Power Link between Italy and Montenegro

The first module of the interconnection at 400 kV between Lastva (Montenegro) and Villanova (Italy), via a submarine cable, was put into operation in December 2019. The second HVDC module (600 MW) of the Italy-Montenegro interconnection project is under construction, and is foreseen to be completed in December 2026. The project, which includes a new HVDC submarine cable between Villanova and Lastva and the DC converter stations, is reportedly on track with the schedule. The second HVDC module is strictly correlated with the Trans-Balkan (project 227) and the Mid Continental East (project 144) corridors, and therefore contributes significantly to enable the usage of an increased transmission capacity between Italy and South-Eastern European Countries (especially Romania and Bulgaria). The main features of the second module are as follows:

- Length: 445 km,
- Investment costs (CAPEX): 345,000,000 EUR + 10% contingencies,
- Estimated OPEX: 700,000 EUR/year.

The route of the interconnection is presented in the following figure.

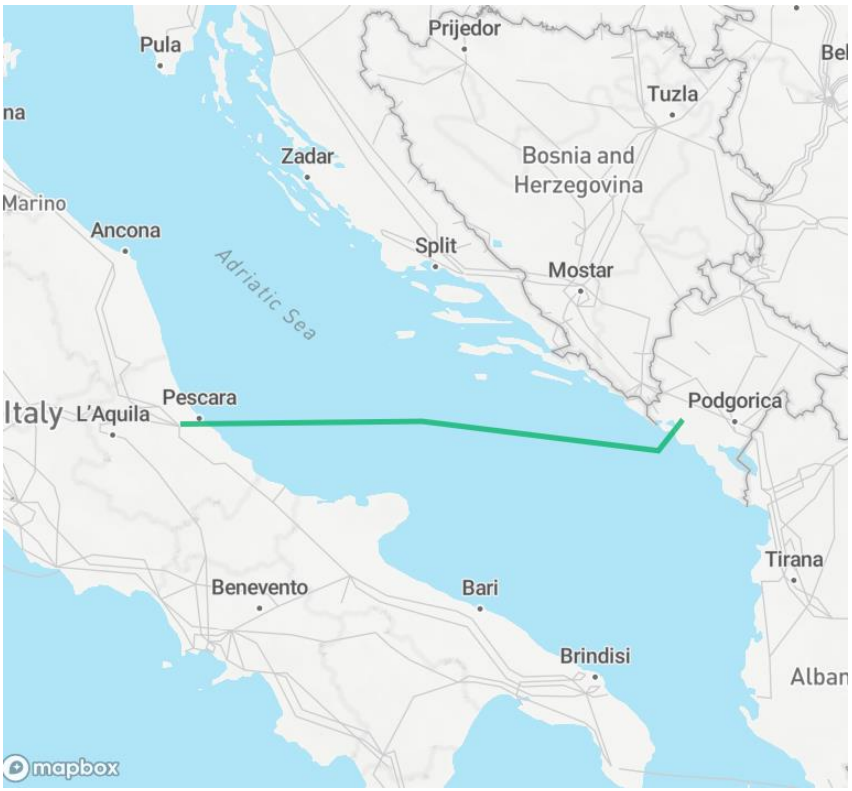

Figure 6. Interconnection Italy - Montenegro

2.1.e Further interconnection projects in the region

Apart from the activities on the Trans-Balkan Electricity Corridor, there are several interconnection developments in the Adriatic-Ionian region, which are of tremendous importance for the transmission system of the region as a whole. The projects are presented in detail below.

2.1.e.1 North Macedonia – Albania interconnection

The North Macedonia – Albania interconnection, via a 400 kV OHL from Bitola (North Macedonia) to Elbasan (Albania), is classified as project TR 350 – South Balkan Corridor[3]. This project consists of two investments:

- 400 kV OHL Bitola (North Macedonia) – Elbasan (Albania), and
- 400/110 kV TS Ohrid (North Macedonia).

The interconnection contributes to increasing the transmission capacity in the East-West direction. The foreseen TS Ohrid will increase the security of supply in the South-West part of North Macedonia. The interconnection is part of the Corridor 8, creating a power transmission corridor between Bulgaria, North Macedonia, Albania and Italy.

The route of the corridor is presented in the following figure.

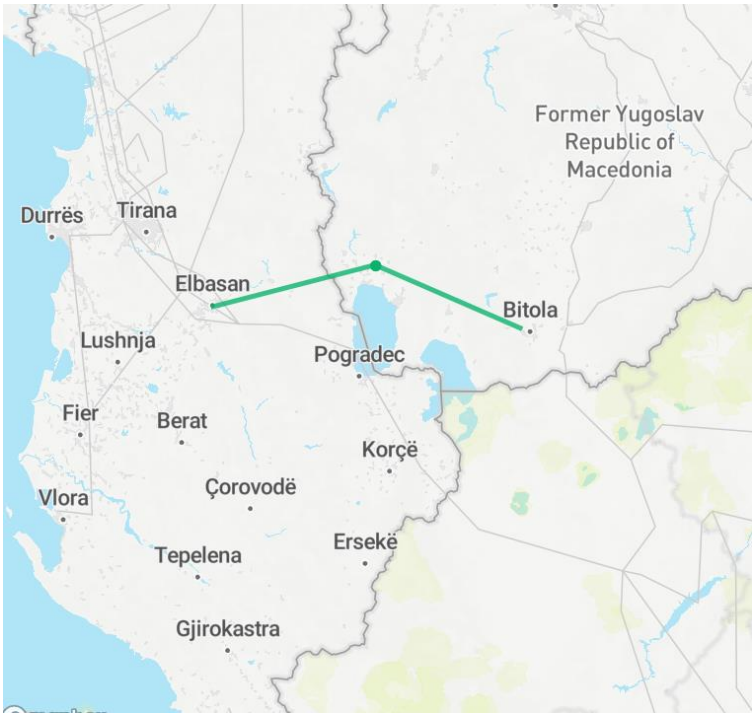

Figure 7. Route of the South Balkan corridor (interconnection North Macedonia – Albania)

[3] ENTSO-E - https://tyndp2022-project-platform.azurewebsites.net/projectsheets/transmission/350.

The main features of the interconnection are as follows:

- Length: 151 km,
- Investment costs (CAPEX): 81,413,000 EUR +/- 10% contingency,
- Estimated OPEX: 4,281,000 EUR/year.

The interconnection is expected to be completed by December 2024.

2.1.e.2 Croatia – Bosnia and Herzegovina interconnections

Two interconnection projects between Croatia and BiH are active at present:

- 400kV OHL Banja Luka (BiH) - Lika (Croatia), Figure 8, and
- Upgrading of existing 220 kV lines between Croatia and BiH to 400 kV lines (Figure 9).

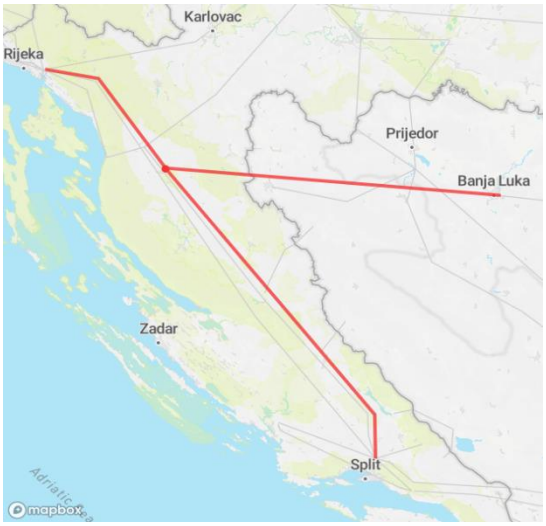

Figure 8. Route of the 400 kV OHL Banja Luka – Lika

Figure 9. Upgrading of existing OHLs from 220 to 400 kV in BiH

The Banja Luka-Lika OHL project is in the Feasibility Study stage and is expected to be completed by 2033, while upgrading of OHLs from 220 to 400 kV is expected to be implemented by 2032.

2.1.e.3 Greece – Italy interconnection

A project called GRITA 2 is being considered at present (). The project encompasses the development of a new HVDC link between Italy and Greece with the capacity of 1,000 MW, in order to address future challenges and EU targets set. The new HVDC will complement the capacity of the existing interconnection GRITA (500 MW). The project is in the planning stage, with the Feasibility Study completed. The project is foreseen to be completed by December 2030.

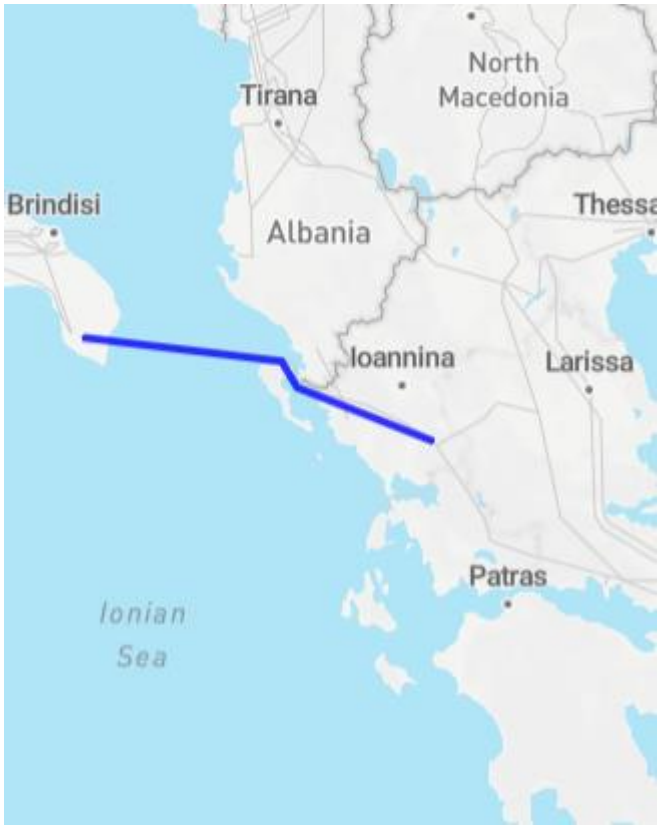

Figure 10. Greece – Italy interconnection GRITA 2

2.2 Power market coupling and integration

Within EUSAIR Pillar 2 – Energy Networks Flagships, construction and establishment of a well-connected power system and well-functioning electricity market for the Adriatic-Ionian region has been defined as a priority, and it was addressed by establishing the Flagship Project “Power Networks and a market for a green Adriatic-Ionian Region”. As one of the main goals of this flagship, creation of a wholesale power market for the Adriatic-Ionian Region was declared, which would include several steps, including harmonisation of electricity transmission tariffs, addressing regulatory barriers and

pending Treaty reform in the Energy Community Parties, progressive market coupling, power purchase agreements and use of blockchain to facilitate electricity trading.

This chapter provides an analysis of the current state of development of regional and national electricity markets, with respect to regulatory frameworks and market maturity. Proposals are also made on how to integrate the power market, considering the market differences.

2.2.a Current state of development of electricity markets in the Adriatic-Ionian region

The Adriatic-Ionian Region consists of EU-members (Italy including San Marino, Slovenia, Croatia and Greece), as well as non-EU countries (Serbia, North Macedonia, Bosnia and Herzegovina, Montenegro and Albania), and as such is heterogeneous in terms of electricity market development. EU members implement the European policy framework and are part of the Single-Day-Ahead-Coupling (SDAC) and Single Intraday Coupling (SIDC) mechanisms. Available transmission capacity is efficiently allocated at the borders of all EU member states, resulting in full market integration. Long-term markets in these countries have been established, and the countries are planning to join the balancing platforms by the end of 2024. The nominated electricity market operators (NEMOs) from EU member countries in the Adriatic-Ionian Region are:

- CROPEX – Hrvatska burza električne energije d.o.o. (Croatia),
- GME – Gestore dei Mercati Energetici SpA (Italy),
- HEnEX – Hellenic Energy Exchange SA (Greece), and
- BSP Energetska borza d.o.o. (Slovenia).

In non-EU countries of the Adriatic-Ionian Region, the market is less developed. All countries except Bosnia and Herzegovina have established electricity market operators. The national day-ahead market (DAM) is operating in Serbia, North Macedonia and Albania, with declared commitment of Montenegro regarding establishing of DAM. As for intraday markets (IDMs), Serbia is planning to launch it by the end of 2023[4]. In neither of these five countries long-term market has been established, and none of these countries are part of the SDAC & SIDC mechanisms.

2.2.b Market integration in the Adriatic-Ionian Region

Market integration of a legislation-wise heterogeneous region, consisting of EU-members and non-EU countries, is possible through implementation of the Clean Energy Package and transposition of EU electricity policy frameworks into national legislation.

A pre-requisite for integrating the markets, within the region as well as with the EU market, is inclusion of all countries of the region into the SDAC and SIDC mechanisms. The non-EU EUSAIR countries, as contracting parties of the Energy Community, have binding commitments regarding the transposition

[4] Source: Energy Community implementation reports 2022

of the European framework[5] into national laws and provisions. Upon completion of these tasks, the markets within the region will be fully integrated with the EU market.

For non-EU countries in the region to participate in the SDAC and SIDC mechanisms, the following preconditions have to be met, in chronological order:

- Incorporation of the CACM regulation acquis in the Energy Community, and
- Extension of the NEMO function outside of the EU.

A roadmap for the implementation of the electricity package within the contracting parties of the Energy Community has been defined for the period 2023-2025[6].

2.3 Digitalisation of the power system, smart grids, deployment of renewable energy sources.

Incorporation of smart metering in the electricity networks, in addition to technical and economic justifications, is expected to have a significant effect on market development, and to be useful for individual categories of system beneficiaries. Accurate and efficient reading of electricity consumption provides timely and reliable data on electricity consumption and production. It would be possible to provide end customers with daily insight (e.g. through a dedicated website) into the exact electricity consumption at their metering points, which can stimulate end customers to consume electricity more rationally.

An overview of digitalisation, smart grids and RES measures applied in individual countries is summarized below.

2.3.a EU members from the Adriatic-Ionian region

According to the study from December 2019 on the deployment of smart meters in the EU[7], approximately 225 million smart meters for electricity are expected to be deployed in the EU by 2024. It is expected that almost 77% of European consumers will have a smart meter for electricity by 2024.

Deployment of smart grids is one of the three priority thematic areas under the Trans-European Networks for Energy (TEN-E). Smart grid projects that have a significant impact on energy markets and market integration in at least two EU countries, are identified as Projects of Common Interest (PCI) and are considered key for implementing cross-border energy infrastructure in the EU. The EU PCI list for

[5] Electricity Directive (EU) 2019/944 – amended and consolidated text (23/06/2022); Electricity Regulation (EU) 2019/943 – amended and consolidated text (23/06/2022); Forward capacity allocation (FCA) Regulation (EU) 2016/1719 – amended and consolidated text (15/03/2021); Capacity allocation and congestion management (CACM) Regulation (EU) 2015/1222 - amended and consolidated text (15/03/2021); Electricity balancing (EB) Regulation (EU) 2017/2195 - amended and consolidated text (19/06/2022); Transmission system operations (TSO) Regulation (EU) 2017/1485; Network codes for emergency and restoration (NC ER) Regulation (EU) 2017/2196, etc.

[6] https://www.energy-community.org/implementation/package/EL.html.

[7] https://energy.ec.europa.eu/benchmarking-smart-metering-deployment-eu-28_en.

the year 2019 includes the one smart grid projects related to EUSAIR countries, members of the EU - SINCRO.GRID (Slovenia, Croatia)[8].

The EU's Joint Research Centre (JRC)[9] compiles and periodically updates an inventory of smart grid projects in the EU, as well as an interactive map of smart grid and meter projects. A total of 950 smart grid projects has been launched in the EU as a whole in the period 2002-2017. Development of smart grids was also supported by the European Commission, through research and innovation projects, funded by Horizon 2020[10].

2.3.b Albania

Introduction of smart metering in the Albanian energy sector is included in the National Energy and Climate Plan (NECP), through the measure R-E7 "Metering strategy and digitalisation of the power sector". A time frame for this measure has not been determined yet, and so far the metering strategy has been drafted, while introduction of smart meters is in the pilot phase.

2.3.c Bosnia and Herzegovina

In Bosnia and Herzegovina, some smart grid/metering developments have been recorded in the previous years (smart grid development in the Republika Srpska (RS) entity[11], grid modernization in RS[12], smart metering/automated meter reading in the Federation of Bosna and Herzegovina (FBiH) entity[13]). Some pilot projects have also been implemented[14]:

- Power distribution company of Zenica – metering points at 5 locations,
- Power distribution company of Tuzla – metering points at 2 transformer areas (18 meters in total), and
- Seven transformer areas, 1,747 metering points in households, throughout FBiH.

[8] https://www.sincrogrid.eu/en.

[9] https://ses.jrc.ec.europa.eu/.

[10]https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-2020_en.

[11] https://www.ebrd.com/news/2018/smart-grid-development-in-bosnia-and-herzegovina.html.

[12] https://balkangreenenergynews.com/elektrokrajina-launches-three-year-eur-15-million-grid-modernization-in-bih/

[13] https://www.wbif.eu/project/PRJ-BIH-ENE-007

[14] https://bhee.ba/bhe_radovi/BHE_06/BHE_06_Rad_10.pdf.

2.3.d Montenegro

Both the development of smart grid and deployment of smart metering have been included in the Energy Sector Development Strategy of Montenegro until 2030 (White Book)[15]. Consequently, the Montenegrin Power Distribution System (CEDIS) has installed more than 338,000 smart electricity meters, and in 2022 a tender has been launched for an extension of this task[16].

Further to the above, a new supervisory control and data acquisition (SCADA) system has been put in operation in the Montenegrin Power Transmission System CGES in 2019[17]. With the new system, better monitoring and control of the power system of Montenegro in ENTSO-E interconnection is expected, and real-time identification of technical problems which might endanger safe operation of the system will be enabled.

2.3.e North Macedonia

Introduction of smart metering in the energy sector of North Macedonia is included in the adopted National Energy and Climate Plan (NECP), through measure PM_IEM6 ("Develop further distribution system network to integrate more RES, including prosumers and more electric vehicles (EVs), as well as continuously improve network reliability"). Within this measure, installation of smart meters is foreseen.

The measure PM_EE24: Smart communities foresees Smart academic campuses which could have an exemplary role where all advanced concepts and principles from smart energy systems can be tested with the goal for roll-out on larger scale. And as a third measure from the NECP, related to smart grids, it is PM_IEM7: Price signal demand response, which will can be one of the main methods that are used in order to reduce the maximum electricity consumption in the system, and thus reduce its peak load and integrate higher level of RES in the system.

Further, the Energy Strategy of North Macedonia envisages introduction of a significant share of electric vehicles in the system, as a way of increasing the RES share in the transport. Therefore, in order to increase the capacity of energy storage using these electric vehicles, and in order to efficiently integrate them in the system, this should be accompanied by improved demand response capabilities, the introduction of real-time price signals and smart grids. The Power Transmission Operator MEPSO has seriously considered these opportunities and has already made analyses within two projects concerning the integration of electric vehicles and demand response.

[15] https://www.epcg.com/sites/epcg.com/files/multimedia/main_pages/files/2013/08/strategija_razvoja_energetike_cg_do_2030._godine_0.pdf

[16] https://cedis.me/danas-pocelo-izvodenje-radova-u-okviru-projekta-amm-prosirenje-trece-faze/.

[17] https://www.cges.me/projekti/novi-sistem-za-daljiski-nadzor-i-upravljanje-scada

2.3.f Serbia

The Distribution System Operator (DSO) "Elektrodistribucija Srbije" initiated the procurement of advanced metering systems, i.e. replacement of classic measuring devices with modern electronic measuring devices that have the ability to communicate (smart meters), as well as the purchase and establishment of systems (software and hardware) for their reading, management and data collection. This was included in the 4th National Energy Efficiency Action Plan (NEEAP), adopted in 2021.

The first phase of this project included the procurement of IT and measuring infrastructure, devices and the installation of about 200,000 measuring devices. In addition to the introduction of smart meters, there is a constant activity of cyclic replacement of existing measuring devices.

The most recent information of April 2023 states that DSO had launched a tender for the procurement and installation of 470,000 smart meters. Most of the new meters will be designed to track three-phase power. The meters will be installed throughout Serbia. Apart from reducing network losses, preventing unauthorized use of electricity, enabling remote billing, and monitoring consumption in real time, installation of smart meters is expected to have an impact on the number of prosumers, as the concept of prosumers has already been incorporated into Serbian legislation.

The transmission system operator (TSO) "Elektromreža Srbije" (EMS) plans to invest 900 million EUR in the development of the transmission system until the year 2030. As of January 2023, 90% of transformer substations (TS) are remotely controlled[18]. Integration of RES projects is also foreseen (e.g. pumped storage HPP Bistrica).

3 Level of implementation and Scenarios at 2030

3.1 Electricity demand forecasts

Starting from the scenario results at individual country level developed in **Section 7**, a summary at the EUSAIR area level is provided below.

As regards **electricity consumption**, on the basis of the **CPS** and **NPS** scenarios, a relatively limited increase is expected by 2030, going from 28.6 Mtoe in 2019 to 30.0 Mtoe in 2030 in the CPS scenario or 30.3 Mtoe in the NPS scenario.

This is therefore a modest increase, equal to around 6% of consumption in the base year (2019).

[18] https://www.tanjug.rs/ekonomija/srbija/7111/elektromreza-srbije-planira-ulaganja-od-900-miliona-evra-u-prenosni-sistem-do-2030-godine/vest.

EUSAIR Country	2019	EUSAIR Scenarios in 2030	
		CPS	NPS
Albania	532	552	536
Bosnia and Herzegovina	945	1,001	988
Croatia	1,389	1,461	1,574
Greece	4,316	4,454	4,788
Italy (EUSAIR Region)	17,034	17,625	17,653
Montenegro	263	280	276
North Macedonia	537	709	659
Serbia	2,407	2,580	2,579
Slovenia	1,176	1,310	1,284
Total	**28,598**	**29,972**	**30,338**

Table 4 - Summary of electricity consumption scenarios in the EUSAIR area by 2030 (ktoe)

Source: Consultant's elaboration on NECP, European Commission, Eurostat and IEA data

Even at the individual area level, there are no significant variations in consumption levels, as evident in the following figure.

Even though there is a slight increase, no strong increases in the use of electricity are in fact evident: this, in particular in the NPS scenario, is mainly due to the higher level of energy efficiency that is achieved, despite a greater penetration of electricity technologies.

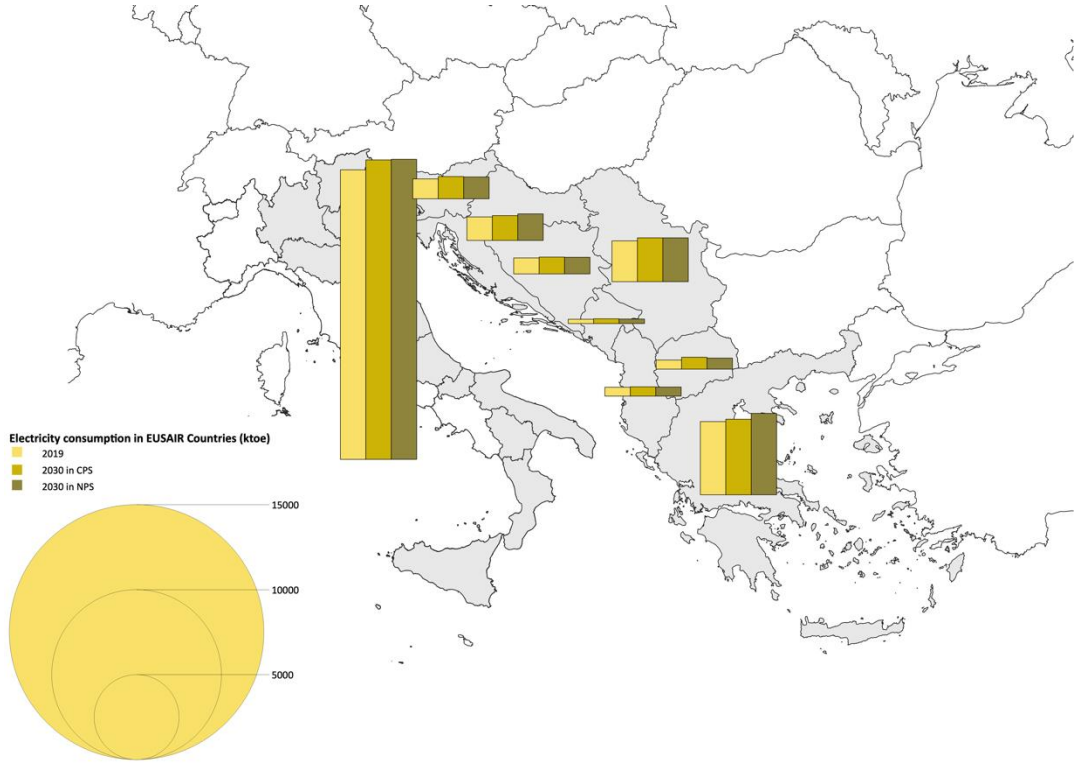

Figure 11 – Electricity consumption in CPS and NPS EUSAIR Scenarios by 2030

Source: Consultant's elaboration on Eurostat, NECP and IEA data

3.2 Power generation forecasts

In the mid-term, a stable level of power generation is expected at the EUSAIR level in the **CPS** scenario (around 29.7 Mtoe), while a slight increase in the **NPS** scenario (32.4 Mtoe).

The role of natural gas remains important in both scenarios, with a peak in 2025 in the NPS scenario and then declining in 2030 to levels below those of the base year (2019); in the CPS scenario, on the other hand, natural gas remains rather stable even up to 2030.

Renewable sources assume a primary role in the NPS scenario as early as 2025, to then grow further in 2030 when is expected they could cover almost two-thirds of total electricity production.

At the same time, the role of coal tends to decrease in both scenarios, but while in the CPS scenario there is still production from coal even in 2030, in the NPS scenario an almost total exit from coal in favor of renewables is foreseen.

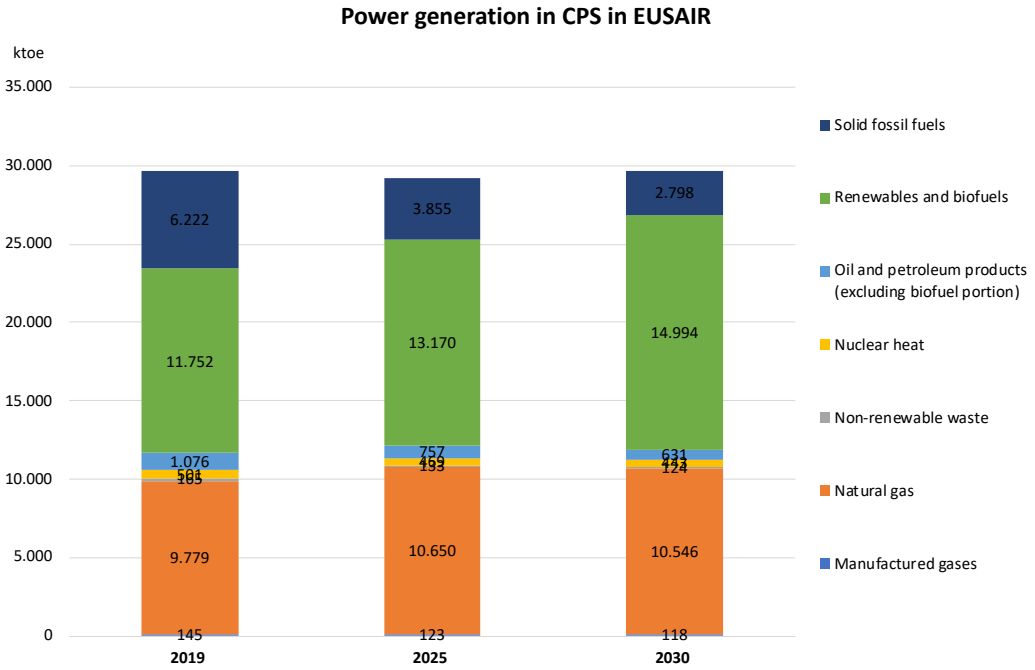

Figure 12 – Power generation in CPS in EUSAIR

Source: Consultant's elaboration on NECP, Eurostat and IEA data

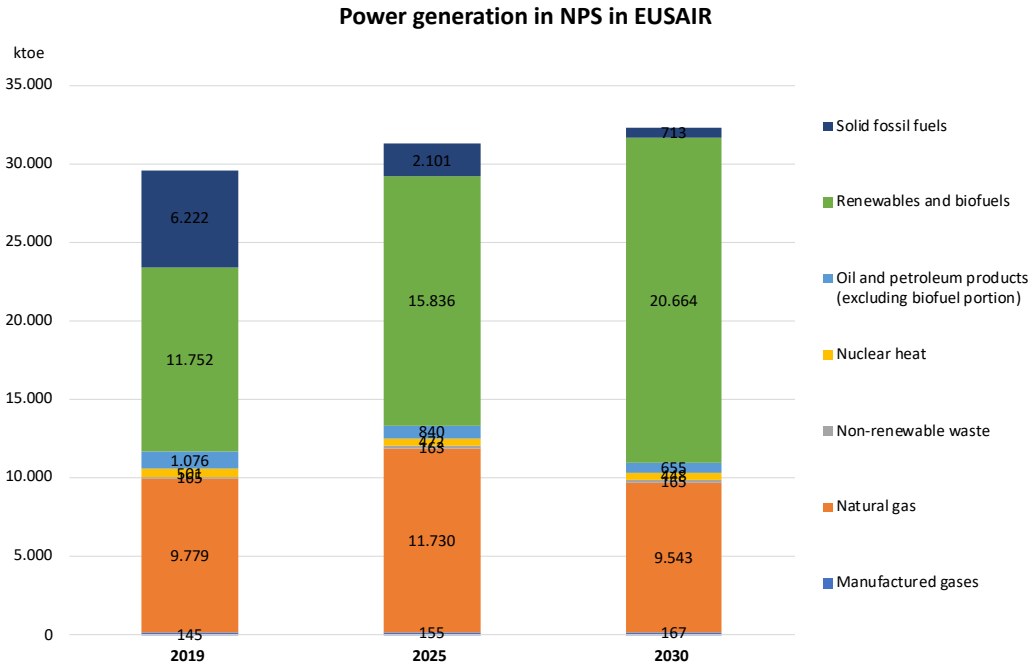

Figure 13 – Power generation in NPS in EUSAIR

Source: Consultant's elaboration on NECP, Eurostat and IEA data

4 Challenges and recommendations

Moving towards RES in energy production, i.e. increasing RES share in energy production, is a trend in Europe supported by corresponding policies and strategic documents, and as such is incorporated in the legislation and strategic documents of EUSAIR countries to smaller or greater extent. The effects of shifting towards RES depend on the energy source that each country previously relied upon. For countries with already dominating hydro power in the energy mix, there will probably be no need for significant changes, since these countries already meet (or are close to) green energy transition standards. On the other hand, this shift might be quite challenging for countries powered by TPPs at present, due to the issue of maintaining system stability and keeping the system operational after abandoning fossil fuel-fired TPPs. Investment in electricity networks and efficient usage of the existing ones, as well as new cross-border interconnection capacities, are a way to cope with these challenges, together with integrating energy markets.

In this regard, the EU has set an interconnection target for each member country of at least 15% by 2030 of their installed electricity production capacity. Further actions include defining the so-called 70 % minimum target for cross-zonal capacity[19], which states that at least the 70 % of the net transmission capacity of active power will be put on disposal for market participants. These targets also have to be followed by the EU EUSAIR countries. Non-EU EUSAIR countries, although not bound by EU interconnection capacity targets and available cross-border interconnection, have the obligation to maximise the cross-border capacity offered to the market, and interconnectivity targets for these countries and guidelines for reaching them have been elaborated in the documents of the Energy Community[20].

[19] Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity.

[20] https://www.energy-community.org/dam/jcr:97afc332-0495-479b-a1d6-848a2c6877a2/ECS_Interconnection_Targets_022021.pdf