

The weakest link

Towards a transmission grid that supports decarbonisation in the Western Balkans



Photo: CEE Bankwatch Network

Executive summary

For the Western Balkan countries to speed up their energy transformation, it is crucial to improve their transmission grids. These enable the flexibility and the stability of the entire system, as well as cross-border integration.

The countries' electricity transmission system operators (TSOs) are responsible for the expansion and improvement of grids. They prepare 10-year network development plans which are updated annually or bi-annually. Their priorities also inform the development of the 10-year network development plan of the European Network of Transmission System Operators for Electricity (ENTSO-E) which is intended to enable a stable European system and cross-border exchange of electricity.

The Western Balkan TSOs are not the most diligent in preparing their long-term plans. Albania has not had a plan for more than 10 years and the others have had shorter delays in either preparing them or approving them. It is unclear how Albania is planning the long-term development of its transmission network at this point.

For more information

Davor Pehchevski

Balkan Energy Coordinator

CEE Bankwatch Network

davor.pehchevski@bankwatch.org

Learn more: bankwatch.org



Both domestic and cross-border transmission capacity is generally well developed. Only two countries are not connected – Albania and North Macedonia – but an interconnector is under construction. Network coverage is not so much a problem – rather the age of the grid. Most of the primary infrastructure was built in the last century at the same time as the major power plants. Only parts have been expanded and upgraded in the last three decades, with most of the work of the TSOs focused on maintaining the existing network.

Much of the infrastructure is operating above the maximum rated voltage for extended periods of time. This is exacerbated by the addition of longer 400 kilovolt (kV) lines across the region without the supporting infrastructure to keep the loads in the grid at appropriate levels. As it is now, the loads are too low in the high voltage network, causing interruptions in supply and additional losses.

The planned cross-border projects in the Western Balkan countries seem sufficient to support their energy sector transformation. However, their implementation is going slower than initially planned, limiting the cross-border capacity of the grid to balance intermittent renewables. The Albania to North Macedonian 400 kV interconnection is the most obvious example – after several years of project development and with all the finances secured, construction has still faced multiple delays.

Some of the interconnections are intended to primarily serve the existing fleet of ageing coal-fired power plants or new controversial large hydropower projects, or even wind and solar plants sited in environmentally sensitive areas. Their purpose might change later, but the prioritisation of such projects is diverting the limited time and resources of TSOs from other investments.

Internally, the countries' transmission systems are not completely prepared to absorb all the intermittent renewables that have requested grid connections. In some countries, planned wind and solar projects exceed the scenarios from their energy planning documents and even exceed the existing installed capacity.

Bosnia and Herzegovina has 16,000 megawatts (MW) of wind and solar projects at different stages of development, Kosovo has 5,850 MW, North Macedonia 8,600 MW and Serbia more than 12,200 MW. For comparison, Bosnia and Herzegovina's TSO has stated that the grid currently has the capacity to integrate up to 3,400 MW of these projects, and North Macedonia's grid can accommodate up to 1,500 MW of new intermittent renewables. Projects are planned in every country to improve this situation, but their timeframe indicates likely delays in the connection of new renewables to the grid.

According to its last 10-year network development plan, Montenegro is an exception to this trend, with only 550 MW of new solar planned. But it also expects three new hydropower plants (Komarnica, Krusevo and Boka) to be completed, adding more than 570 MW of installed capacity. The baseline data in the plan is from late 2021 and is outdated. Komarnica, for example, is very unlikely to go ahead, after the environmental impact assessment was withdrawn in 2025.

Such projects, along with controversial hydropower plants in Bosnia and Herzegovina (Dabar) and North Macedonia (Vardar Valley and Chebren) that would have enormous environmental and social impacts, divert attention from investments in sustainable, appropriately-sited wind and solar projects that can speed up the Western Balkans' energy sector transformation. In addition, some of the wind and solar projects planned in very ecologically sensitive areas also need to be reconsidered since they also come with significant impacts on nature and people's livelihoods.

Western Balkan TSOs need to speed up their domestic and cross-border investments, as well as improving their coordination in resolving regional problems. The issue with the extremely high voltages in the 400 kV network particularly needs urgent attention to prevent accelerated ageing of the equipment and outages.

When upgrading their domestic grids, TSOs need to take the realism of planned generation projects into account and plan their limited capacity for investments appropriately. Focusing on fossil fuel projects, as well as unsustainable renewables that are facing public opposition, will delay the implementation of their plans.

Introduction

The Western Balkan countries are at a critical point in their energy transformation. They need to speed up the decarbonisation of their electricity generation, integrate their markets with the EU's and at the same time maintain or improve security of supply to consumers.

Their electricity transmission systems play a vital role in this transformation. They need to be flexible enough to enable the connection of intermittent renewables and have sufficient and properly regulated cross-border capacities. They also need to reduce the transmission losses and increase overall stability of the system.

With the ongoing process to prepare the new European 10-year network development plan during 2026, now is a good opportunity for some of these priorities to be addressed in the new national plans.

The following analysis is focused solely on the countries' national network development plans. It examines the current situation, as well as planned cross-border infrastructure and new connections of renewables. The objective is to develop recommendations for the next planning periods that will speed up the energy transformation of the Western Balkan countries. The recommendations will be primarily based on the environmental and social sustainability of the considered generation capacities.

Albania

Current situation

Albania's transmission network operator OST (Operatori i Sistemit të Transmetimit) does not prepare long-term development plans regularly. According to the Energy Community Implementation Report 2025,¹ the last such plan is for 2015 to 2025. This is outdated and will not be analysed here.

According to OST's website^{2,3} Albania's transmission grid operates 110 kV, 150 kV, 220 kV and 400 kV. The country has 1,693 kilometres of 110 kV transmission lines, 34.4 kilometres of 150 kV lines, 1,250 kilometres of 220 kV lines and 445.7 kilometres of 400 kV lines. The system also includes four 400/x kV substations, ten 220/x kV substations and one 110/150 kV substation.⁴

Albania is well connected to Montenegro (one 400 kV and one 220 kV line), Kosovo (one 400 kV and one 220 kV line) and Greece (one 400 kV and one 150 kV line). It does not share any cross-border infrastructure with North Macedonia.

The annual energy regulator's reports⁵ offer information on transmission losses. For 2024 they amounted to 201 GWh or 2.02% of the electricity transmitted. And for 2023, they were at 2.17%. The total energy transmitted for 2024 before losses was 9,859 GWh, while for 2023 it was 10,148 GWh. The total transmission and distribution losses for 2024 amounted to 1,614 GWh. With consumption at 8,170 GWh, system losses amounted to a total of 19.75%.

Planned cross-border infrastructure

Based on the information from the network development plans of neighbouring countries, Albania is currently constructing the 400 kV cross-border line towards North Macedonia and is in the early stages of planning a new 400 kV connection to Kosovo.

Recently, the construction of an undersea interconnector to Italy has also been announced, with an initial timeline for completion until 2028.⁶

¹ Energy Community Secretariat, [Albania Annual Implementation Report 2025](#), 1 November 2025.

² Operatori i Sistemit të Transmetimit, [Investment development with OST funds](#), accessed 15 February 2026.

³ Operatori i Sistemit të Transmetimit, [Description of the Transmission System](#), accessed 17 February 2026.

⁴ The 'x' in the 110/x kV, 220/x kV and 400/x kV substations represent different output voltage levels of the substations, e.g. 220/x kV can be 220/110 kV, 220/35 kV, 220/20 kV etc.

⁵ Entit Rregullator të Energjisë, [Annual Report 2024](#), 16, 2025.

⁶ Igor Todorović, [Albania, Italy sign undersea cable deal with UAE as strategic partner](#), Balkan Green Energy News, 15 January 2025.

Planned in-country infrastructure relevant for renewable energy

Although the OST website lists several upcoming upgrades to the grid with new substations and transmission lines, and explains their relevance in resolving existing problems, it is unclear what their connection is to planned new power generation projects.

Bosnia and Herzegovina

Current situation

The latest long-term network development plan by Bosnia and Herzegovina's transmission system operator Elektroprenos/Elektroprijenos BiH is for the period 2024-2033.⁷ It was prepared in May 2025 with some delay and approved in November 2025.⁸ The information it contains is somewhat outdated and refers to the situation in 2022 and 2023. The legal obligation is to prepare an update every year, so it can be expected that a new plan will be developed during 2026.

Meanwhile, the independent system operator NOS BiH develops Indicative Generation Development Plans each year. Their role is to collect information about all existing generation capacity, as well as new projects planned to be connected to the grid, and foresee the needs of the transmission system for the upcoming period. They are also prepared for 10-year periods and the long-term network development plans are based on them. The latest one is for 2026 to 2035⁹ and among other things, contains the most up-to-date information on planned renewable projects.

Bosnia and Herzegovina's electricity transmission system operates at three voltage levels – 110 kV, 220 kV and 400 kV. In 2022, it consisted of 3,751.64 kilometres of 110 kV transmission lines, 1535.19 kilometres of 220 kV lines and 804.83 kilometres of 400 kV lines. They are connected to one hundred and thirty-five 110/x kV substations, nine 220/x kV substations and ten 400/110 kV substations.

The 400 kV lines form a connection between the Stanari, Ugljevik, Tuzla and Gacko coal-fired power plants, the Visegrad hydropower plant, the capital Sarajevo and some of the major cities like Banja Luka, Visegrad and Mostar. Bosnia and Herzegovina is also connected to all the neighbouring countries with high-voltage lines, including two interconnections with Croatia, one with Serbia and one with Montenegro. The country has used this well-developed cross-border infrastructure to export significant amounts of electricity from

⁷ Elektroprijenos BiH, [Dugoročni plan razvoja prenosne mreže 2024-2033](#), May 2025.

⁸ Državna regulatorna komisija za električnu energiju Bosne i Hercegovine, [Odluka o odobravanju Dugoročnog plana razvoja prenosne mreže za period 2024. - 2033. godina](#), 12 November 2025.

⁹ Nezavisni operator sistema u Bosni i Hercegovini (NOSBiH), [Indikativni plan razvoja proizvodnje 2026-2035](#), April 2025.

its fleet of coal power plants which are in some cases operating illegally and in some cases with extreme breaches of pollution control legislation.¹⁰

Most of the larger hydropower plants, and the Kakanj coal power plant, are connected to the 220 kV transmission lines, which complete the country's internal ring. Ten of these lines also function as interconnections to neighbouring countries: seven to Croatia, two to Montenegro and one to Serbia.

The 110 kV lines complete the country's transmission grid and are used to connect some of the smaller hydropower plants, as well as three wind plants and one solar photovoltaic plant to consumers. They also enable an additional seventeen cross-border interconnections.

The losses in the transmission system vary from year to year, but from 2012 to 2022 they were always between 2 and 2.5 per cent. This amounts to average losses of around 330 GWh. The lines and substations appear to be quite unstable. Many of them operate above the maximum rated voltage for extended periods, leading to a high number of random outages. This must be resolved with new infrastructure and needs to be completed soon in order to enable higher uptake of intermittent renewables.

Planned cross-border infrastructure

The main cross-border investment is related to the construction of the Transbalkan Corridor that extends from Romania, through Serbia and Bosnia and Herzegovina, to Montenegro and Italy. The part of this corridor planned in Bosnia and Herzegovina during this ten-year period is the connection from Visegrad to Bajina Basta with 17.1 kilometres of new 400 kV lines. This project also includes an expansion of the existing substation in Visegrad. The cost of the infrastructure in Bosnia and Herzegovina is estimated at almost EUR 10 million. The financial structure is not completely clear, but an EUR 800,000 grant from the German development bank KfW is mentioned. The Corridor should connect Serbia's Nikola Tesla (TENT) coal complex, the Visegrad hydropower plant, the planned Bistrica pumped storage project in Serbia and Montenegro's Pljevlja coal-fired power plant. The undertaking should be completed by 2030.

A much more costly project for BiH is the new planned 400 kV interconnector with Croatia, extending from Banja Luka to Lika. The part in Bosnia and Herzegovina is 127 kilometres long, and again includes an upgrade of the relevant substation – in Banja Luka. The cost is estimated at EUR 56.7 million and project completion for 2035. It was developed with technical assistance from the EBRD amounting to EUR 1.2 million, but it is unclear from the plan how the construction will be financed. Its start is anyway conditional on the strengthening of the grid in Croatia's Lika region, so it might be delayed.

Several more cross-border projects are currently in their early stages. They include four more 400 kV interconnections with Croatia, two more with Serbia and another two with Montenegro. Based on the locations, their prioritisation depends on the progress with planned electricity generation capacity, such as

¹⁰ CEE Bankwatch Network, [Comply or Close 2025 - Seven years of deadly legal breaches by Western Balkan coal plants](#), June 2025.

the highly controversial Upper Horizons¹¹ and Buk Bijela¹² hydropower projects, both of which would have devastating environmental impacts.

Planned in-country infrastructure relevant for renewable energy

The development plan has a clear and limited plan for new connections of renewables during 2024 and 2025. The planned new capacity in the long-term plan is a combination of hydropower (210 MW), wind power (496.8 MW) and solar power (296.7 MW).

This has been adjusted in the new Indicative Generation Development Plan. The list of projects registered by promoters is a lot longer and even still includes the Tuzla 7 coal unit which has in reality been cancelled.¹³ It also includes 34 hydropower projects (1,866 MW), 34 wind projects (2,372 MW) and 108 solar projects (3,182 MW). It also mentions that overall, 3,800 MW of wind projects and 12,500 MW of solar projects are at different stages of development. The analysis in this plan concludes that the grid and the energy system are currently able to accommodate and balance up to 909 MW of the existing and planned wind power plants, and 2,433 MW of the existing and planned photovoltaic plants.

These projects are almost exclusively located in the southwest and southern part of the country, in the regions around Livno, Mostar and Trebinje. The high concentration of projects in a small area is opposed by the local communities who feel threatened by their uncontrolled development and insufficient environmental and social safeguards.¹⁴

To enable these new connections, significant investments are required in that region. The plan foresees multiple investments in the 220 kV and 110 kV grids, as well as upgrades of substations, to accommodate these projects.

The plan is sufficient in this sense, but it is questionable whether the prioritisation of the investments is appropriate. Some of the planned generation capacity, such as the Dabar hydropower plant – part of the wider Upper Horizons project – would have extremely serious impacts on nature and the local population, as well as on water availability and agriculture in the Federation of Bosnia and Herzegovina and the Neretva delta in Croatia. The uncontrolled nature of Bosnia and Herzegovina's wind and solar development, without appropriate siting criteria, environmental safeguards and public participation in decision-making also needs to be taken into account. The limited capacity of the grid should be used for the least damaging and most beneficial projects first.

¹¹ CEE Bankwatch Network, [Upper Horizons hydropower scheme, Bosnia and Herzegovina](#), accessed 17 February 2026.

¹² CEE Bankwatch Network, [Buk Bijela dam and the Upper Drina cascade](#), accessed 17 February 2026.

¹³ CEE Bankwatch Network, [Tuzla 7 lignite power plant, Bosnia and Herzegovina](#), accessed 17 February 2026.

¹⁴ Kristina Perić, [Bitka protiv vjetrenjača - Vlast planira graditi čak 18 vjetroparkova u općini Tomislavgrad. Tko prodaje zemlju, a tko plaća cijenu?](#), Istina Media, 12 June 2025.

Kosovo

Current situation

Kosovo's operator KOSTT prepared the last transmission network development plan¹⁵ in 2024 for the period 2025 to 2034. It is due to be updated after two years, in 2026.

The electricity transmission system operates at three voltage levels – 110 kV, 220 kV and 400 kV. In 2024, Kosovo had 912 kilometres of 110 kV transmission lines, 238.5 kilometres of 220 kV lines and 279.5 kilometres of 400 kV lines. It also had thirty-one 110/x kV substations, six 220/x kV substations and three 400/x kV substations.

The grid branches out from the central region – with the capital Prishtina and the two nearby coal-fired power plants Kosova A and Kosova B – towards the country's borders. Four 400 kV lines go towards the four neighbouring countries – Albania, Montenegro, Serbia and North Macedonia – which also serve as interconnections. The Kosova B power plant is connected directly to this voltage.

Most of the 220 kV lines run almost parallel to the Serbia-Kosovo-Albania 400 kV corridor, creating two additional interconnections with these countries. The Kosova A power plant is connected to the 200 kV line.

The 110 kV lines form most of the in-country grid and enable connections for most towns in Kosovo. Two hydropower plants and two wind plants are also connected to this voltage. In the north, the 110 kV line continues towards Novi Pazar and in the east towards Bujanovac, creating two additional interconnections with Serbia.

The losses in Kosovo's transmission system amount to 35 GWh per year, almost half of which occur in the 110 kV transmission lines. Considering most of the planned wind and solar capacity is probably going to be connected to these lines, it should be a priority to upgrade them.

Kosovo is facing similar issues as Bosnia and Herzegovina with overvoltage in the transmission system, in particular in the 400 kV network. Its plan indicates common occurrences of the 400 kV grid operating above the maximum rated voltage, pointing out that it is a regional problem caused by the commissioning of many new 400 kV lines without adequate compensation for the low load levels.

Kosovo's grid used to be plagued by overloads, causing random outages and interruptions in the supply. However, with well-planned investments, the country has managed to halve its interruption times in the last ten years.

¹⁵ KOSTT SH.A., [10-year Transmission Development Plan for the period 2025-2034](#), June 2024.

Planned cross-border infrastructure

Kosovo plans two new cross-border projects – both with Albania. Considering their electricity markets are now completely joined, it makes sense for the countries to make use of their individual strengths and for Kosovo to use the huge balancing capability of Albania's hydropower fleet.

The first project is a new 110 kV interconnector between Deçan in Kosovo and the Bajram Curri substation in Albania, of which 19 kilometres would be in Kosovo. The intention is to increase the electricity exchange in the 110 kV network, which could be very important for the addition of new intermittent renewables in both countries. The project is expected to be completed in 2029, but the plan does not offer any information on its financing.

The second project is a new 400 kV interconnection between Prizren and the planned Fierza substation in Albania, at the Fierza hydropower plant. Kosovo will benefit from additional system flexibility and will be able to integrate more intermittent renewables and meet the targets from its 2023 Energy Strategy. The length of the new line in Kosovo would be 45 kilometres. The project seems to be in its early stages and not many more details are available. The expected time of completion is 2032, but that also depends on the progress with the new substation in Albania.

Planned in-country infrastructure relevant for renewable energy

Kosovo is also dealing with huge interest and an increasing number of requests for connections of renewables to the grid. From 2021 to 2023, fifty-three requests were submitted for photovoltaic plants with a total installed capacity of 5,344 MW and seven requests for wind plants with an installed capacity of 503 MW.

The transmission system operator is approaching this cautiously and has specific plans only for the near future. The plan foresees new infrastructure to connect just two solar projects in 2026 with a joint installed capacity of 236 MW. It also has plans to connect two battery storage systems with a total capacity of 170 MW, in 2027 and 2028.

The remainder of the planned investments are intended to allow more connections in the future and include much needed rehabilitations of 110 kV transmission lines, upgrades of some of the existing substations and three new substations (one 220/x kV and two 110/x kV). These investments should also reduce transmission losses significantly, particularly important for the planned solar and wind projects.

Montenegro

Current situation

The latest transmission system development plan of Montenegro is for 2023 to 2032.¹⁶ The public consultation for the plan was in April 2025, and it is unclear whether it was formally adopted, but in any case, it is already outdated. The state-owned transmission operator Crnogorski Elektroprenosni Sistem is also overdue in updating the plan for the next planning period. Considering most countries should prepare new updates and contributions to ENTSO-E's 10-year network development plan in 2026, it is possible that Montenegro will do the same.

The country's electricity transmission system operates on three voltage levels – 110 kV, 220 kV and 400 kV. It also includes the 500 kV undersea interconnection to Italy. In late 2021, the system consisted of 649.6 kilometres of 110 kV transmission lines, 372.7 kilometres of 220 kV lines and 355.3 kilometres of 400 kV lines. Montenegro also had nineteen 110/x kV substations, two 220/x kV substations and four 400/x kV substations.

Although it requires upgrades, the grid is well spread out across the country. The 400 kV transmission lines connect the Pljevlja coal-fired power plant to the capital Podgorica and then continue to Budva where they are linked to the undersea cable to Italy. They also branch out to create interconnections with Bosnia and Herzegovina, Kosovo and Albania.

The 220 kV grid follows a similar structure, but it also connects the two big hydropower plants, Piva and Perucica. The lines also create two more interconnections with Bosnia and Herzegovina, one more with Albania, and the only two connections with Serbia.

The 110 kV transmission lines complete the rest of the grid and connect the two existing wind power plants. They also create two additional interconnections with Bosnia and Herzegovina.

The transmission losses in the Montenegrin system were 1.8 per cent in both 2020 and 2021, or around 160,000 MWh. The system is also plagued by high voltages above the maximum allowed, primarily in the 400 kV lines. It is caused by the same reasons as in the entire region and will have to be solved on a regional level.

The connection to Italy also causes issues when Italy exports to southeast Europe, by overloading the 100 kV network in the coastal part of Montenegro. Additional issues have been identified in the coastal towns which are all connected by a single line to the system. This must be remedied as soon as possible to ensure a secure and continuous supply to those areas.

¹⁶ Crnogorski Elektroprenosni Sistem, [Transmission System Development Plan of Montenegro by 2032](#), 2025.

Planned cross-border infrastructure

Two major cross-border projects are planned in Montenegro. The first one is the second stage of the undersea interconnection to Italy which should double the transmission capacity. It is intended to be a direct continuation of the Transbalkan Corridor.

The second project is the Montenegrin part of the Corridor – the 400 kV interconnection from Pljevlja towards Serbia, connecting to the planned Bistrica pumped storage plant in Serbia and continuing to Visegrad in Bosnia and Herzegovina. The estimated completion date is set at 2025 in this plan, but in the newer development plan in Bosnia and Herzegovina it is set at 2030.

Unfortunately, the plan does not offer any additional information on the projects.

Planned in-country infrastructure relevant for renewable energy

The plan was developed around the expectation that by 2025, one new unit would be added to the Perucica hydropower plant, and two new wind plants with a total installed capacity of 155.5 MW would be connected to the grid, as well as four photovoltaic plants with a total capacity of 169 MW.

The plan expects many more additions to the country's electricity generation capacity by 2032, but these are not realistic.

Among these are three new hydropower plants (Komarnica,¹⁷ Krusevo and Boka), adding more than 570 MW of installed capacity. However, in 2025 the environmental assessment for the 172 MW Komarnica plant was withdrawn,¹⁸ and it is unlikely the project will go ahead. The other plants are also highly controversial and are at an even earlier stage of development. The plan also expects an additional 550 MW of solar capacity to be connected to the grid.

The planned investments are more focused on mitigating existing issues than increasing the capacity of the grid to handle more intermittent renewables. Most of the new 110 kV lines are intended to provide the additional needed connections for the coastal towns. These will obviously increase the stability of the grid, but they seem to be focused on enabling transmission capacity primarily for the new hydropower plants, which will certainly not be completed by 2032, if ever.

The planned construction of six 110/x kV substations is a good starting point, but higher ambition is needed to enable capacity for more wind and solar power.

¹⁷ CEE Bankwatch Network, [Komarnica hydropower plant, Montenegro](#), accessed 17 February 2026.

¹⁸ EuroNatur and RiverWatch, [Komarnica Dam: Postponed, not cancelled](#), accessed 17 February 2026.

North Macedonia

Current situation

The last transmission network development plan by MEPSO, North Macedonia's publicly-owned transmission system operator, is for 2025 to 2035¹⁹ and was adopted in October 2024. According to the 2025 Law on Energy, the operator needs to update the plan every two years, so the new plan should be prepared during 2026.

The electricity transmission system of North Macedonia operates at two voltage levels – 110 kV and 400 kV. In 2024, it consisted of 1,656.64 kilometres of 110 kV transmission lines and 577.06 kilometres of 400 kV lines. It also included seventy-three 110/x kV substations and five 400/110 kV substations. The average age of the infrastructure is 40 years and much of it is overdue for upgrades.

Internally, the 400 kV lines connect the biggest electricity generation capacity, the Bitola coal-fired power plant in the southwest, to the capital Skopje in the north and to the central and eastern regions of the country. They are also used to connect to the energy systems of the neighbouring countries. One line connects North Macedonia to each of Bulgaria, Kosovo and Serbia, and two lines connect it to Greece. The line to Albania is currently under construction. Two older 110 kV lines also connect North Macedonia to Bulgaria, but they are only used for occasional emergency exchanges.

The 110 kV lines make up most of the grid in the country, connecting all the major fossil-fuel and hydropower plants, bigger cities and industrial centres. In addition, two wind power plants and five solar photovoltaic power plants are connected directly to the transmission grid. Other than one of the wind plants, the rest have been connected in the past three years.

The plan does not offer information on transmission losses, but the latest energy regulator's annual report²⁰ shows that in 2024, they amounted to 119 GWh of electricity, or 1.3 per cent. This is a significant increase compared to the 102 GWh losses in 2023. The report explains that the increased connections of generation capacity to the distribution grid reduces the output of the transmission grid. This also causes the load in the transmission system to decrease, leading to increased voltages that also increase losses in the power transmission network.

The overvoltage issue is explained in more detail in the plan. The 400/110 kV Dubrovo substation, for example, on some days operates above the maximum allowed voltage levels for 100 per cent of the time. In the 4-month period analysed, the station operated above maximum levels for 78 per cent of the time.

¹⁹ MEPSO, [План за развој на електропреносниот систем за период 2025-2035](#), October 2024.

²⁰ Energy, Water Services and Municipal Waste Management Services Regulatory Commission of the Republic of North Macedonia, [Annual Report 2024](#), 48, April 2025.

According to the plan, this can cause accelerated aging of equipment and unreliable operation, and increases the occurrence of random outages, leading to serious security of supply issues.

For the lower voltage grid, outages are caused by critical loads on the lines caused by maximised output of multiple generation facilities at the same time. This happens in the western part of the country – where one coal power plant and several large hydropower plants are connected in a ring – during periods of high rainfall when hydroelectric generation is high. This has additionally been exacerbated by the connection of three solar plants on the same lines. Most of these lines were built in the 1960s and need urgent upgrades. There are plans for reconstruction of the lines to mitigate this issue, but it is a good example of the vulnerability of the transmission system to increased connections of new renewables without appropriate and timely grid upgrades.

In addition to this, a significant issue has been identified with the grid in the southeast part of the country. This is the region with the highest potential for new solar and wind developments, but according to the plan, the grid there does not have the required capacity to accommodate all projects.

This is particularly important since North Macedonia has witnessed an explosion of investor interest in building new wind and solar plants in recent years. In 2024, sixty-two requests for connections were at different stages of approval for new photovoltaic plants, totalling 6,828 MW of added installed capacity. There were also twenty requests for new wind plants with an additional 1,835 MW of new installed capacity.²¹ For comparison, in the same year the total existing installed capacity of all technologies was 2,983.9 MW. The plan itself highlights that the transmission grid in its current state can allow no more than 1,500 MW of new connections.

Planned cross-border infrastructure

There is only one cross-border project currently being built by MEPSO – a 400 kV interconnection with Albania that also includes a new 400/110 kV substation in Ohrid. This is an extremely important project for the region since the two countries are not connected at all now. It is supposed to improve cross-border balancing capabilities for the entire region. It is also the last missing piece of the Corridor 8 – connecting Bulgaria, North Macedonia, Albania, Montenegro and Italy. The project is supported by the WBIF with EUR 13.7 million in grants and by a EUR 37 million EBRD loan.

Despite its importance, this project is not without its challenges and delays. The initial contractor for the construction of the transmission line tried to renegotiate the terms and requested additional funds on several occasions. After failing to reach agreement for several years, AD MEPSO decided to cancel the contract. In 2025, a new tender was implemented and a new contractor chosen.²²

²¹ The plan also mentions a request for connection of a storage system and one for a CHP in Shtip, but no additional information is available on these projects and the technologies they will use.

²² Faktor, [Ќе се изгради ли конечно „вечниот“ далновод со Албанија? Се пријави „Далековод“, не се знае колку пари се потрошени досега](#), 15 December 2025.

Planned in-country infrastructure relevant for renewable energy

Since the requests for new connections of renewables to the grid significantly surpass even the optimistic forecasts in the 2019 Energy Development Strategy, the transmission grid operator also must speed up investments to accommodate them, as long as they are sited in suitable, non-ecologically sensitive areas.

One of the most important planned investments is the strengthening of the system in the southeast region where many of the new renewable projects are planned. The main part of this investment is the construction of a new 400/110 kV substation along the interconnection to Greece, and its connections to the existing stations and lines. This should not only allow for more renewable connections in that region, but should also stabilise the load in the aforementioned Dubrovo station. This project is also supported by EUR 8.76 million in WBIF grants and a EUR 26.4 million loan from the EBRD. It has also received an additional EUR 0.5 million from the Climate Investment Fund as part of the implementation of North Macedonia's Just Transition Investment Plan. Its construction is planned to be completed by the end of 2027.

Unfortunately, this project was planned with the scandalous Vardar Valley project in mind, that consists of two new large and 10 smaller hydropower plants on the Vardar River.²³ However, this project is very far from materialising, and the importance of the grid upgrade is also linked to four new wind projects and several new solar projects.

The second major investment foreseen in the plan is the strengthening of the transmission system in the west of the country, where the risk of critical loads and random outages is increasing with the addition of new renewables. The project should contribute to the rehabilitation of more than 300 kilometres of 110 kV lines as well as the second interconnection to Greece. The improved infrastructure should allow for the seamless integration of planned renewable capacity in the country's coal regions and support the coal phase-out. The entire undertaking is estimated to cost around EUR 52 million. AD MEPSO has already applied for a grant from the WBIF but also intends to secure a loan of around EUR 25 million and contribute EUR 17 million of its own finances. The project's estimated completion date is 2034.

The plan for the northeast part of the country is similar, and includes the rehabilitation of more than 150 kilometres of 110 kV transmission lines. This should enable the connection to the grid of two 400 MW wind projects planned for that region, as well as several bigger solar projects. The overall investment is estimated at EUR 15.4 million with EUR 6 million secured by AD MEPSO's finances. The remainder should be secured through grants and loans. The project should be concluded in 2035.

While these investments will enable higher uptake of utility-scale renewables, it is questionable whether they can accommodate all requests for connections without affecting grid stability. Their implementation is also going to be spread over the next 10 years, and they will be fully effective only after that.

²³ Elektrani na Severna Makedonija (ESM), [Проект Вардарска Долина](#), 2017.

The sustainability of the projects is also questionable, since some of these projects could have high impacts on biodiversity. The big wind projects are planned at least partially in Important Bird Areas, and one of the larger solar projects would be built in the Lower Bregalnica proposed Natura 2000 site.²⁴ One of the wind projects in the west of the country directly threaten a drinking water source used by more than 180,000 people. The government approved changes in the safety zones for the spring so that the wind turbines are outside of them.²⁵

The plan also mentions additional improvements of the transmission lines and another new 400/110 kV substation in the event that some other planned energy projects go forward. This primarily means the potential construction of the Chebren pumped hydropower project, but the plan even mentions a potential Mariovo nuclear power plant as well. The Chebren project has existed as an idea for five decades, but has never materialised, even after 15 tenders. It is a complicated system that would have enormous impacts on biodiversity, as it would flood parts of five different protected areas. The Mariovo nuclear power plant has been off the table for at least three decades. The country has neither the knowledge nor the capacity to implement such a project, so it is unclear why it is even mentioned in the plan.

Serbia

Current situation

The last available transmission system development plan by Serbia's operator Elektromreza Srbije is for 2025 to 2034.²⁶ Its bi-annual update should start in 2026.

Serbia's system operates at three voltage levels – 110 kV, 220 kV and 400 kV. The current plan does not offer detailed information on the existing infrastructure. According to the previous plan for 2023 to 2032, in 2022, Serbia had 6107.4 kilometres of 100 kV lines, 1752.7 kilometres of 220 kV lines and 1811.9 kilometres of 400 kV lines. The system also included nine 110/x kV substations, fourteen 220/x kV substations and twenty 400/x kV substations.

The 400 kV network is well developed, and connects the largest electricity producers, namely the coal-fired power plants and the Djerdap hydropower system, to the biggest population and industrial centres. Serbia also has 400 kV interconnections with all neighbouring countries except Montenegro.

The 220 kV grid is present only in central and eastern Serbia. Most of the existing large hydropower plants are connected to it, as well as the existing combined heat and power plants. Many of Serbia's eastern towns

²⁴ Eko-svest, [Јавна реакција на Еко-свест : Природата не ни е за распродажба](#), 11 February 2023.

²⁵ Martin Pushchevski, [Македонските планини на удар од „зелените транзиционери“](#), Doma, 16 March 2023.

²⁶ Elektromreza Srbije, [Plan razvoja prenosnog sistema 2025-2034](#), December 2025.

are connected to the 220 kV network. It extends across the borders towards Kosovo and Bosnia and Herzegovina, but not towards the country's other neighbours.

Most the distribution network is formed by the 110 kV grid. It is developed in all directions across the country, but also towards all Serbia's neighbours except North Macedonia.

Serbia's plan also does not contain information on transmission losses, but offers a detailed overview of the amount of time the substations were affected by overvoltage. The 400 kV substations were particularly affected by this, with the Leskovac and Vranje ones operating more 7,000 hours above the maximum rated voltage. Three other substations operated more than 4,000 hours above the maximum, and another five for more than 3,000 hours. The 220 kV and 110 kV networks were less affected compared to this but still operated thousands of hours outside of the rated voltage.

Planned cross-border infrastructure

Serbia has many planned cross-border projects, which is understandable considering the number of neighbouring countries and the length of its borders. However, most are still at the early stages of development.

The main project that is being implemented is the completion of the Transbalkan Corridor and the 400 kV connections to Bosnia and Herzegovina and Montenegro. The first stage of the projects should be completed by 2028, and this includes the construction of the lines from the Bajina Basta substation to the borders. The second stage is tentative and is linked to progress on the construction of the Bistrica hydropower pumped storage plant. This project would be essential for the plant's connection to the grid. The plan does not give any indication of the costs of the infrastructure.

The second – more advanced – project is the construction of a new 110 kV interconnection to Bosnia and Herzegovina. This project should be completed by 2027 and would contribute to the lower voltage exchange and stability of the grid.

The third ongoing project is the Pannonian Corridor that includes the expansion of the 400 kV grid in the Vojvodina region as well as well as a new interconnection to Hungary. The prioritisation of this project arises from the increased interest in intermittent renewables in Vojvodina and the need to balance the new capacity. The cross-border infrastructure should be completed by 2028, and the internal expansion of the grid by 2030.

The remaining planned projects that are not started yet include additional 400 kV interconnections to Romania, Bulgaria and Croatia, as well as a new 110 kV connection to Montenegro.

Planned in-country infrastructure relevant for renewable energy

Compared to other Western Balkan countries, Serbia is seeing significantly more investor interest in new wind projects than solar photovoltaics. Up to 2021, using the old regulatory framework, there were twenty-five contracts for connection to the grid of new wind projects, with an installed capacity of 3,785 MW. There were only five photovoltaic projects in the pipeline, with a total installed capacity of 352 MW.

Since then, the list has been expanded with the Bistrica pumped hydropower plant of 754 MW, nineteen more wind projects with a total installed capacity of 3,552 MW, and thirty-one more solar projects with an installed capacity of 4,514 MW.

Other than strengthening the grid as part of the Pannonian Corridor, many other projects are taking place internally in Serbia to enable all these connections. As part of the Central-Balkan Corridor and the Transbalkan Corridor, extensive upgrades of the 400 kV grid are planned. New 400 kV substations are planned in the longer term, as well as upgrades to the existing ones.

Multiple reconstructions of the existing 110 kV lines are also planned, which are relevant for enabling more connections of intermittent renewables while keeping the system stable. Most of them should be completed before 2030.

New 110 kV lines are also planned until 2032 in the regions where there are more requests for grid connections of wind and solar projects, such as in the northeast. These come with upgrades of the relevant substations.

Some of the projects are also planned to enable more stable connection of existing small hydropower plants in the southern and southeast of Serbia.

Some investments are also planned that are not specifically renewables-related but are needed for energy sector transformation. In order to secure the stability of the system after the closure of the Kolubara A and Morava coal-fired power plants, some interventions in the related substations are required. This closure is planned for 2026 according to the plan and most of the investments related to this should also be completed by the time of the closure.

Conclusions

The countries are facing similar problems with grid stability. The increased additions to the 400 kV grid require shunt reactors to be added to reduce the overvoltage. This is a regional issue and will have to be solved jointly between all Balkan countries.

Higher voltage interconnections, such as the 500 kV undersea cable between Montenegro and Italy, may also cause disturbances to the lower voltage grid in the Western Balkans.

The Western Balkan countries are well connected between themselves. The only exception is the lack of cross-border capacity between Albania and North Macedonia, but a 400 kV line is under construction. However, the age of the transmission lines is an issue, as many are left over from the joint Yugoslav system and need replacing. North Macedonia's plan gives the most relevant information on the age of the grid, specifying that much of it was built in the 1960s and 1970s and has not been upgraded since then.

Diversification in terms of lines with different voltages is also needed to increase cross-border balancing capacities. North Macedonia may have an issue in this regard, as it is the only country in the region that does not have a 220 kV transmission system.

There is a certain mismatch in the planned completion time of cross-border infrastructure. A possible reason for this is the different baseline years of the countries' development plans, but this needs to be aligned in their updates.

The countries have major differences in terms of requests for connection to the transmission grid for new renewable capacities, but share a lack of grid preparedness to handle them. Kosovo's conservative approach seems to be working in the short-term and creates some order, but over a longer period, it is slowing down the energy transformation.

Some countries' plans do not include the financial structure of the investments. In this sense, North Macedonia is the best example and provides both the source of financing and the timing of the investment. Bosnia and Herzegovina has lump sums and timings, but does not disclose the sources of financing. The rest of the countries are less transparent in this aspect. Because of this, it is hard to get a clear picture of the role of EU and IFI funds in transmission grid improvements from the plans and this would require additional analysis.

North Macedonia is also the only country that uses any dedicated just transition funding for the improvement of the transmission grid. This is a good example of how ambitious decarbonisation plans can support multiple actors in the energy sector of a country with timely investments and projects.

Several of the projects around which the grid development is planned are controversial and/or unrealistic. Most of these are new hydropower plants such as Buk Bijela and the Upper Horizons complex in Bosnia and Herzegovina; Komarnica, Krusevo and Boka in Montenegro; and Chebren and the Vardar Valley complex in

North Macedonia. But some are also wind and even solar plants in regions like Herzegovina where wild and ecologically sensitive regions are subject to rapid development without sensitivity mapping or adequate safeguards. In addition, all the countries except Kosovo plan to build gas power plants,²⁷ but this would increase their dependence on an imported fossil fuel, and it is not clear where the financing would come from, so many will merely serve as a distraction from more realistic projects. The gas plans have not yet been included in the ten-year network development plans, and they should not be included in the next versions either. The TSOs need to take the realism of planned generation projects into account and plan the limited capacity for investments appropriately.

Recommendations

The Western Balkan countries must update their transmission network development plans on a regular basis so that they are aligned regarding the development of cross-border infrastructure and the mitigation of regional grid problems. In particular, Albania's operator OST must prepare and publish a new development plan as soon as possible.

Further undersea connections to Italy from Albania and Montenegro need to be reassessed based on the lessons learned from the Montenegrin case. Such investments need to be considered only after the national grids are appropriately upgraded to handle the volume of electricity traded across them. While interconnectivity is important for the energy transition, it must not come at the expense of reduced stability of the systems in the Western Balkans.

Prioritising connections of sustainable, appropriately-sited wind and solar projects can speed up the energy transformation of the Western Balkan countries. Spatial planning needs to be drastically improved, based on sensitivity mapping and prioritisation of brownfield and other land with low natural value. Strategic environmental impact assessments must be carried out meaningfully, with genuine public participation, as well as environmental impact assessments (EIA) where required by the EU EIA Directive and appropriate assessments where required by the Habitats Directive. Without effective public consultations as part of permitting procedures, renewable energy projects will face increasing opposition, making it difficult to predict grid connection needs and priorities.

Dedicating significant time and resources to enable the infrastructure for controversial large hydropower projects that are constantly delayed is only diverting limited resources and is counterproductive to the energy transition. The same applies to the countries' plans for gas power plants, which are not yet included in the ten-year network development plans but – given the fervour with which governments are pursuing them -- are likely to appear in the next ones.

²⁷ Beyond Fossil Fuels, CEE Bankwatch Network, [Dead end ahead: How gas plans are distracting the Western Balkans from the energy transition](#), 25 September 2025.

Although most of the countries' plans do not offer enough information on the financial structure of the investments, funds are available through the WBIF and development banks for such projects. These need to be utilised more often to speed up investments in the transmission grids and subsequently in sustainable renewable energy generation facilities.

The EU and development banks must continue to proactively promote investments in the transmission grids of Western Balkan countries. With the increasing interest of private investors for utility-scale solar and wind capacities, diverting finances from large-scale unsustainable projects towards uncontroversial solar and wind projects that can be deployed quickly makes more sense for the countries' energy transition. Countries must also have a clear coal phase-out date and decarbonisation roadmap. This will enable linked processes, like the just transition of carbon-intensive regions, to diversify funding opportunities and contribute to the expansion and upgrades of the transmission grid.

While the connection of utility-scale wind and solar projects remains important for the energy transformation, it is also important that the system can enable more prosumers and energy communities. From some cases it is obvious that connecting more renewables to the distribution grid is causing issues in the transmission grid, so investments on both levels need to happen at the same pace.



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