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# Energy transition in the Western Balkans

## Main regional challenges and competitiveness pressures

Živković, L., Fabbri, E., Štrbac, D., Mitić, P., Ljumović I.

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**Contact information**
Name: Emanuele Fabbri
Email: emanuele.fabbri@ec.europa.eu

**Joint Research Centre**
https://joint-research-centre.ec.europa.eu

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# Contents

# Abstract

The Western Balkans are entering the energy transition under structurally more demanding conditions than most EU Member States. High carbon intensity, ageing energy infrastructure, and continued reliance on coal and hydropower intersect with increasing pressures stemming from EU climate policy, market integration, and the introduction of the Carbon Border Adjustment Mechanism. This report examines the implications of decarbonisation for competitiveness, energy security, and economic development across the Western Balkans. Drawing on quantitative indicators and qualitative evidence, the analysis highlights structural characteristics of regional energy systems and identifies key barriers to the effective implementation of the transition. The findings indicate that while renewable energy deployment is accelerating, progress is constrained by outdated grid infrastructure, limited institutional capacity, and restricted access to finance. The report concludes that successful decarbonisation will depend on strengthening implementation capacity, mobilising large-scale investment in energy infrastructure, and aligning energy transition policies with broader competitiveness and industrial transformation strategies. Based on these findings, the report outlines a set of policy recommendations aimed at strengthening institutional capacity, accelerating grid modernisation, and improving access to financing mechanisms that can support a sustainable and competitive energy transition in the region.

# Acknowledgements

The authors would like to thank all experts and stakeholders from the Western Balkans who contributed to this study through interviews and an online survey. Their insights and perspectives provided valuable input for the analysis of energy transition and decarbonisation processes in the region. In total, 15 expert interviews were conducted with representatives of ministries and government institutions, chambers of commerce, international organisations, and companies across the region, while the online survey gathered 99 anonymous responses, significantly enriching the empirical basis of this report.

# Executive summary

The Western Balkans – Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, North Macedonia, Serbia – are entering the energy transition under structurally more challenging conditions than most EU Member States. High carbon intensity, ageing energy infrastructure, and long-standing dependence on coal and hydropower intersect with accelerating external pressures arising from EU climate policy, market integration, along with the introduction of the Carbon Border Adjustment Mechanism (CBAM). As a result, the energy transition is not only a climate challenge, but a decisive factor shaping future competitiveness, energy security, and social stability across the region.

This analysis was developed within the policy framework of the EU Competitiveness Compass and the Western Balkans' obligations under the Energy Community Treaty and the EU accession process. It combines quantitative analysis of harmonised international and national energy, emissions, and competitiveness indicators with qualitative evidence from stakeholder interviews and a region-wide survey of stakeholders active in energy, climate, industry, policy, and business support ecosystems. The assessment adopts a place-based perspective, drawing on the Joint Research Centre's long-standing work on territorial development and Smart Specialisation, to examine how energy transition and decarbonisation dynamics interact with competitiveness, investment capacity, and institutional readiness across the Western Balkans.

**Energy systems across the Western Balkans remain largely carbon intensive, but with pronounced heterogeneity between economies.** Coal, particularly lignite, continues to dominate electricity generation in Bosnia and Herzegovina, Kosovo*, North Macedonia and Serbia, while oil remains central to the transport sector. Although renewable energy shares appear relatively high in aggregate statistics, these figures are primarily driven by hydropower and traditional biomass rather than by diversified deployment of modern renewables. The lack of diversification exposes the region to climate variability, particularly droughts, which have already led to sharp declines in hydropower output and increased reliance on electricity imports during peak periods. At the same time, Albania stands out with an electricity system almost entirely based on renewable sources, highlighting that the region is far from homogeneous. These structural differences rule out a single transition pathway and underscore the need for policy approaches tailored to national energy mixes, industrial structures, and exposure to climate and market risks.

**Renewable energy deployment is accelerating, but system-level constraints increasingly limit effective integration.** Solar and wind project pipelines exceed 8 GW across the region, yet transmission and distribution losses remain well above EU levels due to decades of underinvestment and weak network management. Distribution grids designed for unidirectional power flows are under pressure from rapid growth in small-scale solar installations, while utility-scale projects face long connection delays, limited grid flexibility, and unclear balancing responsibilities. Without parallel investment in grid modernisation, storage, and system management, further renewable expansion risks undermining supply security and investor confidence.

**Competitiveness implications are already becoming evident.** While the carbon intensity of GDP has declined, total emissions across most Western Balkan economies have largely stagnated, placing the region in a partial decoupling trap. This structural inefficiency increases exposure to EU climate instruments, particularly CBAM, which imposes tangible cost pressures on electricity exports and energy-intensive industries from 2026 onward. Stakeholder assessments indicate that firms anticipate significant

* This designation is without prejudice to positions on status and is in line with UN Security Council Resolution 1244 (1999) and the ICJ Opinion on the Kosovo declaration of independence.

cost increases even where energy efficiency investments have been implemented, underscoring that current efforts are insufficient to offset regulatory and market pressures.

**National climate and energy frameworks have advanced rapidly, but implementation capacity lags behind formal ambition.** All economies have adopted or are preparing Nationally Determined Contributions and National Energy and Climate Plans that are increasingly aligned with EU objectives. Serbia's adoption of a binding National Energy and Climate Plan in 2024 represents a notable shift toward rule-based climate governance. Nevertheless, weak enforcement, delayed secondary legislation, limited inspection capacity, and shortages of specialised technical skills continue to undermine policy credibility and investment predictability.

**Recent policy developments under the Growth Plan for the Western Balkans further clarify this dynamic.** Reform Agendas provide a comprehensive and largely harmonised policy framework across economies, while WBIF investments increasingly support core infrastructure needs, particularly in transmission, renewable energy and energy efficiency. However, the analysis shows that the main constraint lies in the transition from planned to implemented investments. A significant share of critical projects remains in preparation, particularly in areas such as grid expansion, storage and system flexibility, limiting the pace of system transformation.

**Institutional capacity and challenges related to the effective mobilisation and deployment of financial resources represent the most binding barriers to implementation.** A majority of stakeholders rate national institutions as weak or very weak in their ability to deliver the energy transition, citing fragmented governance, weak coordination between national and local levels, and insufficient technical expertise. Although significant financial resources are available through EU instruments and international financial institutions, stakeholder perceptions of inadequate financial support primarily reflect challenges related to access, project preparation, and effective deployment rather than the absolute absence of funding. As a result, the scale of investment required to implement National Energy and Climate Plans remains difficult to achieve in practice.

**Energy security considerations continue to shape the sequencing and pace of the transition.** Coal phase-down strategies are framed around gradual reduction and reserve-based operation rather than fixed shutdown dates, reflecting concerns over system stability and insufficient balancing capacity. At the same time, dependence on a limited number of external suppliers for oil and gas, combined with climate-induced variability in hydropower output, leaves the region exposed to price volatility, supply disruptions, and geopolitical risks, reinforcing the need for diversification and stronger regional interconnections.

The key policy messages below summarise selected findings with the strongest implications for policy action.

1. **Grid modernisation is a precondition for the energy transition, not a complementary measure.** Outdated transmission and distribution networks are already constraining renewable integration, reducing supply reliability, and discouraging investment. Without large-scale investment in grid upgrades, storage, digitalisation, and balancing capacity, further renewable deployment will face diminishing returns and rising system risks.
2. **The constraint is not the availability of finance, but its effective mobilisation.** Existing EU instruments provide significant support, yet limitations in project bankability, institutional capacity, and financial intermediation prevent investments from scaling.

3. **CBAM will shape competitiveness outcomes well before full implementation.** CBAM is already influencing investment decisions and supply-chain relations. Without reinvesting carbon-related revenues into decarbonisation, innovation, and skills, carbon pricing risks becoming a fiscal burden rather than a catalyst for industrial transformation.
4. **The key bottleneck is the transition from project pipelines to implementation.** A large share of investments supporting grid modernisation, renewable integration and system flexibility remains in preparation. Strengthening project preparation, accelerating permitting and prioritising mature, bankable projects is essential to ensure that existing financial support translates into real system transformation.
5. **Institutional capacity and enforcement remain the weakest links in the transition.** Weak coordination, limited inspection capacity, delayed secondary legislation, and shortages of specialised expertise undermine policy credibility and investor confidence, even where strategic targets are clearly defined.
6. **Energy security concerns require sequenced, differentiated transition pathways.** Coal phase-down strategies in the Western Balkans must reflect system stability constraints and later starting points. A rigid convergence to EU timelines without adequate balancing capacity risks undermining both energy security and public support.
7. **Just transition mechanisms are essential for political and social feasibility.** The absence of dedicated just transition funding comparable to the EU's Just Transition Fund limits the ability to manage regional and social impacts of decarbonisation, particularly in lignite-dependent regions.
8. **Smart Specialisation frameworks can support experimentation and scaling of innovative solutions for the energy transition.** Pilot initiatives enabled through instruments such as regulatory sandboxes, co-creation mechanisms, and innovative public procurement should be systematically linked with investment programmes and regulatory adjustments to allow successful solutions to scale beyond isolated projects and contribute to system-level transformation in the Western Balkans.
9. **One-size-fits-all approaches are unsuitable for the Western Balkans.** Substantial differences in energy mix, industrial structure, and exposure to climate risks require tailored policy design at national and sectoral levels, rather than uniform targets and instruments.

In addition, targeted measures supporting industrial energy efficiency, circular economy solutions, skills development, and stronger stakeholder engagement will be necessary to ensure that decarbonisation translates into sustained competitiveness gains.

# 1 Introduction

## 1.1 Policy context and background

The Western Balkan economies – Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, North Macedonia, Serbia – are navigating a critical moment in their transition toward sustainable, competitive, and EU-aligned energy systems. As the European Union accelerates its pathway toward climate neutrality, the region faces a dual challenge: addressing deep structural dependencies on carbon-intensive fuels while aligning with an expanding set of EU climate and energy rules and policy frameworks. These include major strategic initiatives such as the European Green Deal (the EU's overarching roadmap for achieving climate neutrality), legally binding obligations under the Energy Community Treaty (which extends key EU energy legislation to the region), and new market-based instruments such as the CBAM, designed to reduce carbon-intensive production and to put a carbon price on imports. At the same time, these external pressures intersect with the Western Balkans' own international and regional environmental commitments. These include the Paris Agreement, which sets global climate targets; the Sofia Declaration on the Green Agenda for the Western Balkans, which translates EU green priorities into a regional policy framework; and Nationally Determined Contributions (NDCs), through which countries define their national climate targets and actions. NDCs specify emission reduction targets, priority sectors, and planned policy measures, and are periodically updated to reflect increasing levels of ambition. In parallel, all economies in the region are in the process of preparing or implementing National Energy and Climate Plans (NECPs), integrated strategic documents that translate these commitments into concrete policies and measures across key sectors such as energy, transport, and industry. NECPs provide a medium- to long-term planning framework, including projections, investment needs, and policy instruments required to achieve national energy and climate objectives.

This study is carried out within a broader policy context that supports the territorial dimension of EU policies, including enlargement, neighbourhood, cohesion, and smart specialisation strategy (S3). Its analytical foundation builds on extensive work carried out by the Joint Research Centre on place-based innovation policies and smart specialisation in the EU Neighbourhood and Enlargement region, providing a basis for examining how energy transition and decarbonisation – identified as a central pillar of the EU Competitiveness Compass[2] – shape competitiveness prospects in the Western Balkans.

The Competitiveness Compass is a policy framework developed by the European Commission to guide the EU's long-term economic transformation in response to global structural shifts, including climate change, technological disruption, and geopolitical fragmentation. It identifies key 'imperatives' for strengthening competitiveness, among which energy transition and decarbonisation play a particularly prominent role. In this context, decarbonisation is not treated solely as an environmental objective, but as a fundamental driver of industrial transformation, affecting cost structures, energy security, investment patterns, and the ability of firms to remain competitive in increasingly carbon-constrained markets. The transition toward low-carbon energy systems is therefore closely linked to broader issues of productivity, resilience, and strategic positioning within global value chains. The Competitiveness Compass offers a structured framework for assessing the readiness of economies to confront these transformation pressures, including innovation gaps, exposure to energy price volatility, dependence on carbon-intensive production, and the capacity to mobilise investment in clean technologies. Extending this framework beyond EU Member States enables an assessment of the preparedness of Western Balkan economies for the

[2] https://commission.europa.eu/topics/competitiveness/competitiveness-compass_en

challenges ahead, particularly in light of their structural specificities and their ongoing alignment with EU policy and regulatory frameworks.

These strategic orientations are complemented by a set of EU policy instruments and financial mechanisms aimed at supporting the energy transition and decarbonisation in the Western Balkans. The Economic and Investment Plan (EIP) for the Western Balkans provides a broad investment framework designed to mobilise funding for key sectors, particularly sustainable infrastructure such as renewable energy, energy efficiency, and the modernisation of energy systems. In practice, many of these investments are channelled through the Western Balkans Investment Framework (WBIF), which acts as a key financing platform by blending EU grants with loans from international financial institutions to support large-scale energy and infrastructure projects.

More recently, the Growth Plan for the Western Balkans has built upon this investment-oriented approach by introducing a stronger focus on structural reforms and conditionality. While covering a wide range of policy areas related to economic convergence with the EU, the Growth Plan places increasing emphasis on reforms that are critical for enabling the energy transition, including market functioning, regulatory frameworks, and investment conditions. In this sense, the Growth Plan complements the EIP by linking financial support more directly to the implementation of reforms, thereby reinforcing the effectiveness and sustainability of investments. These instruments form a coherent policy and financial architecture in which strategic priorities are translated into concrete investments and reform incentives. This architecture is particularly relevant for assessing competitiveness, as access to financing, the capacity to implement reforms, and the ability to absorb investments become key determinants of how effectively Western Balkan economies can respond to decarbonisation pressures and position themselves in a low-carbon economic environment.

## 1.2 Purpose of the study and research question

The purpose of this report is to provide a comprehensive, evidence-based assessment of the energy systems and decarbonisation pathways of the Western Balkan economies, and to analyse how these structural characteristics influence their competitiveness in the context of EU accession. The study examines the central question:

> ***How does the 'imperative' of energy transition and decarbonisation affect the competitiveness of the Western Balkan economies, and what policy pathways can strengthen the synergies between green transition and long-term economic resilience?***

This question is particularly significant for a region characterised by a high dependence on lignite and ageing infrastructure, limited diversification into modern renewable energy sources, exposure to energy price volatility and recurring supply shocks, rising external pressures from CBAM and EU market integration, and uneven institutional capacity to implement NECPs and climate commitments.

At the same time, Smart Specialisation Strategies, adopted or under development in all Western Balkan economies, provide an emerging platform for linking innovation policy, industrial transformation, and the green transition. Understanding whether and how S3 processes can contribute to competitiveness and decarbonisation is therefore key for shaping future policy synergies.

## 1.3 Objectives of the Study

The study pursues the following objectives:

- To assess the current state of the energy systems in the Western Balkans, including energy mix, electricity generation patterns, renewable deployment, infrastructure constraints, and energy consumption structures.
- To analyse decarbonisation trends, including $CO_2$ emissions, carbon and energy intensity, sectoral emission structures, and alignment with EU norms.
- To evaluate the implications of energy transition for competitiveness, including CBAM exposure, industrial vulnerabilities, security-of-supply risks, and the capacity of firms to adapt.
- To identify barriers and enabling factors for integrating energy transition and decarbonisation into national competitiveness strategies, including the role of Smart Specialisation.
- To provide evidence-based policy recommendations, grounded in quantitative indicators and qualitative stakeholder insights, to support realistic, sequenced, and financially feasible transition pathways.

## 1.4 How this analysis was developed

The analytical approach underpinning this report combines desk research, quantitative data analysis, stakeholder interviews, and a region-wide online survey. This mixed-methods design reflects established practice in integrating empirical evidence with policy-relevant insights to address multi-dimensional challenges at the intersection of energy transition, decarbonisation, and competitiveness.

The report builds on a systematic review of policy frameworks and strategic documents shaping the energy transition in the Western Balkans, including NECPs, NDCs, national energy and climate strategies, Smart Specialisation Strategies, Energy Community assessments, and relevant EU policy instruments such as the European Green Deal, the EU Competitiveness Compass, and CBAM-related legislation.

Quantitative analysis relies on harmonised international and national data sources to ensure cross-country comparability and benchmarking against the EU. Primary data sources include Eurostat, the International Energy Agency (IEA), the World Bank, Organisation for Economic Co-operation and Development (OECD), Global Energy Monitor, World Development Indicators, and national statistical offices.

To complement desk research and statistical analysis, the study incorporates qualitative evidence from 15 semi-structured interviews conducted across all six Western Balkan economies. Interviewees included representatives of national ministries, energy regulators, state-owned utilities, industrial companies, business associations, and independent experts.

In addition, a structured online survey was conducted across the Western Balkans, gathering 99 responses from stakeholders active in energy and decarbonisation-related activities, industry, policy, and business support ecosystems. The survey broadened the empirical base of the analysis by capturing region-wide perceptions and experiences related to energy transition challenges, decarbonisation investments, grid constraints, financing barriers, regulatory frameworks, and competitiveness impacts.

Throughout the analysis, particular attention was paid to linking energy transition and decarbonisation dynamics with competitiveness outcomes, in line with the second imperative of the EU Competitiveness Compass. The resulting evidence base informed the development of policy-relevant conclusions and recommendations aimed at supporting realistic and context-sensitive transition pathways for the Western Balkan economies.

The remainder of the report is structured as follows. Section 2 provides an overview of the energy system in the Western Balkans, including the energy mix, electricity generation, renewable energy deployment, and import dependency. Section 3 examines key energy performance indicators, with a focus on energy productivity, efficiency, and market conditions. Section 4 analyses decarbonisation trends, including $CO_2$ emissions, carbon and energy intensity, and sectoral emission patterns, as well as alignment with EU mechanisms such as CBAM. Section 5 reviews the policy and governance frameworks supporting the energy transition, with particular attention to implementation constraints, reform agendas, and the role of Smart Specialisation Strategies. Finally, Section 6 presents the main conclusions and policy recommendations.

# 2 Energy System Overview

## 2.1 Characteristics of the energy mix in the Western Balkans

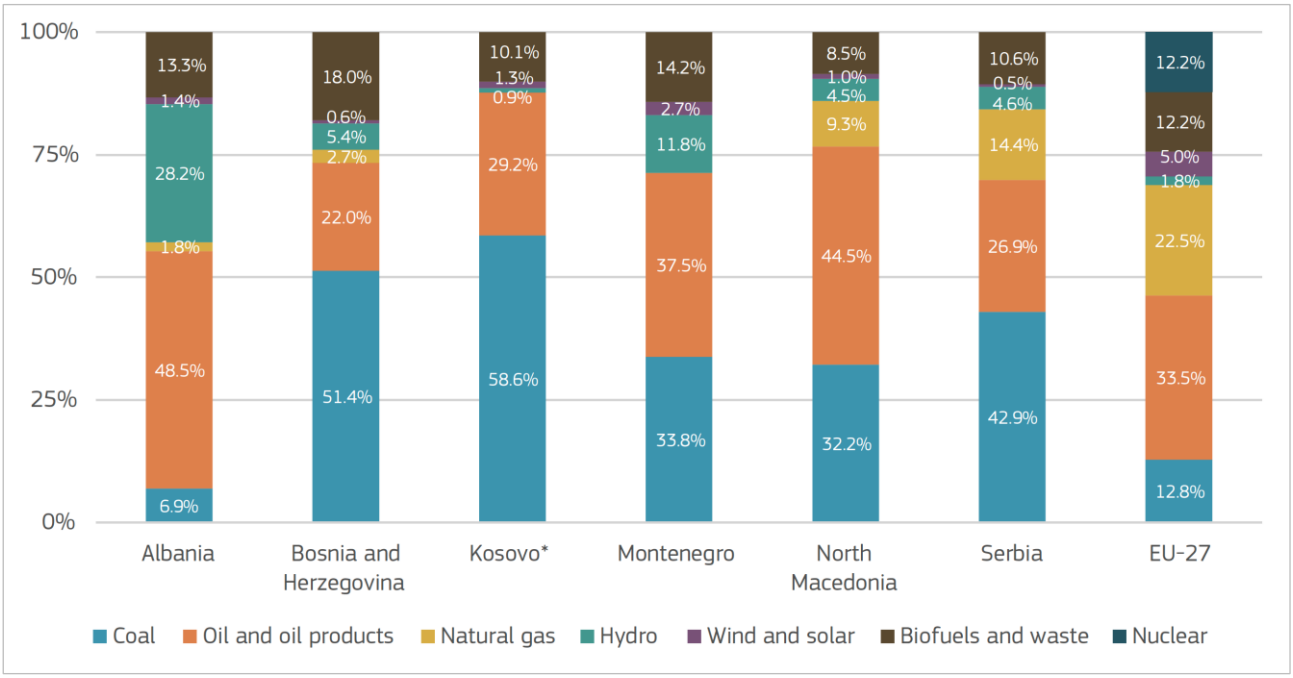
**The Western Balkans remain structurally dependent on fossil fuels. Coal and oil dominate energy supply in most economies, making the region carbon-intensive and vulnerable to energy shocks (Figure 1).** Kosovo* and Bosnia and Herzegovina are coal-dominated, accounting for 58.6% and 51.4% of total energy supply respectively, while Serbia is also heavily reliant on coal (42.9%). Albania and North Macedonia are oil-dominated, with shares of 48.5% and 44.5% respectively, although in absolute terms their oil consumption remains significantly lower than in larger economies such as Serbia and Bosnia and Herzegovina. In contrast, the EU's energy mix is far more diversified than that of the Western Balkans, as the energy mix is more balanced across solid fossil fuels, natural gas, nuclear energy, and renewables. The absence of nuclear and the limited penetration of modern renewables in the Western Balkans leave the region exposed to volatility and structurally locked into two dominant fuels – coal and oil.

**Hydropower is a relative strength for some economies**. Albania relies on hydro for over a quarter of its supply (28.2%), while Montenegro also benefits (11.8%). In contrast, Serbia, Bosnia and Herzegovina, and North Macedonia depend on hydro for less than 6%. This uneven distribution highlights intra-regional disparities, with only a few economies able to leverage hydropower as a stabilising resource, not necessarily due to a lack of natural potential, but rather differences in the extent to which this potential has been developed and utilised.

**Modern renewables remain marginal across the region.** While wind and solar energy account for 5% of energy supply in the EU, they remain below 3% in the entire region, from 0.5% in Serbia to 2.7% in Montenegro. Despite favourable conditions, the region has not increased investment in new renewable technologies. According to the Global Energy Monitor (2024), prospective utility-scale solar and wind power projects in the Western Balkans amount to more than 23 GW, a figure comparable to that of Germany. This pipeline has the potential to displace gas-fired power plants and significantly transform the region's energy mix. This study also highlights that only 6% of this projected capacity is currently under construction and likely to become operational, underlining the gap between ambition and implementation.

**Traditional biomass still plays an outsized role**. Biofuels and waste contribute 18.0% in Bosnia and Herzegovina and 14.2% in Montenegro, compared with 12.2% in the EU. This reflects extensive use of firewood for heating, particularly in rural households. While this raises the renewable share statistically, it contributes to severe air pollution and premature mortality, undermining sustainability (Frey, 2024). Domestic combustion, including the use of traditional biomass for heating, remains a major source of primary PM2.5 emissions in the Western Balkans, making it a critical target for emission reduction strategies to improve public health (Belis et al., 2025). Moreover, inefficient combustion in rural households also masks weak progress in renewable diversification, despite growing investment announcements in solar and wind.

**Figure 1.** Total energy supply in 2023.



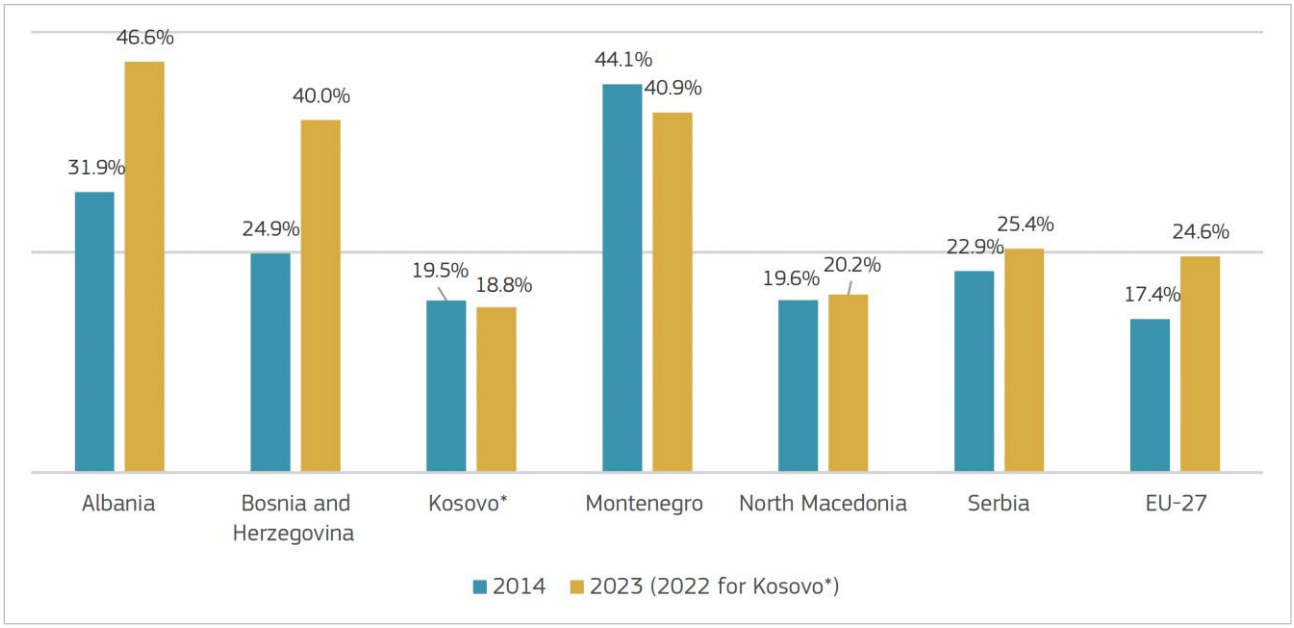

*Source: International Energy Agency. IEA Energy Statistics Data Browser.*

## 2.2 Renewable energy sources in the Western Balkans

**Renewable energy indicators appear strong in the Western Balkans, but the picture is misleading**. Between 2014 and 2023, Albania and Bosnia and Herzegovina increased their renewable shares[3] to 47% and 40% respectively, while Montenegro maintained one of the highest levels in Europe at 41%. Serbia progressed modestly (25%), North Macedonia stagnated (20%), and Kosovo* even declined (19%). At first glance, the region seems ahead of the EU average (25%), but this reflects structural reliance on hydro and solid biomass rather than diversification into new renewables. Hydropower and firewood dominate, whereas EU growth increasingly comes from wind, solar, and advanced bioenergy. These relatively high aggregate shares in some economies, particularly Albania, are largely driven by the electricity sector, where renewable energy, primarily hydropower, dominates generation (see Section 2.3 for a detailed analysis).

[3] The shares refer to the proportion of renewable energy in gross final energy consumption (Eurostat indicator nrg_ind_share), covering electricity, transport, and heating and cooling. This differs from supply-side indicators based on Total Energy Supply (TES) used in Figure 1, and the two are not directly comparable.

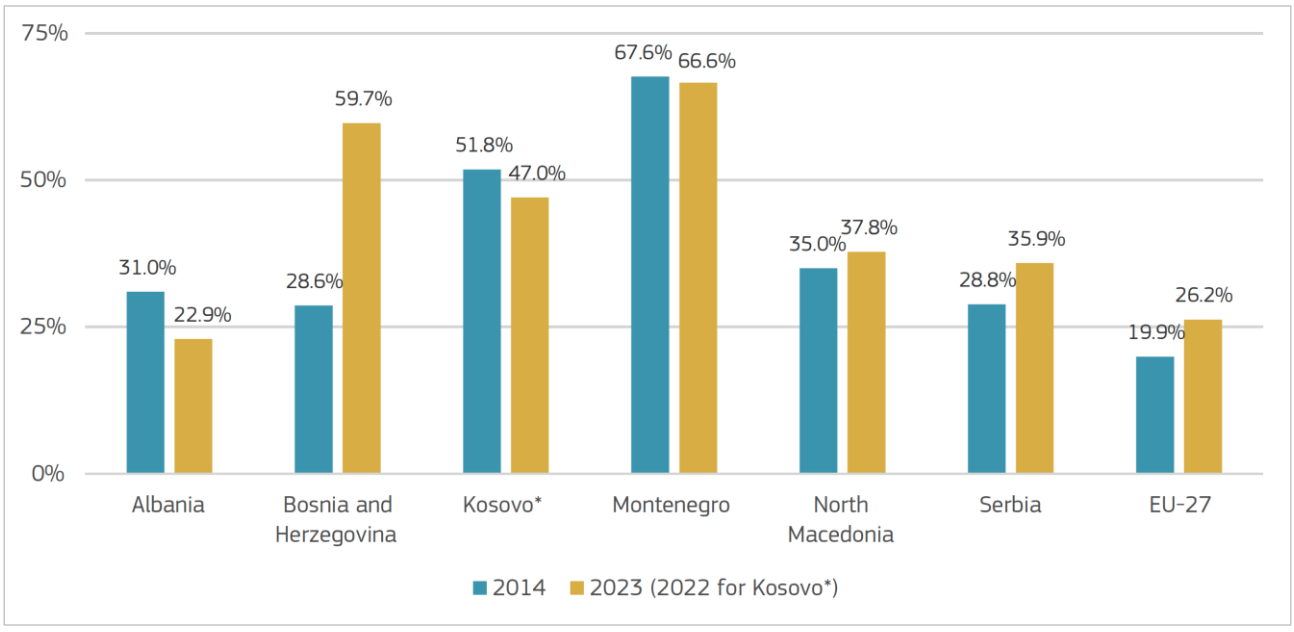
**Figure 2.** Total share of energy from renewable sources.




*Source: Eurostat database (2025). Share of energy from renewable sources.*

**Heating and cooling inflate renewable statistics but conceal major risks.** Bosnia and Herzegovina doubled its renewable share in heating to 60%, Montenegro stands at 67%, and Serbia and North Macedonia both exceed 35%, far above the EU average of 26%. Even Kosovo*, despite declines, remains well above EU levels. Yet this performance stems largely from traditional biomass burned in outdated stoves, which contributes to severe air pollution and high mortality from PM2.5 exposure. Albania is the exception, where renewable shares in heating fell below the EU average (23%), highlighting both the diversity and fragility of regional energy structures.

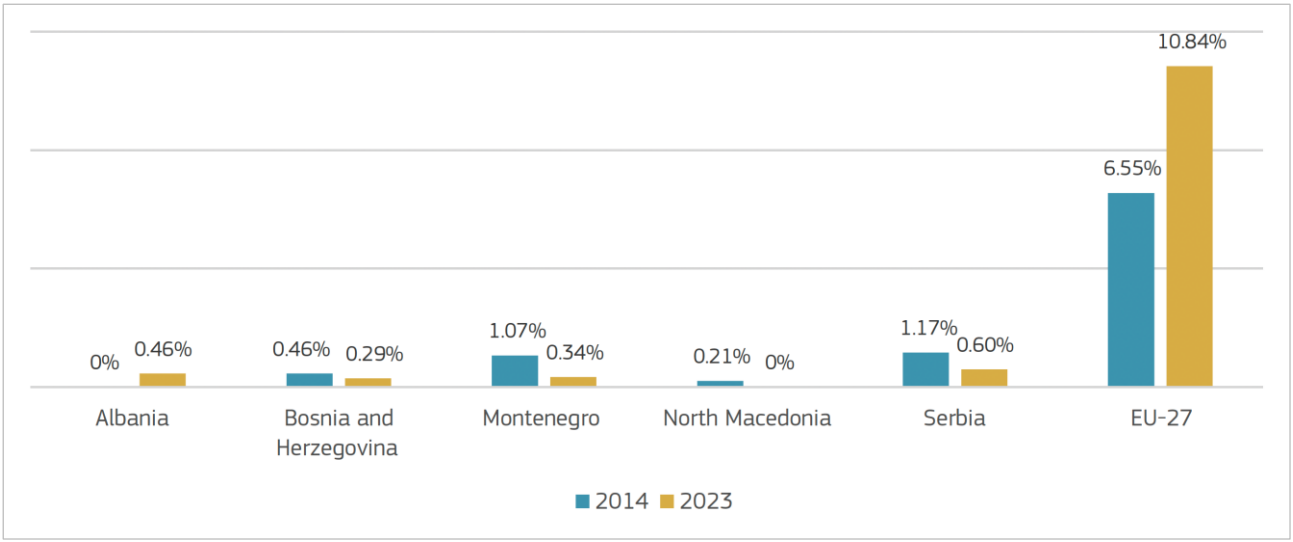
**Figure 3.** Share of renewable energy sources in heating and cooling.




*Source: Eurostat database (2025). Share of energy from renewable sources.*

**Transport is the weakest link in the renewable transition. While the EU almost reached 11% renewables in transport by 2023, no Western Balkan economy exceeded 1%, and several even regressed.** The absence of policies, infrastructure, and incentives for biofuels leaves the sector almost fully dependent on fossil fuels. Without rapid investment and alignment with EU directives, the gap between the Western Balkans and the EU in transport decarbonisation will continue to widen, undermining overall convergence. Qualitative insights from stakeholder interviews help explain this persistent underperformance in the transport sector. They point to a substantial untapped potential for biogas, biomethane, bioethanol, and biodiesel. For example, with approximately 4 million hectares of agricultural land, around 800,000 hectares of which remain unused, Serbia alone could substitute a significant share of fossil fuels used in transport. Experts emphasise that biogas upgraded to biomethane can be injected directly into the existing gas grid, while bioethanol and biodiesel represent mature and cost-effective solutions.

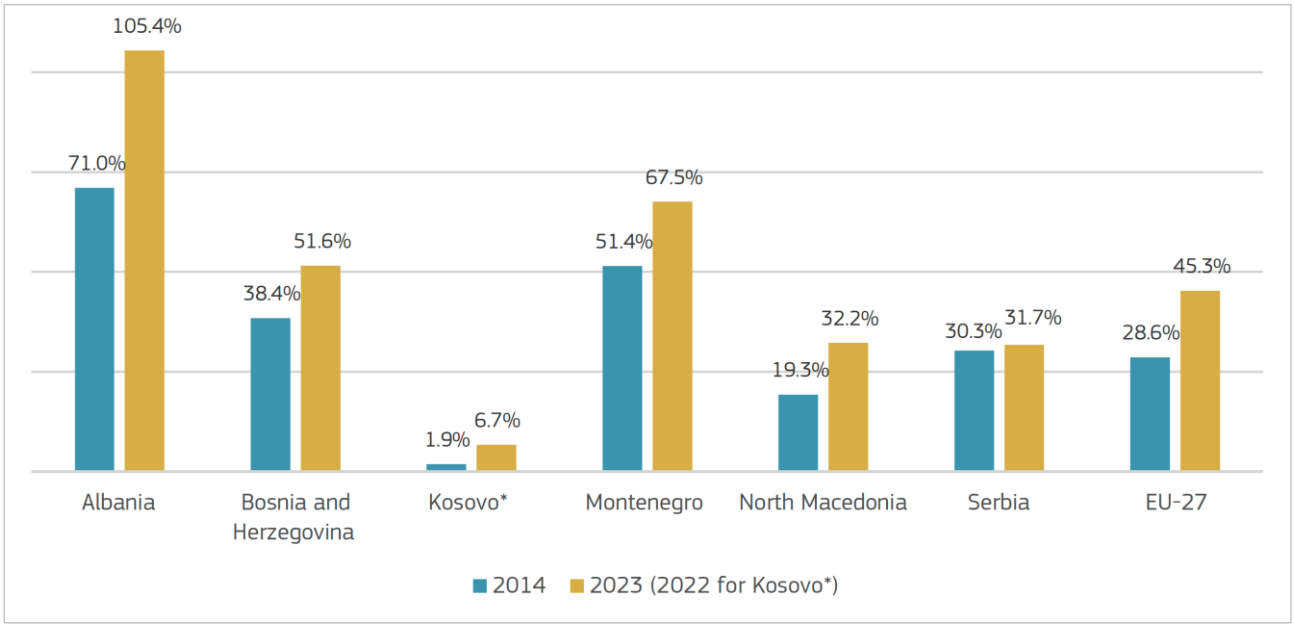
**Figure 4.** Share of renewable energy sources in transport.




*Source: Eurostat database (2025). Share of energy from renewable sources.*

**The electricity sector plays a central role in explaining these aggregate patterns. As shown in Figure 5, the share of renewable energy in electricity is particularly high in several Western Balkan economies, especially Albania, where hydropower dominates generation.** Albania, Montenegro, and Bosnia and Herzegovina significantly exceed the EU average, with Albania even surpassing 100%, reflecting net electricity exports driven by abundant hydropower generation. North Macedonia has also improved notably, while Serbia stagnated and Kosovo* remains far behind. This strong performance in electricity significantly drives the overall share of renewables presented in Figure 2, despite weaker performance in transport and, in some cases, heating and cooling.

**Figure 5.** Share of renewable energy sources in electricity.




*Source: Eurostat database (2025). Share of energy from renewable sources.*

**Despite this technical and resource potential, interviewees highlight that advanced biofuels have not yet been systematically integrated into national decarbonisation strategies.** Although sustainability principles that prioritise waste and residue-based feedstocks are widely recognised, Western Balkan economies have so far failed to operationalise advanced biofuels within their decarbonisation strategies, missing an opportunity for relatively rapid emissions reduction in the transport sector.

**Interviews with business stakeholders further confirm that the deployment of alternative fuels in energy-intensive industries is constrained less by technological limitations than by upstream waste-management systems.** Insufficient waste collection, sorting, and logistics prevent reliable feedstock supply, even where conversion technologies are available. This points to a broader governance gap, in which fragmented responsibilities between municipalities, utilities, and industrial actors undermine the practical uptake of renewable fuels, despite favourable resource endowments.

## 2.3 Electricity Generation

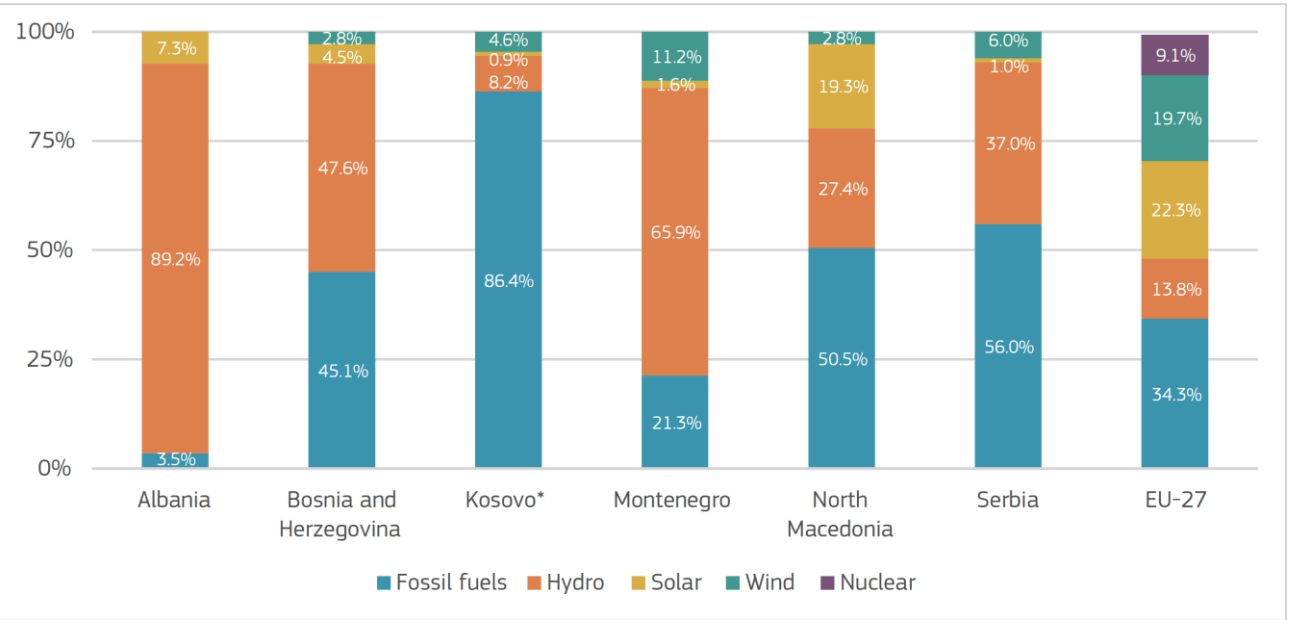
### 2.3.1 Total installed capacity for electricity generation

**The structure of installed electricity generation capacity in the Western Balkans shows a clear dominance of just two sources: fossil fuels and hydropower.** In 2023, fossil fuels dominated in Kosovo* (86%), Serbia (56%), and Bosnia and Herzegovina (45%), while North Macedonia was only slightly more balanced (51% fossil). Albania stands out as an exception, with 89% of installed capacity from hydropower and only 3% from fossil fuels, making it uniquely exposed to hydrological risks. Montenegro also relies strongly on hydro (66%). In contrast, the EU presents a much more balanced mix of fossil, hydro, wind, solar, and nuclear capacity.

**Modern renewable and nuclear sources remain largely absent. Wind and solar account for less than 10% of capacity in most economies, with the notable exception of North Macedonia, where solar alone reached over 19% in 2023.** Nuclear power is entirely absent in the region, while

in the EU it makes up 9% of installed capacity. This leaves the Western Balkans structurally reliant on fossil fuels and hydro compared to the EU's more diversified generation base.

**Figure 6.** Share of installed electricity generation capacity by source, 2023.




*Source: Eurostat database (2025). Electricity production capacities by main fuel groups and operator.*

**Although most EU recommendations are oriented towards shutting down coal plants and reducing fossil fuel capacity, the Western Balkans have moved in the opposite direction.** According to Eurostat, between 2014 and 2023, Bosnia and Herzegovina increased capacity by 17%, Serbia by 7.6%, and North Macedonia by 23%, mainly through new investments, modernisation, and lifetime extensions of existing plants. By contrast, the EU reduced fossil fuel power plant capacity by 13% in the same period, phasing out coal and replacing it with renewables and gas.

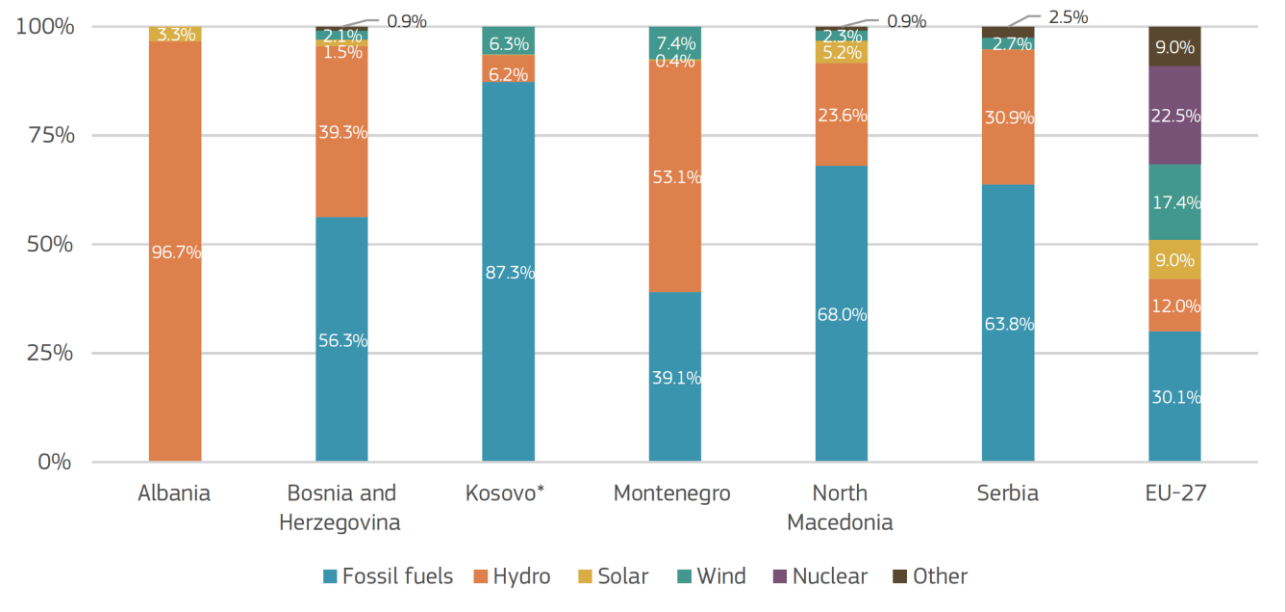
**Autoproducers[4] represent only a marginal share of the electricity system in the Western Balkans compared to the European Union.** According to Eurostat, autoproducers account for slightly more than 16% of total installed electricity generation capacity in the EU, while in the Western Balkans their share is just around 2%. Renewables, and particularly solar photovoltaic, dominate the structure of autoproducers in the EU, whereas in the Western Balkans fossil fuels still prevail. This indicates that autoproducers in the EU are well integrated into the energy transition, while in the Western Balkans their contribution remains limited. However, these figures should be interpreted with caution. Interviews with stakeholders suggest that a growing number of autoproducers, especially industrial companies investing in solar PV for own consumption, are not yet visible in official statistics because they are not legally connected to the system. As a result, the role of autoproducers in the Western Balkans may be somewhat underestimated, and their potential contribution to the energy transition is likely greater than current data suggest

[4] Autoproducers are companies or institutions that generate electricity primarily for their own use rather than for sale to the grid.

### 2.3.2 Total electricity generation

**While installed capacity provides an overview of potential supply, the structure of gross electricity generation shows the actual dependence on different sources, and the gap between the Western Balkans and the EU becomes even clearer.** Fossil fuels dominate electricity generation in almost all Western Balkan economies, with the share ranging from 56% in Bosnia and Herzegovina to 87% in Kosovo*. Hydropower, despite its significant share of installed capacity in most Western Balkans, in practice contributes much less due to seasonal and hydrological fluctuations. An exception is Albania, where almost all electricity is generated from hydropower, making the system extremely dependent on hydrological conditions. Although wind and solar energy are gradually being incorporated into the capacity mix, they only make a marginal contribution to electricity generation, usually less than 8%. This points to clear differences in capacity factors across technologies, with coal operating at much higher utilisation rates than solar and wind in the Western Balkans. In contrast, the EU's electricity mix is far more diversified, nuclear energy (22.5%), wind power (17.4%) and solar energy (9%) together account for almost half of total electricity generation, while the share of fossil fuels has fallen to just 30%.

**Figure 7.** Share of Gross Electricity Production by Fuel Type, 2023.




*Source: Eurostat database (2025). Production of electricity and derived heat by type of fuel.*

**Another notable feature of the electricity sector in the Western Balkans is the near-total dependence on lignite as a solid fossil fuel source, which is one of the most polluting fossil fuels.** In 2023, between 39% and 87% of gross electricity generation in Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia and Kosovo* came from solid fossil fuels, and almost 100% of that was lignite (Table 1). Albania is the only exception where no lignite is used to generate electricity. In the EU, on the other hand, solid fossil fuels account for only 12% of electricity generation, and only about half of this comes from lignite. This makes lignite the most important structural difference between the Western Balkans and the EU, as the region is still committed to the highest-emission form of coal.

**Table 1.** Share of lignite in solid fossil fuel generation, 2023.

| | Total (ktoe) | Solid fossil fuels (ktoe) | % of solid fossil fuels | Lignite (ktoe) | % of lignite in total solid fossil fuels |
|---|---|---|---|---|---|
| **Bosnia and Herzegovina** | 1,477.64 | 824.16 | 55.8% | 824.16 | 100.0% |
| **Montenegro** | 360.01 | 140.71 | 39.1% | 140.71 | 100.0% |
| **North Macedonia** | 591.16 | 237.76 | 40.2% | 237.76 | 100.0% |
| **Albania** | 774.38 | 0.00 | 0.0% | 0.00 | 0.0% |
| **Serbia** | 3,441.77 | 2,024.16 | 58.8% | 2,022.87 | 99.9% |
| **Kosovo*** | 546.30 | 475.86 | 87.1% | 475.86 | 100.0% |
| **EU 27** | 236,333.46 | 27,450.02 | 11.6% | 15,348.14 | 55.9% |

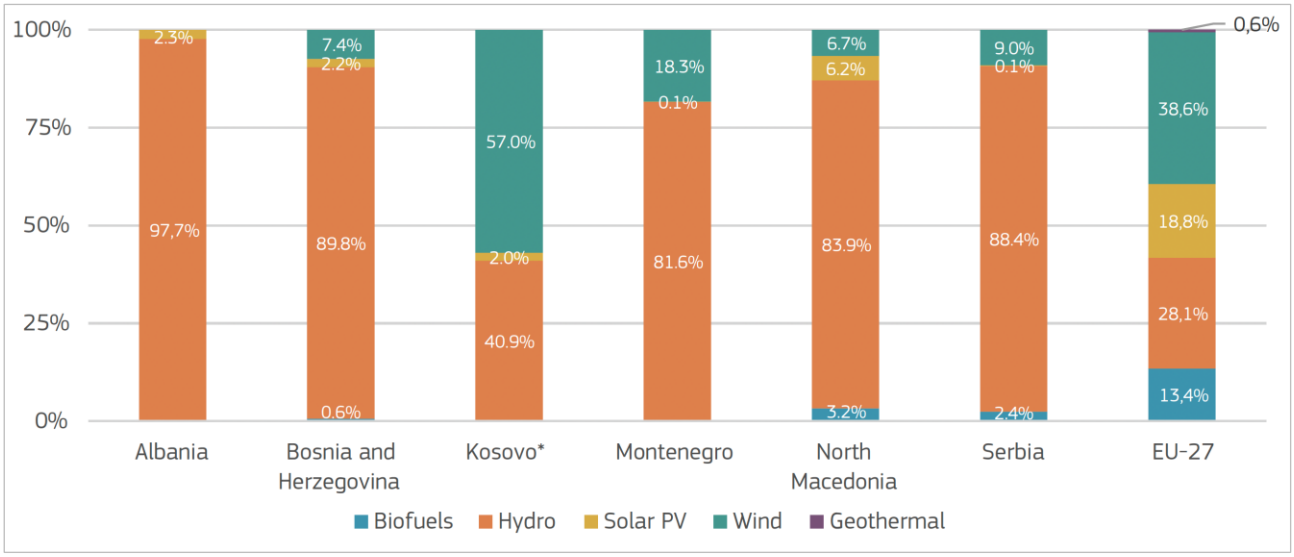
*Source: Eurostat database (2025). Production of electricity and derived heat by type of fuel.*

### 2.3.3 Renewable energy sources in electricity generation

**The EU's renewable electricity mix is much more diversified than that of the Western Balkans.** In 2022, EU generation was distributed among wind (39%), hydro (28%), solar (19%), and biofuels (13%), reflecting a balanced portfolio. In contrast, renewable electricity in the Western Balkans is dominated almost entirely by hydro: Albania (98%), Bosnia and Herzegovina (90%), Montenegro (82%), and North Macedonia (84%). Kosovo* is the only exception, with a renewable mix led by wind (57%). This reliance on a single resource increases vulnerability to hydrological and seasonal variability, unlike the EU's more resilient structure.

**Other renewable technologies remain underdeveloped in the Western Balkan electricity mix. Solar photovoltaics (PV) and biofuels contribute marginally, in sharp contrast to the EU where both are expanding rapidly.** While Kosovo* has pioneered wind integration, no other economy shows significant diversification beyond hydro. The challenge is therefore not the absence of renewables, but the lack of variety: without stronger investment in wind, solar, and bioenergy, the region will remain dependent on hydropower and vulnerable to climate variability.

**Figure 8.** Electricity production from renewables in 2022.




*Source: International Energy Agency. IEA Energy Statistics Data Browser.*

**Institutional and administrative barriers further slow diversification by making renewable deployment unnecessarily complex and costly.** Lengthy permitting procedures, unclear support schemes, overlapping institutional responsibilities, and insufficient grid planning all increase investor uncertainty. These obstacles fall particularly heavily on small-scale investors, prosumers, and emerging energy communities, groups identified by CAN Europe (2024), as crucial for accelerating renewable growth but disproportionately constrained by bureaucratic hurdles.

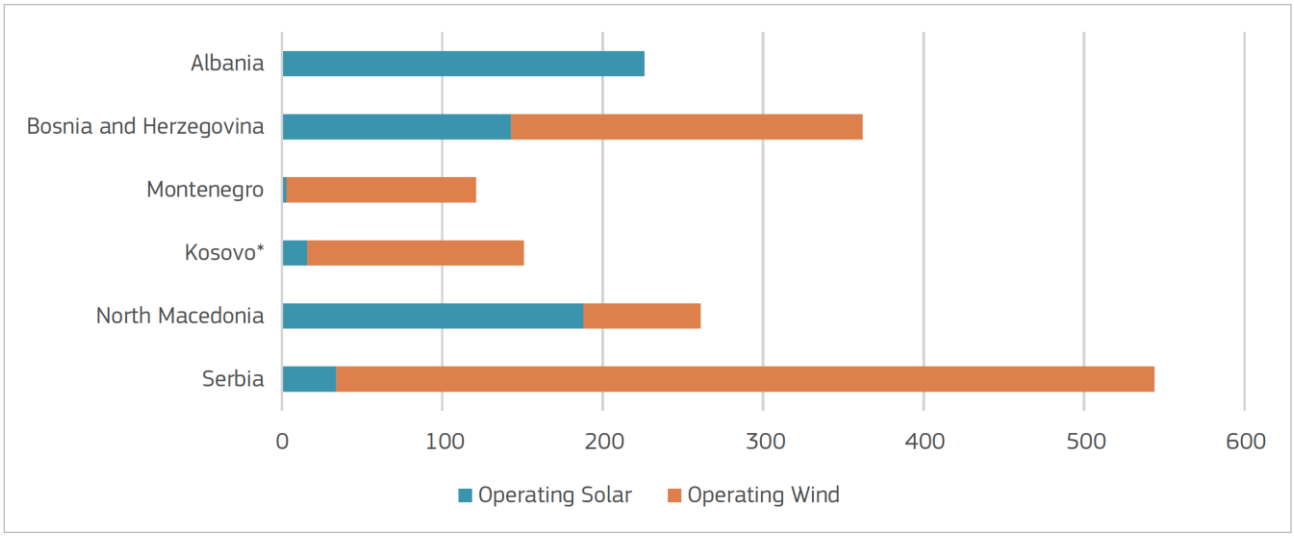
**Qualitative evidence from stakeholder interviews helps explain why renewable electricity deployment remains uneven and weakly diversified across the region. Interviewees consistently emphasise that observed differences in renewable uptake are driven less by natural resource availability than by policy design and implementation.** Economies that have introduced clearer regulatory frameworks, targeted legal reforms, and predictable support schemes have been more successful in stimulating solar and wind investment, highlighting the importance of regulatory clarity and institutional coordination. In Serbia, stakeholders report substantial regulatory progress since 2021. Competitive auctions for solar and wind capacity have become increasingly oversubscribed, reflecting strong investor interest following targeted reforms. The introduction of an active consumer (prosumer) framework and time-bound permitting procedures has further reduced administrative bottlenecks that previously constrained small-scale and distributed generation. By contrast, interview evidence from North Macedonia highlights how regulatory design can constrain diversification. Prosumer installations are capped at 70 kW, while projects exceeding this threshold must establish separate legal entities and navigate complex licensing procedures. Large producers often receive purchasing prices significantly below wholesale market levels, discouraging grid-connected investment and encouraging off-grid or self-consumption models. Frequent regulatory changes and limited institutional coordination further increase uncertainty for investors, slowing diversification beyond hydropower.

### 2.3.4 Solar and wind deployment: scale, momentum, and emerging limits

**Solar and wind remain marginal in the current power mix of the Western Balkans, but they represent the fastest-growing components of the region's transition.** In 2023, the region operated only about 610 MW of solar and just over 1 GW of wind capacity, compared with EU averages where these technologies make up a substantial share of installed capacity. Albania and North Macedonia lead in solar, while Serbia and Bosnia and Herzegovina dominate in wind (Figure 9). This limited base reflects the region's long-standing dependence on hydropower but also sets the stage for potentially rapid change.

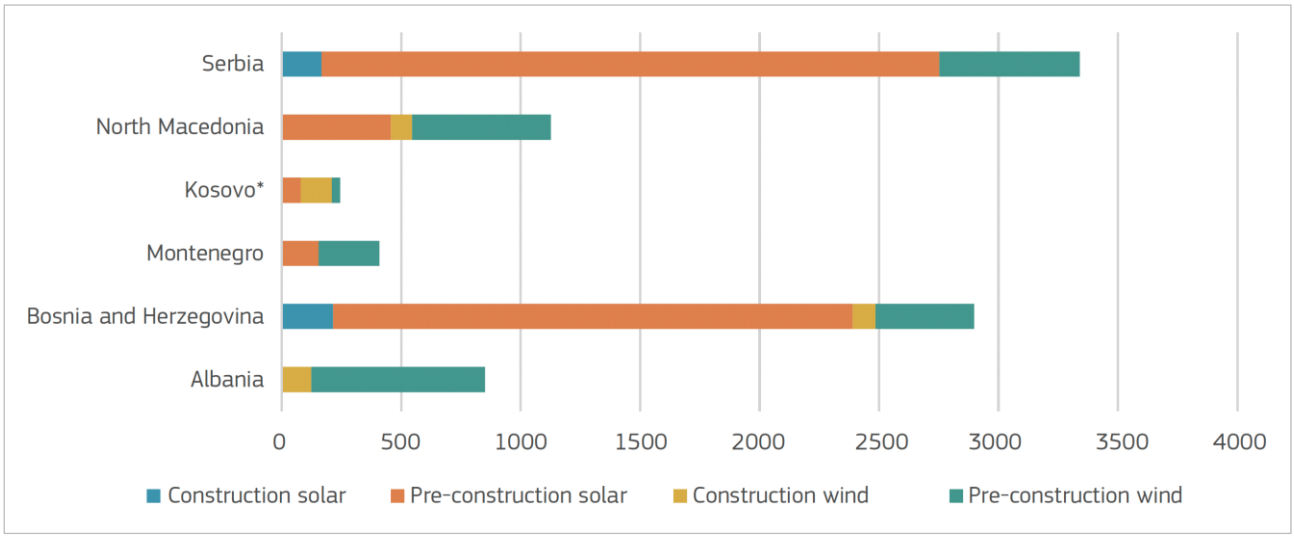
**Project pipelines indicate a structural shift toward large-scale deployment. Recent years have seen a visible acceleration of investment in solar energy across the region.** Several economies have begun scaling up solar projects, with a growing number of large-scale developments either under construction or in advanced preparation. Serbia alone has more than 2.5 GW of wind and 587 MW of solar in pre-construction, alongside 168 MW of wind already under construction. Bosnia and Herzegovina is preparing around 2.2 GW of wind and 412 MW of solar in pre-construction, plus 312 MW already under construction. Albania is advancing 125 MW of solar and 234 MW of wind in construction, while North Macedonia shows similar trends with nearly 550 MW in pre-construction. Montenegro and Kosovo*, despite low operating capacity today, also hold promising pipelines of over 250 MW each in solar and wind (Figure 10).

**Figure 9.** Total operating utility-scale solar and wind power capacity in Western Balkan economies, (MW).




*Note: Data as of February 2025. Figures reflect solar projects of at least 1 MW and wind projects of 10 MW or greater, in line with Global Energy Monitor's methodology.*
*Source: Global Energy Monitor.*

**Figure 10.** Construction and pre-construction solar and wind power capacities in Western Balkan Economies, (MW).




*Note: Data as of February 2025. Figures reflect solar projects of at least 1 MW and wind projects of 10 MW or greater, in line with Global Energy Monitor's methodology.*
*Source: Global Energy Monitor.*

**If realised, these projects would multiply the region's current solar and wind capacity almost five-fold.** At present, the Western Balkans operate roughly 1.7 GW of combined solar and wind capacity, while projects in construction and pre-construction exceed 8 GW. This gap between the modest operating base and the scale of planned investment signals a potential structural shift in the regional energy mix. At the same time, it highlights a growing implementation risk: translating ambitious pipelines into operational capacity will depend less on investment interest and more on the readiness of underlying power system infrastructure.

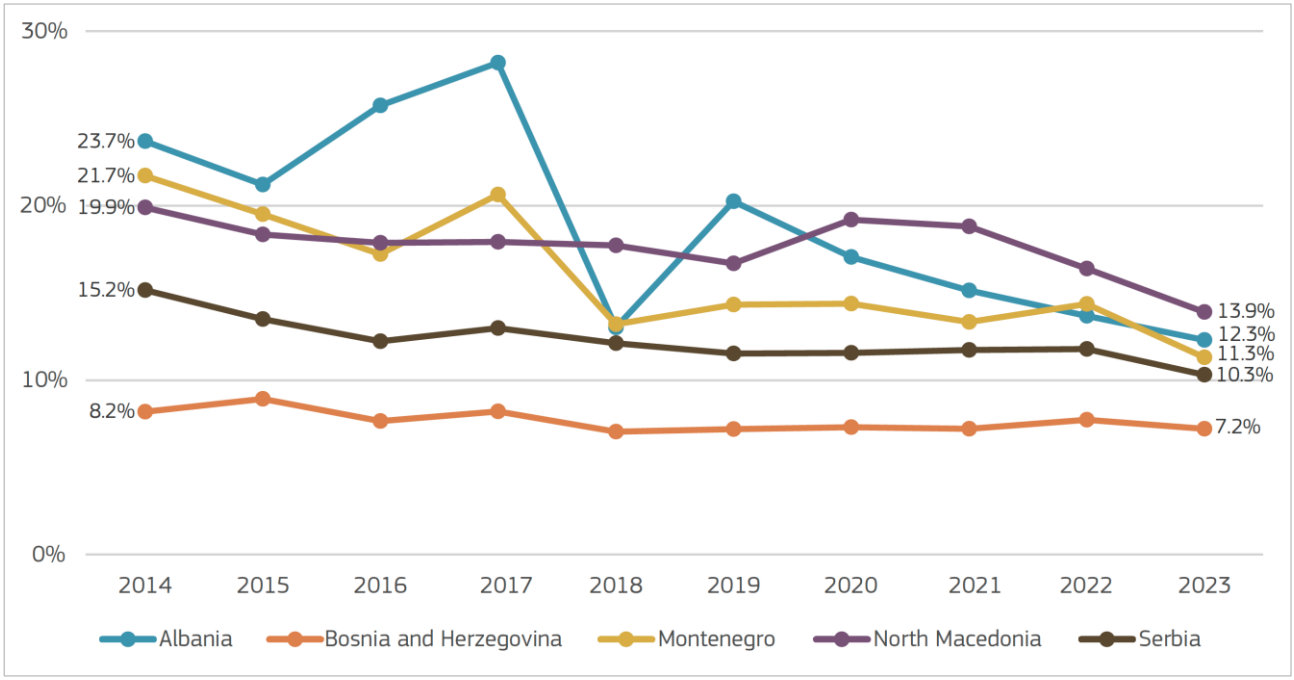
**While the expansion of solar and wind generation is therefore gaining momentum, the ability of existing transmission and distribution systems to absorb this capacity remains uncertain.**

The following sections examine whether regional grids are structurally prepared for this transition and identify the constraints that may limit the pace and scale of renewable integration.

### 2.3.5 Transmission and distribution losses as indicators of grid readiness

**Electricity transmission and distribution losses remain significant across the Western Balkans, though with notable variation between economies (Figure 11).** Persistently high, often double-digit loss rates point to deep structural weaknesses in regional power systems, reflecting a combination of ageing infrastructure, delayed modernisation, and governance and regulatory shortcomings. Albania recorded the highest losses in the region, exceeding 25% in 2016-2017 before gradually declining to 13-15% in recent years, reaching 12.3% in 2023. While this downward trajectory signals incremental progress, loss levels remain well above EU averages, illustrating the scale of remaining inefficiencies. Serbia and Bosnia and Herzegovina perform relatively better, yet still exhibit loss rates that indicate limited grid resilience and ongoing technical constraints.

**Figure 11.** Electric power transmission and distribution losses (% of output).




*Source: World Development Indicators, Electric power transmission and distribution losses (% of output).*

**These patterns suggest that many Western Balkan grids are already operating close to their technical limits, even before the large-scale integration of variable renewable energy.** High losses reduce system efficiency, increase operating costs, and weaken the capacity of networks to accommodate additional generation. In this sense, transmission and distribution losses function not only as indicators of inefficiency but also as early warning signals of limited grid readiness for the next phase of the energy transition.

**This assessment aligns closely with Frey's (2024) characterisation of Western Balkan electricity systems as 'outdated and fragmented,' where insufficient transmission capacity and network bottlenecks constrain overall system performance.** While Frey primarily emphasises transmission-level limitations, the evidence presented here extends this diagnosis by demonstrating that distribution-level inefficiencies are equally consequential. Technical and commercial losses at the

distribution level undermine reliability, increase costs for end users, and reduce the economic viability of clean energy investments, particularly for smaller producers and distributed renewable installations.

**OECD (2025) analysis further indicates that regulated electricity tariffs set below cost-recovery levels have discouraged sustained network investment, contributing to ageing assets and elevated technical losses.** Modelling results suggest that phasing out cross-subsidies could free substantial fiscal space for grid modernisation, an essential precondition for integrating higher shares of variable renewable generation.

**These infrastructure weaknesses also have direct economic consequences for industrial consumers.** Interviews conducted across the region reveal that even short power interruptions generate significant losses in process and metal industries due to damaged equipment, increased scrap rates, and unplanned production shutdowns. In response, several firms have invested in on-site solar generation combined with battery storage to stabilise supply and protect high-value machinery from voltage fluctuations and outages. Such defensive investments underscore that grid inefficiencies are not merely technical indicators but material constraints on industrial competitiveness and long-term investment planning.

### 2.3.6 Grid integration constraints and system-level bottlenecks to renewable expansion

**While quantitative data highlight the scale of planned solar and wind deployment, qualitative evidence from stakeholder interviews reveals how deeply constrained the practical integration of these capacities remains.** Evidence shows that grid infrastructure, not resource availability or investment interest, has become the primary barrier to renewable deployment across the Western Balkans.

**Interview findings point to a fundamental infrastructure paradox. Although there is more than 8 GW of solar and wind capacity is in the pipeline, stakeholders report that existing electricity networks lack the technical and institutional capacity to integrate these resources at scale.** Inadequate adaptation of distribution systems to bidirectional power flows, the absence of local balancing mechanisms, insufficient monitoring and control infrastructure, and acute shortages of qualified personnel systematically constrain renewable integration.

**A recurring theme across interviews is the critical constraint at the interface between low-voltage and high-voltage distribution networks. Distribution systems throughout the Western Balkans were designed as radial networks with unidirectional electricity flows from transmission systems to consumers.** Stakeholders emphasise that all protection schemes, monitoring equipment, and operational protocols were built around this paradigm. The rapid and often uncoordinated proliferation of small-scale solar photovoltaic installations has fundamentally disrupted this architecture by introducing bidirectional power flows. While interviewees note that widespread congestion has not yet materialised in all economies, they report that North Macedonia has already reached this threshold, while Serbia is approaching it. Similar dynamics are observed in Bosnia and Herzegovina and Kosovo*, whereas Montenegro faces relatively fewer distribution-level congestion issues, though permitting delays and grid capacity constraints remain significant concerns.

**Interviews further highlight the absence of controllable balancing resources at the distribution level as a critical operational bottleneck.** Transmission system operators can rely on dispatchable assets, particularly hydropower, to manage variability from wind and solar generation. However, distribution system operators report having no access to controllable generation or demand-side flexibility

tools. When excess renewable generation creates local congestion, operators have limited options beyond curtailment or automatic disconnection of renewable installations to protect network integrity. This approach, while technically necessary, reduces renewable energy utilisation and undermines project economics. Interviewees consistently point to the minimal deployment of battery energy storage systems and demand-side flexibility mechanisms as a key structural weakness. Even in hydropower-rich economies such as Albania, these balancing resources are connected at the transmission level and cannot resolve distribution-level congestion, reinforcing the need for targeted investment in distribution network modernisation.

**Operational blind spots emerge as another central theme in interview evidence. Distribution system operators across the region report lacking comprehensive SCADA (supervisory control and data acquisition) coverage in network segments with growing renewable penetration.** Without real-time monitoring and control capabilities, operators are unable to visualise grid conditions or manage variability effectively. Interviewees repeatedly emphasise that, in many cases, operators do not know what is happening on network sections with high levels of distributed generation, limiting their ability to anticipate congestion, voltage instability, or protection system activation.

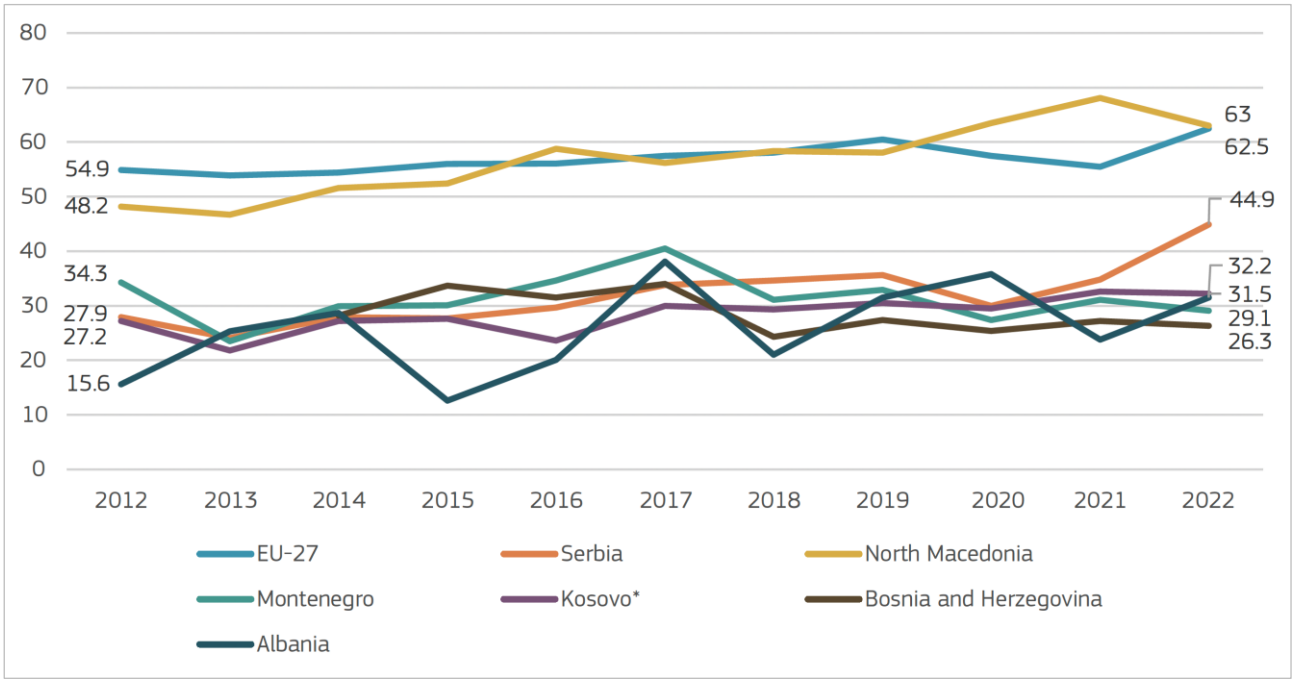
**Human-capital constraints further exacerbate these technical challenges. Interview findings consistently identify shortages of qualified engineers and technical staff within both transmission and distribution system operators, a challenge that is not unique to the Western Balkans, as similar green skills shortages have been widely reported across the EU in the context of the energy transition (European Commission, 2023).** Stakeholders report insufficient capacity to conduct grid studies, assess connection requests, design distribution upgrades, and manage increasingly complex operational conditions. In Serbia and North Macedonia, distribution companies are described as understaffed relative to the demands of existing network management, let alone large-scale renewable integration. In Montenegro, investors more frequently propose projects based on land affordability than on grid suitability, with agreements sometimes signed in the absence of prior technical feasibility assessments. Interviewees emphasized the need for strengthened institutional capacity for technical review and system planning.

## 2.4 Energy Imports and Exports

### 2.4.1 Overall energy import dependency

**Overall, the Western Balkan economies are, on average, less dependent on energy imports than the EU-27, largely due to their reliance on domestic lignite and hydropower resources.** While the EU's import dependency has fluctuated between 55% and 62% in recent years, most Western Balkan economies remain below this level (Figure 12), though with significant internal differences. Bosnia and Herzegovina, Montenegro and Kosovo* exhibit relatively low dependency rates of around 20-35%, whereas Serbia's import dependency, moderate for much of the last decade, increased sharply to nearly 45% by 2022, driven primarily by rising electricity imports linked to ageing and poorly maintained infrastructure. North Macedonia represents the most vulnerable case, with import dependency exceeding 60% in recent years, reflecting limited domestic energy resources and a high exposure to external supply risks. Albania displays a distinct form of vulnerability characterised by extreme volatility, with import dependency ranging from as low as 12% to almost 40%, a direct consequence of its near-total reliance on hydropower and sensitivity to hydrological conditions.

**Figure 12.** Total energy import dependency (in %).




*Source: Eurostat database (2025). Energy import dependency by products.*

**The Western Balkans' relatively low import dependency therefore does not necessarily indicate higher energy system resilience. Unlike the EU, where import dependency reflects a diversified energy mix combining renewables with oil and gas imports, the region's lower dependency is largely achieved through continued reliance on coal, traditional biomass and hydropower.** While this reduces exposure to external supply disruptions, it increases vulnerability to environmental, climate and sustainability risks, a trade-off that is particularly evident when contrasted with North Macedonia's high-dependency profile, which combines external reliance with limited diversification.

### 2.4.2 Natural gas, oil and petroleum products import dependency

**Like the EU, the Western Balkans are highly dependent on imported natural gas. The key difference, however, lies in the sources of supply. While the EU has significantly diversified its imports away from Russia since 2022, the Western Balkans remain heavily reliant on Russian gas, with diversification efforts still at an early stage.** Bosnia and Herzegovina and North Macedonia are fully dependent on imports, while Serbia relies on imports for 70-90%, even exceeding 100% in 2022 due to possible re-exports. Montenegro, Albania, and Kosovo* report 0%, reflecting the absence of natural gas in their energy systems rather than self-sufficiency.

Qualitative evidence from stakeholder interviews provides additional insight into current dependency patterns and future supply dynamics in the region. Interviews with energy experts in Serbia indicate that, while the country remains heavily reliant on imported gas, primarily from Russian and Azerbaijani sources, there is an expectation of gradual diversification over the medium term. Stakeholders point to a growing role for liquefied natural gas (LNG), particularly from the United States and Qatar, as global LNG capacity expands. Interviewees further note that the construction of new LNG tankers and liquefaction facilities is expected to increase global supply and exert downward pressure on prices, potentially improving affordability for import-dependent economies. Serbia's interconnection with Hungary is also highlighted

as an important structural advantage, providing access to the wider European gas network and enhancing supply security through diversified entry points. While these developments do not eliminate high import dependency, they may mitigate price volatility and reduce vulnerability to single-supplier risks over time.

**When it comes to oil and petroleum products, import dependency in the Western Balkans is almost absolute.** Bosnia and Herzegovina, Montenegro, North Macedonia, and Kosovo* have been fully reliant on imports throughout the observed period (2010-2022), often recording values close to or slightly above 100% due to re-exports or stock adjustments. Serbia is somewhat less dependent, ranging from around 60-76% in earlier years but rising to 85% by 2022, reflecting its limited domestic oil production in Vojvodina. Albania stands out as the only regional outlier: thanks to its own crude oil resources, it recorded very low import dependency between 2010 and 2016 (as little as 2% in 2012), although this advantage has weakened in recent years, with dependency climbing back to 46% in 2022 as domestic production declined relative to demand. This pattern is broadly in line with the EU, where oil import dependency has also remained persistently high, averaging around 93-98% over the same period (Eurostat, 2025).

## 2.5 Final Energy Consumption by Sector

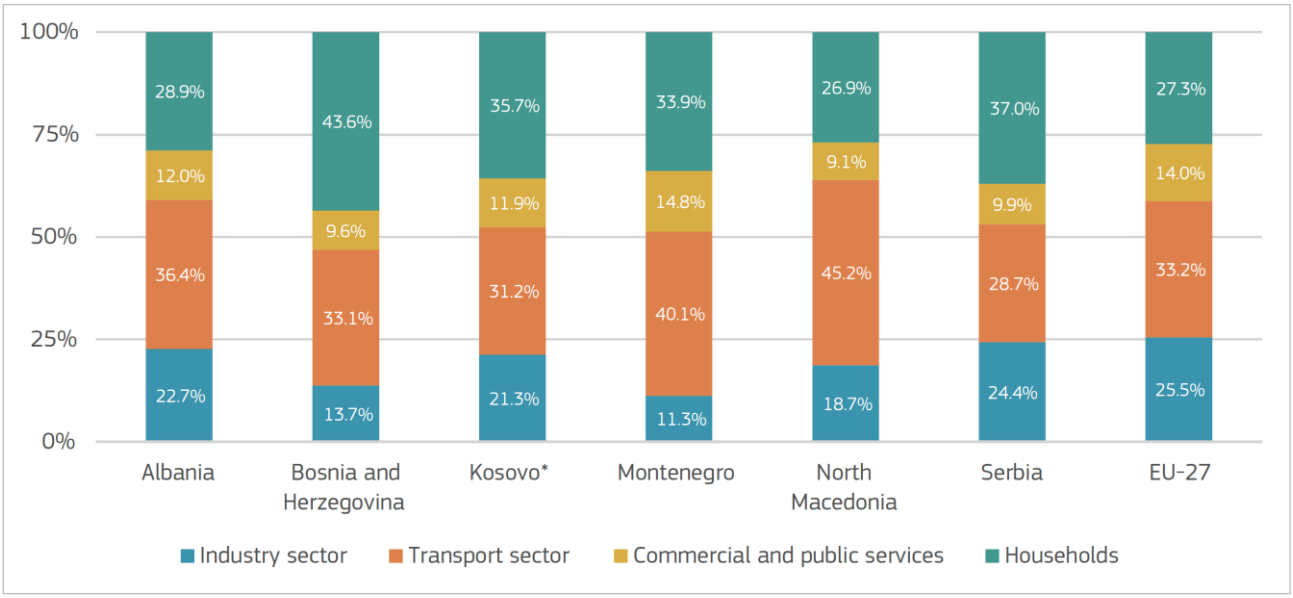
**Households account for a significantly higher share of final energy consumption in the Western Balkans than in the EU.** In 2023, household consumption averaged well above the EU-27 level of 27%, reaching 44% in Bosnia and Herzegovina, 37% in Serbia, 36% in Kosovo*, and 34% in Montenegro (Figure 13). Such high levels point to structural inefficiencies in housing stock, reliance on outdated heating practices, and the slow pace of building renovation. This household bias contrasts with the EU, where efficiency improvements and stricter standards have reduced residential demand.

**Industry's role in final energy consumption is weaker than in the EU.** While the EU average stands at 26%, industry accounts for only 11% in Montenegro and 14% in Bosnia and Herzegovina, reflecting a limited industrial base. Serbia (24%), Albania (23%), and Kosovo* (21%) are closer to EU levels, but still show lower intensity compared to more industrialised economies. The variation highlights both structural economic differences and the limited contribution of energy-intensive industries.

**Transport is an increasingly dominant consumer of energy in the region.** North Macedonia records the highest share at 45%, with Montenegro (40%) and Albania (36%) also well above the EU average. These figures reflect the expansion of road transport, older vehicle fleets, and the limited shift to rail or public transit.

Commercial and public services account for a relatively small share of final energy consumption in the Western Balkans. In most economies, this share remains below that observed in the EU (around 14%), for example in Bosnia and Herzegovina (10%), North Macedonia (9%), and Serbia (10%). This difference reflects structural characteristics of the region's economies, where the service sector remains less developed and less energy-intensive.

**Figure 13.** Final energy consumption by sector in 2023.




*Source: Eurostat database (2025). Final energy consumption by sector.*

### 2.5.1 Energy-intensive industrial sectors and their exposure to shocks and supply vulnerabilities

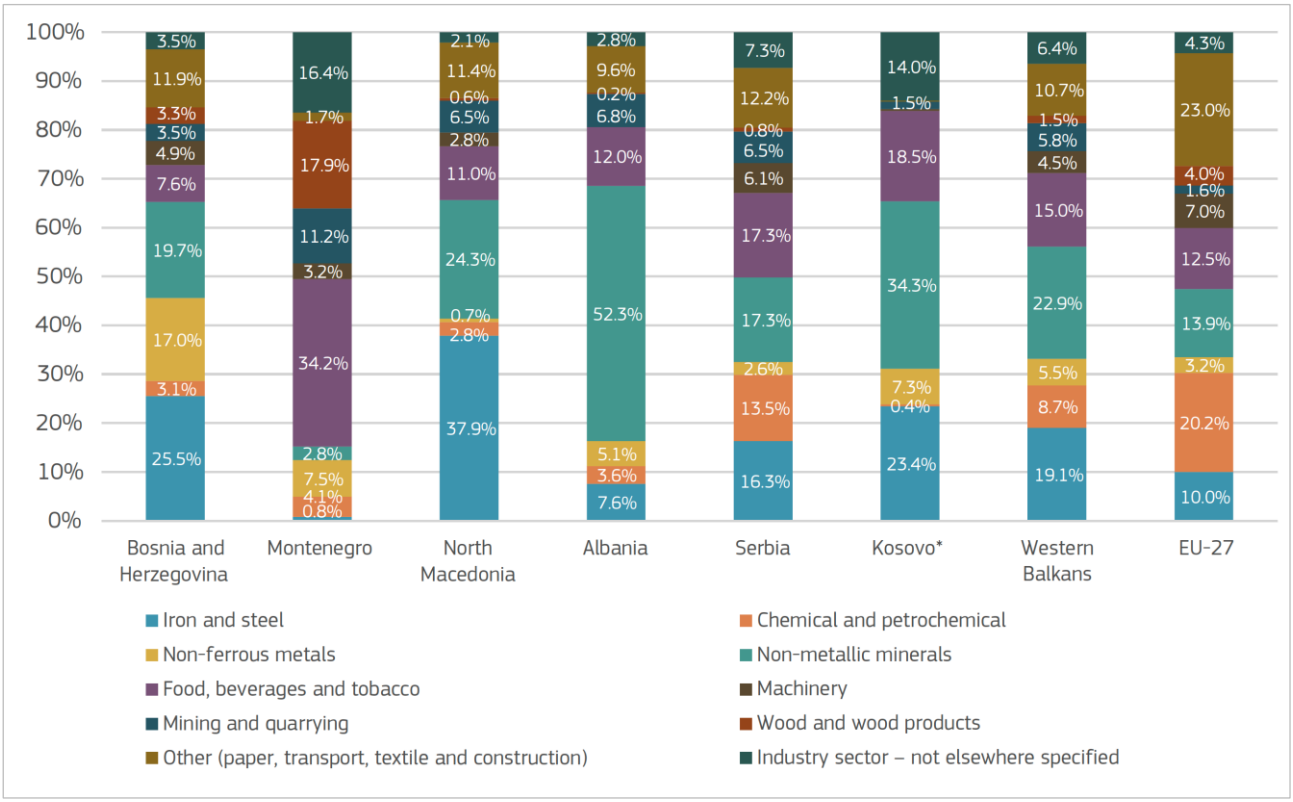
**The exposure of Western Balkan economies to energy shocks is strongly shaped by the structure of industrial energy demand, which acts as a key transmission channel to the broader economy**. While energy supply conditions determine overall system vulnerability, it is the composition of industrial consumption that defines how shocks translate into impacts on production, competitiveness, and exports. Energy-intensive industries, characterised by continuous processes and high energy cost shares, are particularly sensitive to both price volatility and supply disruptions.

**Across the region, industrial energy consumption is concentrated in a limited number of energy-intensive sectors, albeit with significant cross-economy variation. The most prominent sectors include iron and steel, non-metallic minerals (especially cement), non-ferrous metals, and, in several economies, food processing**. However, their relative importance differs substantially: Serbia and Bosnia and Herzegovina exhibit a relatively diversified but energy-intensive industrial base, whereas North Macedonia and Kosovo* are characterised by a high concentration of consumption in a small number of large industrial facilities. Albania and Montenegro, by contrast, have more limited industrial bases, with vulnerability driven less by industrial demand and more by energy supply characteristics.

**In economies with large continuous-process industries, vulnerability is primarily driven by exposure to electricity and fuel price volatility, as well as the reliability of supply**. In contrast, in systems with high reliance on hydropower or limited diversification, exposure is more closely linked to supply variability and the transmission of external price shocks through imports. This distinction is particularly important for understanding the differentiated impact of the 2022 global energy crisis, triggered by geopolitical disruptions following Russia's invasion of Ukraine, across the region.

Figure 14 illustrates the distribution of industrial final energy consumption across sectors in the Western Balkans, highlighting both concentration patterns and cross-economy differences.

**Figure 14.** Structure of Industrial Final Energy Consumption by Sector in the Western Balkans (%).




*Source: Eurostat database (2025). Energy flow – Sankey diagram data.*

Building on the regional patterns and the sectoral distribution presented in Figure 14, the following analysis examines individual Western Balkan economies, ordered according to the overall scale and intensity of industrial exposure to energy price shocks and supply vulnerabilities.

### *2.5.1.1 Serbia*

**Serbia represents the most industrially exposed economy in the Western Balkans, combining a relatively diversified industrial base with high overall energy demand.** Total industrial final energy consumption reached 2,241 ktoe in 2023, exceeding the combined level of all other Western Balkan economies (1,857.5 ktoe), according to Eurostat data. This demand is distributed across several energy-intensive sectors, including non-metallic minerals, iron and steel, chemicals, and food processing. Such diversification creates a more complex exposure profile, as multiple sectors can simultaneously transmit energy price and supply shocks into the broader economy, although differences in energy use across sectors may partially buffer the impact of specific shocks.

**The non-metallic minerals sector, particularly cement production, constitutes a major source of industrial energy demand and vulnerability.** Production is concentrated in three major facilities (Beočin, Kosjerić, and Popovac), alongside glass, ceramics, and tile manufacturing. These processes require continuous high-temperature operations, with energy accounting for 30-50% of production costs. Interview evidence indicates ongoing investments in alternative fuels and solar capacity; however, structural constraints, such as underdeveloped waste management systems and the absence of EU-recognised Guarantees of Origin, limit progress, particularly in the context of CBAM compliance.

The metals sector further amplifies exposure due to its dependence on continuous processes and dual energy inputs. Steel production, centred around the Smederevo plant, alongside copper smelting and

processing facilities, relies on electricity- and gas-intensive operations with limited short-term flexibility. Energy typically accounts for 20-35% of total production costs. The 2022 energy crisis exposed these vulnerabilities, requiring state support to sustain operations, a finding also confirmed through stakeholder interviews. Given their strong export orientation towards the EU, these sectors face additional exposure to CBAM-related cost pressures.

**The chemical and petrochemical industry represents another structurally important and energy-intensive segment of industrial demand.** Facilities in Pančevo and other locations involve highly energy-intensive thermal and chemical processes, particularly in oil refining and fertilizer production, reinforcing the economy's overall exposure to both price and regulatory risks.

**The agri-food sector introduces a distinct form of vulnerability linked to operational continuity and food security.** Sugar production operates on seasonal campaigns where disruptions result in irreversible losses, while dairy, meat processing, and brewing require uninterrupted refrigeration and processing. Even short-term supply interruptions can lead to significant losses, highlighting that energy security concerns extend beyond heavy industry into critical infrastructure.

#### *2.5.1.2 Bosnia and Herzegovina*

**Bosnia and Herzegovina's industrial energy consumption is strongly concentrated in three sectors**. Iron and steel (25.5%), non-metallic minerals, primarily cement (19.7%), and non-ferrous metals, primarily aluminium (17.0%) together accounting for approximately 62% of all industrial energy use. This concentration, combined with strong export orientation towards the EU, increases sensitivity to both energy prices and carbon-related regulatory pressures.

**The metals sector combines high energy intensity with structural carbon exposure, reinforcing vulnerability.** Steel production processes offer limited flexibility, while the coal-dominated electricity mix results in the highest estimated CBAM costs in the region. Interview evidence highlights the lack of long-term power purchase agreements, leaving firms exposed to spot market volatility and margin compression.

**The aluminium and cement sectors illustrate different but equally binding structural constraints.** Aluminium production, historically dependent on preferential electricity pricing, has experienced repeated curtailments during price shocks, with significant implications for employment and exports. Cement production, by contrast, is constrained by technological lock-in and regulatory gaps, particularly the absence of a domestic monitoring, reporting and verification system, increasing compliance costs for CBAM.

**These sectoral vulnerabilities are compounded by broader structural weaknesses in infrastructure, complicated governance, and financing**. Ageing industrial capital, grid instability, and insufficient financial support mechanisms further increase exposure. Firms increasingly invest in on-site solar and storage as a form of self-protection, while delays in adopting key legislation (e.g. electricity law, ETS framework) continue to hinder systemic adjustment.

#### *2.5.1.3 North Macedonia*

**North Macedonia's industrial vulnerability is driven by a high concentration of energy consumption in a small number of sectors and firms**. A limited number of energy-intensive sectors account for the majority of industrial energy demand, with iron and steel alone representing 37.9% of industrial energy use, followed by non-metallic minerals (24.3%) and, at a significantly lower level, food,

beverages and tobacco (11.0%). This concentration is closely linked to the presence of a limited number of large industrial actors.

**The metals and cement industries are particularly exposed due to their reliance on stable electricity supply and limited operational flexibility**. Key firms such as Makstil and Liberty Steel, as well as USJE Cementarnica, operate energy-intensive processes that are highly sensitive to price fluctuations and supply disruptions.

**Structural constraints in the energy system further increase vulnerability**. Grid limitations, insufficient balancing capacity, and regulatory uncertainty reduce investment predictability and increase exposure to future decarbonisation requirements, including CBAM.

#### *2.5.1.4 Kosovo**

**Kosovo's* industrial exposure is characterised by concentration in a few sectors combined with extreme dependence on imported electricity.** Although total industrial consumption is relatively modest, key sectors such as cement and nickel processing dominate demand.

**Non-metallic minerals sector consumption is dominated by cement production at Kosovo's* only cement plant.** The facility faces typical cement vulnerabilities, continuous processes that cannot be easily interrupted, and substantial energy costs as a percentage of production expenses. The plant serves both domestic and regional markets while facing increasing pressure from EU environmental standards and CBAM obligations on exports.

**The non-ferrous metals sector, particularly nickel processing, illustrates the most acute form of industrial vulnerability in Kosovo*.** The main nickel facility has been fully dependent on imported electricity since 2017, creating near-complete exposure to European wholesale electricity markets. Combined with the inherently high energy intensity of smelting processes, this has resulted in repeated production disruptions. The plant shut down during the 2022 energy crisis, resumed operations in 2023, and again ceased production in 2025. As of early 2026, only a minimal administrative workforce remains, highlighting not only energy-related vulnerability but also broader socio-economic implications, including employment and regional economic stability.

**In the absence of heavy industry, the agri-food sector plays a more prominent role in energy demand.** This reflects Kosovo's* economic structure, where medium-scale food processing represents a critical component of industrial activity and energy use.

#### *2.5.1.5 Albania*

**Albania's industrial vulnerability is primarily driven by supply-side risks linked to its hydropower-dominated energy system rather than industrial energy intensity.** Industrial demand is concentrated in non-metallic minerals, particularly cement, but overall industrial energy use remains relatively limited.

**Dependence on hydropower introduces significant exposure to hydrological variability and external price shocks.** During dry years, increased reliance on electricity imports exposes industrial consumers to volatile and often higher market prices. This creates a distinct vulnerability pattern where renewable-based systems, in the absence of diversification, generate instability rather than resilience.

#### *2.5.1.6 Montenegro*

**Montenegro is characterised by low industrial energy demand and a limited presence of heavy industry, resulting in relatively low structural exposure to energy price shocks through industrial channels.** Industrial consumption is primarily concentrated in less energy-intensive sectors such as food processing, wood products, and small-scale mining. The absence of large continuous-process industries such as steel or chemicals reduces overall energy intensity, but also reflects a narrow and weakly diversified industrial base with limited capacity to absorb shocks through sectoral adjustment.

**At the same time, Montenegro illustrates how energy price shocks can directly reshape industrial structures in small economies.** The shutdown of the aluminium plant Kombinat aluminijuma Podgorica (KAP) in 2022, following a sharp increase in electricity prices, effectively removed one of the country's most energy-intensive industrial activities. This development, also confirmed through stakeholder interviews, highlights the extreme sensitivity of non-ferrous metal production to electricity costs and demonstrates that in smaller economies, energy shocks may lead not only to reduced competitiveness but to permanent industrial contraction.

The main sectoral patterns and sources of vulnerability identified across the Western Balkans are summarised in Table 2.

**Table 2.** Key energy-intensive industrial sectors and associated vulnerability features in the Western Balkans.

| WB Economy | Most affected energy-intensive industrial sectors | Key vulnerability features |
|---|---|---|
| **Serbia** | • Non-metallic minerals (cement),<br>• Iron & steel,<br>• Chemical industry,<br>• Mining | • Large and diversified heavy industrial base with strong dependence on stable and continuous energy supply<br>• High exposure to electricity and natural gas price volatility<br>• Significant exposure to CBAM-related cost pressures<br>• Limited short-term flexibility due to continuous production processes |
| **Bosnia and Herzegovina** | • Iron & steel,<br>• Non-ferrous metals (aluminium),<br>• Non-metallic minerals (cement) | • High concentration of industrial energy demand (over 60% in three sectors)<br>• Strong export orientation towards the EU and high structural CBAM exposure<br>• Industrial viability, particularly in aluminium production, closely linked to electricity pricing, with past curtailments affecting employment and exports<br>• Ageing capital stock and grid instability (fluctuations causing equipment damage and efficiency losses) |
| **North Macedonia** | • Iron & steel,<br>• Non-metallic minerals | • Industrial energy demand is highly concentrated in iron and steel and non-metallic minerals<br>• Grid constraints and limited balancing capacity, creating risks for reliable supply and integration of renewable energy sources<br>• Regulatory uncertainty and lack of a clearly defined and coordinated energy transition roadmap, reducing investment predictability |

| | | |
|---|---|---|
| **Albania** | • Non-metallic minerals (cement) | • Industrial energy demand highly concentrated in a single sector (cement)<br>• High reliance on hydropower, exposing industry to hydrological variability<br>• Increased dependence on electricity imports during dry years, leading to higher and more volatile prices |
| **Kosovo*** | • Non-metallic minerals,<br>• Iron & steel<br>• Food processing | • Industrial energy demand is concentrated in a few sectors with medium-scale facilities, primarily non-metallic minerals (cement), non-ferrous metals (nickel), and food processing<br>• Significant share of energy use in agri-food processing<br>• Limited diversification and technological upgrading of the industrial base |
| **Montenegro** | • Food processing<br>• Wood products<br>• Small-scale mining | • Low overall industrial energy demand and limited presence of heavy industry, resulting in lower structural exposure to energy shocks<br>• Industrial structure dominated by less energy-intensive sectors (food processing, wood products, small-scale mining) |

*Source: Authors' compilation based on Eurostat data and stakeholder interviews.*

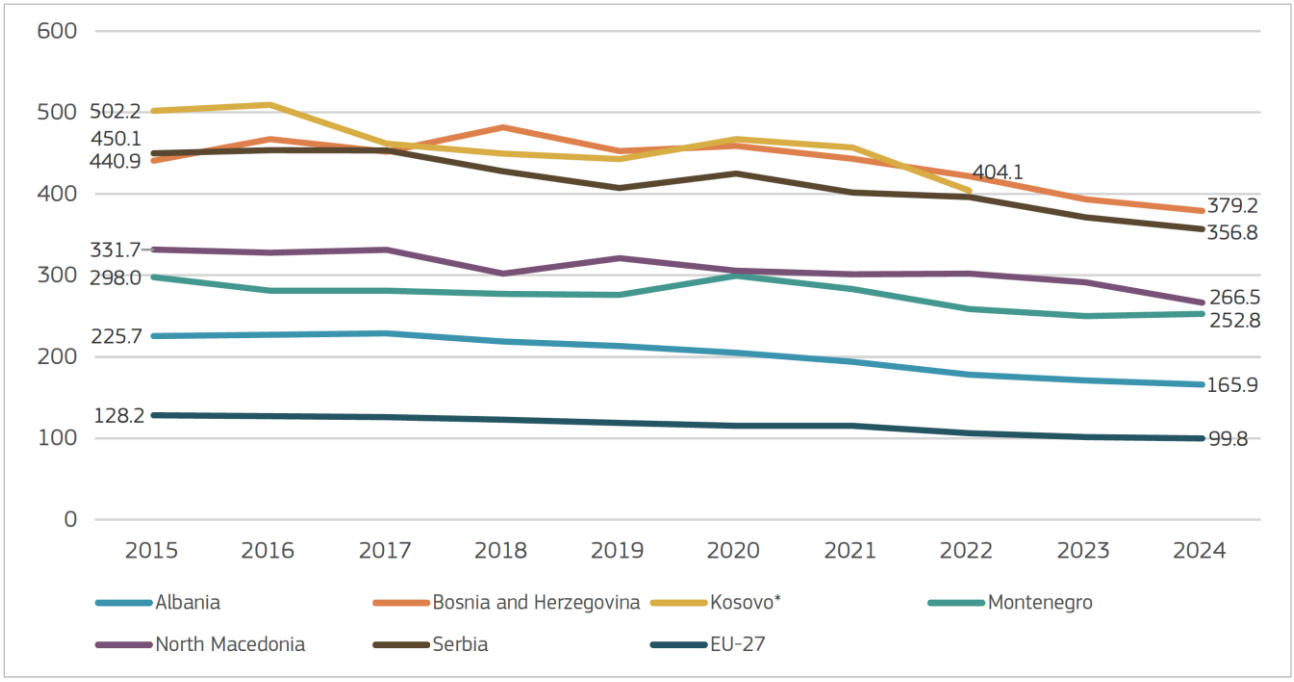
# 3 Energy Performance Indicators

## 3.1 Energy productivity and intensity

**Energy intensity in the Western Balkans is declining, but it remains far above EU levels.** Since 2020, most economies have reduced the amount of energy required per unit of GDP, reflecting gradual efficiency gains and some structural change. Yet even with this progress, Western Balkan values still exceed the EU range of about 100 kgoe per 1,000 EUR GDP. This gap highlights the persistence of outdated industrial processes, lower efficiency standards, and slower uptake of modern technologies.

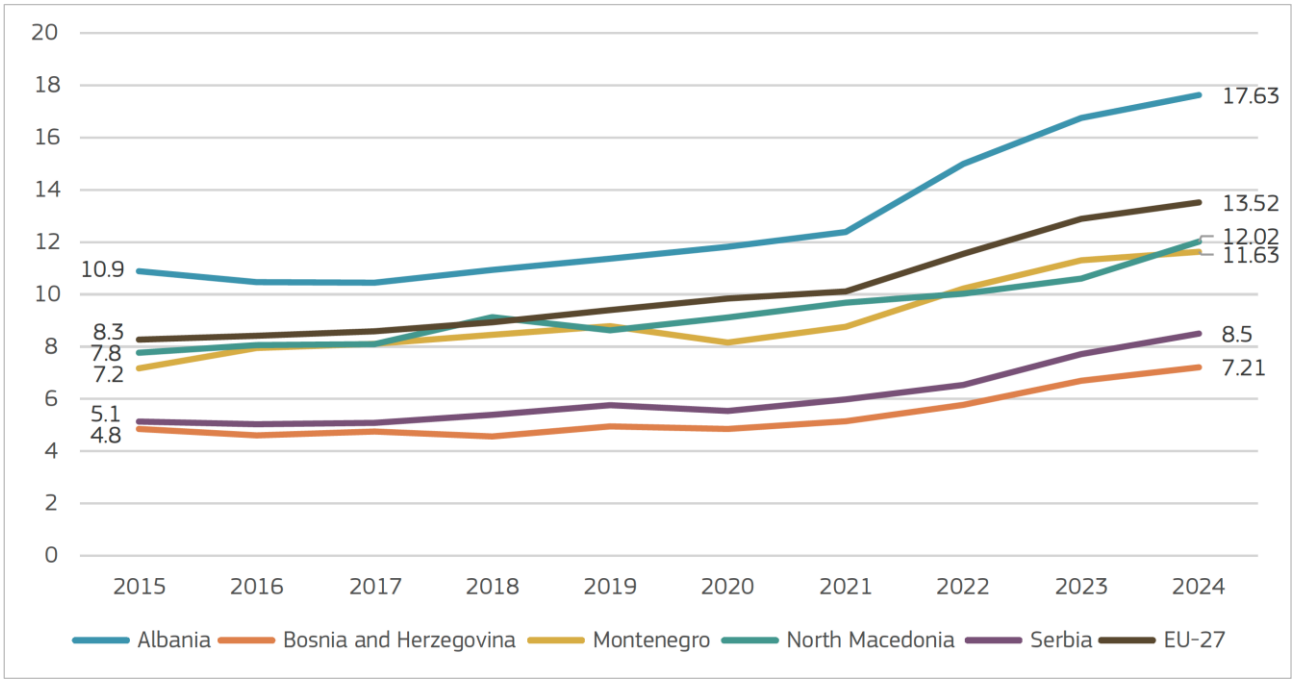
**Energy productivity shows sharp contrasts across the region, with Albania standing out.** Albania generates more economic output per unit of energy consumed than any other Western Balkan economy and even surpasses the EU average. This reflects its service-oriented economy and reliance on hydropower, which reduces fossil fuel dependence. By contrast, Serbia, Bosnia and Herzegovina, North Macedonia, and Kosovo* remain below the EU benchmark, constrained by lignite-heavy energy systems and ageing industry. These differences underline a regional divide between relatively clean but service-dependent economies and those structurally tied to energy-intensive sectors.

**Figure 15.** Energy intensity of GDP in chain linked volumes (2010) (kgoe/1000 EUR).




*Source: Eurostat database (2025). Energy productivity.*

**Figure 16.** Energy productivity (PPS per kilogram of oil equivalent).

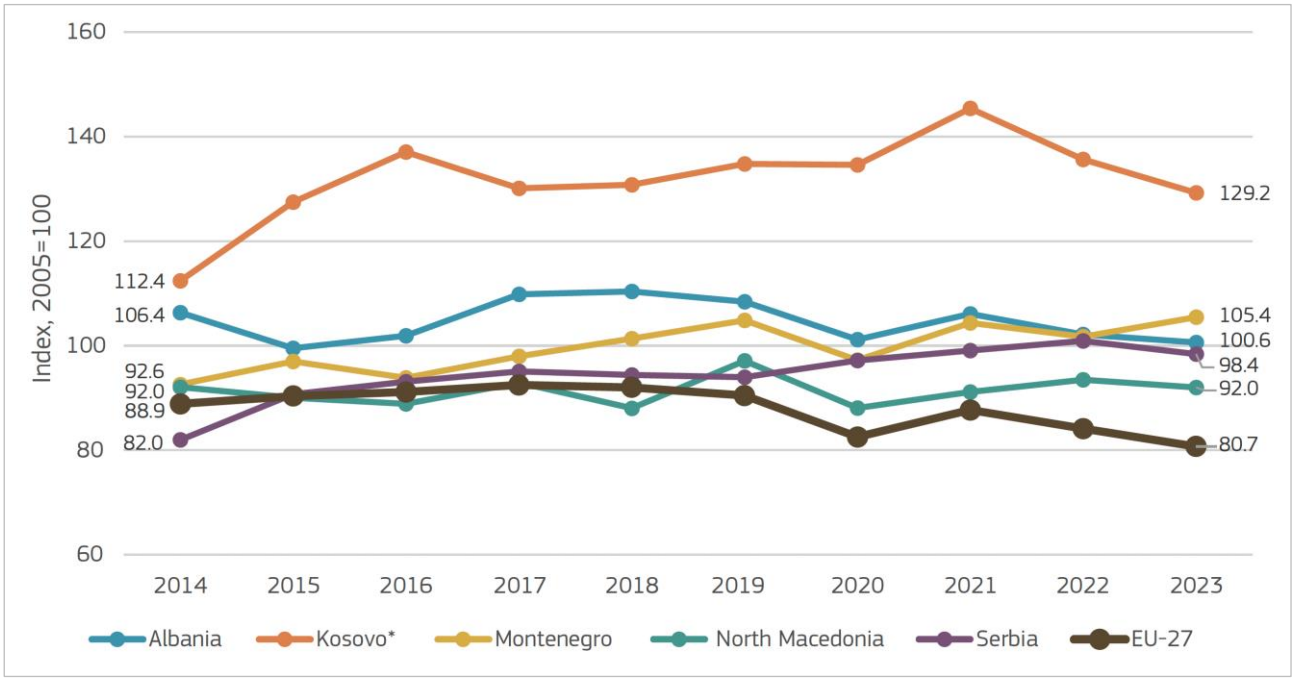



*Source: Eurostat database (2025). Energy intensity.*

## 3.2 Energy efficiency

**Limited progress in reducing overall energy demand continues to highlight the gap between the Western Balkans and the EU.** Primary energy consumption in most Western Balkan economies has remained close to or above 2005 levels (Figure 17). The EU, by contrast, has managed to decouple economic growth from energy use through efficiency improvements, technological upgrades and stricter policies. In the Western Balkans, reliance on outdated infrastructure, fossil fuels and energy-intensive industries continues to shape energy demand. Albania stands out as an exception. Its comparatively lower consumption levels reflect a high share of hydropower in the energy mix and a less energy-intensive economic structure. Kosovo* consumes significantly more primary energy today than in 2005, while Serbia recorded an increase from an index value of 81.95 in 2014 to 98.41 in 2023.

**Figure 17.** Primary energy consumption – Energy Efficiency Directive Index, 2005=100[5].




*Source: Eurostat database (2025). Energy efficiency.*

**Despite these aggregate trends, evidence from the survey conducted across the Western Balkans suggests that individual companies are increasingly responding to energy efficiency imperatives, albeit with varying levels of ambition.** One-third of surveyed firms reported significant investments in energy efficiency measures or renewable energy between 2022 and 2024, allocating more than 15% of their annual investment budgets to these initiatives. A further share of companies reported moderate investments, while others undertook smaller, partial measures. Importantly, a notable proportion of firms that have not yet invested indicated concrete plans to do so in the 2025-2027 period, suggesting that efficiency considerations are gaining strategic relevance in business planning.

**The survey indicates that a substantial majority of companies have already undertaken some level of investment in energy efficiency or renewable energy.** These actions are driven by a combination of market-based incentives, such as rising energy costs, supply reliability concerns, and exposure to price volatility, as well as anticipatory responses to emerging regulatory and trade-related pressures, including the CBAM. Firms increasingly perceive efficiency improvements not only as cost-saving measures but also as a means of managing future regulatory and competitiveness risks. However, the contrast between firm-level investment activity and persistent growth in aggregate primary energy consumption points to a critical scale gap. While company-level initiatives signal growing awareness and responsiveness, their cumulative impact remains insufficient to alter economy-wide demand trends. This divergence underscores the structural nature of the efficiency challenge in the Western Balkans and highlights the need for broader policy frameworks, coordinated investment strategies, and systemic measures capable of translating dispersed firm-level efforts into measurable reductions in overall energy consumption.

[5] The index uses 2005 as the baseline (=100). A value above 100 indicates higher primary energy consumption relative to 2005, while a value below 100 indicates lower consumption.

## 3.3 Energy market and energy prices

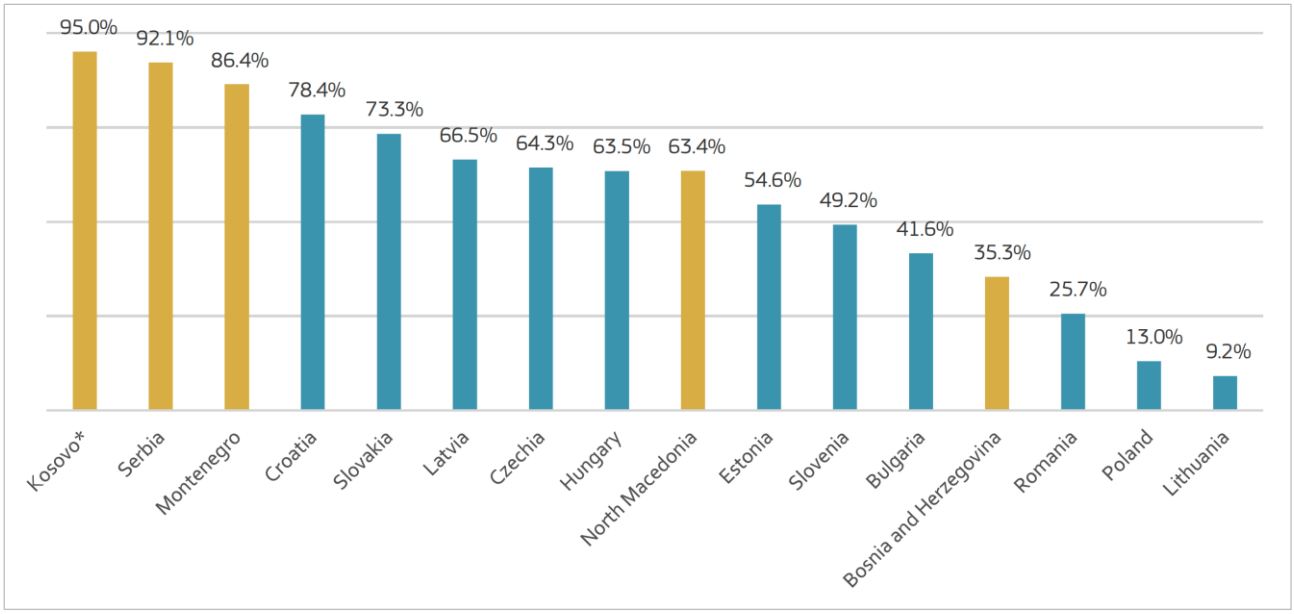
### 3.3.1 Market share of the largest generator in the electricity market

**Electricity markets in the Western Balkans remain among the most concentrated in Europe.** In 2023, the largest generator controlled 95% of supply in Kosovo*, 92% in Serbia, and 86% in Montenegro. North Macedonia (63%) also shows a high concentration, while Bosnia and Herzegovina reports 35% overall because its entities each have their own dominant producers. This duality is partly historical: with the exception of Albania, the Yugoslav energy sector was originally built as a single, coherent system designed to optimise generation and distribution across the federation. After the breakup of Yugoslavia, these infrastructures were divided along new national borders, which characterise today's highly concentrated market structures (Frey, 2024).

**This structural concentration did not remain static; it has been amplified by government interventions in the energy sector.** The OECD (2025) report finds that between 2018 and 2023, Western Balkan governments provided EUR 19 billion in subsidised electricity and EUR 5.8 billion in fiscal and credit support to energy companies, largely state-owned. Such extensive subsidies, according to the OECD, limit competition and reinforce the dominance of incumbent utilities.

**By contrast, the EU presents a far more competitive picture.** In countries such as Poland (13%), Lithuania (9%), or Romania (26%), no single producer controls more than one-third of the market. Even in relatively concentrated cases such as Croatia (78%) or Czechia (64%), levels remain below those of most Western Balkan economies (Figure 18). The contrast underscores the persistence of vertically integrated, state-owned utilities in the Western Balkans, which limit competition and complicate market liberalisation.

**Figure 18.** Market share of the largest generator in the electricity market in 2023.

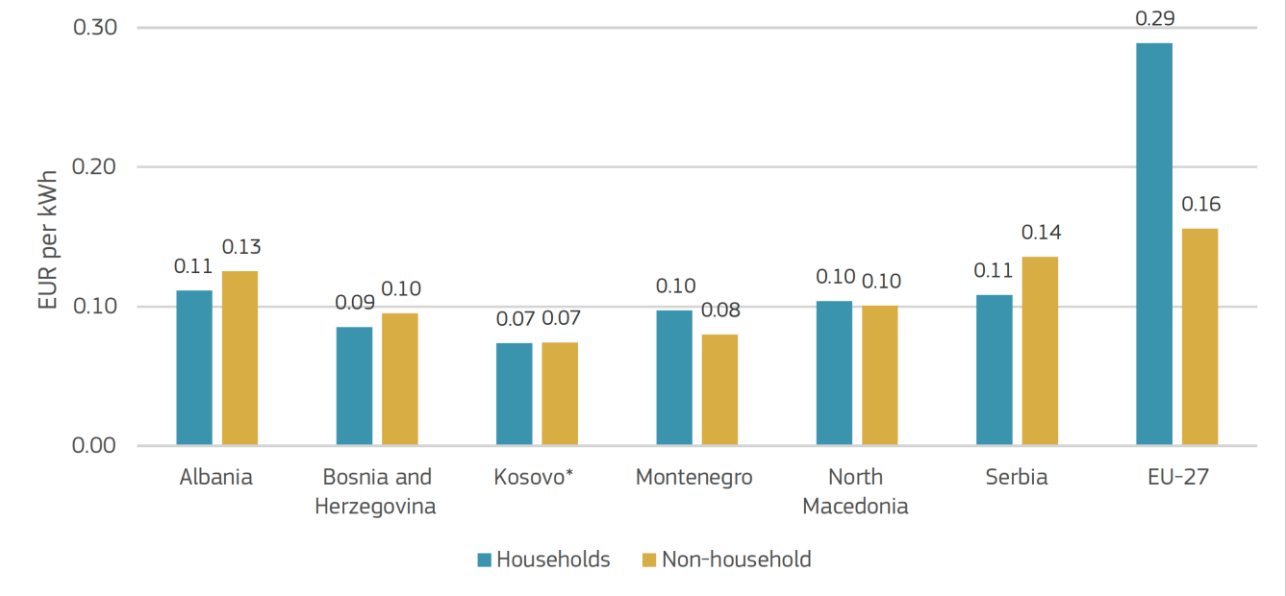



*Note: No data available for Albania.*
*Source: Eurostat database (2025). Market share of the largest generator in the electricity market.*

### 3.3.2 Electricity prices by type of user

**Household electricity remains much cheaper in the Western Balkans than in the EU.** In 2024, prices ranged from 0.07 EUR/kWh in Kosovo* to 0.11 EUR/kWh in Albania, well below the EU average of 0.29 EUR/kWh. Bosnia and Herzegovina (0.09 EUR) and Montenegro (0.10 EUR) also remain at a fraction of EU levels. This affordability reflects lower income levels, heavy subsidies, and regulated tariffs, supported by reliance on domestic lignite and hydropower.

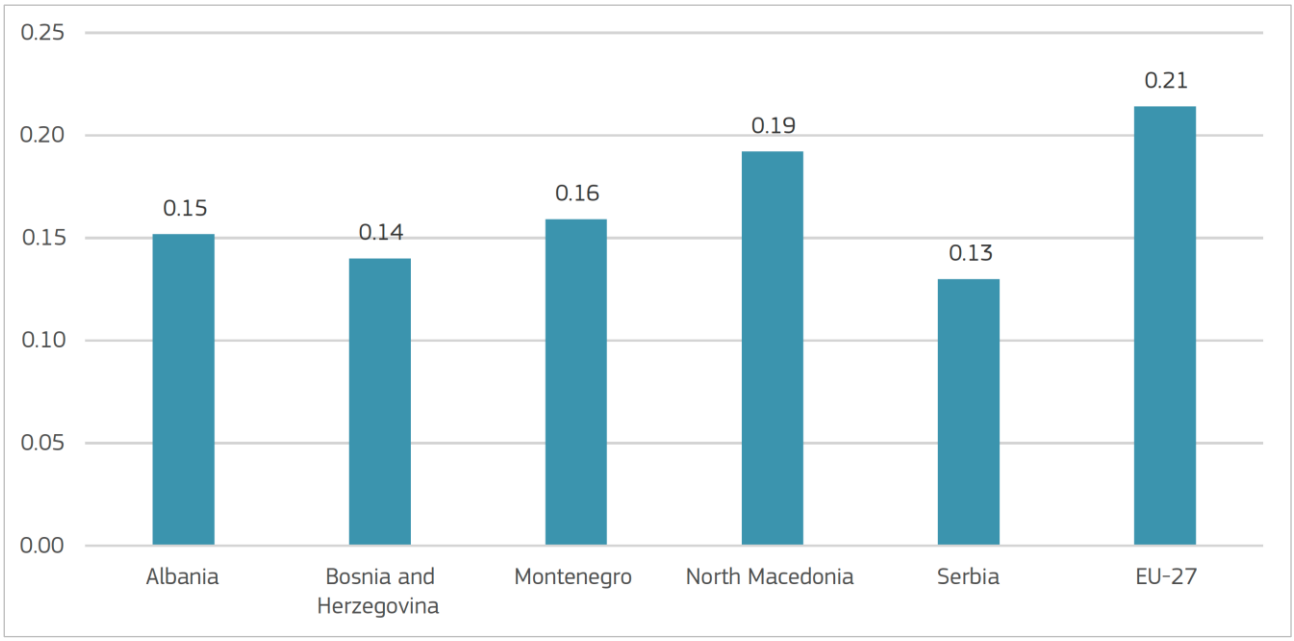
**Figure 19.** Electricity prices for household and non-household consumers 2024 (in euro per kWh).




*Source: Eurostat database (2025). Electricity prices by type of user.*

**While nominal electricity prices in euro terms appear substantially lower across the Western Balkans, this gap narrows considerably when adjusted for differences in purchasing power.** Expressed in Purchasing Power Standards (PPS), which reflect local income levels and price structures, household electricity in the region is much closer to the EU average (Figure 20). In 2024, average household electricity prices in the EU-27 stood at 0.21 PPS/kWh, whereas Western Balkan economies ranged from 0.13 PPS/kWh in Bosnia and Herzegovina to 0.19 PPS/kWh in Montenegro and North Macedonia, and 0.15 PPS/kWh in Albania. Despite lower nominal tariffs, electricity is similarly or even less affordable for households in the Western Balkans compared to those in EU member states once differences in purchasing power are considered. The PPS comparison underscores that lower electricity prices in euro do not necessarily translate into lower cost burdens. Instead, they reflect lower income levels, limited market liberalisation, and the continuing influence of regulated pricing. As Western Balkan economies gradually align with EU energy-market structures, upward pressure on real electricity costs, and the need for stronger social protection and efficiency measures, can be expected.

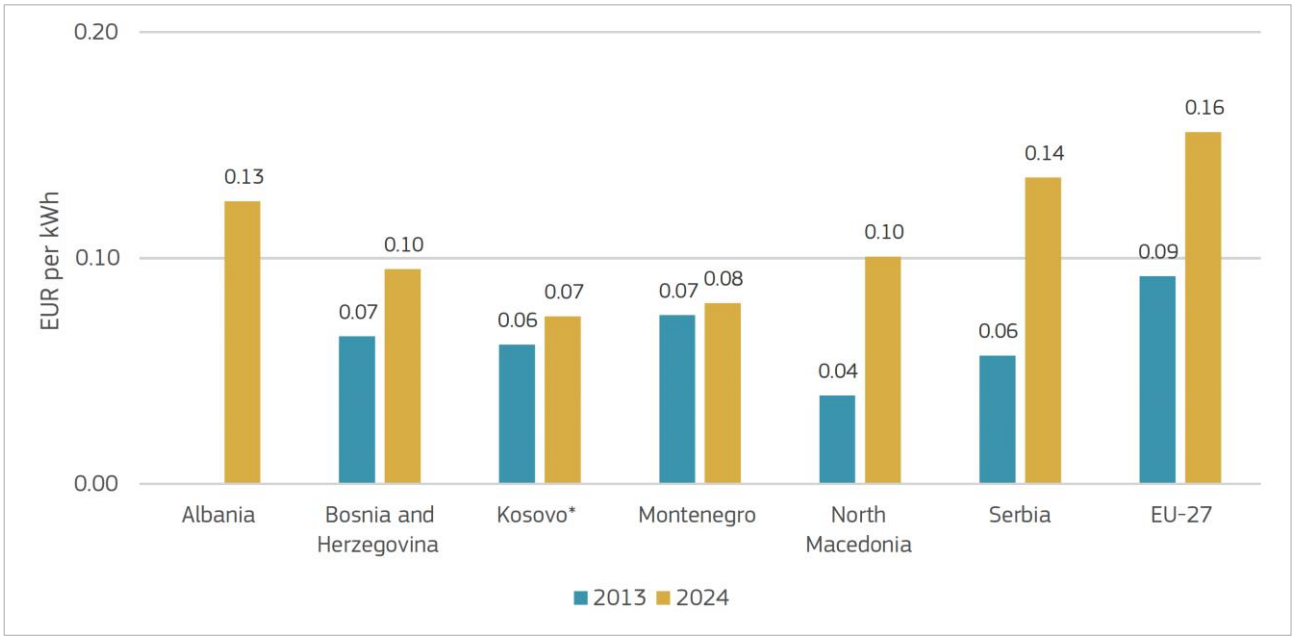
**Figure 20.** Household electricity prices in the Western Balkans and the EU-27, 2024 (in PPS per kWh).




*Source: Eurostat database (2025). Electricity prices by type of user.*

**Non-household prices show a similarly wide gap with the EU, but with a different structure.** In 2024, EU businesses paid 0.16 EUR/kWh on average, while Western Balkan prices ranged from 0.07 EUR/kWh in Kosovo* to 0.14 EUR/kWh in Serbia. Unlike in the EU, where firms consistently pay less than households, the Western Balkans often apply similar or even higher tariffs for businesses, as in Serbia and Albania. This reversal reflects tariff structures shaped more by policy choices than by liberalised markets, with costs shifted away from households toward companies.

**Figure 21.** Electricity prices for non-household, medium size consumers (in euro per kWh).



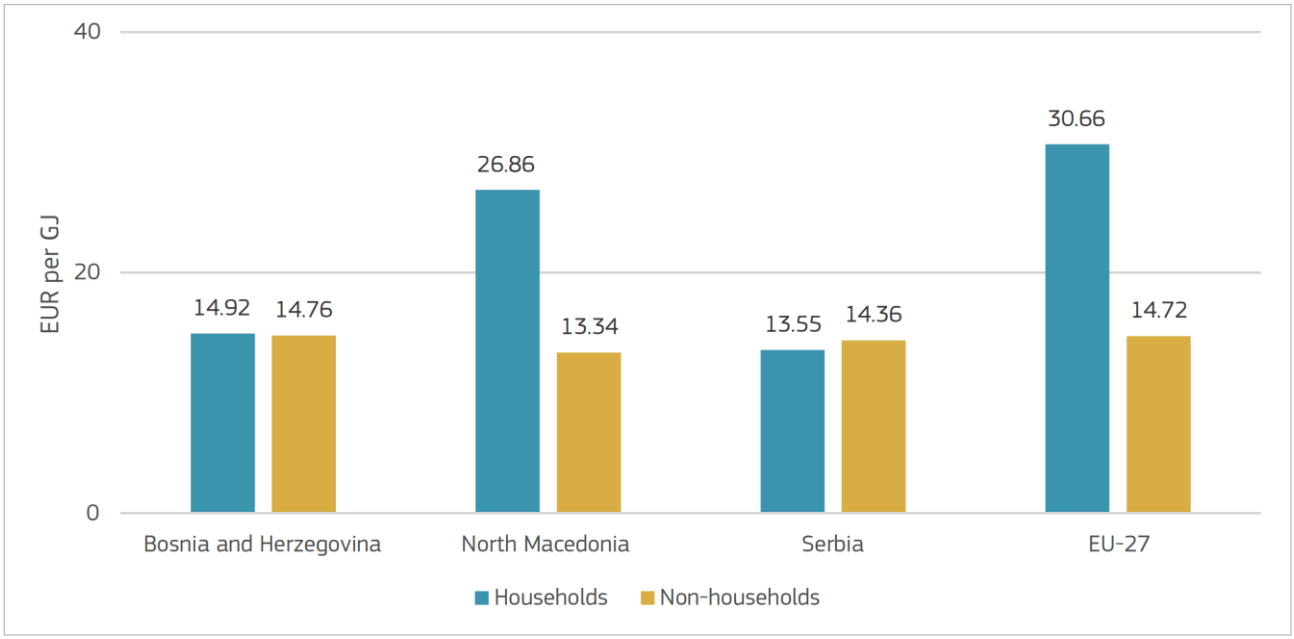

*Source: Eurostat database (2025). Electricity prices by type of user.*

**Although electricity prices for households and firms in the Western Balkans remain below EU averages, interview evidence suggests that companies increasingly value price stability and supply security over the absolute level of tariffs.** Firms report that decisions to invest in self-generation, particularly through solar photovoltaic systems, are driven primarily by the need to reduce exposure to supply disruptions and price volatility during hydrological shortages, rather than by short-term gains from existing price differentials. In this context, self-generation is perceived less as an arbitrage opportunity and more as a risk-management strategy aimed at securing predictable operating costs.

### 3.3.3 Gas prices by type of user

**Gas pricing in the Western Balkans differs markedly from EU patterns.** In the EU-27, households paid 30.7 EUR/GJ in 2024 – more than double the 14.7 EUR/GJ charged to businesses. By contrast, Bosnia and Herzegovina (14.9 vs 14.8 EUR/GJ) and Serbia (13.6 vs 14.4 EUR/GJ) show almost no differentiation, while North Macedonia's households pay far more (26.9 EUR/GJ) than its firms (13.3 EUR/GJ). This indicates a less market-based and more regulated approach, where tariff structures are shaped by policy priorities rather than competition.

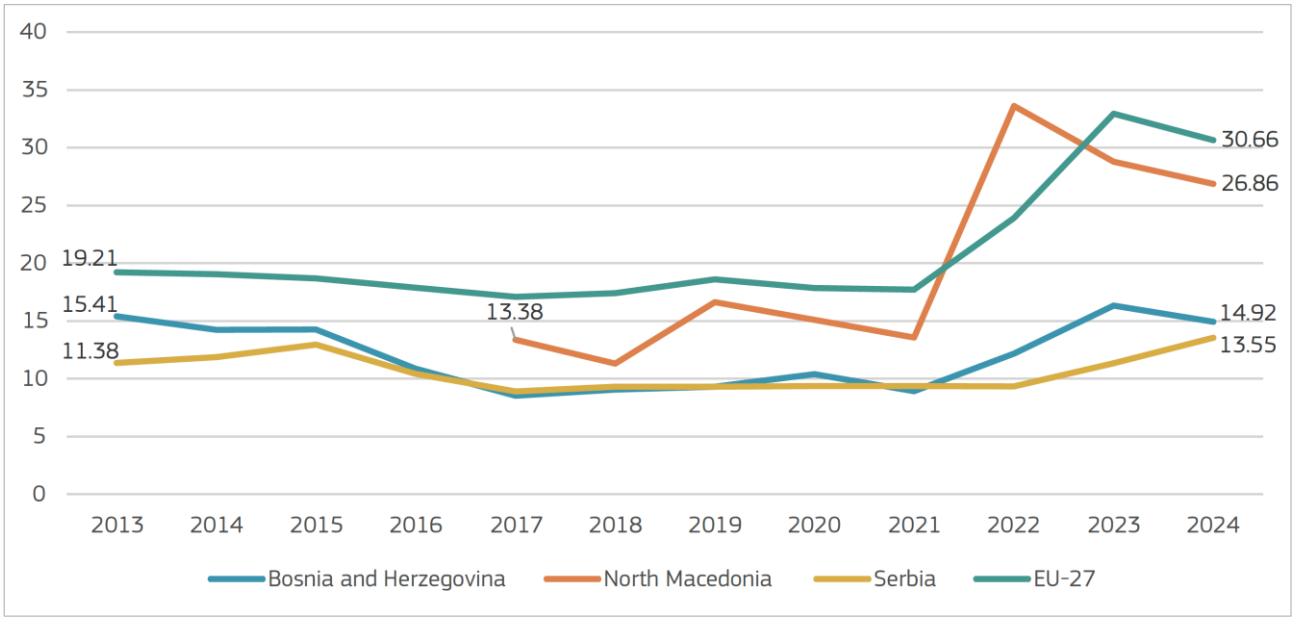
**Figure 22.** Gas prices for household and non-household consumers in 2024 (in euro per Gigajoule).




*Source: Eurostat database (2025). Gas prices by type of user.*

**Long-term price trends highlight regional shielding from global shocks, with exceptions.** EU household gas prices stayed stable at 17-19 EUR/GJ until 2021, then surged during the energy crisis to 32.9 EUR/GJ in 2023 before easing to 30.7 EUR/GJ in 2024. In the Western Balkans, Serbia maintained relatively low and stable prices (9-13 EUR/GJ), Bosnia experienced a dip then gradual rise (8.5 EUR/GJ in 2017 to 14.9 EUR/GJ in 2024), while North Macedonia spiked dramatically in 2022 (33.6 EUR/GJ, above the EU) before falling back. These differences show how subsidies and long-term contracts shield most Western Balkan consumers, but also how exposed individual economies can be when global market shocks penetrate.

**Figure 23.** Gas prices for medium size households (in euro per Gigajoule).




*Source: Eurostat database (2025). Gas prices by type of user.*

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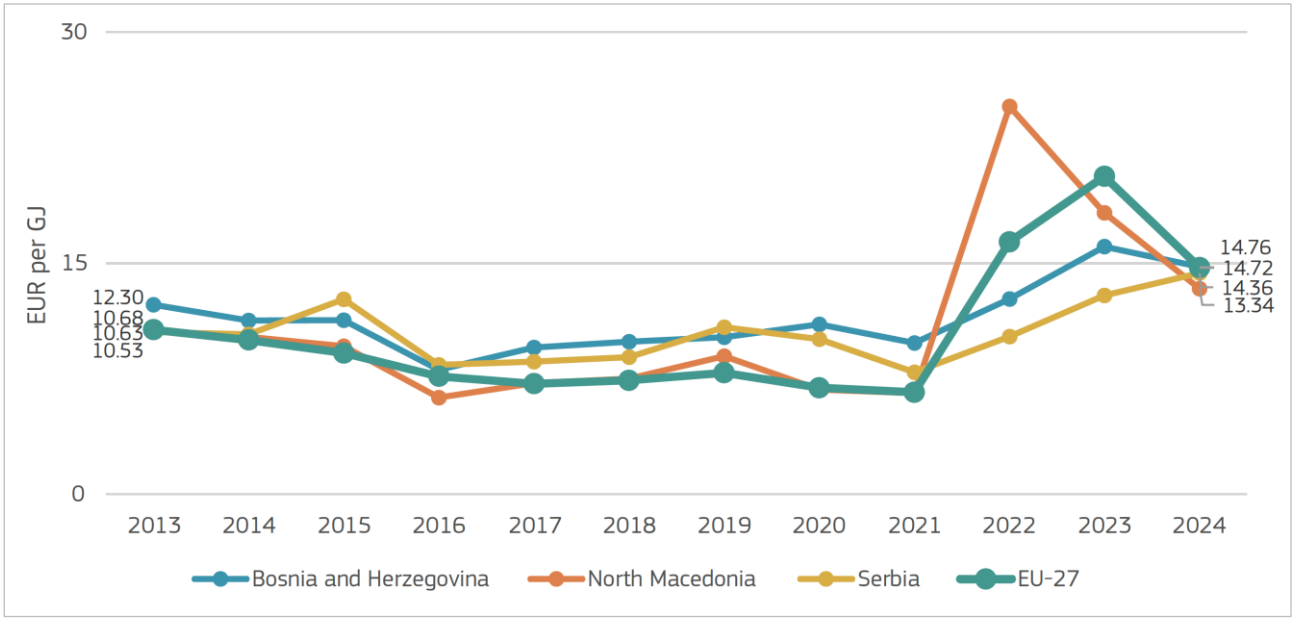
**Figure 24.** Gas prices for non-household, medium size consumers (in euro per Gigajoule).




*Source: Eurostat database (2025). Gas prices by type of user.*

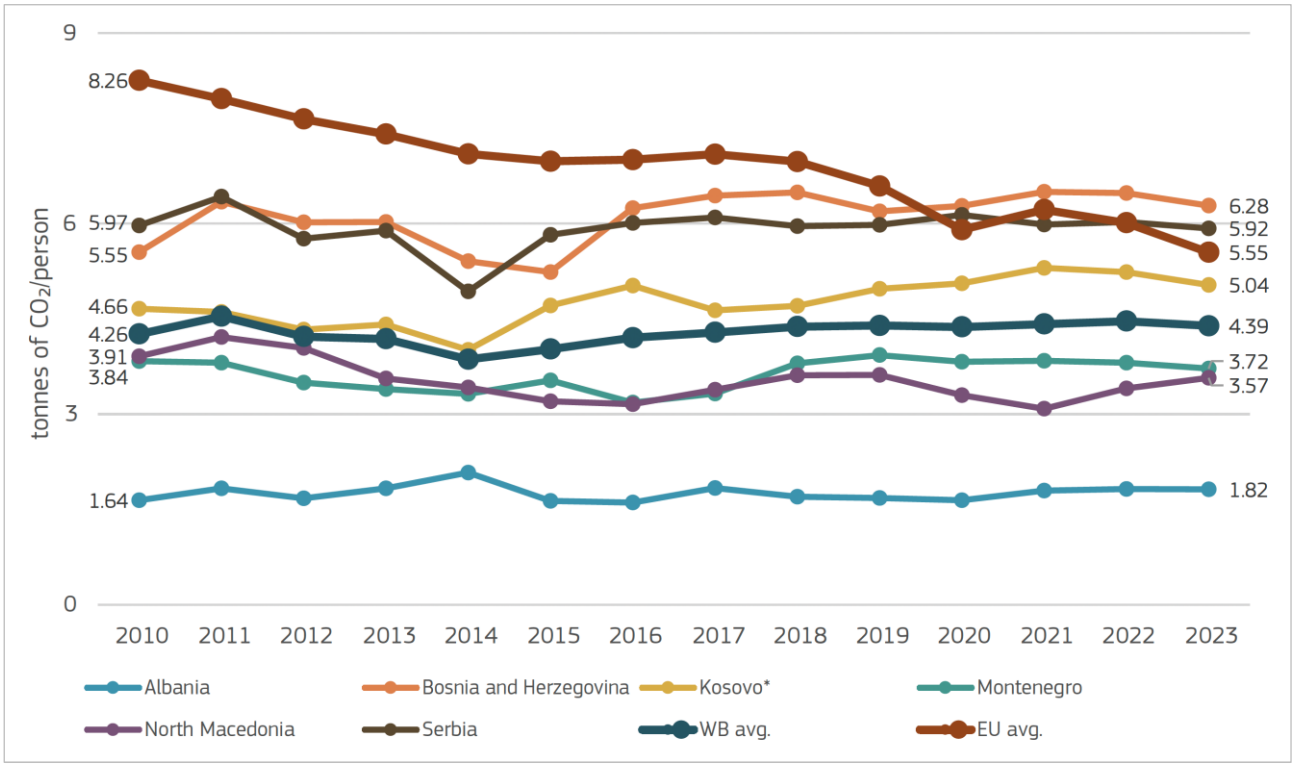
# 4 Decarbonisation Pathways and Emissions

## 4.1 Carbon dioxide emission trends

**Greenhouse gas emissions in the Western Balkans have remained broadly stagnant over the past decade, in sharp contrast to the EU's steady decline.** While the EU-27 has significantly reduced both per capita and total $CO_2$ emissions between 2010 and 2023, the Western Balkans show only marginal changes, reflecting structural dependence on lignite, industrial volatility, and the absence of systematic decarbonization. At the same time, it is important to note that EU per capita emissions, despite their downward trend, remained higher in 2023 than in several Western Balkan economies. This divergence highlights that, despite still higher per capita emission levels, EU countries are progressing steadily toward net-zero, while the Western Balkans risk falling further behind in terms of decarbonisation dynamics.

**Per capita emissions reveal pronounced disparities across the Western Balkans (Figure 25).** Albania consistently records the lowest figures (1.6-2.1 $tCO_2$/person), well below the regional and EU average, thanks to its hydropower-based electricity generation system. On the other side, Bosnia and Herzegovina, Serbia and Kosovo* remain structurally high emitters, each emitting around 5-6 $tCO_2$/person in recent years. Montenegro and North Macedonia lie between these extremes. In Montenegro, these trends were further reinforced by reduced production at the aluminium complex, which significantly reduced industrial emissions.

**Figure 25.** Territorial carbon dioxide emissions per capita ($tCO_2$/person, 2010-2023).

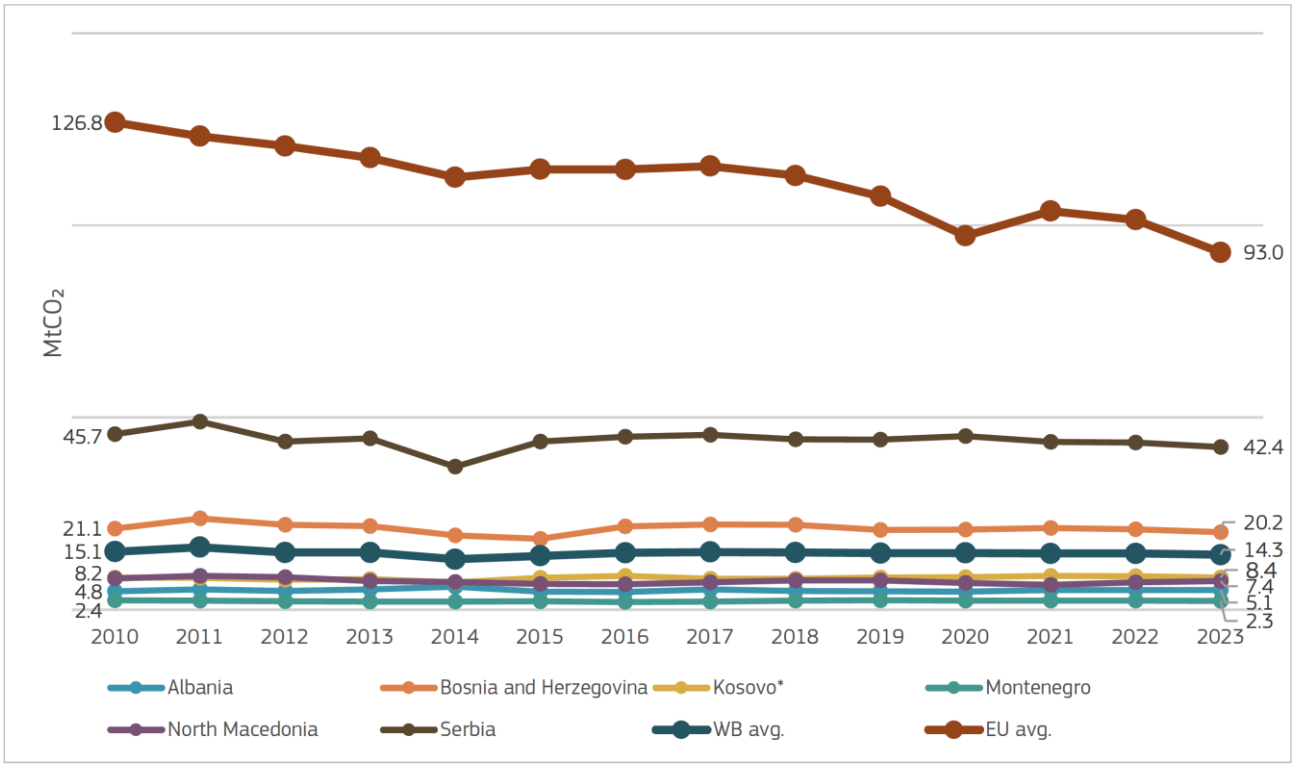



*Source: Friedlingstein et al., 2023; Andrew & Peters, 2024; Peters et al., 2011; United Nations, 2019.*

**The total $CO_2$ emissions illustrate the weight of the individual economies in shaping the regional profile.** Serbia dominates with 42-49 million tons annually, followed by Bosnia and Herzegovina (18-24 million tons) and Kosovo* (8-9 million tons) (Figure 26). Together, these three

economies determine the region's overall footprint, while Albania, Montenegro and North Macedonia contribute comparatively little, despite occasional fluctuations. Year-on-year fluctuations, such as in Bosnia and Herzegovina and Kosovo* in 2015 or in Albania in 2014, show how exposed the region remains to energy shocks and industrial cycles.

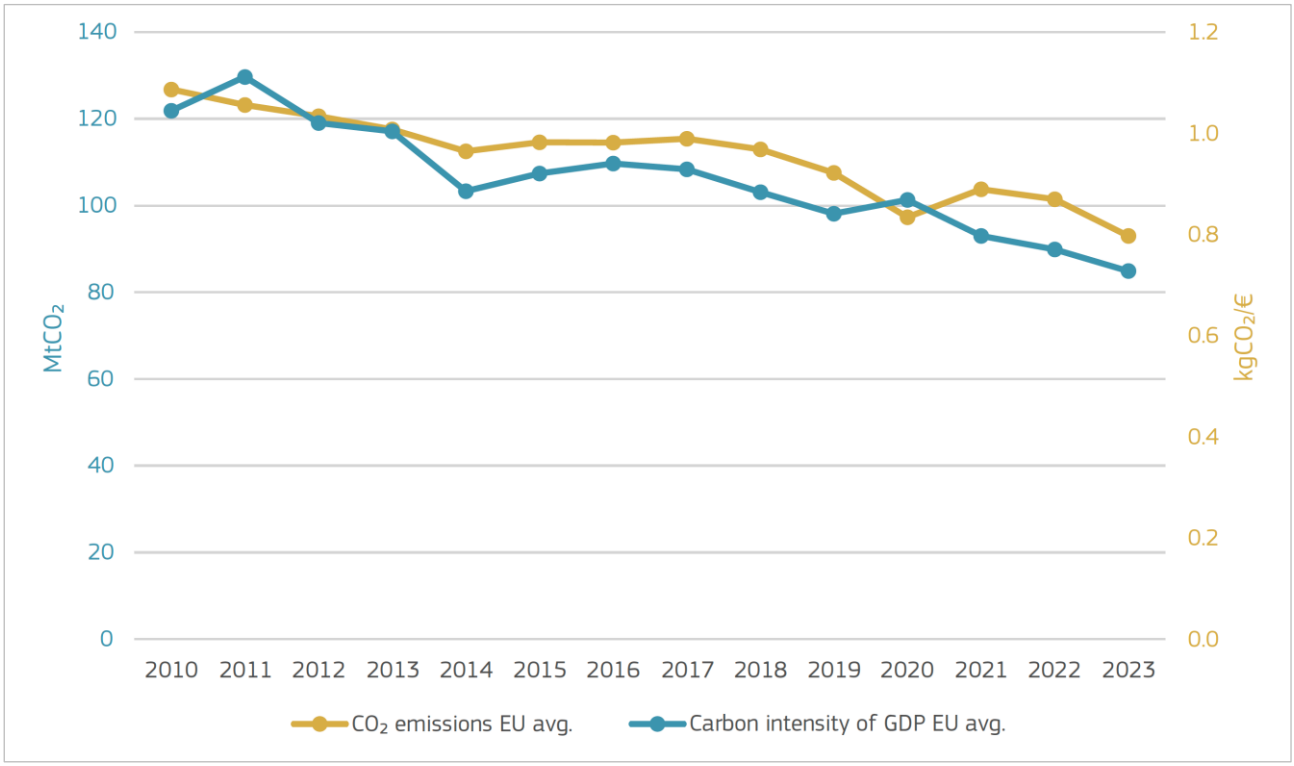
**Figure 26.** Territorial carbon dioxide emissions, total ($MtCO_2$, 2010-2023).




*Source: Friedlingstein et al., 2023; Andrew & Peters, 2024; Peters et al., 2011.*

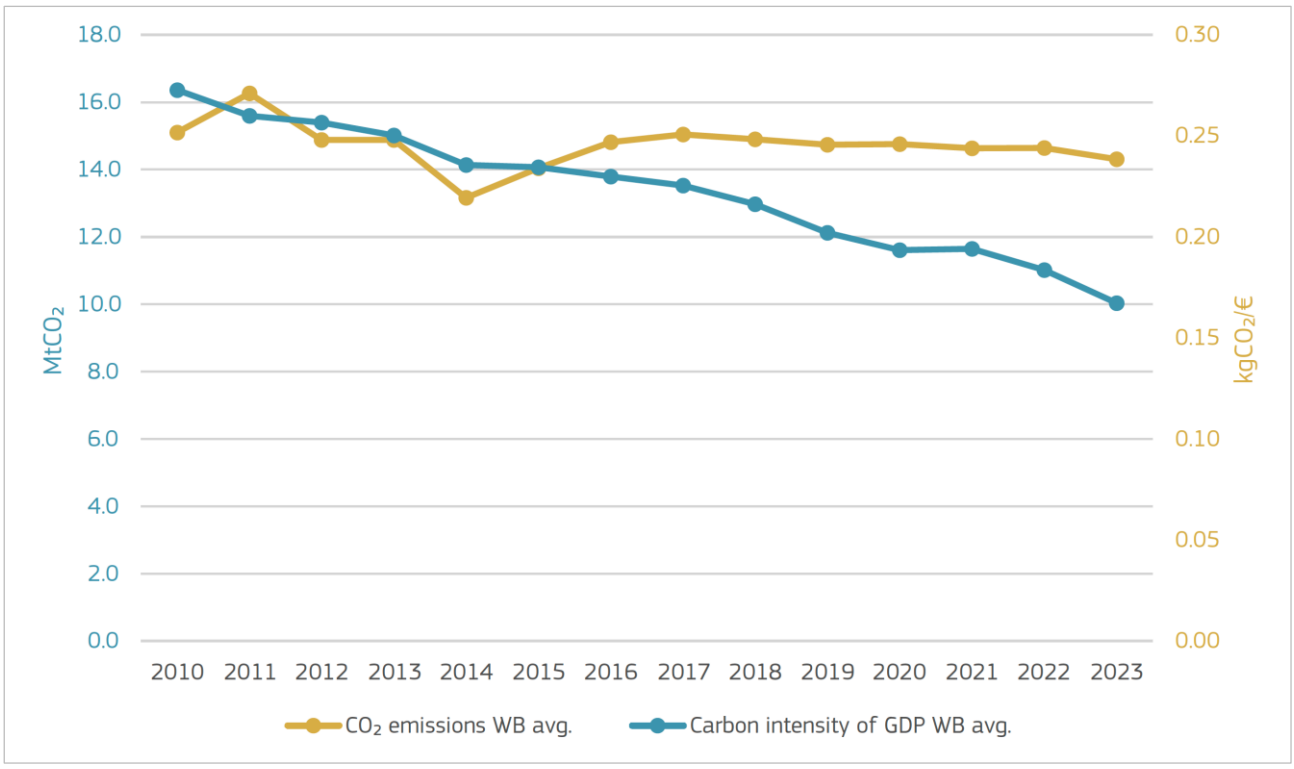
**Figures 27 and 28 underline this divergence in more structural terms.** In the EU, both emissions and carbon intensity of GDP declined consistently between 2010 and 2023, demonstrating how full decoupling, efficiency gains, cleaner energy systems, and climate policy allowed emissions to fall even as the economy grew. In the Western Balkans, by contrast, emissions stagnated while intensity fell, signalling a partial decoupling trap: more economic output per unit of $CO_2$, but without meaningful reductions in total emissions. The convergence gap widened from roughly four times the EU intensity level in 2010 to more than 4.4 times by 2023. The COVID-19 shock illustrates this divergence particularly clearly: while EU emissions fell sharply in 2020, emissions in the Western Balkans remained largely unchanged. This can be partly explained by the dominance of inflexible lignite-based generation and more limited reductions in industrial and energy demand during the pandemic. This persistent inefficiency leaves Western Balkan economies increasingly exposed to EU climate policy instruments, such as carbon pricing, which directly penalise carbon-intensive production.

**Figure 27.** $CO_2$ emissions and carbon intensity of GDP in the European Union.




*Source: Authors' calculations based on Friedlingstein et al., 2023; Andrew & Peters, 2024; Peters et al., 2011; Eurostat (2025). Gross domestic product (GDP) and main components.*

**Figure 28.** $CO_2$ emissions and carbon intensity of GDP in the Western Balkans.




*Source: Authors' calculations based on Friedlingstein et al., 2023; Andrew & Peters, 2024; Peters et al., 2011; Eurostat (2025). Gross domestic product (GDP) and main components.*

**Qualitative evidence from stakeholder interviews provides important context for these emission trends. Interview findings consistently underline that decarbonisation pathways in the Western Balkans are constrained by security-of-supply considerations to a much greater extent than in EU Member States.** In Serbia, lignite remains the only domestically available base-load fuel, making rapid coal phase-out infeasible in the absence of substantial balancing and storage capacity. As a result, national decarbonisation targets prioritise gradual reductions, estimated at 20-25% of coal-based electricity generation by 2030, combined with renewable expansion, rather than accelerated exit strategies.

**Interview evidence further indicates that coal exit strategies across the region are structured around phased operational regimes rather than fixed shutdown dates.** In Serbia, lignite-fired power plants are expected to transition through reduced operation and cold-reserve status before permanent closure, with full phase-out envisaged only toward the middle of the century. This sequencing reflects persistent security-of-supply concerns and the limited availability of large-scale storage and flexibility options capable of supporting variable renewable generation.

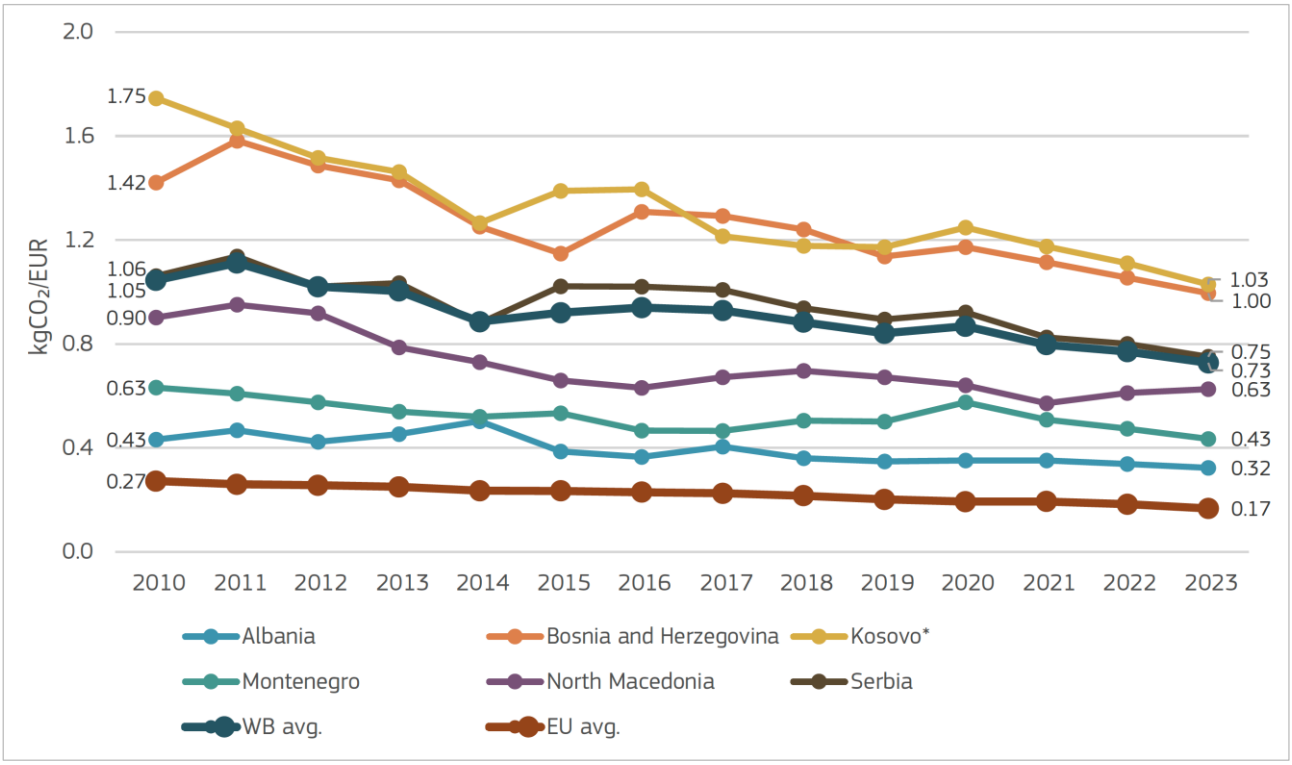
**Beyond the power sector, interviews highlight that outdated industrial equipment represents a major structural barrier to decarbonisation in the Western Balkans**. Aging machinery increases energy consumption, amplifies the economic impact of electricity supply disruptions, and constrains firms' ability to adopt low-carbon technologies. These structural constraints help explain why improvements in carbon intensity have not translated into absolute emission reductions, reinforcing the region's exposure to future EU climate policy instruments such as carbon pricing.

## 4.2 Carbon and Energy Intensity of Growth in the Western Balkans

**Despite gradual improvements, the Western Balkans remain significantly more carbon-intensive than the EU in both economic output and electricity generation.** Between 2010 and 2023, all Western Balkan economies reduced the carbon intensity of GDP and, to a lesser extent, the carbon intensity of electricity, but the pace remains slow and insufficient to narrow the gap with the EU.

**In terms of GDP, all economies show declining intensity but start from very different baselines (Figure 29).** Albania remains the cleanest economy, improving from 0.43 to 0.32 $kgCO_2$/EUR, though still subject to volatility in dry years when fossil back-up is needed. Kosovo* and Bosnia and Herzegovina continue to emit well above the regional average despite progress (Kosovo* from 1.75 to 1.03; Bosnia from 1.42 to 1.00). Serbia shows modest gains, while Montenegro and North Macedonia demonstrate steadier declines, though all remain above EU levels. Over the same period, the EU cut its intensity from 0.27 to 0.17 $kgCO_2$/EUR, a far faster and more consistent reduction.

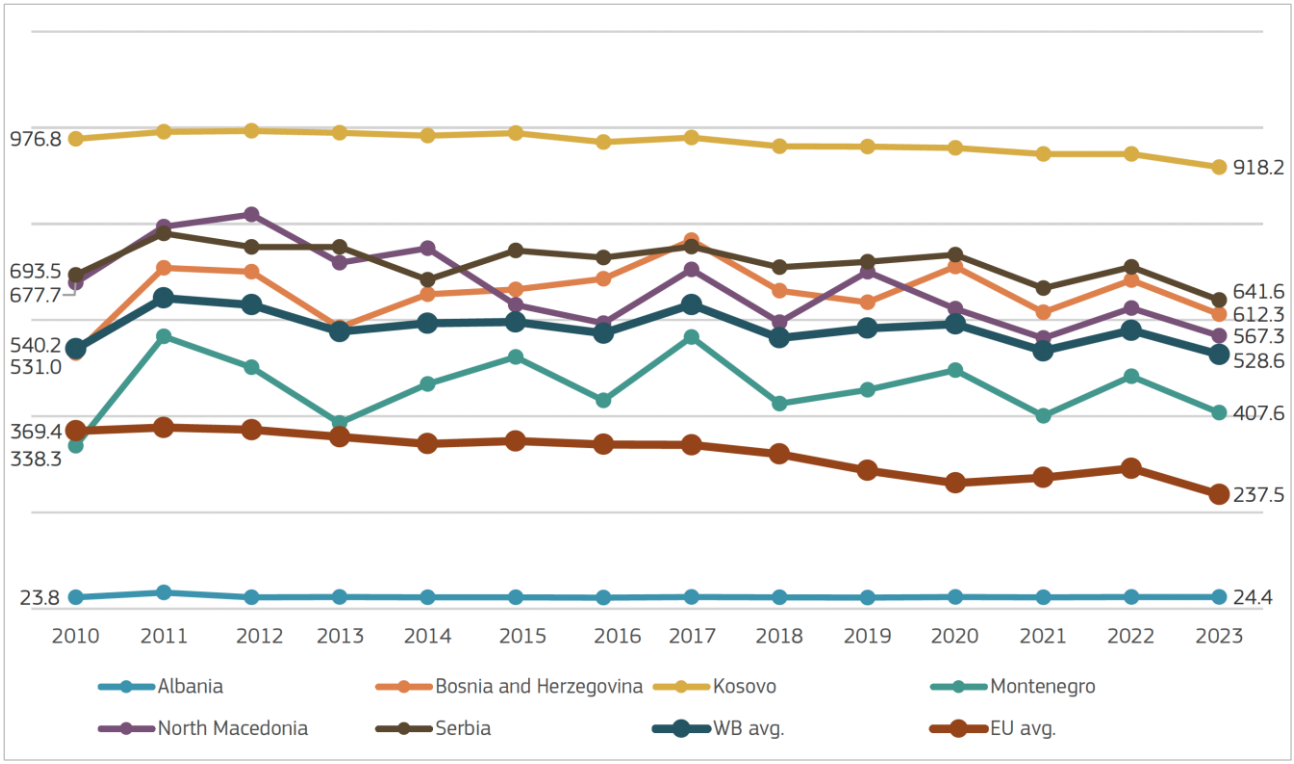
**Figure 29.** Carbon intensity of GDP ($kgCO_2$/EUR, 2010-2023).




*Source: Authors' calculations based on Friedlingstein et al., 2023; Andrew & Peters, 2024; Peters et al., 2011; Eurostat (2025). Gross domestic product (GDP) and main components.*

**Electricity production further illustrates the structural challenge, with Kosovo* standing out as the most carbon-intensive electricity system in Europe**. Its intensity remains close to 1,000 $gCO_2$/kWh throughout the period, far above all other Western Balkan economies and more than four times the EU average. Serbia follows as the second most carbon-intensive system in the region, consistently above 640 $gCO_2$/kWh. Bosnia and Herzegovina also remains at high levels but with significant year-to-year volatility linked to hydropower and coal dispatch. Montenegro and North Macedonia show moderate improvement trends, while Albania stands out with near-zero intensity due to its reliance on hydropower, though this advantage is fragile and weakens significantly in dry years. By contrast, the EU reduced its electricity intensity by around 36%between 2010 and 2023 (from 369 to 237 $gCO_2$/kWh), driven by renewables expansion, efficiency gains, and coal phase-out (Figure 30).

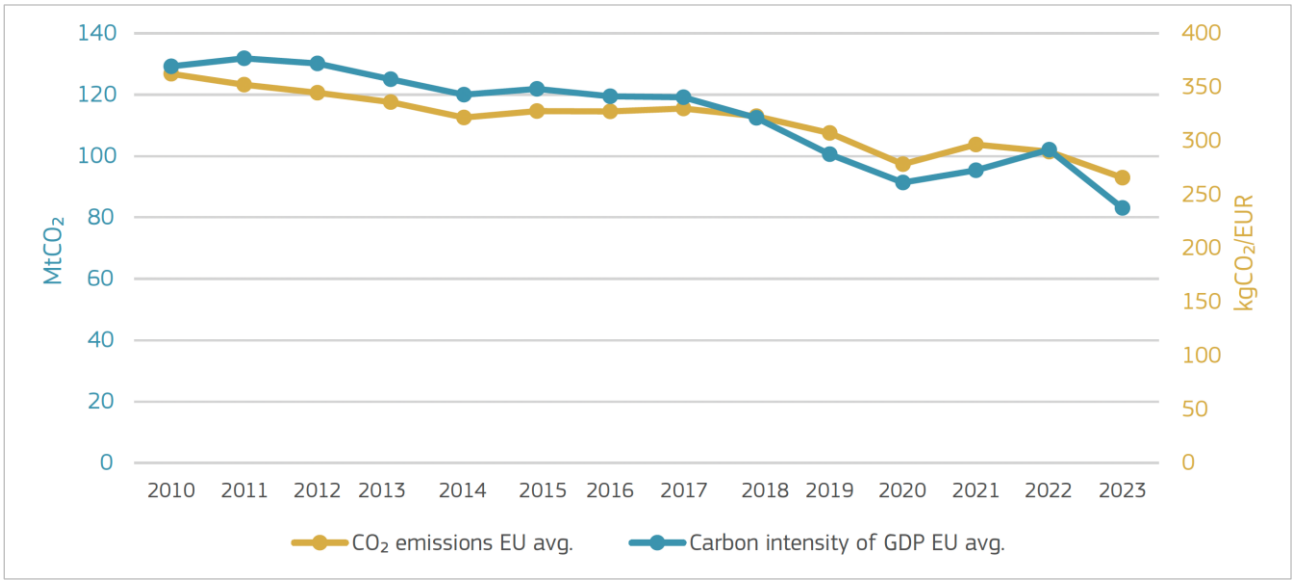
**Figure 30.** Carbon intensity of electricity ($gCO_2/kWh$, 2010-2023).




*Source: Authors' calculations based on Climate Watch (2025). Historical greenhouse gas emissions data explorer; Eurostat (2025). Energy flow – Sankey diagram data*

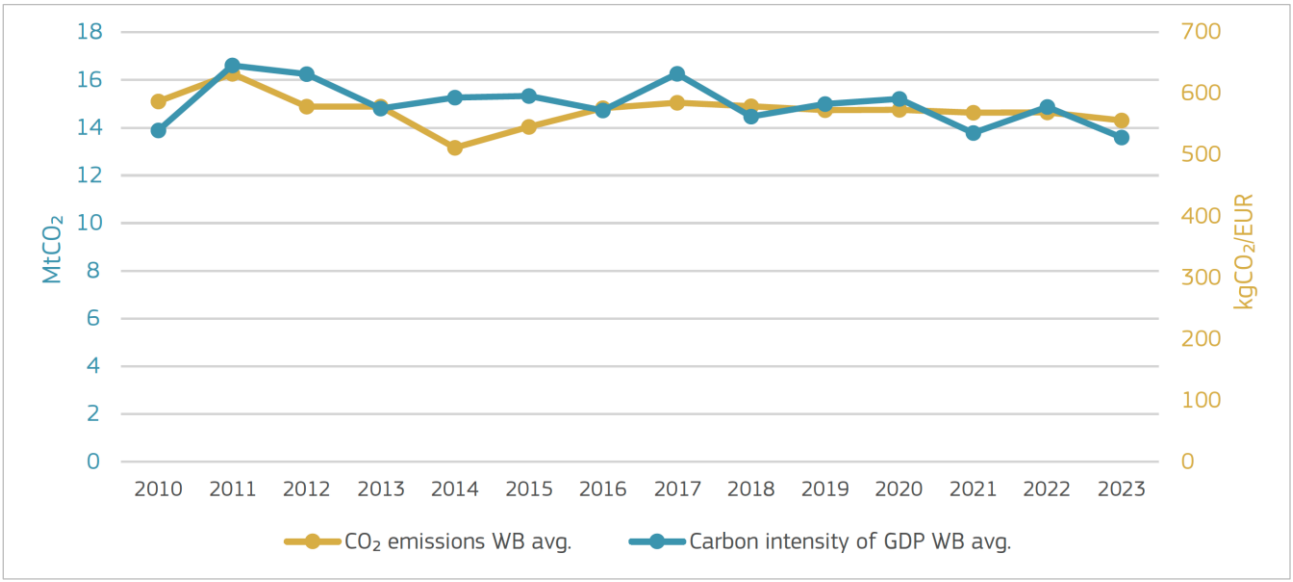
**Figures 31 and 32 highlights this divergence clearly.** In the EU, falling electricity intensity has enabled sustained emissions reductions. In the Western Balkans, emissions have remained broadly flat, reflecting continued lignite dependence and limited diversification. Electricity therefore constitutes a central bottleneck to decarbonisation in the region.

**Figure 31.** $CO_2$ emissions and carbon intensity of electricity in the European Union




*Source: Authors' calculations based on Climate Watch (2025). Historical greenhouse gas emissions data explorer; Eurostat (2025). Energy flow – Sankey diagram data; Eurostat (2025). Gross domestic product (GDP) and main components.*

**Figure 32.** $CO_2$ emissions and carbon intensity of electricity in the Western Balkans.

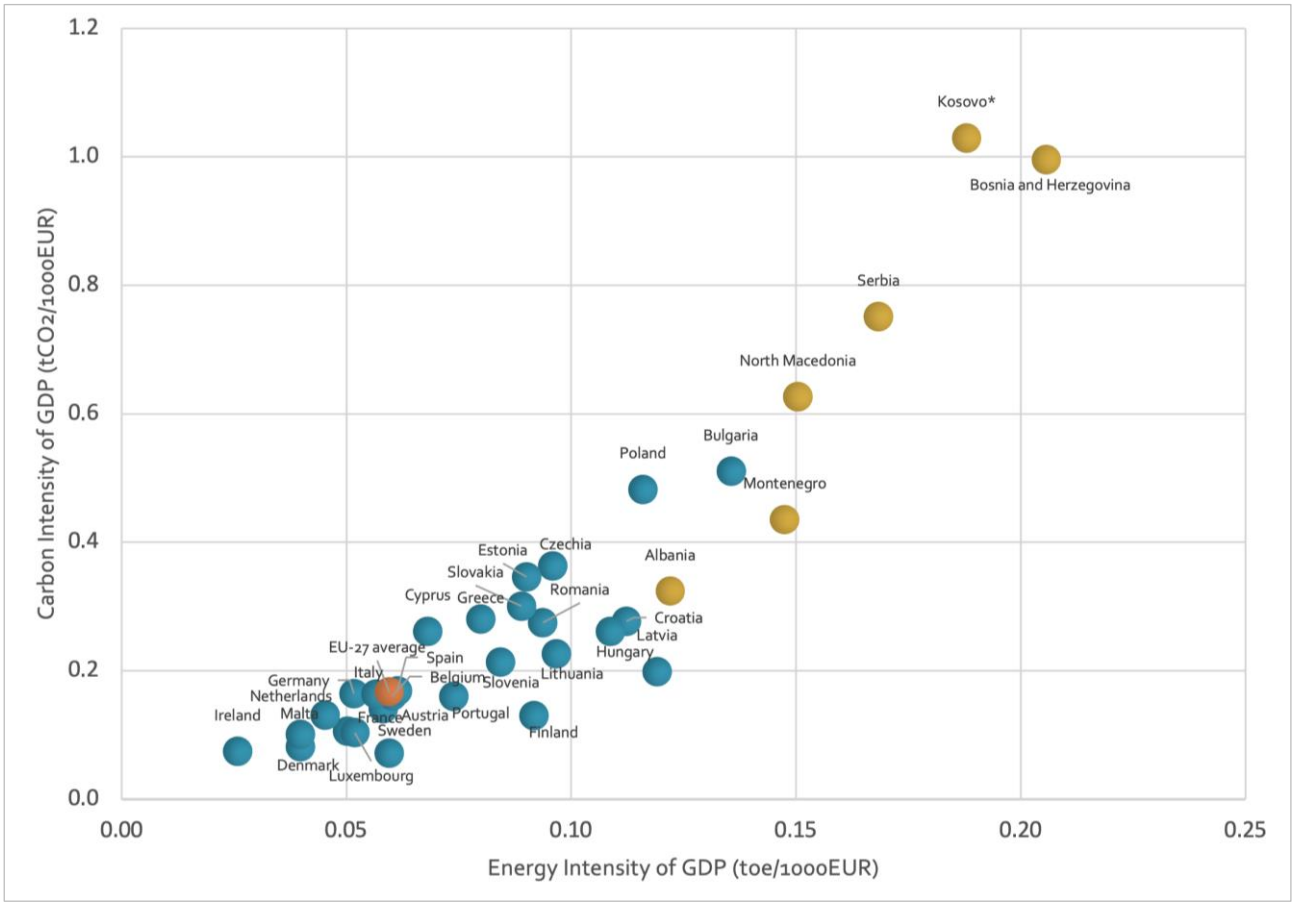



*Source: Authors' calculations based on Climate Watch (2025). Historical greenhouse gas emissions data explorer; Eurostat (2025). Energy flow – Sankey diagram data; Eurostat (2025). Gross domestic product (GDP) and main components.*

**The Western Balkans face a dual challenge: decarbonising carbon-intensive power systems while ensuring that economic growth gradually decouples from fossil energy.** Albania demonstrates the potential of renewable-based systems, but its dependence on hydropower exposes it to supply volatility. Lignite-dependent Bosnia and Herzegovina, Serbia, and Kosovo* remain locked into highly emission-intensive structures, limiting competitiveness and delaying alignment with EU decarbonisation trajectories.

**Building on this, Figure 33 provides a consolidated view of these structural differences by plotting energy intensity against carbon intensity for the EU-27 and the Western Balkans.** The EU cluster appears tightly grouped in the lower-left quadrant, reflecting both efficient energy use and low carbon output. In contrast, the Western Balkan economies occupy the upper-right quadrant, indicating simultaneously higher energy consumption per unit of GDP and significantly higher emissions. Albania, Montenegro, and North Macedonia sit closest to the EU cluster, though still above EU averages, while Kosovo*, Bosnia and Herzegovina, and Serbia form a distinct high-intensity group driven by lignite dependence and outdated power systems.

**Figure 33.** Energy Intensity vs. Carbon Intensity of EU-27 and Western Balkans (2023).



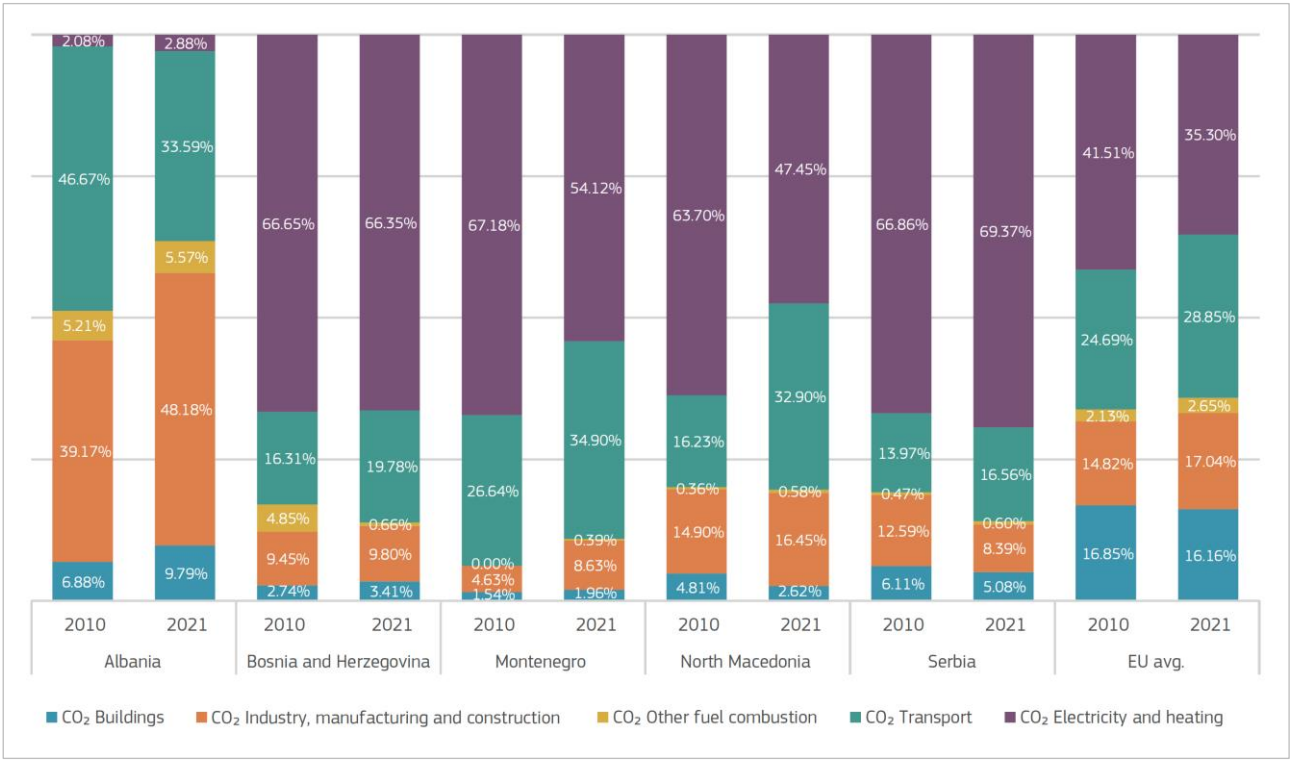

*Source: Source: Authors' calculations based on Friedlingstein et al., 2023; Andrew & Peters, 2024; Peters et al., 2011; Eurostat (2025). Energy flow – Sankey diagram data; Eurostat (2025). Gross domestic product (GDP) and main components.*

**In numerical terms, Kosovo*, Bosnia and Herzegovina, and Serbia recorded the highest $CO_2$ emissions per unit of GDP in Europe in 2023, between 0.75 and 1.03 $tCO_2$ per 1,000 EUR, five to six times the EU-27 average (0.17 $tCO_2$/1,000 EUR).** Their energy intensity levels (0.17-0.21 toe per 1,000 EUR) likewise far exceed the EU benchmark (0.06). North Macedonia (0.15 toe; 0.63 $tCO_2$), Montenegro (0.15 toe; 0.44 $tCO_2$), and Albania (0.12 toe; 0.32 $tCO_2$) perform somewhat better but remain above EU levels. By contrast, advanced EU economies such as Denmark, Ireland, and Sweden combine very low energy intensity with minimal carbon output following decades of efficiency investment, electrification, and renewable integration.

## 4.3 Sectoral structure of $CO_2$ emissions

**The sectoral breakdown of emissions highlights why Western Balkan economies diverge from EU patterns. Most Western Balkan economies remain heavily electricity-dependent, while the EU has shifted toward a more diversified profile.** Between 2010 and 2021, the EU reduced the share of electricity in emissions from 42% to 35% and increased transport and industry shares, reflecting decarbonisation of the power sector (Figure 34). By contrast, Serbia, Bosnia and Herzegovina, Montenegro, and North Macedonia all remain dominated by coal-based power, with electricity accounting for 50-70% of their emissions. Albania is the only exception, where hydropower keeps electricity's share minimal and industry and transport dominate.

**Figure 34.** Sectoral structure of $CO_2$ emissions in the Western Balkans and EU average, 2010 vs 2021.




*Source: Climate Watch (2025). Historical greenhouse gas emissions data explorer.*

**This structural lock-in reinforces the convergence challenge: while the EU is steadily reducing the weight of electricity emissions, Western Balkan economies remain dependent on coal, exposing them to competitiveness pressures and EU climate policies**. Transport increased everywhere, but the EU shift was accompanied by power-sector decarbonisation, whereas Western Balkan increases come on top of stagnant, high electricity emissions.

## 4.4 EU CBAM and alignment of Western Balkan economies

**The European Union's CBAM represents one of the most important instruments of EU decarbonization policy, but also one of the most significant external pressures on the energy and industrial system of the Western Balkans.** Its primary objective is to prevent 'carbon leakage' and ensure a level playing field between European producers, who bear the cost of carbon through the EU Emissions Trading System (EU ETS), and foreign exporters whose products enter the EU market. CBAM covers 303 products from six energy-intensive sectors: cement, iron and steel, aluminium, fertilizers, electricity, and hydrogen. During the transitional period (from October 2023 to the end of 2025), EU importers are required to report embedded GHG emissions quarterly, without financial payments. From January 1, 2026, importers will purchase CBAM certificates whose value is linked to the price of allowances under the EU ETS, while full implementation of the mechanism is expected by 2034. Recent reforms introduced in 2025 have simplified procedures by introducing an exemption for small import volumes, whereby CBAM obligations do not apply if annual imports remain below 50 tons per importer, thereby easing administrative burdens while maintaining requirements for verified production-based emissions data.

**For the Western Balkan economies, which are deeply integrated into EU trade flows, the effects of CBAM are multifaceted. The region is largely dependent on coal-fired (lignite)**

**electricity and carbon-intensive industries.** The primary source of $CO_2$ in the region, except for Albania, is electricity generation and heating. Estimates for electricity exports alone suggest costs could reach over one billion euros annually, with Serbia having the greatest exposure, and estimated annual CBAM costs of 612.5 million euros for electricity exports alone. The estimated average CBAM cost per megawatt-hour ranges from 59.71 euros in North Macedonia to 73.37 euros in Bosnia and Herzegovina, reflecting the carbon intensity of their electricity sectors (Energy Community Secretariat, 2025) (Table 3). However, these estimates should be interpreted with caution, as they are subject to significant methodological uncertainties, particularly regarding the treatment of cross-border electricity flows, the distinction between exports and transit volumes, and the attribution of emissions. In particular, the volume indicator presented in Table 3 combines both electricity directly exported to the EU and electricity transiting through neighbouring systems before reaching EU markets, which complicates the precise allocation of CBAM-related costs. As such, the figures presented in Table 3 (Energy Community Secretariat, 2025) should be understood as indicative of the potential scale of exposure to EU carbon pricing mechanisms rather than precise forecasts, highlighting the structural vulnerability of carbon-intensive electricity systems in the region.

**Table 3.** Estimated CBAM financial exposure of EU importers for imports sourced via Contracting Parties, 2024.

| Contracting Party bordering the EU | Export + Transit Contracting Party → EU (MWh) | Average annual marginal CBAM price per MWh (EUR/MWh) | Total annual CBAM cost for EU importers (EUR) |
|---|---|---|---|
| **Albania** | 1,307,183 | 0.00 | 0 |
| **Bosnia and Herzegovina** | 2,158,417 | 73.37 | 158,364,080 |
| **Montenegro** | 3,042,090 | 62.45 | 189,982,787 |
| **North Macedonia** | 3,354,317 | 59.71 | 200,284,866 |
| **Serbia** | 9,181,098 | 66.71 | 612,471,481 |
| **Total** | — | — | 1,167,331,931 |

*Source: Energy Community Secretariat, 2025.*

**World Bank modelling for the Western Balkans suggests that CBAM's macroeconomic impact will remain relatively small at the aggregate level.** Studies show that CBAM costs on GDP by 2035 would reach -0.23% in Serbia and -0.3% in Kosovo*, assuming governments do not take measures to mitigate CBAM costs. However, sectoral impacts would be significantly larger and would manifest in losses in production, exports, and employment. Bosnia and Herzegovina and Montenegro are the most exposed economy, partly due to large power exports. Carbon-intensive electricity generation (except in Albania) and industrial processes are particularly vulnerable. Serbia's iron and steel sector projects a 31% annual reduction in exports by 2035, with the power sector expecting a 27% decline in exports and a 44% decline in output and employment (World Bank, 2024).

**The greatest challenge regarding CBAM is the lack of domestic mechanisms for monitoring and pricing emissions**. None of the Western Balkan economies has yet established a fully functional emissions trading system, although Serbia and Montenegro have developed registries and announced plans to introduce such systems by the end of the decade.

— **Montenegro introduced a national carbon pricing scheme in 2020, covering the electricity and industrial sectors**. However, its scope remains limited, with only three companies initially included: the Pljevlja coal plant (Elektroprivreda Crne Gore), the KAP aluminium plant, and the Tosčelik steel mill, the latter two of which have since ceased operations. By 2024, only the state electricity company Elektroprivreda Crne Gore remained active in the system, purchasing allowances worth 9.26 million euros at an average price of 6.02 euros per ton—well below both the minimum price initially envisaged (24 euros) and EU ETS levels, which have averaged around 70 euros per ton in recent years (Energy Community Secretariat, 2025).

— **Serbia adopted the Law on Greenhouse Gas Emissions Tax and the Law on Carbon-Intensive Product Imports Tax in December 2025, with both entering into force in early 2026.** The legislation establishes a carbon price of 4 euros per ton of $CO_2$ equivalent, significantly below EU levels, and applies to major industrial emitters in sectors such as fertilizers, cement, iron and steel, aluminium, and electricity, as well as to imports of carbon-intensive products. The tax base is calculated as total emissions, adjusted for reference emissions reflecting best available technologies. Electricity producers may claim a 20% tax credit for eligible decarbonisation investments, capped at 80% of total tax liability. However, the effectiveness of the system will depend on the adoption of several implementing bylaws, which are expected within a defined period following the law's entry into force.

— **Other economies remain at an earlier stage of development.** Albania is considering a hybrid model combining a carbon tax with a gradual transition toward integration with the EU ETS, potentially by the late 2020s. Bosnia and Herzegovina and North Macedonia are exploring the introduction of carbon taxes in the coming years, while Kosovo* currently has no plans to introduce a carbon pricing system.

**The path to CBAM exemption for electricity is extremely demanding**. Western Balkan economies must achieve technical market integration with the EU, implement the full package of EU electricity market regulations, increase the share of renewable energy, and commit to climate neutrality by 2050. Technical market integration refers to market coupling with EU electricity markets and alignment with EU rules enabling cross-border trading and system coordination. These processes take time, while CBAM obligations are being introduced on a faster timeline.

**Beyond institutional readiness, a key issue will be the private sector's capacity to accurately measure emissions at the facility level and provide verified data**. Interviews with private sector representatives have shown that most Western Balkan companies have limited understanding of CBAM, but awareness of its significance and the need for preparation is growing among exporters to the EU. Companies from the metal and chemical sectors are already feeling pressure from European customers to measure and report emissions, while smaller companies still lack the capacity for such processes. Practical implementation of CBAM is already creating significant administrative burdens for companies. According to the interviews, there is widespread confusion regarding reporting responsibilities, as EU importers often transfer the obligation to exporters in the region. Many firms note that they lack clear guidelines on emissions calculation, especially for supply chains, and emphasize the absence of sufficient state support and certification bodies. They believe that carbon pricing and CBAM are still not on ministers' agendas, and the most vulnerable sectors face existential challenges without financial and legislative support.

**Interview evidence further identifies the absence of a fully functional Monitoring, Reporting and Verification (MRV) system as a critical institutional bottleneck across the region** (see also CEE Bankwatch Network, 2025). Without a nationally recognised verification framework, companies are unable to issue credible certificates demonstrating the low-carbon origin of electricity, including hydropower and solar generation. As a result, firms are often forced to rely on EU-based verifiers,

increasing compliance costs and creating additional delays in meeting CBAM reporting requirements. In Serbia, this challenge is compounded by the non-recognition of domestic guarantees of origin within the EU. Although the national electricity utility issues 'green megawatt' certificates domestically, these certificates have no value for exporters facing CBAM obligations. Combined with Serbia's coal-dominated electricity mix, this significantly increases the carbon cost embedded in exported industrial products. Stakeholder interviews further indicate that the country has not yet conducted a comprehensive assessment of CBAM impacts, leaving firms exposed to rising compliance risks without a clear policy response.

**The general view of the stakeholders from the region is that CBAM will increase business costs and reduce the competitiveness of those who do not modernize production, but it can also serve as a strong incentive for investments in green technologies**. This is consistent with the interview findings indicating that CBAM-related costs could increase export prices of covered products by up to 20%, particularly in the metal and electricity sectors, directly affecting the price competitiveness of Western Balkan exporters.

**Stakeholder interviews also suggest that, in the absence of targeted support mechanisms for industrial transformation, CBAM risks accelerating deindustrialisation rather than triggering a transition to low-carbon production in parts of the Western Balkans**. EU buyers are increasingly transferring anticipated compliance costs and reporting obligations to non-EU suppliers, effectively reshaping supply-chain relationships ahead of CBAM's full implementation. In this context, CBAM already influences commercial terms and investment decisions, not only as a reporting mechanism but also through the uncertainty surrounding reporting requirements, verification procedures, and implementation timelines. Business advisory organisations emphasise that uncertainty around reporting thresholds, verification procedures, and the non-recognition of domestic certification schemes has led many firms, particularly SMEs, to delay preparatory actions. This delay risks increasing future compliance costs and reinforcing competitive disadvantages once CBAM financial obligations come fully into force.

**These qualitative findings are further corroborated by results from the survey conducted for this study. When asked to assess the expected cost impacts of EU green transition regulations, including CBAM, potential ETS alignment, and broader environmental sustainability requirements, none of the surveyed companies anticipated avoiding cost increases altogether over the next five years.** A clear majority of firms expect substantial impacts: 72% anticipate cost increases of 10% or more, with 39% projecting moderate increases in the range of 10-20%, and 28% expecting significant impacts of 20-40%. A smaller share anticipates very large increases exceeding 40%, while the remainder expect more limited, though still positive, cost effects. These expectations align closely with earlier findings that a large share of firms have already invested, or plan to invest, in energy efficiency and renewable energy. However, the fact that two-thirds of surveyed companies still expect cost increases of at least 10% despite these efforts underscores three critical dynamics. First, current decarbonisation investments remain insufficient to fully offset regulatory compliance costs, particularly for firms in carbon-intensive sectors directly exposed to CBAM. Second, companies anticipate that future alignment with EU carbon pricing will significantly increase cost pressures, given the large gap between current domestic carbon prices and EU ETS levels. Third, the concentration of expected impacts in the 10-40% range reflects the reality highlighted in interviews: CBAM-related charges alone may raise export prices of covered products by up to 20%, with cumulative effects from multiple EU regulations potentially pushing total cost impacts higher.

# 5 Policy frameworks and implementation of the energy transition in the Western Balkans

**Over the past few years, Western Balkan economies have progressively developed national frameworks for climate action and energy transition, shaped by obligations under the Energy Community Treaty and the ambition to align with the EU Green Deal**. These frameworks, ranging from long-term energy strategies to NDCs and emerging NECPs, form the core policy architecture guiding the shift away from carbon-intensive structures toward more sustainable and resilient economies. However, assessments of implementation reveal a significant gap between strategic commitments and practical delivery. A recent analysis finds that the average implementation rate of the Green Agenda across the region is only about 43%, with Montenegro and Serbia showing the strongest progress. Yet even in these economies, enforcement and monitoring remain uneven, particularly in sectors such as agriculture, biodiversity, and depollution (Djatkov, 2024). These findings reflect broader structural challenges: governance fragmentation, limited administrative capacity, and restricted access to finance continue to slow the translation of strategic objectives into concrete decarbonisation measures.

**The evolving national strategies nonetheless provide an important foundation for the region's green transition, setting the overall direction for climate and energy reform while also revealing the constraints that shape implementation in practice.** Against this background, the following analysis examines differences in national targets and governance capacity, identifies key barriers to implementation, and considers the role of complementary policy and investment frameworks, including Reform Agendas under the Growth Plan, WBIF-supported investments, and Smart Specialisation Strategies, in supporting the energy transition across the region.

## 5.1 Climate and energy targets and governance

**The Western Balkan economies have made varying progress in defining their 2030 climate and energy objectives, which form the foundation for aligning national policies with the EU Green Deal and Energy Community obligations**. Although formal commitments through NDCs and draft NECPs provide a strategic roadmap, they also reveal significant differences in ambition, institutional capacity, and implementation readiness across the region.

**Stakeholder interviews indicate that Serbia represents a notable institutional turning point within the region.** The NECP adopted in July 2024 constitutes the country's first fully binding climate and energy planning instrument aligned with Energy Community obligations. Unlike earlier strategic documents, the NECP establishes enforceable targets for 2030 and ensures consistency with Serbia's updated NDC, marking a structural shift from largely voluntary commitments toward rule-based climate governance. While this transition narrows the institutional gap with EU Member States, it also reflects a delayed starting position and places immediate pressure on implementation capacity.

Some analysts warn that these asymmetries create structural vulnerabilities. According to the RES Foundation (2023), under current arrangements the Western Balkans risk becoming a 'low-cost energy corridor' for the EU, exporting electricity while retaining the environmental and social burdens of fossil-based generation. From this perspective, deeper EU integration must ensure that the benefits and costs of the energy transition are distributed more equitably, and that regional industries are not locked into carbon-intensive dependency patterns.

**Table 4 summarises the 2030 targets for greenhouse gas reduction and renewable energy shares across the Western Balkans. The data show a wide range of ambition.** North Macedonia

and Montenegro have the most transformative GHG reduction paths (82% and 55% reductions relative to 1990, respectively), reflecting their clearer long-term energy strategies and relatively favourable renewable energy potential. Serbia, Bosnia and Herzegovina, and Albania have adopted more moderate targets, though Albania stands out with high projected shares of renewables in final energy consumption due to its hydropower-dominated system. Kosovo*, which is not a Party to the Paris Agreement, outlines expected reductions only through its draft NECP, with scenarios that vary significantly depending on the policy mix applied.

**When comparing renewable energy objectives, the region again shows considerable variation.** Albania and Montenegro project the highest RES shares by 2030, while Serbia, North Macedonia, and Kosovo remain closer to the EU's minimum threshold, reflecting their structural dependence on coal and slower diversification. Transport remains the weakest sector across all economies, with RES shares rarely exceeding single digits, highlighting persistent challenges in decarbonising mobility.

**Table 4.** Overview of 2030 Greenhouse Gas Reduction and Renewable Energy Targets by Economy.

| **Western Balkan Economy** | **Strategic documents** | **Targets (2030)** |
|---|---|---|
| **Albania** | • Has a revised NDC (submitted in 2021 and adopted).<br>• Draft NECP (not adopted) | • Albania's **revised NDC** sets an economy-wide target **for 2030 of 11.978 $MtCO_2e$** covering all GHGs (including LULUCF), which is about 21% lower than if no action were taken.<br>• **The draft NECP specifies** that the share of renewable energy sources (RES) in gross final energy consumption should be **at least 59.4% by 2030** with additional measures (WAM).<br>o The share of RES in **gross final electricity consumption** should reach at least **145.8% by 2030** (values above 100% are due to electricity exports).<br>o The share of RES in covering **heating and cooling** demand should reach **22.6% by 2030.**<br>o The share of RES in the **transport sector** should reach **34.8% by 2030.** |
| **Bosnia and Herzegovina** | • Updated NDC adopted in 2021.<br>• Draft NECP (not adopted) | • The **updated NDC** specifies that the unconditional GHG emissions reduction target (excluding LULUCF) **for 2030 is 33.2% compared to 1990. The conditional target** (with intensified international support for the decarbonization of mining areas) **for 2030 is 36.8% compared to 1990.**<br>• The draft NECP envisages a **41.21 reduction in GHG emissions (with LULUCF) by 2030 compared to 1990.**<br>• **Draft NECP specifies overall share of RES: 43.6% in 2030,** up from 36.7% in 2021.<br>o **Heating and cooling (RES-H&C): 63.0% in 2030,** compared to 53.48% in 2021.<br>o **Electricity (RES-E): 65.0% in 2030,** compared to 46.32% in 2021.<br>o **Transport (RES-T): 8.25% in 2030,** compared to just 0.23% in 2021. |

| | | |
|---|---|---|
| **Kosovo*** | • Not a Party to the Paris Agreement, so it has no NDC.<br>• Draft NECP (not adopted) | • According to the draft NECP, **total GHG emissions** (including LULUCF) are projected to **decrease by 16.3% by 2030** compared to 2016 levels. However, the modelling of the NECP shows that they can be exceeded: from -36% (WEM) to 49% (WAM).<br>• **The NECP draft specifies the overall share of RES: 32% in 2030.**<br>○ **Heating and cooling (RES-H&C): 50% in 2030.**<br>○ **Electricity (RES-E): 45% in 2030**<br>○ **Transport (RES-T): 4% in 2030.** |
| **Montenegro** | • Updated NDC submitted in February 2025 (adopted).<br>• Draft NECP (not adopted) | • Updated NDC (submitted February 2025): **55% GHG reduction by 2030 vs. 1990** (including LULUCF).<br>• The NECP draft specifies the overall share of **RES: 53.3% in 2030** WAM.<br>○ **Heating and cooling (RES-H&C): 49.2% in 2030.**<br>○ **Electricity (RES-E): 79.4% in 2030**<br>○ **Transport (RES-T): 24.4% in 2030.** |
| **North Macedonia** | • Enhanced NDC adopted in 2021.<br>• Draft NECP prepared in line with the 2040 Energy Strategy. | • The NDC aims to reduce total greenhouse gas emissions by 82% by 2030 compared to 1990 levels.<br>• According to the NECP, **RES should reach 38% of total energy consumption by 2030.**<br>○ **Heating and cooling (RES-H&C): 45% in 2030.**<br>○ **Electricity (RES-E): 66% in 2030**<br>○ **Transport (RES-T): 9% in 2030.** |
| **Serbia** | • Updated NDC (adopted in 2022).<br>• NECP – Adopted by the Government in July 2024. | • Serbia's NDC sets a 33% cut in total GHG emissions in 2030 compared to 1990 levels (without LULUCF). NECP specifies reduction of GHG emissions by 40% (with LULUCF) by 2030 compared to 1990 levels.<br>• According to the NECP, **RES should reach 33.6% of total energy consumption by 2030.**<br>○ **Heating and cooling (RES-H&C): 41.4% in 2030.**<br>○ **Electricity (RES-E): 45.2% in 2030**<br>○ **Transport (RES-T): 7% in 2030.** |

*Source: Authors' compilation based on NDCs and NECPs, including adopted and draft documents.*

**The 2030 targets show that the Western Balkans are aligning their strategic frameworks with EU expectations, but implementation remains uneven and depends heavily on governance capacity, financial mobilisation and regional coordination**. These climate and energy commitments provide a crucial context for understanding the role of Smart Specialisation Strategies in the region. The extent to which S3 can contribute to the green transition will depend on how effectively these targets are implemented through innovation investments, R&D priorities, and technology deployment in the coming decade.

**The survey suggests a significant disconnect between the ambition of national climate and energy frameworks and their perceived effectiveness in shaping private-sector investment behaviour.** When companies were asked to assess whether national regulatory frameworks encourage investments in energy efficiency, renewables, or process optimisation, responses were widely dispersed across the full spectrum, from 'not at all' to 'very strongly', indicating uneven policy reach and implementation. A substantial share of firms reported that national policies have limited influence on investment decisions, implying that decarbonisation actions are often driven more by market pressures

(energy costs and supply security) and external requirements (notably CBAM) than by domestic incentives. At the same time, a comparable share of respondents reported that policies do provide strong investment signals, suggesting that certain instruments, likely sector or technology-specific, are effective for particular groups of firms. These results reinforce the interview evidence that implementation and enforcement gaps, rather than the absence of strategic targets, remain a central constraint on the region's transition.

## 5.2 Implementation constraints and barriers

### 5.2.1 Institutional capacity to implement the energy transition: stakeholder perspectives

**Despite the formal strengthening of national climate and energy strategies across the Western Balkans, stakeholder assessments indicate that their effective implementation remains constrained by institutional capacity**. The survey evidence consistently points to a significant gap between formally adopted policy frameworks and their translation into concrete measures on the ground.

**Across the region, 59% of respondents rate national institutions as weak or very weak in their capacity to implement energy transition and decarbonisation policies, while 36% assess capacity as moderate**. Only 4% consider institutions strong, and none rate them as very strong, indicating a broadly shared perception of systemic implementation deficits. This pattern suggests that administrative capacity, enforcement capability, and technical expertise remain insufficient to support the scale and pace of transition implied by NECPs and long-term strategies.

**Weak vertical coordination between national and local institutions further constrains implementation**. Across the region, 64% of respondents assess coordination as weak or very weak, while only 9% consider it strong or very strong.

**Perceptions of the regulatory framework are somewhat more balanced, but still fragile**. A significant share of respondents (46%) describes regulatory frameworks as unclear or unstable, while 38% assess them as moderately clear, and only 15% consider them clear or very clear. Frequent regulatory changes, delayed secondary legislation, and inconsistent enforcement continue to undermine investment predictability, even where strategic targets are clearly defined.

**Financial support mechanisms are widely perceived as inadequate**. Around 65% of respondents rate existing financial support as not adequate or inadequate, while only 12% consider it adequate or very adequate. However, this perception should be interpreted with caution. While substantial financial resources are available through EU instruments and international financial institutions, these responses primarily reflect challenges related to access, project preparation, and the effective deployment of funds rather than their absolute absence. Limited project development capacity, perceived investment risks, and underdeveloped financial intermediation constrain the ability of firms and public entities to translate available funding into implemented investments, particularly in capital-intensive sectors such as power generation, industry, and district heating.

Table 5 summarises stakeholder assessments across four core dimensions of implementation capacity: institutional strength, vertical coordination, regulatory stability, and adequacy of financial support.

**Table 5.** Stakeholder assessment of institutional capacity and enabling conditions for the energy transition.

| **How would you rate the capacity of national institutions in your economy to implement energy transition and decarbonisation policies?** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Very weak (institutions lack the necessary capacity and resources) | | Weak (institutions have limited capacity, major gaps exist) | | Moderate (institutions have some capacity, but important weaknesses remain) | | Strong (institutions are generally capable, only minor gaps exist) | | Very strong (institutions are fully capable and effective in implementation) | |
| 24 | 24.24% | 35 | 35.35% | 36 | 36.36% | 4 | 4.04% | 0 | 0.00% |
| **How would you rate the level of coordination between national and local institutions?** | | | | | | | | | |
| Very Weak | | Weak | | Moderate | | Strong | | Very Strong | |
| 25 | 25.25% | 39 | 39.39% | 32 | 32.32% | 8 | 8.08% | 1 | 1.01% |
| **How clear and stable do you consider the regulatory framework for energy transition in your economy?** | | | | | | | | | |
| Very unclear/unstable (frequent changes, unclear rules) | | Unclear/unstable (some rules exist, but frequent gaps and changes) | | Moderate (partly clear and stable, but with weaknesses) | | Clear/stable (framework is mostly predictable and consistent) | | Very clear/stable (framework is fully transparent, consistent, and reliable) | |
| 13 | 13.13% | 33 | 33.33% | 38 | 38.38% | 13 | 13.13% | 2 | 2.02% |
| **How adequate is the current level of financial support (subsidies, tax incentives, loans) for accelerating the energy transition?** | | | | | | | | | |
| Not adequate at all (almost no financial support available) | | Inadequate (support exists but is very limited) | | Moderately adequate (some support available, but not sufficient) | | Adequate (support is generally sufficient, with some gaps) | | Very adequate (support is comprehensive and sufficient to accelerate transition) | |
| 15 | 15.15% | 49 | 49.49% | 22 | 22.22% | 11 | 11.11% | 1 | 1.01% |

*Source: Authors' calculations based on the survey results.*

### 5.2.2 Perceived barriers to the energy transition

**Stakeholder assessments provide a consolidated view of the perceived key obstacles slowing the energy transition across the Western Balkans**. Respondents were asked to rate the extent to which a predefined set of barriers represents an obstacle to the energy transition in their economy or sector, on a scale from 1 (not a barrier) to 5 (very significant barrier). The results reveal a clear hierarchy of constraints, dominated by governance, infrastructure, and financing-related factors.

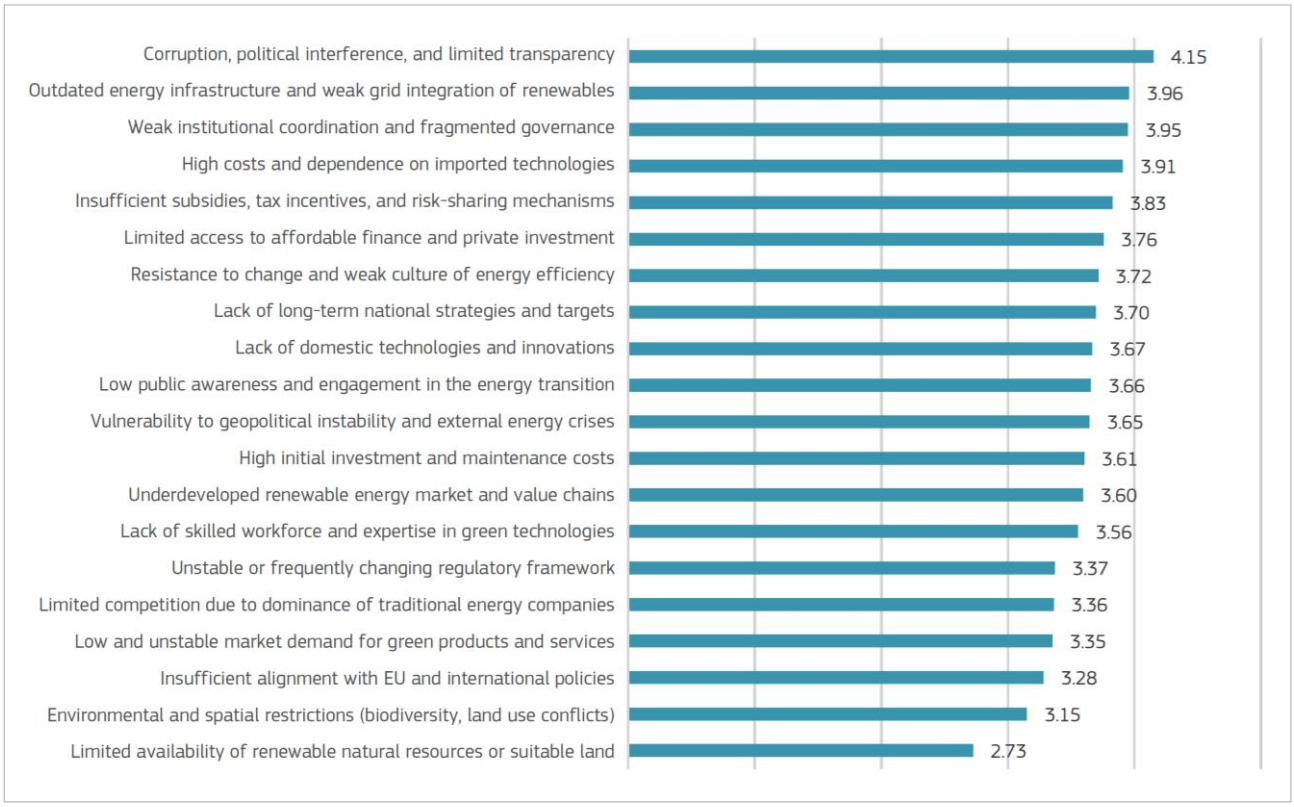
**The results point to governance-related barriers as the most severe constraints on the energy transition.** Corruption, political interference, and limited transparency rank as the perceived single most significant obstacle (average score 4.15), followed closely by outdated energy infrastructure and weak grid integration of renewables (3.96) and weak institutional coordination and fragmented governance (3.95).

**Financial and technological barriers form a second cluster of high-impact constraints**. High costs and dependence on imported technologies (3.91), insufficient subsidies and risk-sharing mechanisms (3.83), and limited access to affordable finance and private investment (3.76) underline the scale of the investment challenge facing the region.

**Societal and market-related factors, while still relevant, are perceived as comparatively less binding**. Low public awareness (3.66), resistance to change (3.72), and limited competition in energy markets (3.36) score lower than governance and infrastructure constraints, suggesting that institutional and structural bottlenecks currently outweigh behavioural barriers.

Notably, natural resource availability and spatial constraints receive the lowest average scores, indicating that the energy transition in the Western Balkans is constrained less by physical resource endowments and more by governance quality, institutional capacity, and investment conditions.

**Figure 35.** Stakeholder assessment of perceived key barriers to the energy transition (average scores: 1 = not a barrier, 5 = very significant barrier).




*Source: Authors' calculation based on the survey results.*

**The open-ended responses reinforce the quantitative findings by demonstrating that barriers to the energy transition in the Western Balkans are not primarily technological, but systemic - rooted in governance, institutional capacity, financing, and infrastructure.** While respondents were asked to identify a single dominant obstacle, their answers converge around a limited number of structural challenges, revealing how these barriers manifest in practice:

— **Governance-related constraints emerge as the most pervasive issue.** Corruption, political interference, lack of transparency, and the incompetence of decision-makers are repeatedly cited as perceived fundamental obstacles. These responses explain why governance-related barriers rank highest in the quantitative results, highlighting that institutional weaknesses undermine both policy credibility and investor confidence.

- **Respondents frequently point to fragmented and unstable institutional frameworks.** Weak coordination between national and sub-national authorities, overlapping competences, slow and unpredictable permitting procedures, and inconsistent regulatory signals are identified as major deterrents to investment. This is particularly evident in economies with complex governance structures, reinforcing the high scores attributed to weak institutional coordination and regulatory instability.
- **Financial constraints constitute a central barrier across sectors and economies.** Stakeholders emphasize limited access to affordable finance, insufficient public support mechanisms, and difficulties in mobilising private capital for new technologies. These concerns provide qualitative depth to the high quantitative scores associated with financing gaps and inadequate incentives.
- **Outdated energy infrastructure and grid limitations are frequently mentioned, especially in relation to the integration of renewable energy sources.** Respondents underline insufficient transmission and distribution capacity, lack of storage solutions, and slow infrastructure modernisation as binding constraints on the pace of transition.
- **Many responses highlight the absence of clear long-term strategic vision and political commitment.** Even where strategies and targets formally exist, stakeholders perceive weak enforcement, limited follow-through, and short-term political priorities as undermining effective implementation.
- **A smaller but consistent set of responses points to human capital shortages and low public awareness as additional constraints.** Lack of skilled professionals, insufficient institutional expertise, and limited societal understanding of the transition reduce the system's capacity to absorb and sustain change.

## 5.3 Reform Agendas and WBIF investments

**The Growth Plan for the Western Balkans provides a strategic framework for accelerating economic convergence with the European Union, with Reform Agendas serving as its central implementation instrument at the economy level.** These agendas define priority reforms and investment-related measures that economies must implement to access support under the Reform and Growth Facility, which links disbursement of EU funds to progress on agreed milestones. The Facility, with a total envelope of up to 6 billion euros for the period 2024-2027, combines grants and concessional loans, and is designed primarily to support policy and institutional reforms rather than large-scale capital investments. In the energy sector, the focus is on alignment with EU acquis and policy objectives, particularly in electricity market integration, renewable energy deployment, energy efficiency and decarbonisation. However, while Reform Agendas define the policy direction and establish the enabling conditions for the energy transition, their effective implementation depends on the availability of substantial investment resources. In this context, the WBIF plays a critical complementary role. WBIF provides blended finance, combining EU grants with loans from international financial institutions such as the European Investment Bank, European Bank for Reconstruction and Development and KfW Development Bank, as well as technical assistance for project preparation and implementation. This enables the translation of reform commitments into concrete infrastructure projects and system upgrades. The interaction between Reform Agendas and WBIF can be understood as a sequencing mechanism: reforms supported by the Reform and Growth Facility aim to remove regulatory and institutional barriers, while WBIF-financed investments operationalise these reforms through the development of physical infrastructure.

**Across the Western Balkans, the Reform Agendas show a clear set of shared priorities in the energy sector (Table 8).** All economies are working toward electricity market integration, including the development and coupling of day-ahead and intraday markets. Tariff reform is another common element, with a gradual shift toward cost-reflective pricing combined with targeted support for vulnerable consumers. There is also a strong push for renewable energy deployment through auctions, simplified permitting procedures and growing use of prosumer models and guarantees of origin. Each economy is also developing a decarbonisation framework, mainly based on NECPs, while preparing for carbon pricing through MRV systems and future participation in emissions trading. Just transition measures are also included in all economies, especially in coal regions, with an emphasis on employment, reskilling and local development.

**At the same time, the focus and level of development differ across economies.** Serbia and Bosnia and Herzegovina place more emphasis on gas market reform, which reflects their structural position and supply considerations. Montenegro and North Macedonia go further in terms of climate policy development, with more detailed approaches to ETS preparation and broader policy frameworks linked to NECP implementation. Kosovo* gives more attention to market functioning and flexibility, including storage and retail liberalisation. There are also differences in how just transition is organised, with North Macedonia and Serbia putting in place more structured governance mechanisms and clearer implementation steps.

**WBIF investments show that the regional investment pattern is focused on the physical transformation of the energy system, with priority given to infrastructure that supports market integration and renewable energy deployment (Table 8).** A large share of ongoing and planned projects is directed toward transmission networks and cross-border interconnections, improving regional integration and security of supply. Renewable energy investments, particularly in solar and wind, are complemented by grid reinforcement and digitalisation to support variable generation. Energy efficiency investments, especially in public buildings, are present across the region, while battery storage and system flexibility are increasingly included in project pipelines. WBIF support also covers heating system modernisation and gas infrastructure, contributing to diversification and system resilience.

**The alignment between WBIF investments and Reform Agenda priorities differs across economies**. In some cases, projects under implementation directly support key reform priorities, while in others, relevant investments are still in preparation. Table 6 summarises these differences by comparing Reform Agenda measures with WBIF investments across economies.

**Table 6.** Alignment between Reform Agenda measures and WBIF energy investments in the Western Balkans.

| Economy | Reform Agenda measures | WBIF investments (implementation and pipeline) | Alignment of WBIF investments with Reform Agenda measures |
|---|---|---|---|
| **Albania** | • Integrated electricity market development (day-ahead, intraday, market coupling, EU integration package).<br>• Tariff reform towards cost-reflective pricing, including measures for vulnerable consumers.<br>• Renewable energy expansion through auctions, regulatory alignment and permitting reform.<br>• Implementation of RED II (guarantees of origin, energy communities).<br>• Preparation for carbon pricing (MRV systems and ETS development). | **Implementation:**<br>• Transmission reinforcement (Tirana-Rrashbull).<br>• Albania-North Macedonia power interconnection.<br>• Vau i Dejës floating solar plant.<br>**Pipeline:** Offshore wind, additional transmission lines, storage solutions, hydropower rehabilitation, grid digitalisation. | • Strong alignment in market integration and renewable energy, supported by transmission and solar projects under implementation, with further expansion through pipeline investments.<br>• Investments in storage and system flexibility are mainly in the pipeline. |
| **Bosnia and Herzegovina** | • Electricity market reform (EU integration package, unbundling, nominated electricity market operator, day-ahead and intraday markets, market coupling).<br>• Gas market liberalisation (Third Energy Package alignment).<br>• Gradual tariff reform towards cost-reflective electricity pricing.<br>• Renewable energy deployment (auctions and permitting reform).<br>• Development of climate policy framework, including NECP implementation, MRV systems and preparation for ETS.<br>• Implementation of just transition measures in coal regions. | **Implementation:**<br>• Smart metering systems.<br>• Preparatory grid reinforcement for RES integration.<br>**Pipeline:** Wind farms, hydropower rehabilitation, battery storage, pumped storage, gas interconnection, energy efficiency projects | • Partial alignment, with current investments focused on energy efficiency and system operation.<br>• Renewable energy, storage and interconnection infrastructure remains largely in the pipeline. |
| **Kosovo*** | • Electricity market reform and integration (day-ahead market/intraday market, market coupling, retail liberalisation).<br>• Tariff reform towards market-based pricing.<br>• Renewable energy deployment (auctions, prosumers, permitting, storage).<br>• Development of MRV system and preparation for carbon pricing mechanisms.<br>• Just transition and social measures (vulnerable consumers and energy poverty support). | **Implementation:**<br>• Solar4Kosovo I (utility-scale solar).<br>• Solar4Kosovo II (solar district heating).<br>• Public sector energy efficiency.<br>**Pipeline:** Heating system modernisation, additional efficiency programmes, cross-border interconnections | • Strong alignment in renewable energy, and energy efficiency through projects under implementation, with additional support in the pipeline.<br>• Transmission and interconnection infrastructure for market integration remains limited in implementation. |

| | | | |
|---|---|---|---|
| **Montenegro** | • Electricity market integration and EU coupling (day-ahead market/intraday market, electricity market operator).<br>• Tariff reform and energy poverty measures.<br>• Renewable energy expansion (auctions, permitting, prosumers).<br>• Decarbonisation framework (NECP, MRV, ETS).<br>• Just transition in coal regions.<br>• Energy efficiency and building renovation. | **Implementation:**<br>• Trans-Balkan Electricity Corridor (regional transmission integration).<br>**Pipeline:** Substations, grid reinforcement, digitalisation (SCADA), regional gas infrastructure | • Alignment focused on transmission and regional integration.<br>• Renewable energy generation and energy efficiency investments remain limited in implementation. |
| **North Macedonia** | • Electricity market reform and integration.<br>• Tariff reform and reduction of price regulation with support for vulnerable consumers.<br>• Implementation of climate and energy policies under the NECP, including coal phase-out and decarbonisation measures.<br>• Just transition in coal regions (reskilling, re-employment).<br>• Renewable energy deployment (permitting, guarantees of origin, energy communities).<br>• Development of carbon pricing mechanisms (MRV system and preparation for ETS).<br>• Energy efficiency and buildings. | **Implementation:**<br>• Albania-North Macedonia power interconnection.<br>• North Macedonia – Greece Gas Interconnector.<br>• Oslomej solar plant,<br>• public sector energy efficiency.<br>**Pipeline:** Wind and solar expansion, hydropower rehabilitation, battery storage, grid digitalisation, gas interconnections | • Strong alignment across market integration, renewable energy and energy efficiency, supported by both implementation and pipeline projects<br>• Investments in storage are mainly in the pipeline and not yet implemented |
| **Serbia** | • Electricity and gas market reform (electricity integration package, third energy package for gas, market coupling, TSO unbundling).<br>• Tariff reform towards cost-reflective pricing with energy poverty measures.<br>• Just transition (Action Plan, governance structures, reskilling and regional development).<br>• Renewable energy deployment (permitting reform, prosumers, guarantees of origin, capacity expansion, alternative fuels).<br>• Carbon pricing (MRV and ETS preparation).<br>• Energy efficiency and buildings. | **Implementation:**<br>• Energy efficiency programmes (public buildings).<br>• Kostolac wind farm.<br>**Pipeline:** Transmission corridors (Trans-Balkan, Central), smart metering, solar projects, hydropower rehabilitation, district heating modernisation | • Strong alignment across energy efficiency, renewable energy and transmission, supported by projects under implementation and a broad pipeline.<br>• A large share of infrastructure investments remains in preparation. |

*Source: Authors' elaboration based on national Reform Agendas adopted under the Reform and Growth Facility for the Western Balkans available at: https://enlargement.ec.europa.eu/funding-technical-assistance/reform-and-growth-facility-western-balkans_en and WBIF project database, available at: https://wbif.eu/wbif-projects.*

A closer look at individual economies highlights important differences in how WBIF investments support the implementation of Reform Agenda measures in practice.

— **WBIF investments in Albania focus on transmission infrastructure and renewable energy diversification.** This directly supports Reform Agenda priorities related to electricity market integration and renewable deployment. Projects currently in implementation, such as the Tirana-Rrashbull transmission reinforcement and the Albania-North Macedonia interconnection address key bottlenecks in the grid and strengthen cross-border electricity exchange, while the Vau i Dejës floating solar plant contributes to diversification of a system heavily dependent on hydropower and reduces exposure to hydrological variability. The project pipeline includes further transmission expansion, offshore wind and storage. These projects are still in preparation, which delays improvements in system flexibility and the integration of variable renewable energy.

— **In Bosnia and Herzegovina, WBIF investments are focused on system efficiency and operational improvements, particularly through smart metering and preparatory grid upgrades.** This supports Reform Agenda priorities related to market functioning and cost-reflective pricing. The rollout of smart metering improves billing accuracy, reduces losses and increases transparency, while early-stage grid reinforcement creates the basis for future renewable integration. The project pipeline includes wind energy, hydropower rehabilitation, storage and gas interconnections. These investments are largely still in preparation, which limits their current contribution to renewable deployment, system integration and broader decarbonisation.

— **WBIF support in Kosovo* focuses on renewable energy deployment, heating decarbonisation and energy efficiency.** This supports Reform Agenda priorities related to reducing coal dependence and improving energy efficiency. The Solar4Kosovo photovoltaic plant contributes to diversification of the electricity mix, while Solar4Kosovo II introduces solar-based district heating, improving efficiency in urban heating systems. Additional investments in public sector energy efficiency further reduce energy intensity. The project pipeline includes further heating modernisation, efficiency improvements and interconnections. However, transmission and interconnection infrastructure supporting market integration remains limited in implementation.

— **WBIF investments in Montenegro focus on transmission infrastructure and regional integration.** This supports Reform Agenda priorities related to electricity market integration and system readiness for renewable energy. The Trans-Balkan Electricity Corridor enables cross-border electricity exchange, strengthens system stability and supports integration with EU electricity markets. The project pipeline includes grid reinforcement, digitalisation and regional gas infrastructure. Renewable energy generation and energy efficiency investments remain limited in implementation.

— **WBIF investments in North Macedonia combine transmission infrastructure, renewable energy deployment and energy efficiency.** This supports Reform Agenda priorities related to market integration, decarbonisation and energy efficiency. The Albania-North Macedonia interconnection strengthens regional integration and system balancing, while the Oslomej solar plant supports the transition from coal to renewable energy. Energy efficiency investments in public buildings further reduce energy consumption. The project pipeline includes storage, grid digitalisation and renewable expansion. These projects are still in preparation, delaying improvements in system flexibility.

— **WBIF investments in Serbia are among the most comprehensive in the region, combining energy efficiency improvements, renewable energy deployment and transmission infrastructure.** This supports Reform Agenda priorities related to market integration, decarbonisation and energy efficiency. Investments in public buildings reduce energy consumption, while the Kostolac wind farm contributes to diversification of the energy mix. The broader investment pipeline includes major transmission corridors, smart grid systems, renewable energy projects and hydropower rehabilitation, directly supporting reforms related to market integration, system flexibility and renewable expansion. A significant share of these investments remains in preparation, delaying full system impact.

## 5.4 Role of Smart Specialisation Strategies

Smart Specialisation Strategies have been adopted across all Western Balkan economies as a framework for prioritising research and innovation investments through the Entrepreneurial Discovery Process (EDP). Although S3 were initially designed to identify competitive domains and foster innovation-driven growth, recent policy and research literature highlights their potential to support sustainability objectives, including environmental and green transition goals. Joint Research Centre policy studies show how S3 approaches are being used to prioritise environmentally oriented activities and align regional innovation with climate and sustainability challenges (Harding et al., 2021; Nakicenovic et al., 2021; Miedzinski et al., 2022; Radovanovic and Stevanovic Carapina, 2024; Radovanovic et al., 2026). This shift reflects the region's shared structural challenges: high carbon intensity, slow diversification of renewable energy sources, outdated energy infrastructure, and limited R&D capacity, all of which require coordinated, knowledge-based responses.

**Findings from desk research and interviews conducted in all six Western Balkan economies confirm that the link between S3 and the green transition is now formally acknowledged.** However, the extent to which energy, decarbonisation and circular economy priorities are embedded in S3 processes varies significantly across economies, depending on the maturity of governance systems, institutional capacity, and the stage of S3 implementation. This aligns with the assessment of the Joint Research Centre (Radovanović and Stevanović Carapina, 2024; Radovanovic et al.; 2026), which notes that while most Western Balkan economies have incorporated elements of the Green Agenda into their S3 frameworks, the alignment between innovation policy and climate objectives remains incomplete. The report emphasises the need for stronger inter-ministerial coordination, clearer strategic coherence and more effective use of S3 as a vehicle for advancing decarbonisation and circular economy commitments.

### 5.4.1 State of the development of S3 in the Western Balkans

**Across the Western Balkans, the Smart Specialisation process shows markedly different levels of institutional maturity and implementation readiness. These differences influence how effectively S3 can support the green transition.** Serbia and Montenegro have fully adopted their strategies and are well into implementation, supported by dedicated innovation funding instruments. North Macedonia and Albania have also adopted their S3 strategies and initiated implementation, though both are still strengthening governance mechanisms, operational capacities, and stakeholder engagement. Kosovo* has made substantial progress with analytical work, priority identification, and EDP activities, but the strategy has not been formally adopted. Bosnia and Herzegovina remains at the earliest stage, having conducted quantitative and qualitative mapping in a highly fragmented governance context, which affects the scope and speed of S3 development.

**Despite these differences, interviews with S3 coordinators across all economies confirm that the S3 process has strengthened dialogue among government, academia, and the business sector**. However, respondents consistently highlight structural constraints, limited institutional capacity, fragmented governance, and insufficient R&D investment, as key barriers to translating S3 priorities, including those related to the green transition, into operational measures.

**Interviews further confirm that energy and decarbonisation are widely recognised within the S3 process, though with varying levels of formal integration (Table 7).** Albania and Montenegro designate these themes as explicit priority domains, while Kosovo* similarly identifies Green, Clean, and Efficient Energy as a core area emerging directly from the EDP. In Serbia and North Macedonia, energy-related topics appear mainly as horizontal, cross-cutting priorities, such as energy efficiency, eco-smart solutions, and the circular economy, yet stakeholders note that their operationalisation into concrete R&D measures remains limited. Bosnia and Herzegovina shows the least formalised integration, with energy and decarbonisation reflected only as cross-cutting enablers across mapped sectors. Overall, interviewees agree that although these themes are increasingly present in S3 narratives, their translation into targeted innovation actions remains incomplete.

**Table 7.** Positioning of energy and decarbonisation priorities within Smart Specialisation Strategies in the Western Balkans.

| Western Balkan Economy | Role of Energy and Decarbonisation in S3 process | Strategic Framing | Key Focus Areas (desk research + interviews) |
|---|---|---|---|
| **Albania** | Explicitly included | Priority domain: *Renewable Energy and Natural Resources* | Hydropower, diversification into solar/wind, resource management, clean energy leadership |
| **Bosnia and Herzegovina** | Cross-cutting priority | Energy and decarbonization are embedded across identified potential priority areas within mapping exercises | Energy efficiency; cleaner production; digital optimisation; emission reduction in traditional industries |
| **Kosovo*** | Explicitly included | Identified within the EDP: *Green, clean and efficient energy* | Renewables, smart grids, storage, energy efficiency |
| **Montenegro** | Explicitly included | Priority domain: *Energy and Sustainable Environment* (2019-2024), likely retained 2026-2031 | Renewables (hydro, wind, solar, biomass), energy efficiency, smart systems, $CO_2$ reduction, circular economy |
| **North Macedonia** | Cross-cutting priority | Horizontal domain: *Energy for the Future* | Renewable deployment, eco-solutions, circular economy, cross-sector links (agriculture, Information and communication technologies, tourism) |
| **Serbia** | Cross-cutting priority | Horizontal domain: *Energy Efficiency & Eco-smart Solutions* | Smart grids, biomass, solar, geothermal, waste-to-energy, eco-innovation, circular economy |

*Source: Authors' compilation based on national Smart Specialisation Strategies and JRC mapping studies (Fabbri et al., 2022; European Commission, JRC, 2021; Government of Montenegro, 2019; Government of the Republic of North Macedonia, 2023; Government of the Republic of Serbia, 2020), complemented by desk research and stakeholder interviews.*

### 5.4.2 Linking S3 Implementation to energy and decarbonisation priorities

**In economies where the S3 process has progressed into implementation, such as Montenegro, Serbia, and North Macedonia, the connection between S3 and the green transition is beginning to take more concrete shape**. Although still at an early stage and uneven across policy areas, these economies have introduced various policy instruments that support applied research in green technologies, strengthen laboratory and testing capacities, and encourage science-industry collaboration. Support for SMEs is also prominent, especially through advisory services related to energy efficiency, circular economy practices, and preparations for low-carbon transition requirements. In Serbia, national research funding instruments, such as the Science Fund's programmes, provide an additional channel for supporting applied R&D relevant to the green transition.

**Despite these developments, interviews highlight that significant implementation challenges persist**. Limited funding, fragmented institutional responsibilities, and the lack of fully operational governance structures continue to constrain the impact of these measures. Stakeholders note that without more sustained financial commitments and stronger coordination between innovation and energy policy institutions, S3-related support for decarbonisation may remain too modest to drive broader structural change. Even so, the emerging mix of R&D support, capacity-building initiatives, and incentives for industrial innovation suggests that S3 is gradually being used as a platform to align innovation policy with the priorities of the green transition.

**These findings are also in line with main conclusions from other Joint Research Centre studies on smart specialisation strategies in the region (Radovanovic et al. 2026).** Clean energy is a common S3 priority across the region, however, energy decarbonisation alone does not deliver results unless combined with innovation systems upgrading, enhanced digitalisation, and sustainable economic transformation pathways. Progress in shifting toward renewable energy and more sustainable systems is underway, but it is uneven and often constrained by weak institutions, limited data, and insufficient technical capacity. Challenges such as skills shortages, governance fragmentation, and lack of coordination continue to slow down progress.

**Within Smart Specialisation approaches, regions are encouraged to identify and build on their existing strengths, meaning that energy transition pathways differ depending on local industrial structures, skills, and innovation capacities**. This makes decarbonisation not only a climate objective but also a driver of regional economic transformation. Strengthening energy efficiency, improving resource use, and fostering collaboration across regions and sectors are therefore essential to accelerate both decarbonisation and regional innovation performance.

# 6 Conclusions and Policy Recommendations

## 6.1 Conclusions

The study has examined the energy systems, decarbonisation pathways, and competitiveness implications of the green transition across the Western Balkans within the broader context of EU climate policy, the Competitiveness Compass, and accession-related obligations. The analysis shows that the region faces a structurally demanding transition, shaped by high carbon intensity, ageing infrastructure, and a delayed shift toward binding climate governance, while simultaneously being exposed to accelerating external pressures such as CBAM and deeper EU market integration.

**A central conclusion is that most Western Balkan economies remain structurally locked into carbon-intensive energy systems.** Coal and oil continue to dominate the energy mix, with lignite playing a particularly critical role in electricity generation in Bosnia and Herzegovina, Serbia, Kosovo*, and North Macedonia. While renewable energy shares appear relatively high in aggregate statistics, this is largely driven by hydropower and traditional biomass, rather than by diversified deployment of modern renewables such as solar and wind. As a result, energy systems remain vulnerable to hydrological variability, climate shocks, and supply disruptions, as demonstrated during recent drought periods that reduced hydropower output and increased reliance on electricity imports.

**Although solar and wind deployment is accelerating and project pipelines now exceed 8 GW across the region, the translation of planned capacity into operational generation is increasingly constrained by infrastructure bottlenecks.** Transmission and distribution losses remain well above EU levels, reflecting ageing networks, chronic underinvestment, and weak system management. Distribution grids, originally designed for unidirectional power flows, are already under pressure from the rapid expansion of small-scale solar PV, while utility-scale projects face long and uncertain grid connection procedures. Without parallel investment in grid modernisation, storage, and balancing capacity, renewable deployment risks outpacing system readiness, undermining both supply security and investor confidence. Grid investment therefore emerges as the single highest-leverage intervention for both decarbonisation and competitiveness

**Energy transition challenges are closely linked to competitiveness outcomes. High energy and carbon intensity persist across most Western Balkan economies, and while the carbon intensity of GDP has declined, total emissions have largely stagnated.** This places the region in a partial decoupling trap and increases exposure to EU climate instruments, particularly CBAM, which will begin to impose tangible material cost pressures on electricity exports and energy-intensive industries from 2026. Survey results and stakeholder interviews confirm that firms already anticipate rising costs, even where energy efficiency investments have been made, highlighting the growing interaction between climate policy and competitiveness.

**At the same time, the report underscores pronounced heterogeneity across the Western Balkans.** Albania stands out with an electricity system almost entirely based on renewable sources, primarily hydropower, while most other economies remain structurally dependent on coal-based generation. Industrial structures also differ significantly across the region, shaping both energy demand and exposure to decarbonisation pressures. These differences confirm that there is no single transition pathway for the Western Balkans. Effective policy design must therefore be tailored to national energy mixes, industrial profiles, and economy-specific climate and transition risks.

**The timing of the transition is another critical dimension. For most Western Balkan economies, binding climate and energy governance is a relatively recent development, following**

**commitments under the Paris Agreement and gradual alignment with EU frameworks through the Energy Community.** Unlike many EU Member States, which have pursued decarbonisation for decades, the region is still in the early stages of building institutions, regulatory systems, and implementation capacity. Progress therefore needs to be assessed considering this late-starter position, rather than solely against EU benchmarks.

**Across all economies, challenges related to the effective mobilisation and deployment of financial resources emerge as a key constraint on implementation.** While significant financial support is available through EU instruments and international financial institutions, including the Economic and Investment Plan, the Growth Plan for the Western Balkans, and the Western Balkans Investment Framework, the scale of investment required to fully implement National Energy and Climate Plans remains substantial. In this context, the main challenge lies not only in the availability of funding, but in the capacity to develop bankable projects, manage risks, and absorb available financial resources. Survey evidence indicates that green investments are still largely financed through internal company resources, while commercial banks show limited risk appetite and sector-specific expertise. This points to the need for stronger financial intermediation, improved project pipelines, and expanded use of de-risking and blended-finance instruments to bridge the gap between strategic ambition and effective implementation.

**Recent policy developments under the Growth Plan for the Western Balkans confirm this pattern.** Reform Agendas provide a clear and largely harmonised policy framework across economies, while WBIF investments increasingly support core infrastructure needs, particularly in transmission, renewable energy and energy efficiency. However, the analysis shows that the main challenge lies in the translation of these frameworks into implemented projects. In many cases, critical investments remain in the pipeline, while implementation capacity and project preparation continue to limit the speed and scale of the transition.

**Governance and institutional capacity represent an equally critical bottleneck.** Although national strategies and NECPs increasingly align with EU objectives, implementation gaps remain substantial. Weak enforcement, fragmented institutional responsibilities, delayed secondary legislation, and shortages of specialised technical skills continue to undermine policy credibility and investment predictability. Survey results indicate that governance-related barriers are perceived as more binding than technological or resource constraints, suggesting that the effectiveness of the transition depends less on physical potential and more on institutional performance.

**Energy security and geopolitical vulnerability further complicate the transition.** While the Western Balkans appear less import-dependent than the EU on paper, this is largely due to reliance on domestic coal and hydropower. In practice, droughts, outages in thermal generation, and limited diversification of supply sources have already exposed economies to volatile electricity imports and global price shocks. Continued dependence on a narrow set of fuels and suppliers adds an additional layer of risk in the current geopolitical context.

**Most Western Balkan economies are approaching the introduction of CBAM without a clear and comprehensive response strategy.** Carbon pricing frameworks are still under development, and in many cases there is limited clarity on how revenues from carbon-related instruments will be used. If reinvested into green infrastructure, innovation, and skills, carbon pricing could become a driver of competitiveness and structural transformation. However, the absence of clear reinvestment mechanisms risks turning CBAM into a fiscal burden rather than a tool for accelerating the transition. This further reinforces the importance of linking carbon pricing frameworks with investment support and implementation capacity, as highlighted by the interaction between Reform Agendas and WBIF investments.

## 6.2 Key Policy Recommendations

The findings of this report point to a clear conclusion: the energy transition in the Western Balkans is no longer primarily constrained by the absence of strategic frameworks, but by the limited capacity to implement them at scale. While alignment with EU climate and energy policies has progressed, persistent gaps in infrastructure, institutional capacity, skills, and the ability to effectively mobilise and absorb available financial resources continue to slow down decarbonisation and weaken competitiveness. The following recommendations therefore focus on shifting policy attention from formal alignment towards implementation, capital mobilisation, and system-level transformation. They are addressed to national governments, EU institutions, international financial partners, and regional stakeholders involved in shaping the Western Balkans' green transition:

- **Prioritise grid modernisation as a precondition for renewable deployment and competitiveness.** Grid modernisation should be treated as a strategic priority rather than a complementary investment. Outdated transmission and distribution networks across the Western Balkans already constrain the integration of new renewable capacity, reduce supply reliability for industry, and increase system losses. Without substantial investment in grid reinforcement, digitalisation (including SCADA systems), balancing capacity, and storage, further renewable deployment risks creating instability rather than strengthening energy security. Policymakers should ensure that renewable targets are systematically aligned with grid investment plans, and that EU and IFI support explicitly prioritises system-level infrastructure alongside generation projects.
- **Shift EU support from regulatory alignment towards capital mobilisation.** While legal and regulatory alignment with EU energy and climate frameworks has advanced, challenges remain in effectively mobilising and accessing available financing at scale. Although significant financial support is already provided through EU instruments such as the Economic and Investment Plan, the Growth Plan, and the Western Balkans Investment Framework (WBIF), barriers related to project preparation, risk perception, and institutional capacity continue to limit the full utilisation of these resources. EU support to the Western Balkans could therefore increasingly focus on strengthening financial intermediation, expanding blended finance instruments, guarantees, and risk-sharing mechanisms, and improving the pipeline of bankable projects.
- **Accelerate the transition from project pipelines to implementation.** Across the Western Balkans, a significant share of WBIF-supported investments remains in preparation, particularly in areas critical for system transformation such as transmission expansion, storage and renewable integration. Policymakers and financial partners should prioritise the rapid maturation of these projects by strengthening project preparation facilities, streamlining permitting procedures, and improving coordination between reform planning and investment pipelines. Ensuring that priority measures identified in Reform Agendas are matched with projects ready for implementation is essential to avoid delays in system-level impact.
- **Align carbon pricing and CBAM implementation with investment support.** Carbon pricing instruments, including CBAM and emerging national $CO_2$ charges, could be further designed not only as compliance mechanisms but as tools for structural transformation. Revenues generated through carbon pricing could be transparently earmarked for investments in industrial decarbonisation, energy efficiency, innovation, and skills development. Without such reinvestment mechanisms, carbon pricing might risk becoming a fiscal burden that undermines competitiveness rather than accelerating the transition of carbon-intensive sectors.

- **Strengthen enforcement and implementation of existing energy and environmental legislation.** Regulatory alignment alone is insufficient if enforcement remains weak. Delayed secondary legislation, limited inspection capacity, and low sanctions for non-compliance reduce policy credibility and discourage investment. Strengthening enforcement mechanisms, increasing institutional capacity for monitoring and verification, and ensuring timely adoption of implementing bylaws are essential to translate strategic targets into real-world outcomes.
- **Improve regulatory predictability through stronger integration of technical expertise.** Frequent changes in strategies and regulatory frameworks reflect insufficient integration of technical expertise into policymaking processes. Strengthening the role of professional and scientific expertise in long-term planning would improve policy continuity, reduce regulatory uncertainty, and enhance investor confidence. Stable, evidence-based policymaking should be prioritised over frequent strategic revisions that undermine predictability.
- **Scale up targeted support for energy efficiency and waste heat recovery in industry.** Mature and cost-effective energy efficiency technologies remain underutilised due to long payback periods and investment risk. Dedicated grant-loan blending instruments, de-risking mechanisms, and targeted support for waste heat recovery could significantly accelerate uptake, reduce emissions, and lower exposure to energy price volatility, particularly in energy-intensive sectors.
- **Address skills shortages and territorial disparities as part of the just transition.** A structural shortage of specialised skills in energy efficiency, emissions monitoring, and decarbonisation planning constrains implementation, especially in smaller municipalities and industrial regions. Targeted training programmes, regional competence centres, and partnerships with vocational and higher education institutions should accompany industrial transition efforts. Addressing territorial skills gaps is essential to ensure that decarbonisation does not exacerbate regional inequalities.
- **Strengthen regional interconnections and diversification to enhance energy security.** Diversification of supply sources and stronger regional interconnections are essential to reduce exposure to price volatility, supply disruptions, and geopolitical risks. Although reliance on domestic coal and hydropower creates an appearance of lower import dependence, recent shocks have demonstrated the region's vulnerability to droughts and outages. Enhanced regional cooperation and cross-border infrastructure would strengthen both energy security and market integration.
- **Integrate social dialogue and environmental governance into energy policy frameworks.** Environmental activism and social acceptance risks increasingly shape the feasibility of large-scale energy projects. Effective policy frameworks should therefore integrate social dialogue, transparent decision-making, and environmental governance alongside technical and financial instruments. Early stakeholder engagement can reduce delays, strengthen legitimacy, and improve long-term policy sustainability.

— **Use Smart Specialisation and place-based transformation frameworks to pilot and scale innovative solutions for the energy transition.** Smart Specialisation strategies and placed-based transformation frameworks[6] provide an important platform for identifying and testing innovative solutions that can support decarbonisation and industrial transformation in the Western Balkans. Policy instruments such as regulatory sandboxes, co-creation mechanisms, and innovative public procurement can enable experimentation with new technological and organisational approaches in areas including renewable integration, energy efficiency, circular economy solutions, and smart energy systems. However, the impact of such initiatives will remain limited unless effective mechanisms are established to scale successful pilots into broader system-level deployment. Strengthening the link between S3-driven experimentation, regulatory adaptation, and large-scale investment programmes would help transform promising pilot initiatives into scalable solutions capable of supporting long-term competitiveness and the structural transformation of energy systems across the region.

Across all policy areas, improving the capacity to design, finance, and implement bankable projects will be critical to ensuring that existing EU support instruments translate into tangible outcomes on the ground.

6 Preparatory Action (2024-2026) - Innovation for place-based transformation

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# List of abbreviations and definitions

| Abbreviations | Definitions |
|---|---|
| CBAM | Carbon Border Adjustment Mechanism |
| CEE | Central and Eastern Europe |
| $CO_2$ | Carbon Dioxide |
| EDP | Entrepreneurial Discovery Proces |
| EIP | Economic and Investment Plan |
| EU | European Union |
| EU ETS | European Union Emissions Trading System |
| EU-27 | European Union (27 Member States) |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GW | Gigawatt |
| GJ | Gigajoule |
| H&C | Heating and Cooling |
| IEA | International Energy Agency |
| JRC | Joint Research Centre (European Commission) |
| kgoe | Kilogram of Oil Equivalent |
| kWh | Kilowatt-hour |
| ktoe | Kilotonne of Oil Equivalent |
| LNG | Liquefied Natural Gas |
| LULUCF | Land Use, Land-Use Change and Forestry |
| MRV | Monitoring, Reporting and Verification |
| $MtCO_2$ / $MtCO_2e$ | Million Tonnes of Carbon Dioxide / Carbon Dioxide Equivalent |
| MW | Megawatt |
| NDC | Nationally Determined Contribution |
| NECP | National Energy and Climate Plan |
| OECD | Organisation for Economic Cooperation and Development |

| Abbreviations | Definitions |
|---|---|
| PM2.5 | Particulate Matter with Diameter ≤ 2.5 Micrometres |
| PPS | Purchasing Power Standard |
| PV | Photovoltaic (solar power) |
| R&D | Research and Development |
| RES | Renewable Energy Sources |
| RES-E | Renewable Energy Sources in Electricity |
| RES-H&C | Renewable Energy Sources in Heating and Cooling |
| RES-T | Renewable Energy Sources in Transport |
| S3 | Smart Specialisation Strategy / Strategies |
| SCADA | Supervisory Control and Data Acquisition |
| SME | Small and Medium-sized Enterprise |
| Toe | Tonne of Oil Equivalent |
| TRL | Technology Readiness Level |
| WB | Western Balkans |
| WAM | With Additional Measures |
| WEM | With Existing Measures |
| WBIF | Western Balkans Investment Framework |

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## Annex 1. Stakeholder survey questionnaire and sample composition

The survey was conducted between 10 and 25 November 2025 and collected a total of 99 valid responses from stakeholders across the Western Balkans. Respondents represent a diverse range of institutions, including private companies, public authorities, research organisations, and civil society. The questionnaire was designed to capture perceptions of the energy transition, decarbonisation challenges, competitiveness, and key implementation barriers.

### Survey sample composition

**Table 8.** Distribution of responses by Western Balkan economy.

| Western Balkan Economy | Number of responses | Share |
|---|---|---|
| **Albania** | 10 | 10.1% |
| **Bosnia and Herzegovina** | 25 | 25.3% |
| **Kosovo*** | 7 | 7.1% |
| **Montenegro** | 11 | 11.1% |
| **North Macedonia** | 9 | 9.1% |
| **Serbia** | 37 | 37.4% |
| **Total** | 99 | 100% |

*Source: Authors' calculations based on the survey results.*

**Table 9.** Distribution of responses by stakeholder type.

| Stakeholder type | Number of responses | Share |
|---|---|---|
| **Private company** | 18 | 18.2% |
| **Research institution/University** | 28 | 28.3% |
| **Government institution/Regulatory body** | 14 | 14.1% |
| **Non-governmental organization** | 33 | 33.3% |
| **Other** | 6 | 6.1% |
| **Total** | 99 | 100% |

*Source: Authors' calculations based on the survey results.*

## Survey questionnaire

The following questionnaire was used in the survey.

**ENERGY TRANSITION AND DECARBONISATION IN THE WESTERN BALKANS: STAKEHOLDER PERSPECTIVES**

1. **Please indicate which Western Balkan economy you are from:**
   - Albania
   - Bosnia and Herzegovina
   - Montenegro
   - Kosovo*
   - North Macedonia
   - Serbia

2. **What type of organisation do you represent?**
   - Private company
   - Research institution / university
   - Government institution / regulatory body
   - Non-governmental organisation
   - Other (please specify)

3. **Number of employees in your company:**
   - 0-10
   - 11-50
   - 51-250
   - 250+

4. **In which sector do you operate?**
   - Energy (generation, distribution)
   - Energy-intensive industries (e.g. steel, cement, chemicals, fertilizers)
   - Manufacturing / processing industry
   - Services / IT / consulting
   - Other (please specify)

5. **Has your company invested in energy efficiency measures or renewable energy in the past 3 years (2022-2024)?**
   - Yes, we have invested significantly (major projects or high share of investment budget) – (over 15% of our annual investment budget)
   - Yes, we have invested moderately (5-15% of our annual investment budget)
   - Yes, we have invested partially (some projects or a minor share of our budget) – (less than 5% of our annual investment budget)
   - No, but we are planning to invest in the next 3 years (2025-2027)
   - No, and we have no investment plans

6. **To what extent do you expect EU green transition regulations (e.g. ETS, CBAM, environmental and sustainability standards) to increase your business costs in the next 5 years (2025-2029)?**
   - Not at all (no expected cost increase)
   - Slight increase (up to 5-10% higher costs)
   - Moderate increase (10-20% higher costs)
   - Significant increase (20-40% higher costs)
   - Very large increase (over 40% higher costs)

7. **To what extent do national regulatory policies in the area of energy and decarbonization encourage your company to invest in new technologies or processes (energy efficiency, renewable energy, emission reduction)?**
   - Not at all (It will have no effect on investment decisions)
   - Slightly (some minor influence, but not decisive)
   - Moderately (policies will influence part of our investment decisions)
   - Strongly (policies will have a significant influence on investments)
   - Very strongly (policies will be a decisive factor for major new investments)

8. **How do you assess the impact of the energy transition on your overall competitiveness in the next 5 years (2025-2029)? It will significantly reduce our competitiveness (major negative impact on costs, exports, or market position)**
   - It will somewhat reduce our competitiveness (moderate negative effects expected)
   - It will not significantly affect our competitiveness (no major change expected)
   - It will somewhat increase our competitiveness (new opportunities may outweigh the costs)
   - It will significantly increase our competitiveness (strong positive effect through innovation, efficiency, and new markets)

9. **How would you rate the capacity of national institutions in your economy to implement energy transition and decarbonisation policies?**
   - Very weak (institutions lack the necessary capacity and resources)
   - Weak (institutions have limited capacity, major gaps exist)
   - Moderate (institutions have some capacity, but important weaknesses remain)
   - Strong (institutions are generally capable, only minor gaps exist)
   - Very strong (institutions are fully capable and effective in implementation)

10. **How would you rate the level of coordination between national and local institutions?**
    - Very weak
    - Weak
    - Moderate
    - Strong
    - Very strong

11. **How clear and stable do you consider the regulatory framework for energy transition in your economy?**
    - Very unclear/unstable (frequent changes, unclear rules)
    - Unclear/unstable (some rules exist, but frequent gaps and changes)
    - Moderate (partly clear and stable, but with weaknesses)
    - Clear/stable (framework is mostly predictable and consistent)
    - Very clear/stable (framework is fully transparent, consistent, and reliable)

12. **How adequate is the current level of financial support (subsidies, tax incentives, loans) for accelerating the energy transition?**
    - Not adequate at all (almost no financial support available)
    - Inadequate (support exists but is very limited)
    - Moderately adequate (some support available, but not sufficient)
    - Adequate (support is generally sufficient, with some gaps)
    - Very adequate (support is comprehensive and sufficient to accelerate transition)

13. **Please rate to what extent each of the following barriers represents an obstacle to the energy transition in your economy/sector (1 = not a barrier, 5 = very significant barrier).**
    Political-regulatory barriers
    - Unstable or frequently changing regulatory framework
    - Lack of long-term national strategies and targets
    - Weak institutional coordination and fragmented governance

- Corruption, political interference, and limited transparency
- Insufficient alignment with EU and international policies.

Technological barriers

- Lack of domestic technologies and innovations
- High costs and dependence on imported technologies
- Outdated energy infrastructure and weak grid integration of renewables

Economic-financial barriers

- High initial investment and maintenance costs
- Limited access to affordable finance and private investment
- Insufficient subsidies, tax incentives, and risk-sharing mechanisms

Market barriers

- Underdeveloped renewable energy market and value chains
- Limited competition due to dominance of traditional energy companies
- Low and unstable market demand for green products and services.

Socio-cultural barriers

- Low public awareness and engagement in the energy transition
- Resistance to change and weak culture of energy efficiency
- Lack of skilled workforce and expertise in green technologies

Geographic-ecological barriers

- Limited availability of renewable natural resources or suitable land
- Environmental and spatial restrictions (biodiversity, land use conflicts)

Geopolitical and external barriers

- Vulnerability to geopolitical instability and external energy crises

**14. In your view, what is the single biggest barrier to the energy transition in your sector/country?**

## Annex 2. Interview framework and guiding questions by stakeholder category

This annex presents the semi-structured interview guidelines used in the study. Interviews were conducted with different stakeholder groups, including policymakers, energy companies, industry representatives, independent experts, and S3 coordinators, with questions tailored to their specific roles.

**Policymakers & regulators (Ministries of Energy, Environment, Economy; regulatory agencies)**

1. The Western Balkans are expected to align progressively with the EU's climate and energy objectives, including the Green Agenda, NECPs, and national contributions under the Paris Agreement. How would you assess your country's alignment with EU climate and energy targets (NECPs, NDCs, Green Agenda)?
2. While many strategies and plans have been adopted, their implementation often faces practical and political challenges. We are interested in understanding these obstacles from your perspective. What are the main gaps or challenges in implementing these strategies?
3. Beyond strategic ambitions, the success of the transition often depends on the regulatory and institutional framework. For example, how easy it is to get permits for renewable projects, access the grid, or how subsidies influence investment decisions. Do you see regulatory or institutional barriers that slow down the green transition (e.g. permitting, grid access, subsidies for coal)?
4. Every country faces choices about where to focus first in its decarbonisation efforts, depending on energy mix, economic structure, and available resources. Which sectors or measures are currently the highest priority for decarbonisation?
5. Timelines are a critical part of transition planning, particularly for coal phase-out, renewable integration, and efficiency measures. Are there specific timelines for coal phase-out, renewable integration, or energy efficiency improvements?
6. The regulatory framework plays a major role in either enabling or slowing down investment in clean energy solutions. How effective are current regulations in supporting renewables, energy efficiency, and clean technologies?
7. Investors often point to practical barriers such as permitting, licensing, and access to the electricity grid as critical bottlenecks. Do you see barriers in permitting, licensing, or grid access for investors?

8. Strong institutions with sufficient expertise and resources are essential for designing and implementing ambitious energy transition policies. In your view, what capacities or resources are missing at the institutional level to advance the green transition?
9. Energy and climate issues often cut across several ministries and agencies, making coordination and monitoring a challenge. How are coordination and monitoring across ministries handled?
10. What do you see as the biggest challenges for your country in the energy transition?
11. Different parts of the energy system — electricity, heating, transport, industry — have varying degrees of vulnerability to shocks, such as price volatility, supply disruptions, or climate events. Which parts of the energy system (power, heating, transport, industry) are most vulnerable to future shocks?
12. International support, both technical and financial, is a significant driver of transition efforts in the Western Balkans. What support would be most valuable from the EU, Energy Community, or international partners?

**Energy Companies & Utilities (State-owned energy companies, grid operators)**

1. Energy companies play a central role in shaping the pace and direction of the transition. Their strategies and decisions directly affect how fast the energy mix changes. How do you see your role in the transition to a cleaner energy mix?
2. Decarbonisation requires long-term investment in new generation, efficiency, and infrastructure. We are interested in understanding what is already in motion. What investment plans (renewables, efficiency, grid modernisation) are currently underway?
3. Across the region, renewable projects often face delays due to financing difficulties, administrative procedures, or technological constraints. What are the main obstacles for deploying new renewable capacity (e.g. permitting, financing, technology)?
4. Energy markets are increasingly exposed to volatility, regulatory pressures, and new EU measures such as the CBAM. Companies need to adapt to these risks. How do you handle risks related to energy price volatility, security of supply, or CBAM?
5. New technologies such as energy storage, smart grids, and digital solutions are becoming critical for integrating renewables and improving efficiency. Are you investing in storage, smart grids, or digital solutions?
6. In many countries, autoproducers and prosumers, companies or households generating their own electricity, often from solar, are increasingly shaping the energy landscape. How do you see the role of autoproducers/prosumers evolving in your country?
7. The transition often requires strong policy frameworks, financing mechanisms, and technical expertise to overcome barriers. What policy, financial, or technical support would most help your transition?
8. EU and international programmes provide significant funding for renewables and green transition in the Western Balkans. How important is EU funding (IPARD, IPA, IFI loans…) for your investment plans?

**Businesses & Industry – Energy-Intensive Sectors (Steel, cement, aluminium, chemicals; large industrial companies)**

1. Energy-intensive companies are directly exposed to fluctuations in electricity and gas prices, which can significantly affect competitiveness. How have rising energy prices affected your competitiveness?
2. Many companies are trying to lower costs through efficiency measures or by producing part of their own energy. Are you taking measures to reduce energy costs through efficiency or self-production?
3. The EU's climate agenda, including the CBAM, is likely to affect energy-intensive exporters in the region. How prepared is your company/sector for CBAM and other EU climate measures?
4. Carbon costs can directly impact the price competitiveness of exports to the EU market. Do you expect carbon costs to affect your export competitiveness?
5. Decarbonisation requires investment in cleaner technologies and processes. Are you investing (or planning to invest) in renewable energy, efficiency, or clean technologies?
6. Access to finance can be a decisive factor for companies willing to modernise their production and reduce emissions. What has been your experience with accessing finance for such projects?
7. Even when companies are willing to act, they often encounter obstacles along the way. What are the main regulatory, financial, or technical barriers to implementing decarbonisation measures?
8. The transition also requires skilled workers and managers who understand new technologies and processes. Do you face skills or knowledge gaps in workforce or management?

9. National governments, the EU, and international institutions provide a variety of support instruments for green investments. What type of support would help you most (national incentives, EU programmes, IFI loans, skills development)?
10. While the transition is challenging, it may also create opportunities for new products, services, or market positions. Do you see opportunities for your sector in the green transition (e.g. producing green materials, services)?

**Independent experts**

1. The Western Balkans remain heavily reliant on fossil fuels, especially lignite, while the EU is rapidly diversifying. How would you assess your country's progress in reducing coal dependence and increasing renewables compared to EU trajectories?
2. Some progress has been made in renewables or efficiency, but gaps remain visible across the region. What do you see as the most significant achievement so far in your country, and what remains the biggest gap in the transition?
3. Coal, especially lignite, still dominates electricity generation in several WB economies. To what extent does reliance on lignite in your country block decarbonisation, and are there credible replacement plans?
4. Different factors can slow down the decarbonisation of the economy. For example: lack of political will, weak institutions and regulation, limited financing, social resistance in coal regions, and similar. From your perspective, which of these factors are the most important in your country? Could you indicate which ones are critical?
5. The region has significant untapped renewable potential, but investment remains low. Which renewable sources, solar, wind, hydro, or biomass, have the highest potential in your country, and why are they underutilised?
6. Some solutions, like rooftop solar or modernising heating systems, can be introduced quickly without major reforms. Which quick and realistic measures could your country implement in the next 3-5 years?
7. The EU's CBAM will directly affect exports from carbon-intensive industries. How exposed is your country's industry to CBAM, and are companies preparing adequately?
8. EU alignment requires long-term reforms in energy and climate policy. In your view, is your government realistically preparing for EU integration in this field, or is the gap with EU standards still widening?
9. Some reforms are more urgent than others to accelerate transition. Which single reform do you see as the most urgent for your country's government to implement?
10. Financing remains one of the biggest bottlenecks for clean energy projects. Where do you see the largest financing gaps in your country, grid infrastructure, renewable deployment, or energy efficiency?
11. The EU and international donors play a key role in supporting reforms. What should be their priority role in helping your country - more funding, stronger governance support, or technical expertise?
12. Looking 5-10 years ahead helps us understand where the transition is heading. What do you realistically expect your country's energy mix to look like in a decade, in terms of coal, renewables, and gas?
13. Delays in reforms and investments carry clear risks for competitiveness and security. What are the biggest risks for your country if reforms and investments are postponed?
14. If you had one message for decision-makers, it should capture the top priority for action. If you could recommend one priority measure to your government, what would it be?

**S3 coordinators**

1. Have research and development in the field of energy and decarbonisation been recognised as an important topic during the preparation of the S3 and the EDP workshops?
2. If so, how have these priorities been integrated into the S3 document itself, or, where the document has not yet been adopted, into the EDP reports (qualitative analysis)?
3. In what way do you expect research and development in the field of energy and decarbonisation to be reflected through measures and activities in the forthcoming Action Plan?
4. Are there already planned instruments or initiatives aimed at supporting R&D projects in this field?

## Annex 3. List of interviewed stakeholders

The list below presents the stakeholders interviewed and consulted as part of the study.

1. Aleksandar Latinović, Electric Power Industry of Serbia, Serbia
2. Aleksandar Zlatković, Ministry of Mining and Energy, Serbia
3. Biljana Ramić, Ministry of Mining and Energy, Serbia
4. Boško Borojević, Chamber of Commerce of the Republic of Srpska, Bosnia and Herzegovina
5. Ivana Ćurčić, PWO SEE Serbia, Serbia
6. Ivana Janković Mijanović, Ministry of Education, Science and Innovation, Montenegro
7. Jasmina Majstoroska, Ministry of Economy and Labour, North Macedonia
8. Marijana Galić, S3 independent expert, Bosnia and Herzegovina
9. Nada Nedeljković, Moravacem d.o.o., Serbia
10. Ognjenka Lalović, Foreign Trade Chamber of Bosnia and Herzegovina, Bosnia and Herzegovina
11. Ranko Vukmirović, Chamber of Economy of Montenegro, Montenegro
12. Savica Vujičić, S3 coordinator, Ministry of Education, Science and Innovation, Montenegro
13. Tanja Lindell, Chamber of Commerce and Industry of Serbia, Serbia
14. Tanja Lučić, Directorate for Economic Planning, Council of Ministers of Bosnia and Herzegovina, Bosnia and Herzegovina
15. Valbona Mazreku, Milieukontakt, Albania
16. Vedat Segonjeva, S3 coordinator, Office of the Prime Minister, Kosovo*
17. Viktor Nedović, S3 coordinator, SAIGE Project, Serbia
18. Zdravko Stefanovski, Independent expert in energy efficiency and renewable energy, North Macedonia

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