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WESTERN BALKANS 6

Serbia
Country Compendium

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000;
Internet: www.worldbank.org

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Acknowledgments

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Abbreviations

A&R	Adaptation and Resilience
AERS	Energy Agency of the Republic of Serbia
AEWS	International System for Early Warning of Emergencies in the Danube River Basin
ALMP	Active Labor Market Policies
ASA	Advisory Services and Analytics
BCR	Benefit-Cost Ratio
BIH	Bosnia and Herzegovina
BOS	Businesses of the State
CAPEX	Capital Expenditures
CBAM	Carbon Border Adjustment Mechanism
CCA	Climate Change Adaptation
CCDR	Country Climate and Development Report
CCIA	Climate Change Institutional Assessment
CCS	Carbon Capture and Storage
CEP	Clean Energy Package
CC-MFMod	Macro-Structural Model with Climate Change Module
CPAT	Carbon Price Assessment Tool
CPS	Carbon Pricing Scenario
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EBRD	European Bank for Reconstruction and Development
EE	Energy Efficiency
EM	Emergency Management
EnC	Energy Community
EPS	Elektroprivreda Srbije
ETS	Emissions Trading System
EU	European Union
EU-27	Refers to the 27 Countries of the EU
EV	Electric Vehicle
FSA	Financial Social Assistance
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GPP	Green Public Procurement
GW	Gigawatt
ha	Hectare
ICE	Internal Combustion Engine
IEA	International Energy Agency
IFI	International Financial Institution
IMF	International Monetary Fund
IPPU	Industrial Processes and Product Use
JSC	Joint Stock Company
KINESYS-WB6	Knowledge-Based Investigation of Energy System Scenarios for the WB6
LCDS	Low-Carbon Development Strategy
LSG	Local Self-Government
LT-LEDS	Long-Term Low-Emissions Development Strategy
LULUCF	Land Use, Land Use Change, and Forestry
MRV	Monitoring, Reporting, and Verification (of Ghg Emissions)
$MtCO_2eq$	Million Tons of CO_2 Equivalent
NAP	National Adaptation Plan
NAPA	National Adaptation Programme for Action
NBS	Nature-Based Solutions
NCASPD	National Climate Actions Strategies and Policies Database
NCCC	National Climate Change Committee
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
NDRMP	National Disaster Risk Management Plan
NECP	National Energy and Climate Plan
NPV	Net Present Value
NRW	Nonrevenue Water
NZE	Net Zero Emissions Scenario

NZE-HG	Net Zero Emissions Scenario with Higher Growth
OECD	Organization for Economic Co-Operation and Development
OFA	One-Off Financial Assistance
OPEX	Operational Expenditure or Expenses
PFM	Public Finance Management
PIF	Project Identification Form
PIM	Public Investment Management
PPP	Public-Private Partnership
PV	Photovoltaic
R&D	Research and Development
RCP	Representative Concentration Pathway
RE	Renewable Energy
RS	Reference Scenario
SAI	Serbian Audit Institution
SEPA	State Environmental Protection Agency
SNG	Sub-National Governments
SOE	State-Owned Enterprise
STEM	Science, Technology, Engineering, and Mathematics
TCFD	Task Force on Climate-Related Financial Disclosures
TIMES	The Integrated MARKAL-EFOM1 System
TWh	Terawatt Hour
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention On Climate Change
US	United States
WAM	with Additional Measures
WB6	Six Western Balkan Countries (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia)
WEM	with Existing Measures
UNICEF	United Nations Children's Fund
US	United States
VAT	Value Added Tax
WAM	with Additional Measures
WB6	Six Western Balkan countries (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia)
WEM	with Existing Measures
WHO	World Health Organization

Executive summary

Serbia, an upper-middle-income economy with a population of 6.7 million, faced returns to lower growth rates in 2022 and 2023 despite its robust recovery from the COVID-related recession. In addition to modest growth of 2.5 percent in 2022/23, challenges persisted due to domestic and international factors. The national power company (Elektroprivreda Srbije or EPS) crisis and soaring international energy prices widened the current account deficit to 6.9 percent of gross domestic product (GDP), exacerbating inflation to a record high of 16.2 percent by March 2023. However, fiscal deficit and consequently the public debt were on a declining trend, with the deficit reaching 2.2 percent and overall public debt reaching 52.6 percent of GDP at the end of 2023.

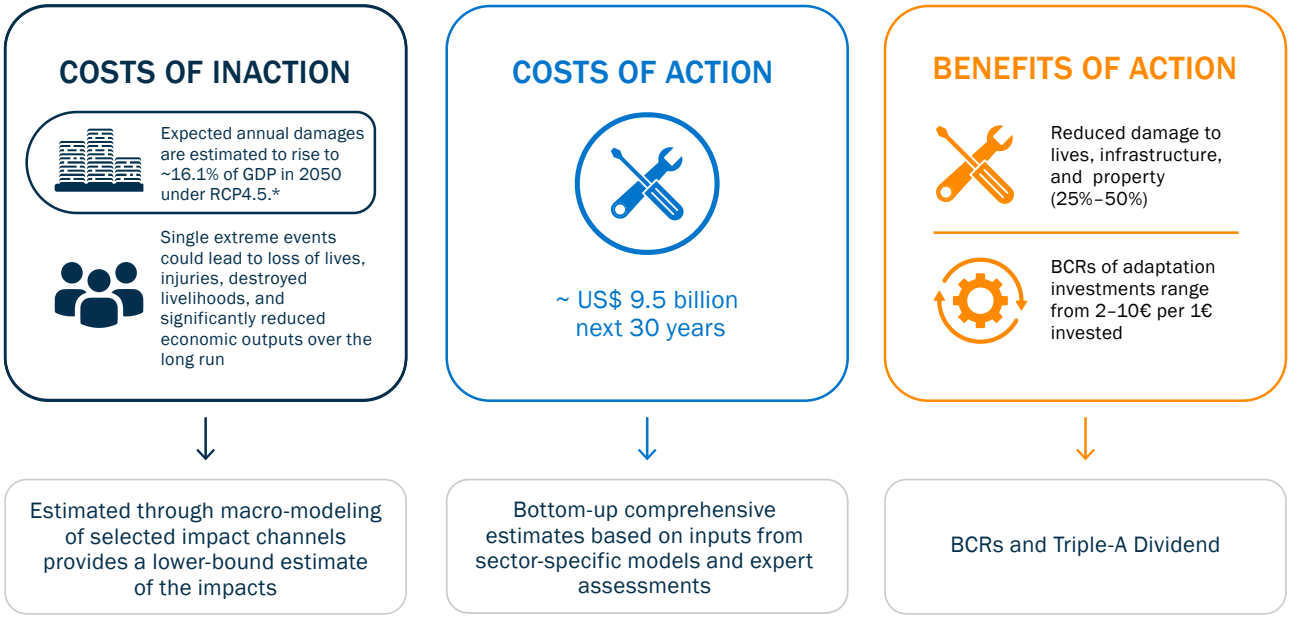
As an EU (European Union) candidate country, Serbia is compelled to align policies with the Aquis communautaire and regional treaties, highlighting the importance of its green transition. However, Serbia's high energy and carbon intensity pose environmental and social risks for the country, driven by its lignite-fired electricity production, energy-intensive industries, and low efficiency in end-use sectors. Mitigation efforts are crucial, especially in the energy sector, where fossil fuels dominate supply, with coal generating 68 percent of electricity. The transition away from coal requires managing impacts on workers and communities in a holistic way, recognizing the potential for economic diversification in coal-dependent communities, such as into renewable energy (RE), other mining operations, or other sectors, and also recognizing recent labor shortages in these sectors. Regulatory improvements as well as full implementation of climate policies are necessary to ensure sustainable growth in mining, alongside efforts to position Serbia as a hub for the Western Balkans 6 (WB6) electricity market and as a facilitator for regional decarbonization through increased trade and RE integration.

Serbia has made significant strides in aligning its legislative framework with EU standards, particularly in the realm of climate change and energy policy. The adoption of a comprehensive set of climate- and environment-related laws in early 2021, aimed at harmonizing domestic policies with EU regulations, marked a pivotal step toward transitioning to a lower-carbon development trajectory. Notably, Serbia is in the process of transposing the full EU "Clean Energy for All Europeans" package, focusing on climate change governance and regional electricity market integration. In terms of adaptation, the country has established a national adaptation program with a three-year action plan to address climate change impacts across various sectors. However, challenges persist in fully implementing and enforcing strategies and laws, which can be attributed to weak enforcement mechanisms and limited capacities. While progress has been made, strategic policy documents lack ambition in terms of coal phaseout and a net zero target, necessitating further action to accelerate decarbonization efforts. Additionally, institutional capacities and coordination mechanisms require enhancement to effectively drive climate action and investments. The presence of state-owned enterprises, particularly in high-emitting sectors, poses challenges to market dynamics and climate adaptation, necessitating stronger accountability and stakeholder engagement mechanisms.

Serbia is exposed to several natural and climate-related hazards, and the potential costs of inaction are high. Past extreme weather events have caused extensive physical damage, financial losses, and fatalities in Serbia, greatly affecting its economy. Serbia faces exposure to a range of hydro-meteorological hazards, such as floods, landslides, droughts, heat waves, wildfires, and earthquakes. Increasing risk from these climate-induced hazards impact water and energy security, agriculture, and rural and low-income communities, as well as disrupt transportation and road infrastructures. Shocks are highly localized and amplify vulnerabilities with downstream consequences on the nation's services and productive value chains. Serbia could suffer major economic damages from climate change under all the greenhouse gas (GHG) representative concentration pathways (RCPs). In the absence of any investments to adapt to a changing climate, the potential reduction in GDP is between 14.7 to 17.8 percent in 2050 under trend growth (from RCP 8.5 to RCP 2.6), which can be considered a lower-bound estimate. It should be emphasized that modeling the effects of natural hazards and climate change on GDP is not straightforward, and focusing on expected average impact can hide how dramatic the impact of individual events may be. For instance, the 2014 floods caused €864 million in damages and €648 million in losses.

The costs of action to adapt to climate change are high, but the benefits of this action can be even higher. Serbia would need to invest US$9.5 billion (in 2020 dollars, undiscounted) in the next 30 years to protect people and property from the damaging and escalating impacts of climate change (Figure ES.1). This initial comprehensive adaptation investment package would cost equivalent to around 0.4-0.6 percent of GDP per year until 2050. Investments in adaptation will yield a "triple-A dividend," which includes three types of benefits: avoided losses, accelerated economic potential, and amplified social and environmental co-benefits. Implementing adaptation climate actions at the national level greatly reduces human and economic losses from disasters and climate events and facilitates human capital development.

FIGURE ES.1. Summary of adaptation investment narrative



Source: World Bank analysis
Note: GDP = gross domestic product, RCP = representative concentration pathway, BCR = benefit-cost ratio.
* The macroeconomic model yields annual estimates for damages based on the expected annual loss from each climate hazard. The expected damages are projected to grow over time, reflecting increasingly unpredictable and volatile climate conditions. Combined damages from the drought impact on maize and wheat, heat stress on labor productivity, and riverine floods, are estimated to be 16.1 percent of GDP under RCP 4.5 in 2050 for Serbia.

Adaptation investments can be a precursor to employment growth, improvement of skills, and increased trade opportunities, further bolstering the case for a proactive approach to climate resilience. Relatedly, while investments in education serve as economic drivers, they also inform pro-climate behaviors, beliefs, and green voting.[1] Enhancing climate resilience in urban and transportation sectors unlocks economic and trading opportunities and supports employment. The integration of risk information into the planning, design, and maintenance stages of all infrastructure investments should thus be encouraged. Moreover, investing in nature-based solutions (NBS) promotes adaptation while yielding substantial co-benefits for the ecosystem and local communities, especially the vulnerable and those in the mountainous and downstream areas. NBS for flood prevention can yield high net benefits, with benefit-cost ratios that are generally greater than 2, and that can be up to 12 for peatland restoration or 18 for floodplain restoration. Lastly, investing in human capital helps adapt systems through improved education and productive skills, identifying health issues early, and protecting vulnerable populations from impoverishment.

[1] Angrist, Noam, Kevin Winseck, Harry A. Patrinos, and Joshua S. Graff Zivin. 2023. "Human Capital and Climate Change." Working Paper no. 31000, National Bureau Of Economic Research, Cambridge.

Accelerating the energy transition to achieve economy-wide net zero emissions in Serbia by 2050 is feasible, but it would require radical transformations and decisive action. The energy system modeling analysis conducted as part of the WB6 Country Climate and Development Report (CCDR) aimed to assess sectoral decarbonization pathways for Serbia and other WB6 countries. Using the KINESYS-WB6 (Knowledge-Based Investigation of Energy System Scenarios for the WB6) model, various scenarios were developed, including an unconstrained reference scenario (RS)[2] and a net zero emissions scenario (NZE) by 2050. The modeling shows that Serbia could meet its 2030 target (40.3 percent emissions reduction versus 1990 levels) by implementing all measures outlined in its "with additional measures" (WAM) scenario in the Serbian National Energy and Climate Plan (NECP), namely through scaling up solar photovoltaic (PV) and wind capacities and building additional natural gas capacity to support the phasedown of coal. Interestingly, the gas-fired generation capacity required in the RS and NZE scenarios is similar, which highlights the fact that Serbia should pursue a significantly larger penetration of natural gas in power generation regardless of its climate goals. Beyond 2030, significant transformations would be required in Serbia's energy system to achieve net zero GHG emissions by 2050. The NZE scenario indicates the need to decommission coal-fired generation by 2040 and substantially increase the penetration of renewables (solar, wind, and hydro). The transport and buildings sectors would also require substantial changes, with a focus on electrification, energy efficiency (EE) improvements, and the adoption of cleaner fuels. Additionally, the industrial sector would need to undergo significant shifts, including the installation of carbon capture and storage (CCS) systems and transitioning away from coal and oil products. Overall, achieving net zero emissions by 2050 necessitates ambitious policies and investments across all sectors of Serbia's economy.

Net zero emissions by 2050 can be achieved within the potential growth of the economy. Compared to the RS, Serbia would need to invest an additional US$10.4 billion (in 2020 US$ terms) until 2050 (expressed at present values) to achieve economy-wide net zero; this is equivalent to an average of 1.6 percent of GDP a year until 2050. These investments, which are incremental to those needed in the RS, would primarily focus on the power sector, with investments in wind, hydro, and solar PV capacities being the main areas of expenditure. However, the higher investment required would be at least partially compensated by lower operating costs, estimated at -0.6 percent of GDP per year on average. While the investments required until 2030 would be similar in both the NZE and RS scenarios, significant regulatory and policy efforts would be needed in the short term to create an enabling environment for future decarbonization investments and put Serbia on the pathway towards net zero emissions by mid-century. The impact of decarbonization investments on domestic output would be modest relative to how significantly it would reduce emissions, as GDP per capita would be only 0.4 percent lower in 2050 in the NZE scenario compared to the RS.

Serbia needs to develop its green debt market, and leverage guarantees and public-private partnerships to boost climate investment. Serbia can tap into EU pre-accession financing and international finance institution financing to support climate action. However, under a net-zero emissions trajectory, the private sector is expected to do most of the investment in decarbonization (88 percent), especially in the transport, buildings, and power sectors. Raising capital to finance climate change-induced investments will require an enabling regulatory environment, as the green finance landscape in the country is at an early stage. The country needs to implement a sustainable finance framework in alignment with the EU, that can support the issuance of thematic debt instruments such as green, social and sustainability-linked bonds. Some international banks operating in Serbia are already using capital optimization guarantees against the risk of expropriation of mandatory reserves, freeing up capital to finance climate mitigation and adaptation projects. Going forward, guarantees could be used for public and public-private partnership (PPP) projects to mobilize significant cross border investments, deepen the credit markets and to foster green finance in Serbia. Serbia would also benefit from implementing a centralized, climate-focused, multisectoral PPP strategy, aimed at maximizing mitigation and adaptation impacts on key sectors, including power, transport, and buildings.

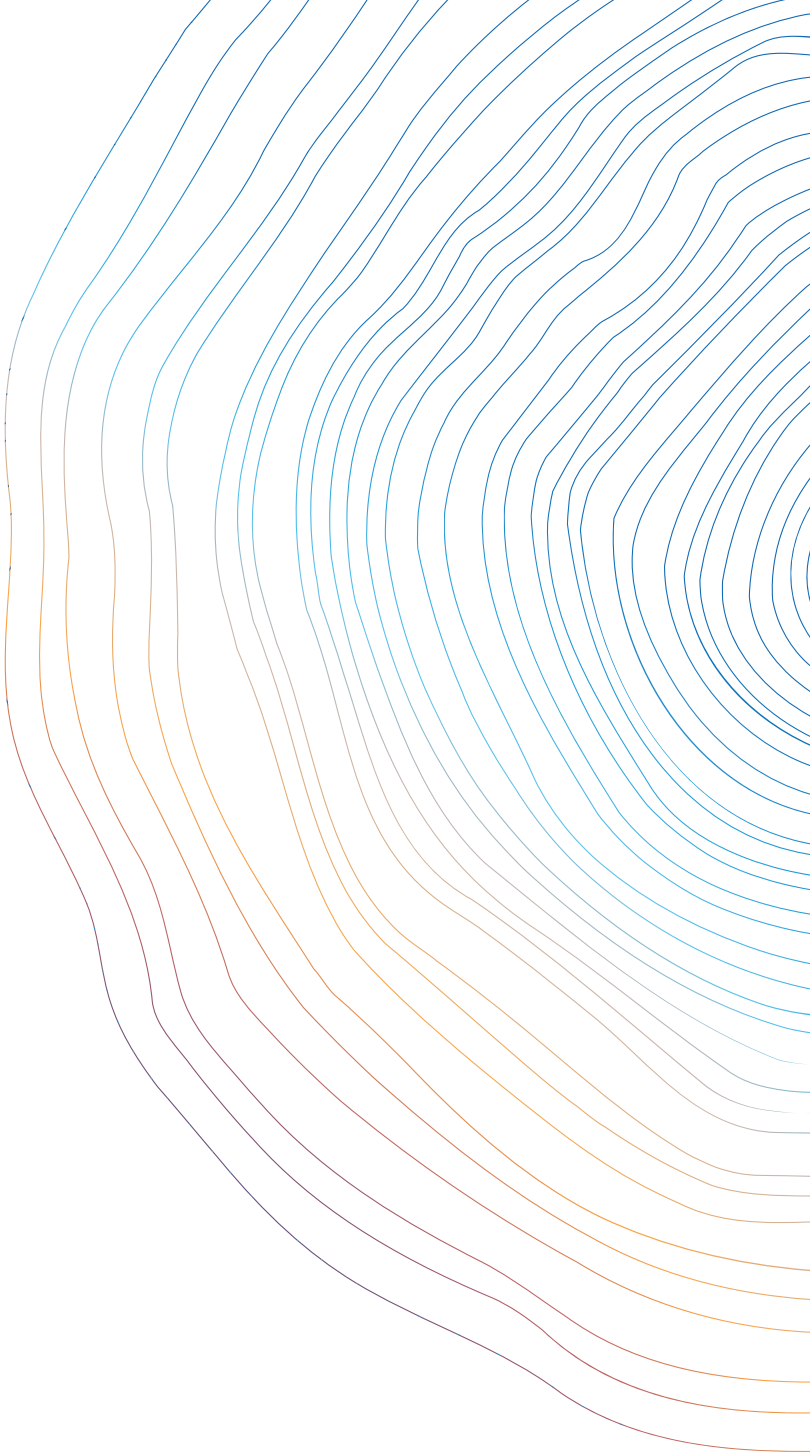
[2] This modeling scenario represents an unconstrained least-cost evolution of the energy system. No specific assumptions are made on the introduction of new policies supporting decarbonization, and the evolution of the energy system is purely driven by economic considerations. This scenario is incompatible with the WB6 countries' aspirations of EU integration and their existing climate change commitments, but it provides a comparable baseline across the six countries for the other decarbonization scenarios.

The green transition will have to be designed and implemented in a just manner. While aggregate employment impacts of the green transition may be manageable, shifts are likely to occur between sectors, firms, occupations, and regions. Low-educated workers and men, on average, are expected to be disproportionately affected by the change in the nature of work associated with the green transition in Serbia. In general, it is also expected that the net zero transition will have a distributional impact on household consumption due to variations on generation and supply costs, potentially leading to changes in the prices of energy and non-energy products. Such impacts highlight the need to prepare for social and labor transformations due to the decarbonization of the power sector, which should include supporting a just transition in coal regions and workforce reskilling.

Adaptation and mitigation can be part of a sustainable growth strategy that delivers higher productivity. Adaptation and mitigation investments require concerted effort towards to bolstering private investment. Higher investment rates could be achieved by reforming the financial sector to better serve small enterprises and startups; enhancing labor skills through quality education and training; and fostering competition and innovation. Expanding investment also requires improved infrastructure and improved regulatory frameworks (by simplifying regulations, curbing corruption, and promoting transparency). Moreover, Serbia can unleash competition and growth thereafter in several markets by reducing state intervention and preferential treatment of SOEs. This relates primarily to some of the key industries such as energy, transport, telecommunications, pharmaceuticals, and professional services. These reforms collectively represent a transformative agenda that can unlock Serbia's full economic potential.

Fiscal policy and public financial management will need to be strengthened. First, there is a need to adopt policies that mitigate the economic and social impact of climate change by incentivizing private sector and household action (i.e. zoning, insurance, financing instruments, carbon pricing, incentives for research and innovation, etc.). Second, strengthening efficiency of public spending and public investment management, including management of state-owned enterprises. Third, increase fiscal space by bolstering domestic revenue mobilization, while reducing tax expenditures and increasing the tax base by reducing the informal economy.

A summary of detailed recommendations for policy reforms and investments, along with the associated complexities and timelines for implementation are presented at the end of this compendium. The recommendations focus on what could and should be done in the short term (until 2030), with an eye to laying the groundwork for the scale-up of climate action in the subsequent decades. The recommendations span across resilience and adaptation, decarbonization and mitigation, macroeconomy and financing, and regulatory and institutional framework, and education and labor.



Chapter 1

Introduction: Setting the scene

1.1. Climate and development context

Serbia is a small, open economy with an upper-middle-income status aspiring to join the EU (European Union). As of 2023, its population stood at 6.7 million with about 7.1 percent living below the international poverty line of $6.85 per day (purchasing power parity). After a robust economic recovery following the COVID-19-related recession in 2020, Serbia faced an economic slowdown in 2022 and 2023 due to a combination of domestic and international factors. The economy recorded a modest growth rate of 2.5 percent in both 2022 and 2023. Although there were several rounds of massive fiscal stimulus programs in 2020 and 2021, budget deficit was brought back to 2.2 percent in 2023 and public debt remained relatively stable at around 52.6 percent of gross domestic product (GDP) at the end of 2023. Crises in the national power company Elektroprivreda Srbije (EPS), coupled with the major increase in international energy prices, led to a significant increase in energy imports and consequently the country's current account deficit widened to 6.9 percent of GDP in 2022. Increase in international prices coupled with the domestic economic problems also led to a significant increase in inflation, which reached a record high level of 16.2 percent in March 2023. Not only does the EU play a pivotal role as Serbia's primary economic partner, but it is also an important benchmark for the country's green transition. Most importantly, as an EU candidate country and an Energy Community (EnC) contracting party, Serbia is obliged to align its policies with the Aquis Communautaire.

EU accession, coupled with changes in the regulatory and trade environments, can offer opportunities to revive growth in a sustainable manner. Accession to the EU can be an anchor for future growth and development. In the context of limited fiscal space and ability to attract investment, Serbian firms can seek EU funds for research, development, and innovation in green and digital technology. The EU Growth Plan for the Western Balkans incentivizes the region's preparations for EU membership and accelerates reforms via the €6 billion Reform and Growth Facility in 2024-2027, with €1586 million tentatively allocated to Serbia, subject to the achievement of the payment conditions.

Serbia's high energy and carbon intensity is not only a climate change issue but also has serious environmental and social impacts. Serbia's energy and carbon intensity remain higher than the EU-27 average and among the three highest in the WB6 region (Figure 1.1). This is driven by lignite-fired electricity and heat generation, industrial growth based on energy-intensive sectors such as steel and cement production, and low energy efficiency (EE) in most end-use sectors, including poorly insulated buildings. Air pollution—resulting primarily from coal- and biomass-fired residential heating as well as transport sector emissions—is a serious problem, especially in larger cities, and has impacts on public health and mortality rates. In 2019, the World Health Organization reported on the results of a comprehensive investigation on the impact of air quality on health in Serbia, in which it assessed the effects of air pollution on health in major cities. The analysis showed that nearly 3,600 premature deaths every year are attributable to exposure to fine particulate matter measuring ≤ 2.5μm ($PM_{2.5}$) in 11 studied cities in Serbia.[3]

Being the largest greenhouse gas (GHG) emitter in the WB6 region, Serbia needs to continue its efforts to decouple its economic growth from emissions, particularly in the energy sector. Serbia accounts for 51 percent of total WB6 GHG emissions excluding land use, land use change, and forestry (LULUCF) in 2019.[4] Total GHG emissions have declined since 1990 (Figure 1.2) while GDP per capita has increased, demonstrating the decarbonization of the economy. Energy-related emissions—that is, from fuel combustion, transport, and fugitive emissions—represent about 80 percent of total emissions. In 2019, electricity and heat accounted for the largest share of the emissions (55 percent), followed by transport (12 percent), agriculture (11 percent) and waste (10 percent), while LULUCF are functioning as carbon sinks (Figure 1.2).

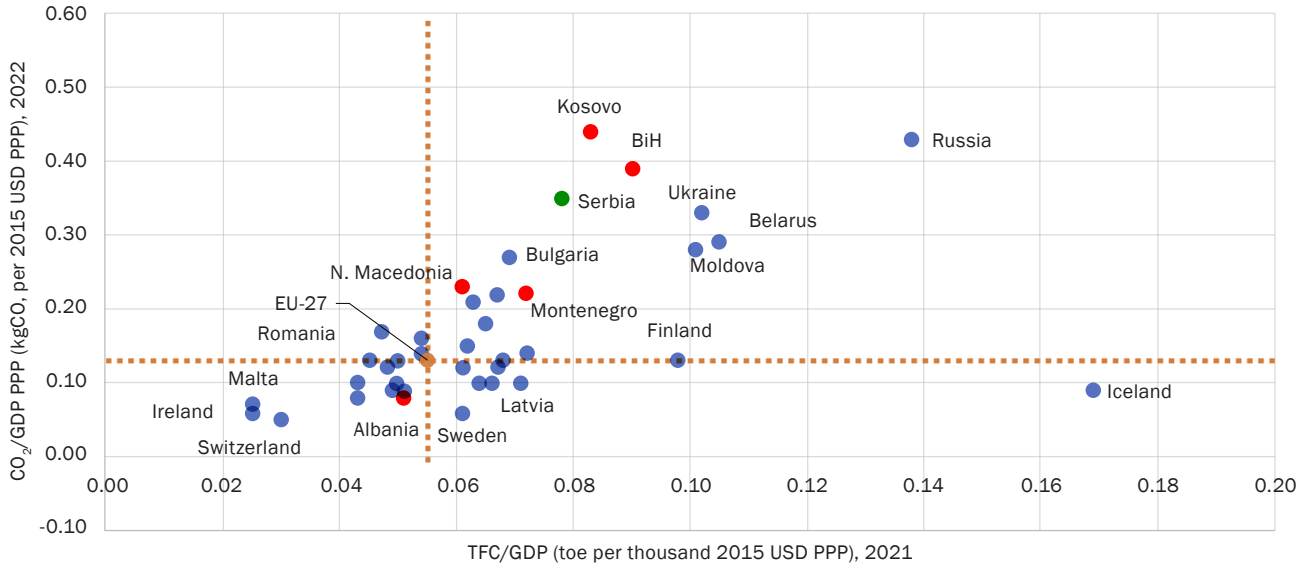
Serbia's GHG emissions profile highlights the utmost importance of mitigation measures targeting energy supply and use. Serbia relies on fossil fuels for 83 percent of its total energy supply, with domestic

[3] WHO (World Health Organization). 2019. "Health Impact of Ambient Air Pollution in Serbia: A Call to Action". Assessment report, Geneva.

[4] To avoid COVID-related distortions, 2019 is used as final historical emissions year.

lignite accounting for the largest share (40 percent). In the electricity sector, 68 percent of Serbia's electricity generation comes from coal, 27 percent from hydropower, and 3 percent from wind.[5] EPS, which operates most of the coal mines in the country (see Box 1.1), according to its Go Green Strategy, envisages investing about €3 billion in renewable sources until 2030. The launch of the EU's Carbon Border Adjustment Mechanism (CBAM) is an important catalyst for accelerating coal phase-out. If the current EU Emissions Trading System (ETS) carbon price levels were imposed on EPS (80 €/tCO_2eq), the company is modeled to face a cost of about €2 billion in one year.[6] This would substantially weaken the utility company's financial results.

FIGURE 1.1. Energy intensity versus carbon intensity of European countries



Sources: IEA 2021 World Indicators; IEA 2022 Indicators for CO_2 Emissions.
Note: BIH = Bosnia and Herzegovina; CO_2 = carbon dioxide; GDP = gross domestic product; $kgCO_2$ = kilograms of carbon dioxide; PPP = purchasing power parity; TFC = total final consumption; toe = tonne of oil equivalent; USD = US dollar.

Phasing out coal is a complex process that requires managing impacts on workers and communities caught within the energy transition and addressing environmental legacy issues. The retirement of coal power plants and the closure of coal mines will directly impact coal communities, risking the loss of thousands of jobs and causing social and economic inequalities, including poverty and reduced access to essential services. EBRD estimates that approximately 12 thousand jobs are at risk in Serbia from the planned phase- down of coal up to 2030, based on the country's National Energy and Climate Plan (NECP) targets.[7] A successful Just Transition approach to coal mine closure is built upon three pillars: institutional governance, people and communities, and environmental remediation and repurposing of land and assets (see box 3.4 in the regional CCDR). The cleanup of legacy pollution and remediation of former mining land can provide work for many current miners as the required skill sets are similar. Mined lands can be rehabilitated and repurposed into agriculture, light industry, and the commercial or recreational sectors while former employees of the mines can be retrained for new roles. Transitioning away from coal can also be an opportunity to develop renewable energy (RE) via private sector participation, such as through public-private partnerships (PPPs). Identifying new economic opportunities with priority work for the current mines' labor force (with retraining) is a solution that would ensure a productive use of the workforce and limit the burden on the existing social protection system. For example, shifting from exploitation of coal to the exploitation of bentonite clay and

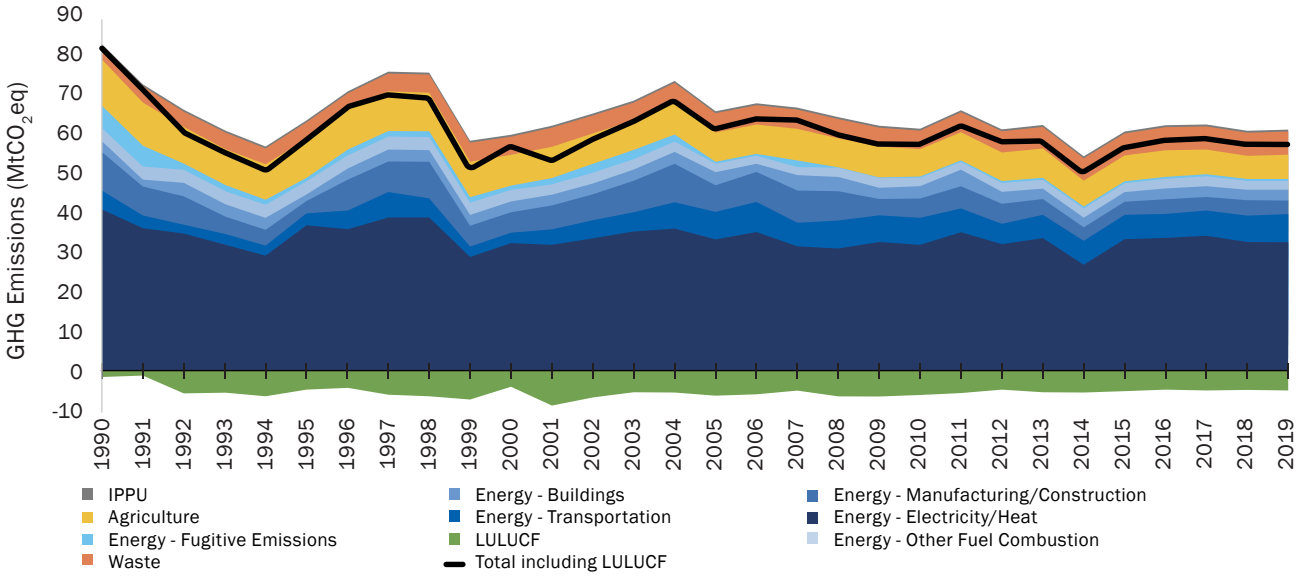
[5] AERS (Energy Agency of the Republic of Serbia). 2023. "2022 Energy Agency Annual Report". Belgrade.

[6] According to a financial model developed by the World Bank. Analysis of the estimated emissions from the Go Green strategy suggests similar numbers.

[7] See Just Transition Diagnostics: Serbia (EBRD-14896) at https://www.ebrd.com/work-with-us/projects/tcpsd/14896.html.

activated carbon might be possible in some of the Resavica mines,[8] which would save jobs and prevent serious livelihood impacts on local communities. The transition out of coal will require short-term investments in the upskilling or reskilling of workers affected by the coal phaseout, together with income support to enable job transitions or protect those closer to retirement who will face a difficult labor market. For the longer term, improvement of vocational and nonformal education systems will be key. Stronger mental and other health support would also be required for the affected population.

FIGURE 1.2. GHG emissions by sector in Serbia



Source: Source: CAIT 2023.
Note: GHG = greenhouse gas; IPPU = industrial processes and product use; LULUCF = land use, land use change, and forestry; $MtCO_2eq$ = million tons of CO_2 equivalent.

BOX 1.1. Serbian coal sector

Serbia produces around 35 million metric tons of lignite and hard coal per year, and about 99 percent of total production comes from open-pit mines operated by EPS (the largest ones being Kolubara and Kostolac). The quality of available lignite is poor and deteriorating, and lignite production has been decreasing almost continuously since 1990. EPS open cast mines face high climate risks because they are surrounded by hills that shed large quantities of floodwaters. EPS's vulnerability to climate change events was highlighted by a catastrophic flood in 2014. EPS also has inactive surface lignite pits that closed previously under different regulatory standards and are now idle brownfield sites, which can be repurposed for other economic activities, including renewable power generation. The remaining one percent of Serbian coal is produced at loss-making PE Resavica mines that are dependent on government subsidies (€35–€40 million annually). A tragic accident in Resavica's Soko mine in April 2022, which killed eight miners and injured many more, has highlighted that Serbian underground mining comes with a significant cost to human lives: the Soko mine has been operating since 1908 and reportedly, 57 miners had died in previous accidents.[9] Serbia has significant coal reserves, with 4 billion tons of proven lignite deposits with a medium calorific value of 7.7 megajoules per kilogram. Those reserves could secure the supply of coal for Serbia's energy sector through the end of the 21st century, but the country's decarbonization objectives are encouraging it to diversify the electricity generation mix.

[8] Socioeconomic Assessment and Stakeholder Mapping for Mine Closure, prepared by LINK 011 (Belgrade) in 2021 commissioned by the World Bank during preparation of a mining lending operation.

[9] Telegraf. 2022. "Ministry Tells Telegraf: When Accident Happened There Was 96% Methane in the Soko Mine, No Time to React." *Telegraf.rs*, April 7, 2022. https://www.telegraf.rs/english/3481734-ministry-tells-telegraf-when-accident-happened-there-was-96-methane-in-the-soko-mine-no-time-to-react.

Serbia has a rich mineral endowment and long history of mining activities with more than 200 legacy mines and at least 2,500 mapped mineral occurrences. The most important minerals include copper, lead, zinc, gold, silver, and lithium-borate. These metals are essential for the construction of RE infrastructure and battery storage; therefore, Serbia can play a vital role in the supply of minerals that are driving the global energy transition thanks to its competitive advantage over copper and lithium. In October 2023, Serbia signed an agreement with the European Commission on a strategic partnership that would involve lithium exploitation.[10] The International Energy Agency (IEA) foresees a 500 percent increase in lithium demand, consistent with the World Bank's 2050 forecast. This is driven by poverty reduction, urbanization, and low-carbon economic needs. However, a shift towards a more sustainable mining sector in Serbia would require improvements in the regulatory, institutional, and governance framework. Historically, mining in Serbia has been accompanied by substantial soil, water, and air pollution, and there is a budding movement around environmental concerns related to severe pollution accumulated over decades. Modern mining can be much less polluting, but adequate regulation and enforcement are needed to ensure that companies follow best practices, including strong engagement with civil society stakeholders. To enable the Serbian mineral mining sector to grow in a sustainable manner, it will be important to apply climate-smart mining principles (Box 1.2).

BOX 1.2. Climate-smart mining principles

The first key climate-smart mining principle is the decarbonization of the existing (and expanding) mining sector and associated value chains. To avoid significant increases in the sector's carbon footprint, emissions per unit of output must be reduced. This can be done by adopting the best available energy-efficient technologies and by encouraging private sector investment in off-grid renewable energy (RE) infrastructure to provide clean power to mines. The latter requires concurrent energy sector restructuring to lower the perceived risk for private investors in RE. The second climate-smart mining principle consists of developing critical mineral value chains, particularly for copper and lithium, for example, by creating industrial clusters that would explore opportunities for demand of processed minerals, components, and manufactured products for the energy transition. Serbia could also develop the lithium-ion battery value chain for electric vehicles (EVs) and rapidly build competitiveness by identifying niche markets for batteries or EV components in which it can develop, such as battery management systems, software equipment, and power electronics.[11]

The Serbian power market is heading towards becoming the hub for the WB6 electricity market, which could help decarbonization by facilitating trade across broader geographical areas and more cost-effective integration of variable RE. Serbia, like the other EnC countries, is transposing the ambitious electricity package adopted in December 2023, which aims to create a pan-European electricity market with full reciprocity between EU member states and EnC contracting parties. Serbia has the most mature spot power market within the WB6 countries, operated by SEEPEX (the nominated electricity market operator in Serbia), with the prices highly correlated with the Hungarian market prices. Serbia is also the first country in the WB6 to have an intraday market and a futures market. The location of Serbia, with its eight borders, could make it an ideal place to become a future hub for the Balkans; however, the impact of the increased trade on decarbonization in the region will also depend on the pace of the coal phase-down and the growth of renewable generation.

[10] Balkan Green Energy News. 2023. "Leaked – Serbia Signs Lithium Exploitation Agreement with European Commission." Balkan Green Energy News, October 28, 2023. https://balkangreenenergynews.com/leaked-serbia-signs-lithium-exploitation-agreement-with-european-commission/.

[11] IFC (International Finance Corporation). 2021. "Could Serbia Compete in the Global Lithium Market? A Deep-Dive Report". Washington, DC.

1.2. Climate change commitments and strategies

Serbia is one of the most advanced of all EnC contracting parties in the transposition of the EU Clean Energy Package into the national legislation.[12] The Serbian legislative package adopted in early 2021—consisting of a framework Law on Climate Change, new laws on EE and RE, and amendments to existing laws on energy and mining—aimed to align Serbia's domestic climate and energy policies with the requirements of the EU Third Energy Package and ushered in a start towards transitioning to a lower carbon development (Table 1.1). Following the adoption of the ambitious energy and climate-related decisions by the Energy Community Ministerial Council in December 2022, Serbia is transposing the full EU "Clean Energy for All Europeans" package, including the provisions related to climate change governance and regional electricity market integration.

TABLE 1.1. Key national laws and strategies

Paris Agreement			Strategies			Laws			
Entry into force	NDC last update	LT-LEDS and Low-Carbon Development Strategy	NECP	National Adaptation Plan	Energy Strategy	Law on Climate Change	Law on Air Quality	Law on Energy Efficiency	Law on Renewable Energy
Aug 2017	Aug 2022	2023-2030, projections until 2050	» (until 2050)	✓	✓ until 2025 Drafting one until 2040	✓	✓	✓	✓

Source: World Bank compilation of various energy national laws and strategies; National Climate Actions Strategies and Policies Database (2023).
Note: Green = document approved and valid; blue = draft document exists but has not yet been approved; red = document does not exist or is expired. LT-LEDS = long-term low-emissions development strategy in accordance with Article 4 of the Paris Agreement; NDC = nationally determined contribution; NECP = National Energy and Climate Plan.

1.2.1. Adaptation

The national policy for climate change adaptation is established with the recently enacted National Adaptation Plan covering a mid-term horizon (2023–30), with a three-year action plan for the period 2024–26.[13] The program includes an assessment of impact and vulnerability and adaptation and resilience (A&R) objectives as well as assessments of climate change scenarios, which helps decision-makers to integrate adaptation in the most vulnerable sectors. As a part of the program, the 2024–26 action plan defines 25 measures for adaptation to climate change in key sectors including agriculture, forestry, transport, urbanism, energy, biodiversity, health protection, and measures of general importance, as well as the financial and institutional frame and timeline for the implementation and monitoring of the measures.

Progress has also been made in disaster risk mapping. A digital disaster risk register is available as an interactive, electronic, geographic information database for the country's territory.[14] Climate change scenarios are available on an online platform for climate data entitled Digital Atlas of Climate. In addition, as a part of Serbia's National Disaster Risk Management Plan (NDRMP), flood hazard and risk maps have been made for 75 areas of potentially significant flood risk, covering 16 percent of the country's territory.[15] The maps

[12] EnC (Energy Community). 2022. "Serbia: Annual Implementation Report". Vienna.

[13] Spasić, Vladimir. 2023. "Serbia Adopts First Programme for Adaptation to Changed Climatic Conditions with Action Plan." Balkan Green Energy News, December 29, 2023. https://balkangreenenergynews.com/serbia-adopts-first-programme-for-adaptation-to-changed-climatic-conditions-with-action-plan/.

[14] UNDP (United Nations Development Programme). 2022. "Serbia Gets Disaster Risk Register." UNDP Serbia page, October 13, 2022. https://www.undp.org/serbia/news/serbia-gets-disaster-risk-register.

[15] Government of Serbia, Public Investment Management Office, Ministry of Agriculture, Forestry and Water Management. 2021a. "Component 2 of Serbia National Disaster Risk Management Plan (NDRMP): Flood Hazard and Risk Mapping". Evaluation report, Belgrade.

can be used by local authorities in managing floods and reducing losses, as well as in urban planning and infrastructure development.

1.2.2. Mitigation

Serbia's climate change mitigation targets and policy directions stem from its international commitments and the country's obligations as an EnC contracting party. The Low-Carbon Development Strategy (LCDS), approved in 2023, sets long-term directions aligned with the revised nationally determined contribution (NDC) under the Paris Agreement. The LCDS includes four mitigation scenarios that would lead to GHG emissions reduction between 65 percent and 76 percent by 2050 compared to 1990 (or between 55 percent and 69 percent compared to 2010). The LCDS sets separate emission reduction targets for the sectors covered by the EU emissions trading system (ETS) and non-ETS sectors. The National Energy and Climate Plan (NECP)—to be adopted by June 2024—is expected to set national emission reduction, EE, and RE targets to 2030, aligned with the Energy Community Clean Energy Package adopted in December 2022. However, the draft NECP of June 2023 has somewhat lower ambitions (Table 1.2). The key climate change mitigation actions—envisaged in NDC, LCDS, and the draft NECP—mainly consist of policies and measures to reduce energy consumption in the key end-use sectors and to develop RE sources. Serbia has also been considering including modular nuclear power plants into its forthcoming Energy Strategy, and its draft NECP contains one scenario with nuclear power. NECP envisages the introduction of a carbon tax, while there are ongoing discussions within the EnC about the possible creation of a regional ETS for the WB6.

TABLE 1.2. Serbia's key mitigation targets

Nationally determined contribution (NDC)	Clean Energy Package (CEP) and draft NECP targets for 2030					
GHG emission reduction by 2030 (without LULUCF)	Net GHG emissions reduction (including LULUCF)	Emissions level, $MtCO_2eq$	Share of energy from RES in gross final consumption		Final energy consumption, Mtoe	
	CEP/NECP	*CEP*	*CEP*	*NECP*	*CEP*	*NECP*
−13.2% compared to 2010 −33.3% compared to 1990	−40.3% compared to 1990	47.8	40.7%	33.6%	9.5	9.7

Sources: Nationally Determined Contribution (NDC) of the Republic of Serbia for the 2021–30 period; Draft National Energy and Climate Plan 2023; Energy Community Clean Energy Package targets 2022.
Note: GHG = greenhouse gas; LULUCF = land use, land use change, and forestry; $MtCO_2eq$ = million tons of CO_2 equivalent; NECP = National Energy and Climate Plan.

The strategic policy documents lack ambition in terms of coal phase-out and a net zero target. As a signatory to the Sofia Declaration on the Green Agenda for the Western Balkans, Serbia has expressed an intention to work towards the EU's 2050 net zero emissions target and is expected to develop an action plan to phase out coal. Nevertheless, there is no net zero target date defined in Serbia's policy documents. Moreover, the politically sensitive matter of mine closure and the timing of the phaseout of coal-fired electricity and heat generation is still under consideration by the government and political leadership.

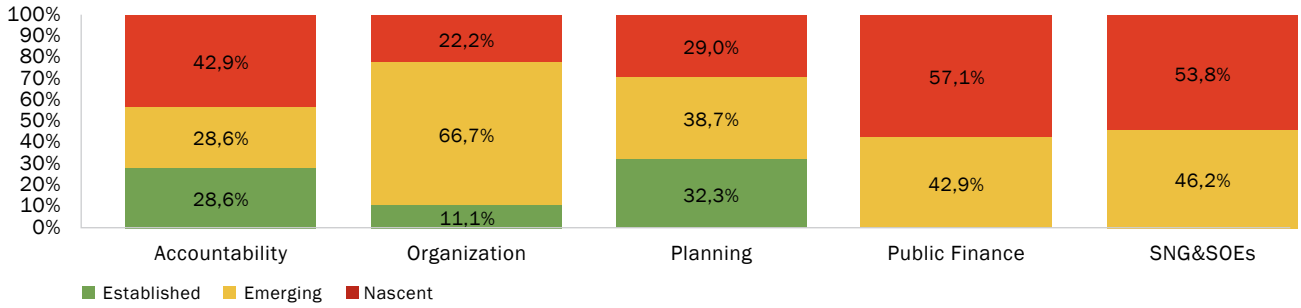
While Serbia has made progress in aligning its legal framework with EU acquis communautaire related to climate change, there are challenges in fully implementing and enforcing strategies and laws. Weak enforcement mechanisms and limited capacities contribute to the slow progress. As of December 2023, Serbia still needs to finalize its strategic framework (NECP, the action plan for the Long-term Low-carbon Development Strategy, and the new long-term Energy Sector Strategy). Additionally, some secondary legislation under the Law on Climate Change, Law on Renewable Energy Sources, and Law on Energy Efficiency and Rational Use of Energy is still being finalized.

The monitoring, reporting, and verification (MRV) system is under preparation with an anticipated finalization in 2026. The enforcement of MRV systems for GHG emissions is pending with first permits yet to be issued and the first report anticipated by 2026. This is particularly concerning given the upcoming implementation of EU's CBAM, which is discussed in the regional CCDR.

1.3. Institutions, policies, and capacities

Overall, Serbia features an emerging institutional maturity for addressing climate change, according to the World Bank's Climate Change Institutional Assessment (CCIA). The CCIA examines countries' capacity to plan, implement, and sustain climate change policies over multiple political cycles by analyzing 74 indicators across 5 pillars. The indicators measure different aspects of countries' institutional maturity for climate action as nascent, emerging, or established, with further breakdown within each category. Given the fact that the CCIA is a point-in-time analysis, the findings may not capture recent developments due to the rapid pace of regulatory and institutional development across the region. Nevertheless, it serves as a useful empirical baseline to highlight achievements and gaps across the region, helping to inform peer learning and innovation in climate action. Annex 1 outlines the CCIA methodology and summarizes the CCIA results, which demonstrate that Serbia's institutional maturity is slightly more advanced than the Western Balkans average across all pillars. However, the level of ability and action varies among the five pillars, as demonstrated in Figure 1.3.

FIGURE 1.3. Serbia's institutional maturity for climate action: Overview by CCIA pillar



Sources: Country Institutional Capabilities for Climate Change Action: Western Balkans CCIA (forthcoming); D4C National Climate Actions Strategies and Policies Database (2023).

The institutional framework in Serbia faces challenges due to insufficient and fragmented capacities and a lack of coordination mechanisms. The leadership role for climate change is assigned to the Ministry of Environmental Protection, while the Ministry of Mining and Energy and the Ministry of Agriculture, Forestry and Water Management have units dealing with climate change issues. The teams dealing with climate change are understaffed and have insufficient capacities. Efforts are made to improve coordination among the ministries (for example, via working groups) but the existing mechanisms are used on an ad-hoc basis. The National Climate Change Committee (NCCC) was established in September 2021 with representatives of central government, academia, local self-governments (LSGs) and civil society organizations, however, it does not meet regularly. Although the NCCC is mandated to advise the government, in practice, it has been acting more like an exchange platform rather than an advisory body. As part of its EU accession negotiations, the government has submitted an Action Plan for Administrative Capacity Development, but its implementation is delayed, and capacity building depends on technical assistance.

Public finance management (PFM) and public procurement do not currently integrate climate change, but there are commitments and initial actions in this direction. There are no mechanisms for planning for, and accounting of, climate change-related revenues and expenditures. The focus so far has been on reporting on environment-friendly budgetary expenditures by introducing green budget tagging. However, PFM is being improved, with the support of the World Bank and other development partners, aiming to introduce climate risks in PFM and increase climate-responsive capital expenditures. Climate-informed public investment

management (PIM) is only emerging. Climate impact is one of the criteria for assessing the relevance of capital investment projects; however, there is no climate proofing guidance yet. Also, the government plans to introduce the methodology for assessing the climate co-benefits of completed capital projects. The Law on Public Procurement establishes a foundation for green public procurement (GPP), but the implementation is in early stages.

The regulatory and institutional set-up falls short of actively driving investments in the areas of climate change mitigation and adaptation. Lack of a carbon tax and sustainable climate finance hampers green investments and climate action. The current trend shows an increase in investments primarily supported by grants, with a heavy reliance on international donors and financing institutions due to insufficient national financing and a lack of sustainable financing mechanisms at the local level. The level of investments is constrained by limited institutional capacities, both in terms of the public sector's ability to provide support and capacity to receive it. Sustainable financing mechanisms for GHG reduction are absent, and the potential of PPPs for attracting private sector financing remains largely untapped.

The LSGs have limited functions for mitigation and adaptation. LSGs have no mandate to mitigate GHG emissions except for an obligation to set up EE targets and adopt a municipal energy saving program every three years. As for adaptation, the Law on Climate Change requires the subnational governments to align their planning documents with the objectives of the national adaptation program. Subnational strategic plans for climate action are not obligatory, and only some local low-carbon action plans or local adaptation plans were enacted on a voluntary basis, supported by donors. The Standing Conference of Towns and Municipalities does not have a permanent body or specific coordination mechanism for climate action.

The state not only intervenes in markets relevant to low-carbon transition as a regulator but also as an economic agent, that is, by directly managing state-owned enterprise (SOEs).[16] With 121 businesses of the state (BOS),[17] that is, businesses where the state holds more than 10 percent of shares,[18] Serbia has the highest presence of BOS in high-emitting sectors across the Western Balkans.[19] This is important for Serbia's mitigation agenda, as a large state footprint was found to be associated with lower business dynamism, discouraging new firms from entering markets, curbing private investment and potentially slowing the transition to a greener, more sustainable economy.[20] Moreover, as they are not profit-maximizing, BOS are known to reduce the effectiveness of market-based policies (for example, carbon pricing) or distort the playing field and hinder needed private investments, (for example, in RE).

The presence of BOS is also important for Serbia's climate adaptation agenda. In Serbia, 467 BOS (or 55 percent of all BOS) operate in climate-vulnerable sectors—that is, sectors that will experience the negative effects of climate change, in line with 63 percent on average across WB6 countries, but significantly above the global average of 44 percent. At the same time, Serbia scores higher on the Notre Dame Global Adaptation Initiative (ND-GAIN) climate vulnerability index with a score of 0.41[21] than most of their peers. This suggests Serbia has higher adaptation needs because the country is more vulnerable to climate change while being more exposed to climate change as it also has BOS in vulnerable sectors. The fact that many of these BOS are performing poorly and are often owned by municipalities has implications for financing and coordinating the climate agenda in Serbia (see Section 4).

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[16] When the State acts as a *regulator*, it supervises and controls the economic agents that supply products and services. The State does that through the exercise of legal powers—control regulation—but without directly interfering in the market. When the State acts as an *economic agent*, it assumes a direct participation in the market by supplying goods and services through a state-owned enterprise (SOE).

[17] World Bank Global Businesses of the State (BOS) database. Employment data coverage for Serbia: 91 percent, revenue data coverage: 90 percent, profit/loss data coverage: 90 percent; data entry 2019.

[18] The term "businesses of the state" (BOS) refers to all businesses owned by the state with a holding greater than 10 percent, both directly or indirectly (for example, owned through subsidiary holdings), differentiating BOS from state-owned enterprises (SOEs) which are often companies where the state has a controlling stake.

[19] Compared to 62 in Bosnia and Herzegovina, 27 in North Macedonia, 19 in Albania, 14 in Montenegro, and 13 in Kosovo.

[20] World Bank. 2023b. "The Business of the State". Washington, DC: World Bank.

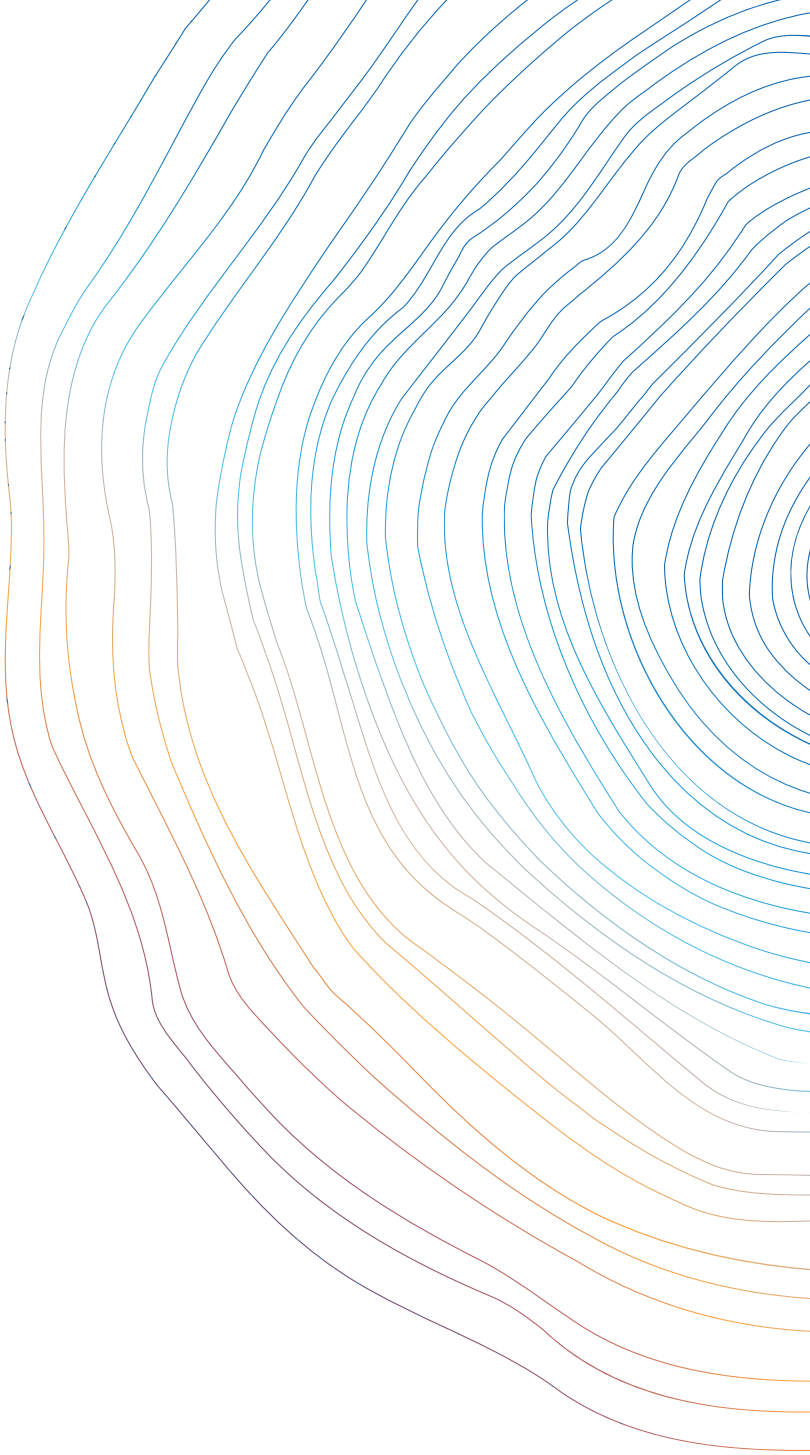
[21] ND-GAIN Index measures the vulnerability to climate change and other challenges for more than 180 countries. It consists of two scores: the Vulnerability score and the Readiness score. The Vulnerability score summarizes a country's level of exposure, sensitivity, and capacity to adjust to the adverse effects of climate change. Lower scores (less than 0.37 as of January 2024) are better.

While SOEs have limited obligations for climate action, the country's largest emitter takes initial actions towards decarbonization with donor support. SOEs and public sector entities must monitor and manage their energy consumption, and large enterprises, including SOEs, must conduct obligatory energy audits every four years. Large GHG emitters will be also obliged to implement GHG emission monitoring plans as part of the national MRV system. The national electricity utility joint stock company (JSC) EPS is Serbia's largest GHG emitter. JSC EPS has prepared its "Go Green" strategy, planning to increase the share of renewable energy in power generation. In the scope of an EBRD loan, signed early 2023, JSC EPS has committed to the development of a decarbonization plan in accordance with Serbia's NECP and climate risk reporting in accordance with recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD). In terms of A&R, the Law on Disaster Risk Reduction and Emergency Management Situations obliges companies in the fields of energy, telecommunications, mining, and transport to prepare a risk assessment.

Serbia has working mechanisms for stakeholder engagement and is increasing access to information related to climate change; however, the mechanisms for ensuring accountability could be strengthened. Several websites provide information on GHG emissions, energy consumption, climate-related historical data and forecasts, relevant policies and measures, and so on. Obligatory public consultations take place during preparation of policies and legislation related to climate change and a website portal 'e-consultation' was introduced in 2022. The parliament has a board for environmental protection but not for climate change. According to the publicly available documents, the hearings on climate change are scarce. The Serbian Audit Institution (SAI) has not been involved in the review of the implementation of climate change policy. However, SAI started reviewing the enforcement of environmental protection and EE regulations.

Human capital in Serbia will be critical for climate action, yet it will need significant investments. In 2022, 20 percent of the population was poor or vulnerable to falling into poverty, with around 7 percent living in absolute poverty. In Serbia, children are more likely to live in poverty than any other age group. Across Serbia's regions and population groups, health and education access and outcomes differ significantly. Although health outcomes for children are strong overall, regions with higher poverty levels (largely in southern and eastern Serbia) are more likely to show worse health outcomes for children. For example, infant mortality rates and the share of low birthweight babies are higher in poor regions. Despite the presence of social health insurance, a comprehensive health network, and a generous benefits package, Serbia has not achieved universal coverage in its full meaning, and the system's performance shows weaknesses in financial protection, effectiveness, efficiency, and equity.[22] Between 2017 and 2022, the unemployment rate declined from 13.5 to 9.4 percent. Serbia's employment rate was 64.5 percent in 2022 and while it outperforms most of its neighbors on key indicators for labor market access, with lower inactivity rates, lower levels of unemployment, and a lower share of youth not in employment, education, or training, it still lags EU countries, where employment rates reached 69.8 percent in 2022. Serbian women have the highest employment rates in the Western Balkans region, but the gap with Serbian men has remained constant at around 13–14 percentage points. Over the past decade, labor productivity has remained at less than half of EU levels. The labor market is also faced with skills gaps and mismatches owing to the limited avenues for reskilling and upskilling, which hinders its capacity to adapt to global megatrends such as the green transition. Against this backdrop, investments in human capital are critical to ensuring that Serbia's labor force is able to respond to the changing demand for skills brought about by the green transition, as discussed in section 2.

[22] Nguyen, Ha Thi Hong, Predrag Djukic, Jelena Zajeganovic-Jakovljevic, Ivana Misic, Nemanja Sormaz, and Milena Gajic-Stevanovic. 2023. "Serbia: Toward a More Effective, Efficient, Equitable and Resilient Health System." Review report, World Bank, Washington, DC.



Chapter 2

Adaptation risks and opportunities

2.1. How is a changing climate affecting risks and opportunities?

A landlocked country in the central Balkan Peninsula in Southeastern Europe, Serbia faces heightened vulnerability to the adverse impacts of climate change. The country experiences a moderately continental climate. In the north, the climate is more continental, with cold winters and hot humid summers, while in the south, summers and autumns are drier and winters are relatively cold, with heavy inland snowfall in the mountains.[23] However, climate change is affecting the region, leading to changes in temperature and precipitation, with rising average temperatures, less cold winters, and an increased risk of floods and droughts.[24] The risks are not uniform across its entire territory and vary depending on the type of hazard, exposure, vulnerability, and coping capacity.[25] Risk levels of the hazards to which Serbia is exposed are presented in Table 2.1.

TABLE 2.1. Main hazards in Serbia and associated risk levels

Hazard	Risk level
River flood	High
Urban flood	High
Wildfire	High
Extreme heat	Medium
Landslide	Medium
Earthquake	Medium
Water scarcity	Medium

Source: World Bank and GFDRR ThinkHazard: FYR of Serbia 2023.

Past extreme weather events caused major physical damage, financial losses and even deaths, with significant impacts on Serbia's economy. Floods, earthquakes, landslides, wildfires, and droughts are all prevalent hazards in the country, with about 2,800 large-scale disasters recorded from 2000 to 2010.[26] The predominant hazard in the area arises from excessive rainfall, resulting in both flooding and landslides. In late May 2014, Serbia experienced its most severe flooding and landslides in 120 years which impacted over 1.6 million people, causing over US$1.7 billion in damages, losses, and recovery expenses.[27] Serbia, in its updated NDC, estimated damages between 2015 and 2020 to be €1.8 billion, additional to €5 billion from 2000 to 2015, attributable to climate change and extreme weather events.[28] Table 2.2 highlights some of the major weather events that have impacted Serbia in recent decades. Most recently, in May and June 2023, heavy rainfall and floods affected more than 56 municipalities and cities, causing landslides in some municipalities, while severely damaging essential infrastructure, such as roads and bridges, agricultural land, as well as impacting more than 15,000 people. The damage caused by these floods on transport infrastructure (highways and roads) was estimated at 2.5 billion dinars (approximately US$2.3 million).[29]

[23] JCI (Jaroslav Černi Institute for the Development of Water Resources). 2014. "Climate and Climate Change Data on National Level". Project report, Belgrade.

[24] USAID (United States Agency for International Development). 2017. "Serbia Climate Risk Profile." Fact Sheet, Washington, DC.

[25] World Bank. 2022a. "Serbia—Ready 2 Respond: Emergency Preparedness and Response Assessment". Country report, Washington, DC.

[26] Ibid.

[27] Government of Serbia. 2014. "Serbia Floods 2014". Needs assessment report, Belgrade. https://fpi.ec.europa.eu/document/download/49e306d2-c3d8-41b4-aef3-52827c9f4d7e_en?filename=pdna_-_serbia_2014_-_report.pdf; World Bank. 2017. "Ready2Respond: Rapid Diagnostic User Guide—Emergency Preparedness and Response Systems". Washington, DC: World Bank.

[28] UNFCCC (United Nations Framework Convention on Climate Change). 2021. "Nationally Determined Contribution (NDC) of the Republic of Serbia for the 2021–2030 Period." Bonn.

[29] Serbia: Flood June 2023 - DREF Operation (MDRRS015)

TABLE 2.2. An overview of some extreme weather events in Serbia (1980–2014)

Hazards	Date	Catchment area or region	Municipality	Fatalities	Overall losses (€)	Additional information
Earthquakes	May 1980	Kopaonik	***	***	***	Measuring 5.8 on Richter scale
	Sep 1998	***	Mionica	***	***	Measuring 5.7 on Richter scale
	Nov 2010	***	Kraljevo	2 killed, 180 injured	***	Measuring 5.4 on Richter scale
Floods	1999	The river Velika Morava	Sumadija	8	***	30 bridges damaged
	2005	The river Tamis	Secanj, Zitiste, Plandiste	***	***	85,000 hectares (ha) and 150 houses flooded; 1,000 people evacuated
	2005	The river Juna Morava	Nis Jablanica, Rasina, Toplica	***	***	***
	2014	Serbia	24 municipalities	51	1,800,000,000	31,879 people evacuated
Landslides and escarpments	2006	Bogdanje	Trstenik	***	***	130 houses destroyed
	2014	Umka — Duboko	Belgrade	***	54,000,000	Area of 1.8 km, about 14,000,000 m
	2014	Krupanj	Krupanj	***	4,680,000	389 facilities either damaged or destroyed
	2014	Kladovo	Kladovo	***	***	30 landslides
Droughts	2000	Vojvodina and Central Serbia	***	***	657,000,000	Extreme drought, 37–61 tropic days
	2003	Vojvodina and Central Serbia	***	***	940,000,000	Extreme drought
	2007	Serbia	***	***	564,000,000	Caused 258 forest fires
	2011	Eastern, Southeastern and Central Serbia	***	***	470,000,000	Extreme drought
	2012	Vojvodina and Central Serbia	***	***	1,900,000,000	5 to 8 heat waves
Large-scale fires	2007	Staraplanina, Rtanj	Pirot, Kraljevo, Vranje	Several injured	40,000,000	22,000 ha of forest, 258 forest fires
	Aug 2012	Tara, Zlatibor	Bajinabasta	2 killed, 22 injured	more than 30,000,000	11,000 ha of forest, 20 large—scale fires

Source: Glock et al. 2016[30]
Note: *** = data unavailable.

[30] Glock K., Tritthart M. et al., 2016. "Report on natural disasters in the Western Balkans". NatRisk. Project number: 573806-EPP-1-2016-1-RS-EPPKA2-CBHE-JP.
https://www.researchgate.net/publication/349240500_Report_on_natural_disasters_in_the_Western_Balkans-NatRisk_Project_number_573806-EPP-1-2016-1-RS-EPPKA2-CBHE-JP/link/602673a445851589399b6962/download?_tp=eyJjb250ZXh0Ijp7InBhZ2UiOiJwdWJsaWNhdGlvbiIsInByZX

Serbia is exposed to hydro-meteorological hazards, such as foods, landslides, droughts, heat waves, wildfires, and earthquakes. The 2020 flood risk assessment in Serbia identified 115 towns and municipalities, housing around 5.5 million people (approximately 75 percent of the nation's total population), as highly susceptible to potential flooding.[31] In the scenario of a 100-year flood, an estimated 4,135 km2 of land is expected to be submerged, directly impacting about 1.15 million people, while the population that can be affected by the rarer 1,000-year flood is projected to be higher at 1.4 million people. About 19.6 percent of Serbia's total area is under medium risk for wildfires and 2.6 percent is under high risk for wildfires[32], while 28.8 percent of Serbia' total area is susceptible to very high and high landslide risks.[33] About 15.71 percent of the country's crop area is under medium risk for wildfires and 4.74 percent is under very high wildfire risk12. Belgrade experiences significant drought impacts on maize yield.[34] Novi Sad land areas are expected to expand by 0.6–1.3 million km2 between 2015 and 2050, an increase of 78 percent and 171 percent over the urban footprint in 2015. This urban land expansion could contribute to the warming of average summer daytime and nighttime air temperatures by 0.5°C–0.7°C, up to ~3°C in some locations, particularly in the city's south and east zones.[35]

Projected climate change impacts are expected to amplify the existing vulnerabilities in Serbia. Serbia's history of floods and natural disasters has shown that rural and low-income communities are particularly vulnerable to the impacts of climate change due to heightened water insecurity, increased health risks, and reduced agricultural productivity.[36] The country faces an elevated risk of severe droughts, heat waves, and wildfires as the century progresses.[37] According to climate change projections, the increased frequency and intensity of droughts will become stronger in the future and potentially will emerge in more places. Consequently, there will be an increase in the number of wildfires and the number of territories that will be affected by fires. These climatic shifts pose significant challenges with potential adverse impacts on the environment, society, and the economy.

The changes in climate have cascading impacts on Serbia's national service and productive value chains. Excessive rainfall often results in widespread urban flooding, industrial and sewage spills, and extensive landslides that further damage housing and infrastructure assets. For instance, damages to housing and urban infrastructure from the 2014 floods are estimated at €398 million, while damages to agriculture and trade are estimated at €453 million.[38] Mining, energy production, and energy distribution were also severely affected by this event, with direct damages estimated at €494 million.[39] In 2012, Serbia lost over a million hectares of agricultural production, incurring US$141 million in damages due to temperatures exceeding 35ºC for over 50 days.[40] Nevertheless, the largest losses in Serbia's agricultural sector were caused by droughts.[41] These effects place great stress and losses on key economic sectors, such as energy production and consumption, agriculture, water, transport, health, and forestry.

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[31] World Bank. 2021a. "Flood Hazard and Risk Mapping: Component 2 of Serbia National Disaster Risk Management Plan (NDRMP)". Project report, Washington, DC.

[32] Team calculations, data transmitted by CIMA in 2023, recent unpublished research on Wildfires in the Balkans. Contact Paolo Fiorucci paolo.fiorucci@cimafoundation.org for further detail

[33] See European Landslide Susceptibility Map V2 (ELSUS v2) at 200m resolution at https://esdac.jrc.ec.europa.eu/content/european-landslide-susceptibility-map-elsus-v2.

[34] Fridman, D., Burek, P., Politti, E., Sahu, R., Kahil, T., Wens, M. 2024. "Western Balkan and Eastern Europe Drought Impact Assessment – Regional report", IIASA, Laxenburg, Austria

[35] CRP, 2023, *Urban Heat in Novi Sad and Niš, Serbia presentation*.

[36] GCF (Green Climate Fund). 2019. "Readiness and Preparatory Proposal with United Nations Development Programme (UNDP) for Republic of Serbia: Adaptation Planning." GCF, Incheon.

[37] Serbia's First National Adaptation Plan (draft) 2015.

[38] Government of Serbia. 2014. "Serbia Floods 2014". Needs assessment report, Belgrade. https://fpi.ec.europa.eu/document/download/49e306d2-c3d8-41b4-aef3-52827c9f4d7e_en?filename=pdna_-_serbia_2014_-_report.pdf

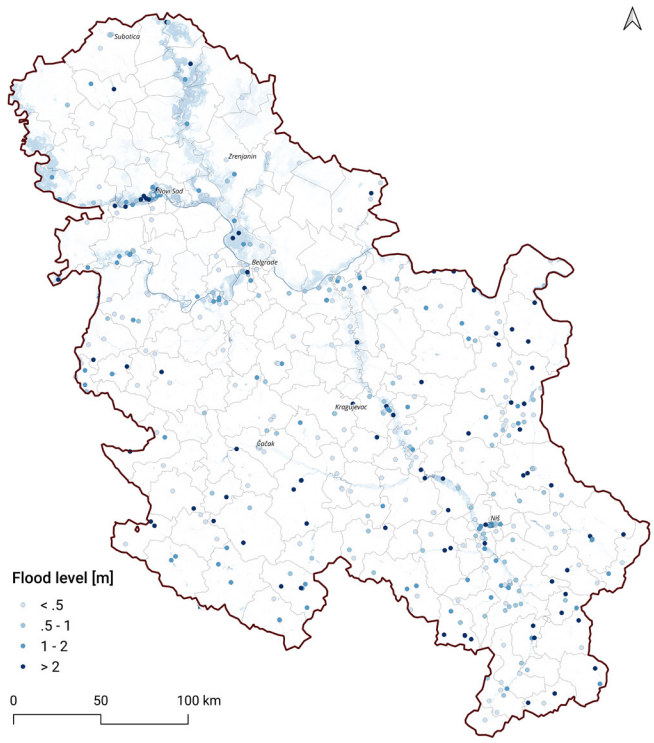
[39] GCF (Green Climate Fund). 2019. "Readiness and Preparatory Proposal with United Nations Development Programme (UNDP) for Republic of Serbia: Adaptation Planning." GCF, Incheon.

[40] USAID (United States Agency for International Development). 2017. "Serbia Climate Risk Profile." Fact Sheet, Washington, DC.

[41] Đurđević, Vladimir, 2020. "Drought initiative–Republic of Serbia: recommendations for development of the national drought plan of the Republic of Serbia." Ministry of environmental protection, Belgrade, Serbia. https://www.unccd.int/sites/default/files/country_profile_documents/NDP_SERBIA_2020.pdf

Extreme climate events have profound impacts on transportation and road infrastructures. Extreme rainfall is prevalent in Serbia, and it frequently causes floods and drainage system damage, particularly in river basins and lowland terrain, while landslides are more common in mountainous regions.[42] In lower river basins, large structures such as bridges are also vulnerable to damage. Year-round precipitation adds to pavement deterioration, particularly in low-lying places with thinner soil. Summer heat waves harm asphalt, primarily in urban and southern areas. Drought induces fires, slope instability, and road dust, especially during the summer, and it is influenced by embankment height.[43] In 2014, floods led to over 2000 landslides on Class I and II state roads, along with more than 3000 landslides on local roads.[44] The associated reconstruction costs for roads, bridges, culverts, and landslide remediation were approximately €98.0 million.[45] An analysis of extreme disaster events and their consequences from 2006 to 2021, conducted by a United Nations Development Program (UNDP) team, indicated that the damage to infrastructure amounted to €192 million, with the total damage to transport infrastructure reaching €166.4 million.

FIGURE 2.1. Serbian educational facilities' exposure to floods



Source: World Bank, JBA 2023.

Essential services such as educational facilities are also exposed to climate hazards and require interventions aimed at limiting disruptions to local communities. A substantial number of schools in Serbia are exposed to climate hazards. Matching the geolocation of primary and secondary schools with their localized exposure to hazards suggests that around 12 percent are highly exposed to floods (Figure 2.1).[46] Similarly, 10 percent of schools have medium or higher exposure to landslides, with 1.5 percent of those being highly exposed. Exposure to wildfires is lower, possibly due to schools being more often located in urban areas further away from forests where wildfire risk is higher. Only 0.3 percent of schools are highly exposed to wildfires, while around 1.3 percent display medium or higher exposure. Flood exposure is uncorrelated with the other hazards. Hence, there are only two institutions in the sample facing at least medium severity of exposure to all three hazards, while 14 (0.6 percent of schools) face medium to high exposure to the potentially compounding effects of wildfires and landslides. School closures caused by disaster events significantly impact student outcomes, as recently confirmed by Jakubowski, Gajderowicz, and Patrinos (2024).[47]

[42] Mladenović, Goran, and Jelena Ćirilović Stanković. 2022. "Report on the Impact of Climate Change on Road Infrastructure, with a Proposal for Adaptation Measures."

[43] Ibid.

[44] Jotić, Milovan, Vladeta Vujanić, Branko Jelisavac, Mile Zlatković, and Svetozar Milenković. 2015. "Landslides and Damage to Traffic Infrastructure in Serbia." *Construction* 69 (5–6): 215–224.

[45] Government of Serbia. 2014. "Serbia Floods 2014". Needs assessment report, Belgrade. https://fpi.ec.europa.eu/document/download/49e306d2-c3d8-41b4-aef3-52827c9f4d7e_en?filename=pdna_-_serbia_2014_-_report.pdf

[46] High exposure is defined as a 1 percent yearly probability of a flood, either fluvial or surface water, with depth over half a meter.

[47] Jakubowski, Maciej, Tomasz Gajderowicz, and Harry A. Patrinos. 2024. "Covid-19, School Closures, and Student Learning Outcomes: New Global Evidence from PISA." Discussion Paper No. 16731, Institute of Labor Economics, Bonn.

Climate change, with its related hazards, has a strong impact on human health in Serbia. Rising temperatures and heat waves have notably heightened heat-related mortality and illnesses such as heat strokes.[48] The warm and dry weather in cyclone-prone areas has been linked to an increased incidence of strokes in the country.[49] There was also a substantial 38 percent increase in excess deaths during a nine-day heat wave in Belgrade in 2007.[50] Moreover, a 1°C rise in air temperature in Serbia correlates with a 2 percent increase in the crude death rate. In Novi Sad, a 1°C increase in maximum temperature resulted in a 1 percent surge in hospital admissions.[51] Rising air temperature has affected water quality, leading to higher concentrations of pollutants in Serbia's vital rivers, such as Velika Morava, South Morava, and West Morava, which has had negative consequences for human health.[52] Moreover, the higher temperature prevalent in the country poses an elevated risk of malaria vectors.[53] Projections show that more frequent and prolonged droughts will affect rain-fed crops in the country.[54] Droughts causing pollen exposure are expected to raise respiratory infections. Intensified UV radiation is likely to increase the cases of skin cancer in the country. Moreover, weather conditions in Kragujevac have been linked with mental health issues.[55] Floods pose another significant threat to public health in Serbia. The health-related risks associated with flooding are diverse and include vector-borne diseases, trauma, injuries, and population displacements.[56] For instance, the 2014 floods resulted in 50 deaths and displaced over 32,000 individuals.[57] More recently, in June 2023, heavy rainfall and subsequent floods caused over 50 municipalities and cities to declare states of emergency.[58] These floods affected over 15,000 people and 1,700 households, causing damage to their living spaces, and disrupting their food supplies.[59]

Exposure to natural hazards is linked with and aggravates existing socioeconomic vulnerabilities. Serbia is divided into 169 municipalities (opštine, in 2019) that are facing different levels of socioeconomic stresses that interact with and are compounded by climate shocks. Population decline represents a significant challenge. The 2022 census recorded a population decrease of just below 8 percent in only 11 years since the last census. Eighty-five percent of all municipalities have shrunk in the last two decades. Of the municipalities that are facing demographic decline, 60 percent are rural and among the most isolated, as well as more exposed to hazards. On the other hand, high-density urban areas are overwhelmingly represented among the growing municipalities (58 percent). Unlike what is seen in other WB6 countries, the average declining municipality has a lower exposure to floods compared to an average growing municipality. This is due to the high exposure of the most urbanized municipalities, often comprising fluvial cities. Indeed, when only focusing on lower density urban areas and rural ones, the result is reversed (but the difference is not statistically significant). Declining, mostly rural areas are instead more exposed to wildfires (23 percent higher average exposure).[60]

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48 USAID (United States Agency for International Development). 2017. "Serbia Climate Risk Profile." Fact Sheet, Washington, DC.

49 Sekulić, Goran, Duška Dimović, Zvezdan Kalmar Krnajski Jović, and Nataša Todorović. 2012. "Climate Vulnerability Assessment: Serbia". Assessment report, WWF, Belgrade.

50 Bogdanović, Dragan C., Zoran G. Milosević, Konstansa K. Lazarević, Zana C. Dolićanin, Dragan M. Randelović, and Stefan D. Bogdanović. 2013. "The Impact of the July 2007 Heat Wave on Daily Mortality in Belgrade, Serbia." Central European Journal of Public Health 21 (3):140–45. 10.21101/cejph.a3840.

51 Milosevic, Dragan, Jelena Dunjić, Stevan Savic, Daniela Arsenovic, and Zorana Luzanin. 2023. "Extreme heat, mortality and hospital admissions in Serbia." https://www.researchgate.net/publication/370134337_Extreme_heat_mortality_and_hospital_admissions_in_Serbia

52 Serbia's First National Adaptation Plan (draft) (2015).

53 Mihailović, Dragutin, Dušan Petrić, Tamaš Petrović, Ivana Hrnjaković-Cvjetković, Vladimir Djurdjevic, Emilija Nikolić-Đorić, Ilija Arsenić, Mina Petrić, Gordan Mimić, and Aleksandra Ignjatović-Ćupina. 2020. "Assessment of Climate Change Impact on the Malaria Vector Anopheles hyrcanus, West Nile Disease, and Incidence of Melanoma in the Vojvodina Province (Serbia) Using Data from A Regional Climate Model." PLoS ONE 15 (1): e0227679. https://doi.org/10.1371/journal.pone.0227679.

54 UN (United Nations). 2021. "National Pathways for Food Systems Transformation". Summit dialogue report, New York.

55 Sekulić, Goran, Duška Dimović, Zvezdan Kalmar Krnajski Jović, and Nataša Todorović. 2012. Climate Vulnerability Assessment: Serbia. Assessment report, WWF, Belgrade.

56 Vasconcelos, Paula. 2006. "Flooding in Europe: A Brief Review of the Health Risks." Eurosurveillance 11 (16). https://www.eurosurveillance.org/content/10.2807/esw.11.16.02947-en?crawler=true.

57 USAID (United States Agency for International Development). 2017. "Serbia Climate Risk Profile." Fact Sheet, Washington, DC.

58 Davies, Richard. 2023. "Floods in Serbia, Kosovo and Romania – June 2023." Copernicus, July 20, 2023. https://european-flood.emergency.copernicus.eu/en/news/floods-serbia-kosovo-and-romania-june-2023.

59 IFRC (International Federation of Red Cross and Red Crescent Societies). 2023. Serbia: Flood June 2023 – Disaster Response Emergency Fund Operation (MDRRS015)". Situation report, Belgrade.

60 World Bank analysis (CIMA data).

All urban areas in Serbia have been expanding, despite no pressing needs to accommodate population. In doing so, they have become significantly more exposed to floods. The regional report identifies 127 urban areas with populations over 5,000 in Serbia.[61] Only 28 of these have been growing in the last 20 years, while all of them have increased their urban footprint. This suggests cities have been expanding inefficiently. New urban expansion in the last two decades has occurred on city parcels whose average exposure to floods is 151 percent higher than previously existing urban built-up areas. That translated into an average increase in flood exposure of around 23 percent. The same does not apply for landslide exposure, which is virtually unchanged (0.1 percent overall average increase in exposure due to new expansion being 1 percent more exposed than older parcels).

The business of modeling the effects of climate change—whether shocks or slower-moving stressors—on GDP is tricky, even with the best that economics has to offer. The channels via which impacts take place are difficult to account for in an exhaustive way. This is further compounded by the uncertainties in climate and exposure data, especially when projected, and the difficulty of calibrating vulnerabilities. For instance, while overall flooding risks are expected to fall, the incidence of flash floods is expected to rise. More generally, modeling fails to capture the impacts of certain extreme events. Wildfires are a case in point: historical data quickly becomes sparse as one goes back in time, impact channels are multifaceted and seldom understood, and projection of the hazard is yet to be tested. Modeling the impacts at a yearly level is next to impossible for highly nonlinear climate shifts (for example, the hydrological cycle) whose dynamics are not yet fully captured in climate models and yield large uncertainties, once again expensive to propagate. Finally, as described above, climate hazards interact and compound, yet models can best capture dynamics critical to a given climate hazard, missing the complexity of the links. Nonetheless, chapter 4 provides the very best assessment of the potential lower-bound magnitudes of damages and their impacts on GDP. These estimates should be supplemented with an understanding of the uncertain and extreme nature of climate shocks and stressors, as described in this section.

To counter the growing risks linked to a changing climate, Serbia will need to consider large investments in adaptation—investments that will come with large benefits (see the following section). The total cost of proposed policy actions and investments for an initial adaptation package in Serbia is approximately US$9.5 billion (see Estimate of Adaptation Needs in Annex B), including sectoral estimates of US$444 million (disaster risk management or DRM), US$345.54 million (urban), US$2.23 billion (water), US$112.3 million (forestry and biodiversity), US$457.18 million (agriculture), US$5.44 billion (transport), US$175.32 million (education, skills, and labor markets), US$223.17 million (social protection systems), and US$55.43 million (health systems). Multiple sources of information were used to estimate the needs. These included extracting identified needs and costs from the country's national strategic document (that is, the National Adaptation Plan). This was supplemented by input from local and international sectoral experts and validated with costs from previous projects, including those previously financed by the World Bank Group. A technical annex (Annex #1) provides a detailed assessment of the methodology used. The proposed measures cover a range of adaptation needs such as policies and hard and soft infrastructures with varying timelines and complexities depending on the area of focus. These are further elaborated on within Annex B.

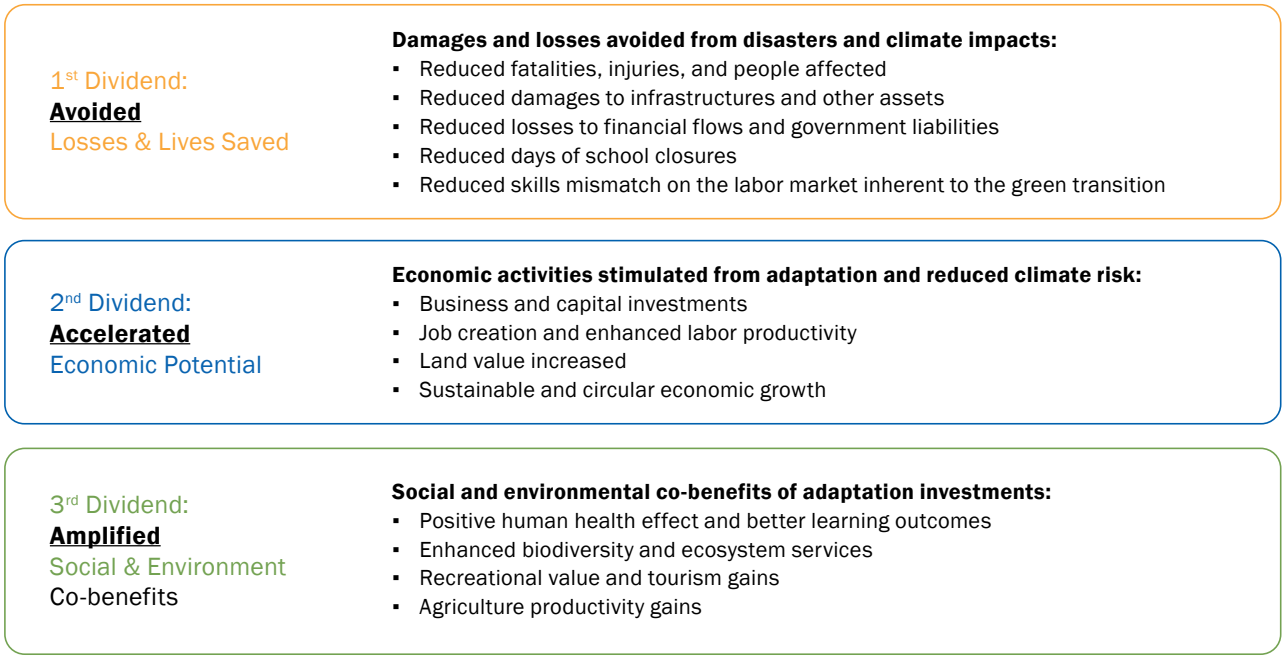
2.2. A changing climate comes with greater risks — but also greater opportunities

Investing in adaptation can yield substantial social, economic, and environmental benefits. Such benefits could be expressed through the Triple-A Dividend—that is, investments that bring with them three distinct sets of returns: avoided losses, economic benefits, and, finally, social and environmental spillovers. The Triple-A Dividend framework reconciles perspectives from the humanitarian, environmental,

[61] See chapter 3 of the Regional Report for further details on the identification of urban areas.

and economic fields (see figure 2.2).[62] It identifies three types of benefits: avoided losses and lives saved during a disaster or climate event; accelerated economic potential as a result of stimulated investments and bolstered economic activities due to the reduction in background climate and disaster risks; and amplified social and environmental co-benefits of adaptation investments.

FIGURE 2.2. The "Triple-A dividend of resilience" framework



Source: Adapted from Tanner et al. 2015.[63]

Avoided losses: Taking adaptive actions can reduce financial losses, enhance security, and make investments in vulnerable areas more attractive. Climate change adaptation is essential for businesses to prevent economic losses; to drive innovation for revenue growth, cost savings, and sustainability; and to safeguard the well-being of communities and ecosystems in their operational areas.[64] Global reports have indicated that investments in adaptation could yield a total net benefit of US$7.1 trillion, with an average benefit-cost ratio (BCR) of 4.[65] Typical BCRs range from 2.5 to 5.5, but some may exceed 10. Early warning systems offer substantial, cost-effective benefits by saving lives and protecting assets.[66] Providing a one-day warning of an impending heat wave can reduce subsequent damage by 30 percent and allocating US$800 million to such systems in developing countries could avert losses of US$3–16 billion annually.[67] The Government of Serbia has funded several projects in this regard. The "International System for Early Warning of Emergencies in the Danube River Basin and the Sava" project aims to establish a national center for early warnings and coordinate with the Accident Emergency Warning System AEWS in the Danube and Sava river basins.[68] The "Building the Link between Flood Risk Management Planning and Climate Change Assessment

[62] Tanner, T. et al., 2015. The Triple Dividend of Resilience: Realizing Development Goals through the Multiple Benefits of Disaster Risk Management. Overseas Development Institute and World Bank, London and Washington, DC. https://documents1.worldbank.org/curated/en/993161515193991394/pdf/P151463-01-05-2018-1515193988640.pdf

[63] Tanner, T. et al., 2015. « The Triple Dividend of Resilience: Realizing Development Goals through the Multiple Beneffts of Disaster Risk Management". Overseas Development Institute and World Bank, London and Washington, DC. https://documents1.worldbank.org/curated/en/993161515193991394/pdf/P151463-01-05-2018-1515193988640.pdf

[64] WEF (World Economic Forum). 2023. "Accelerating Business Action on Climate Change Adaptation." White Paper, WEF, Cologny.

[65] GCA (Global Commission on Adaptation). 2019. "Adapt Now: A Global Call for Leadership on Climate Resilience". Report, Rotterdam.

[66] Ibid.

[67] GCA (Global Commission on Adaptation). 2019. "Adapt Now: A Global Call for Leadership on Climate Resilience". Report, Rotterdam.

[68] Ibid.

in the Sava River Basin" project, led by the International Sava River Basin Commission, addresses issues of trans-boundary flood management. It considers the impacts of climate change under different scenarios and the perspective adaptation measures envisaged by leveraging available data and constructing a GIS (geographic information systems) model for flood management-related information.[69]

Accelerated economic potential: Climate change adaptation provides opportunities for green and sustainable economic development, especially in key economic sectors and in job creation. According to the Economic and Investment Plan for the Western Balkans developed by the European Commission, taking actions in climate adaptation and mitigation promotes circular economic growth and provides new business opportunities related to sustainability and energy efficiency.[70] Recently, the World Bank approved a US$100 million equivalent loan to support Serbia's LSGs in managing sustainable infrastructure, promoting equitable growth, and facilitating the green transition.[71] This funding is part of the US$300 million allocated for the Local Infrastructure and Institutional Development Project, developed in collaboration with the French Development Agency.[72] The project aims to assist the Government of Serbia in realizing its goals of delivering improved infrastructure services, enhancing mobility, reducing the carbon footprint, and expanding access to economic opportunities and services for all citizens. Through this support, LSGs are expected to increase infrastructure investments by an annual 8 percent, ensuring a fair distribution of resources with a focus on vulnerable communities.[73] Consequently, climate change adaptation and resilience efforts will be enhanced through nonmotorized transport, slope stabilization, riverbank protection, drainage works, greening of public spaces, and addressing legacy pollution.[74] These initiatives will drive economic growth, provide improved access to public services, markets, and jobs for the most disadvantaged, and enhance the attractiveness of cities, towns, and underdeveloped regions in Serbia. Investing in adaptation also supports employment as well as sustainable and climate-resilient urban development, although education and training systems will need to adapt to the skills required by these investments for this labor demand to be met.[75] Some jobs will also be lost in the process, but the net effect is expected to be positive. Moreover, there will be significant changes in many jobs, which are expected to require additional (green and other) skills.[76] Increased retraining and overall improvement in education may also benefit the country's economy. According to a recent study, a year of education increases pro-climate beliefs, behaviors, most policy preferences, and green voting, with voting gains equivalent to a substantial 35 percent increase.[77]

Amplified social and environmental co-benefits: Climate actions also yield substantial social and environmental co-benefits, safeguarding agriculture, water resources, and the ecosystem. Benefiting from international partnerships, Serbia is proactively establishing essential institutional structures to maintain consistency and continuity in the development of initiatives and projects related to climate change adaptation, with a specific focus on disaster risk reduction (DRR).[78] These projects receive funding directly from the government as well as bilateral and multilateral sources. An agricultural risk reduction and reinsurance mechanism has been developed as part of a project funded by the Global Environment Facility

[69] Liška, Igor. n.d. "AEWS—Accident Emergency Warning System." International Commission for the Protection of the Danube River. https://www.icpdr.org/tasks-topics/tasks/accident-prevention-control/accident-emergency-warning-system.

[70] European Commission. 2020. "Economic and Investment Plan for the Western Balkans 2021–2027". Brussels.

[71] World Bank. 2022b. "Serbia's Transition to More Equitable and Greener Growth to Benefit From Better Local Service Delivery, with World Bank Support." Press Release, March 9, 2022.

[72] Serbia Local Infrastructure and Institutional Development Project (P174251).

[73] World Bank. 2022b. "Serbia's Transition to More Equitable and Greener Growth to Benefit From Better Local Service Delivery, with World Bank Support." Press Release, March 9, 2022.

[74] *Ibid.*

[75] Gajšak, Marijan, Lili Ilieva, Miodrag Grujić, Tamara Trumbić, and Dragan Blažev. 2022. "Study on the Climate-Resilient Infrastructure in North Macedonia". Consultant report, E Co., Chislehurst.

[76] Sanchez-Reaza, Javier, Diego Ambasz, Predrag Djukic, and Karla McEvoy. 2022. "Making the European Green Deal Work for People: The Role of Human Development in the Green Transition". Washington, DC: World Bank.

[77] Angrist, Noam, Kevin Winseck, Harry A. Patrinos, and Joshua S. Graff Zivin. 2023. "Human Capital and Climate Change." Working Paper no. 31000, National Bureau Of Economic Research, Cambridge.

[78] GCF (Green Climate Fund). 2019. "Readiness and Preparatory Proposal with United Nations Development Programme (UNDP) for Republic of Serbia: Adaptation Planning." GCF, Incheon.

(GEF), the World Bank, and the Swiss State Secretariat for Economic Affairs under the Southeastern Europe and Caucasus Catastrophe Risk Insurance Facility.[79] The government has secured additional financing of approximately US$50 million from the World Bank for the implementation of the Irrigation and Drainage Rehabilitation Project.[80] The project's objectives centered on enhancing agricultural productivity through the rehabilitation of drainage and irrigation infrastructure, reducing flood-related risks to land, property, and life, and improving water resource management and associated institutions and policies.

2.3. Human capital is a cornerstone of adaptation efforts.

Human capital is a cornerstone of adaptation efforts. Climate change adaptation politics and investments will require reforms and adjustments to which people will need to respond by changing their consumption and investments, including in education, and, possibly, employment. People-focused interventions are therefore required in education, health, social protection, and labor markets to enable people to take advantage of these opportunities, while also protecting them from changing access to resources and higher food and fuel prices, for example. Without such investments, there is a risk that people will be left behind, threatening political support for such transformations.

Adaptation to climate change will require significant but manageable investments into human capital. A systematic approach to human capital development in such conditions should address several issues. It may include establishing mechanisms (for example, skills development funds) co-led by the private sector to support at a larger scale reskilling and upskilling of the workforce, developing tools to consistently identify changes in skills demand associated with the greening of the labor market, investing in labor mobility schemes to support a more optimal geographical reallocation of jobs and workers, and investing in the conditions needed for more labor market-responsive and larger-scale training (that is, curricula, teachers or instructors, infrastructure, equipment, and so on).

Education and science play an important role in adaptation to climate change, but more attention is required at the country level. Key education system issues to be tackled in Serbia include quality of teaching, digitalization and digital skills, the quality and relevance of vocational education and training, curricula modernization, access and equity, financing, governance, and early childhood education.[81] The new results of the Organization for Economic Co-operation and Development's Program for International Student Assessment 2022 showed that more work is needed in Serbia to improve stagnant performance and students' learning outcomes and to mitigate the consequences of the pandemic.[82] Education improvement will require preparing all teachers in Serbia for green education and may cost US$9.8–29.5 million. Higher education and science would also play a significant role in advancing adaptation in the Western Balkans. Given the many common challenges and the limited resources, more collaboration projects between Western Balkan countries should be promoted and supported. This would strengthen the role of higher education in the provision of skills and undertaking research and innovation in support of climate change adaptation. As part of the adaptation, Serbia will need to consider greening schools and health facilities.[83] The response to the challenges that green transition puts in front of the education system in Serbia is not optimal. There are many ongoing initiatives, but there is no systematic approach to transforming the education system. According to interviews

[79] GEF (Global Environment Facility). 2012. "Regional—Southeastern Europe and Caucasus Catastrophe Risk Insurance Facility (CRIF)." GEF News, November 27, 2012. https://www.thegef.org/newsroom/news/regional-southeastern-europe-and-caucasus-catastrophe-risk-insurance-facility-crif.

[80] Serbia Irrigation and Drainage Rehabilitation Project: Additional Financing (English) (P105270).

[81] Almeida, Rita, Ciro Avitabile, and Tigran Shmis. 2023. "Beyond the Learning Drop: Why Countries in Eastern Europe and Central Asia Should Act Now to Avoid A Teacher Crisis." World Bank Blogs, December 14, 2023. https://blogs.worldbank.org/en/education/beyond-learning-drop-why-countries-eastern-europe-and-central-asia-should-act-now-avoid.; OECD (Organization for Economic Co-operation and Development). 2022a. *Multidimensional Review of the Western Balkans: From Analysis to Action.* Paris: OECD.

[82] OECD (Organization for Economic Co-operation and Development). 2022b. *PISA 2022 Results.* 2 vols. Paris: OECD.

[83] Dozol, Adrien, Diego Ambasz, and Tigran Shmis. 2023. "Greening Public Human Development Buildings in Croatia: Support for the Implementation of the European Green Deal in the Croatian Health and Education Sectors." Policy Note, World Bank, Washington, DC.

with Serbian experts, the country will need to focus more on new programs that would improve skills output and decrease occupations with low to no demand in the transformed market.

The health system in Serbia also has a good foundation to support climate change adaptation, but it has some weaknesses. Despite the presence of social health insurance, a comprehensive health network, and a generous benefit package, the system's performance shows weaknesses in financial protection, effectiveness, efficiency, and equity. Furthermore, regardless of a widespread and well-organized service delivery system, critical inputs such as health workforce and infrastructure are behind the EU average.[84] Adequate health workforce capacity is crucial to effectively manage potential climate emergencies. Serbia has had a long-standing issue of being unable to absorb the available health workforce capacity. Notably, there was a discernible improvement in workforce absorption during the COVID-19 pandemic, showing the health system's ability to be responsive during disasters.[85] However, the existing issue of a constrained number of health workers employed results in overworked staff and a higher chance of getting ill due to the higher exposure to sick patients. Despite the efforts of the health care workforce during the COVID-19 pandemic, there has been limited impact on addressing policy gaps to improve health workforce employment.[86] A comprehensive approach is crucial to strengthen the health care system, implementing sustainable measures for optimized workforce utilization amid evolving climate-health challenges. This approach not only enables an effective response to climate emergencies but also establishes sustainable measures for long-term resilience.

Strengthening the resilience of the health care system to manage and respond to climate change and related hazards is a multifaceted approach. The extent to which Serbia's health system is prepared for and has the capacity to manage changes in hazards, exposure, and susceptibility will play a crucial role in protecting and promoting the population's health and well-being amid climate change challenges. Serbia's initial communication under the UNFCCC[87] highlights specific adaptation measures to address climate health risks such as conducting detailed climate vulnerability assessments; ensuring availability of medications, vaccines, and equipment; and improving climate and heat wave early warning systems and climate monitoring systems.[88] The health system faces additional challenges in effectively managing climate hazards due to existing gaps. For instance, Serbia's disease surveillance system, mandated by the 2016 Law on Protection from Communicable Diseases, requires daily reporting of climate-related diseases.[89] However, the health system lacks integrated monitoring for climate disasters. Although health promotion and risk education exist for vulnerable groups,[90,91] there is no evident inclusion of climate risk communication. To enhance climate adaptation and mitigation, it is essential to invest adequate resources in managing risks and disasters. Furthermore, the health system needs to be able to adequately respond to both urgent and sudden climate-related events (like floods, heat waves, or epidemics) but also to be able to adapt to changing disease burdens in the medium term. Strengthening surveillance and monitoring mechanisms for climate-related diseases and providing continuous capacity-building opportunities for health care professionals are important in ensuring the health care system's readiness to address the evolving challenges posed by climate change. The continued use of electronic health systems for emergencies should be promoted. Health systems have

[84] Nguyen, Ha Thi Hong, Predrag Djukic, Jelena Zajeganovic-Jakovljevic, Ivana Misic, Nemanja Sormaz, and Milena Gajic-Stevanovic. 2023. "Serbia: Toward a More Effective, Efficient, Equitable and Resilient Health System." Review report, World Bank, Washington, DC.

[85] Šantrić Milićević, Milena, Stefan Mandić-Rajčević, and Aleksandar Stevanovic. 2022. "Health Workers Labor Market Before and During the COVID-19 Pandemic: Health Sector Capacity of Serbia." European Journal of Public Health 32 (Supplement 3): ckac131.283. https://doi.org/10.1093/eurpub/ckac131.283

[86] Vračar, Ana. 2022. "Shortage of Health Workers in Serbia is A Risk for Both Patients and System." People's Dispatch, October 07, 2022. https://peoplesdispatch.org/2022/10/07/shortage-of-health-workers-in-serbia-is-a-risk-for-both-patients-and-system/.

[87] Government of Serbia, Ministry of Environment and Spatial Planning. 2010. "Initial National Communication of the Republic of Serbia under the United Nations Framework Convention on Climate Change." National report, Belgrade.

[88] National Determined Contribution of the Republic of Serbia for 2021–2030.

[89] See Law on the Protection of Population from Infectious Diseases at https://leap.unep.org/en/countries/rs/national-legislation/law-protection-population-infectious-diseases#:~:text=This%20Law%20hereby%20regulates%20various,suppression%20is%20of%20general%20interest.

[90] See Social Inclusion through Education and Training at https://national-policies.eacea.ec.europa.eu/youthwiki/chapters/serbia/66-social-inclusion-through-education-and-training.

[91] See Nurturing Care for Healthier Futures (UNICEF Serbia) at https://www.unicef.org/serbia/en/nurturing-care-healthier-futures.

a role in supporting green transition and people that migrate because of climate change.[92] Similarly, as the green transition progresses, the need for mental health support would increase as it would be significant in supporting the population to go through it. Lastly, as people that migrate due to climate change may have limited access to health services and insurance, the health system needs to be agile enough and ready to adapt to climate change- and green transition- related migrations to provide adequate health care support when and where necessary. That would include enhancing provision of health services in new settlement areas and optimization of the service provision in old ones. In these processes, special attention should be given to the needs of the most vulnerable populations to ensure equitable access and use of various health services as those populations are most at risk.

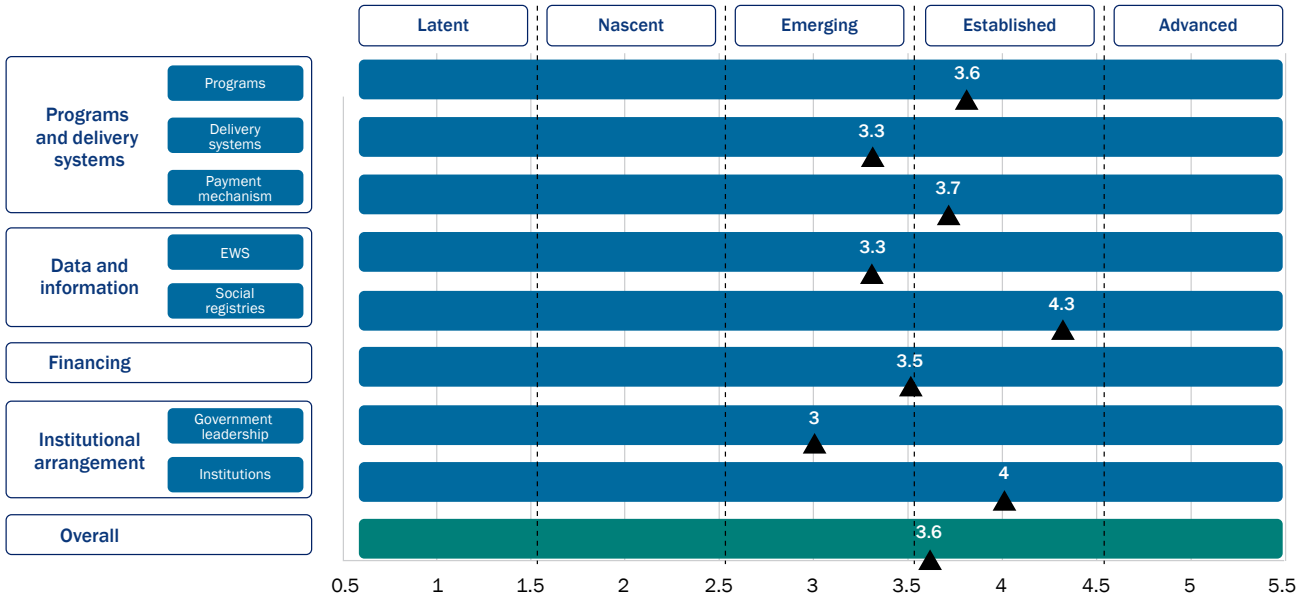
To reduce the risks and uncertainty of climate change on people's income, consumption, and human capital investments, increased coverage and adequacy of social protection systems are required. The social protection system in Serbia is mature, providing protection against a range of income shocks and lifecycle vulnerabilities. The right to unemployment benefits is regulated by the Law on Employment and Unemployment Insurance, which gives workers the right to unemployment benefits in the case of termination of employment due to dismissal if the worker has been under compulsory insurance for the past 12 months. This may limit eligibility for some workers, for example, those in informal sectors. Temporary income support programs are also somewhat constrained in their coverage, limiting the ability for temporary social support to some poorer households. Serbia has introduced an energy-vulnerable consumer program that allows people to apply based on their financial and health status, although initial analysis suggests low uptake to date.

Serbia has an established social protection system, but it is not used to fully support households affected by climate-related challenges, specifically acute shocks. Figure 2.3 presents an assessment of the capacity of Serbia's social protection system to respond to climate shocks along four pillars: programs and delivery systems, data and information, financing, and institutional arrangements.[93] As currently designed, social assistance programs in Serbia lack the capacity and legal frameworks to expand coverage to additional households to help them cope with shocks, as was witnessed during the COVID-19 pandemic response. However, the delivery systems, such as payments into bank accounts and ongoing advances in information systems—including establishment of the Social Card Registry and development of an integrated social protection information system—provide the platform for building such scalability, which could be introduced into the financial social assistance (FSA) program. This could be done by defining rules that would expand FSA to new households affected by shocks and increasing payment to existing beneficiaries, as well as establishing the mechanisms to trigger such as scale-up. Serbia has a one-off assistance (OFA) program primarily designed to address idiosyncratic shocks, which could evolve into an instrument to respond to localized climate-induced shocks. For this, improvements are needed in the procedures and criteria for award of OFA. Revising and aligning social protection, DRM, and climate change adaptation legislation and policies could permit greater flexibility in the targeting and duration of social assistance. The allocation of adequate financing in climate change adaptation budgets to enable such investments in the social protection system, and, importantly, to rapidly fund an expansion of the system, is also required. This should be informed by analyses of the individual- and household-level impacts of climate shocks to inform the design of such support in terms of the eligibility criteria, duration, and amounts.

[92] Lebano, Adele, Sarah Hamed, Hannah Bradby, Alejandro Gil-Salmerón, Estrella Durá-Ferrandis, Jorge Garcés-Ferrer, Fabienne Azzedine, Elena Riza, Pania Karnaki, Dina Zota, and Athena Linos. 2020. "Migrants' and Refugees' Health Status and Healthcare in Europe: A Scoping Literature Review." *BMC Public Health* 20 (1): 1039. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-08749-8; Schulte, Paul A., A. Bhattacharya, C.R. Butler, Heekyoung Chun, Brenda Jacklitsch, T. Jacobs, Max Kiefer, Jennifer M. Lincoln, S. Pendergrass, J. Shire, Joanna R. Watson, and Gregory R. Wagner. "Advancing the Framework for Considering the Effects of Climate Change on Worker Safety and Health." *Journal of Occupational and Environmental Hygiene* 13 (11): 847-865. https://doi.org/10.1080/15459624.2016.1179388.

[93] The World Bank's Social Protection Stress Test Tool rapidly assesses the readiness and ability of national social protection systems to adapt or scale-up in response to shock, thereby pinpointing areas for greater investment. World Bank. 2021b. "Stress Testing Social Protection: A Rapid Appraisal of the Adaptability of Social Protection Systems and Their Readiness to Scale Up." Guidance Note, World Bank, Washington, DC.

FIGURE 2.3. An assessment of Serbia's social protection system



Source: Fitzgibbon and Coll-Black 2023.[94]

2.4. What is Serbia doing and how well?

Several policies and laws have been implemented over the past two decades to enhance DRR and emergency management (EM). The 2009 Law on Emergency Situations[95] mandated the assessment of multi-hazard vulnerability at national and municipal levels, serving as a foundation for subsequent disaster-related legislative developments. The aftermath of the severe 2014 flood prompted additional progress in legal and institutional accountability for DRM.[96] Serbia introduced the NDRMP later that year in response to the identified vulnerabilities.[97] Two additional laws were adopted in 2015 to address post-disaster response and recovery, focusing on public procurement rules and reforming the national system for reconstruction and recovery.[98] The comprehensive 2018 Law on Disaster Risk Reduction and Emergency Management Situations further regulated the national DRR strategy, aiming to enhance resilience and readiness at both individual and community levels.[99] The National Protection and Rescue Plan guides response activities and has been adopted by 100 LSG units and will increase.[100]

The legislative framework and organizational structure in Serbia can adopt a top-down approach for the implementation of DRR and EM. Despite the legal DRR and EM framework, local governments face challenges in fully implementing the required risk assessments, DRR plans, and protection and rescue plans.[101] While the risk assessments are reported to be implemented at all local levels, the DRR plans and the protection and rescue plans highlight variation in completeness and quality. The central-local approach,

[94] Fitzgibbon, Catherine, and Sarah Coll-Black. 2023. "Stress Testing the Serbia Social Protection System". Unpublished Memo.

[95] Law on Emergency Situations, available at https://www.fao.org/faolex/results/details/en/c/LEX-FAOC154419 /

[96] Implementation Completion and Results Report on a Loan in the Amount of € 66.1 million (US$ 70 Million Equivalent) To the Republic of Serbia for the Disaster Risk Management Development Policy Loan with a Catastrophe-deferred Drawdown Option (P157489).

[97] See Serbian National Disaster Risk Management Program at https://documents1.worldbank.org/curated/en/449541638846853264/pdf/Serbia-Disaster-Risk-Management-Project.pdf.

[98] See Law on Reconstruction Following Natural or Other Hazards at https://www.obnova.gov.rs/uploads/useruploads/Documents/Zakon_o_obnovi%20nakon%20el%20i%20druge%20nepogode_engl.pdf.

[99] See Law on Disaster Risk Reduction and Emergency Management Situations at https://pravno-informacioni-sistem.rs/eli/rep/sgrs/skupstina/zakon/2018/87/1/reg

[100] World Bank. 2022a. "Serbia—Ready 2 Respond: Emergency Preparedness and Response Assessment". Country report, Washington, DC.

[101] Ibid.

coupled with the government's hiring freeze, restrain the capacity to align with European civil protection standards. The system needs the local capacities to incorporate the central authorities' vision for DRR and EM in their structure and to reach the necessary level of functionality.

Serbia can provide fundamental disaster responses, but improvement over equipment, capacity, data availability, and implementation of missing DRM policies in the existing legal framework are still needed. The recently launched Digital Climate Atlas for Serbia is a valuable resource for evidence-based decision-making and contributes to the country's efforts in climate adaptation.[102] Over recent years, Serbia has made impressive developments in the Disaster Risk Information System and a risk register but there is need for further integration of information and creation of strong operational awareness during response for all agencies. The information management systems require integration into one system that can be accessed by all relevant agencies. Also, the National Training Center for Emergency Management lacks the capacity to function as a training facility for all emergencies and agencies. While strong in terms of training programs and exercises, the system could benefit from additional facilities to support multiagency training, coordination workshops, and simulation exercises.[103] As for the legislative and institutional accountability component, the country's legislative framework needs to be improved by filling in missing policies and bylaws and implementing legislation on critical infrastructure resilience and safety and information campaigns on risks and insurance.

Serbia has progressed in establishing an effective institutional and legal framework to address climate change. Aligned with the EU Water Framework Directive and the EU Flood Directive, the country adopted the Law on Water in 2010. The 2014 Law on Post-Flood Rehabilitation was a direct response to a devastating flood event. Specific regulations addressing fire protection, along with the National Strategy for Emergency Response and a Fire Protection Strategy further contribute to Serbia's overall disaster preparedness and response efforts.[104] The adoption of the Climate Change Law in 2021 establishes a legal obligation to provide an appropriate response to climate issues and the Low-Carbon Development Strategy 2023–2030 supports Serbia in meeting the obligations from the Paris Agreement.[105]

Serbia has developed a relevant legislative, policy, and institutional framework to improve the quality and inclusiveness of education as well as its alignment with the labor market. Several important laws have been adopted in recent years to promote reforms in the education sector, with the laws on higher education (2017), adult development (2017), dual education (2017), national qualification framework (2018), and student organization (2021) being among the most important ones. The Strategy for Education and Upbringing Development in Serbia by 2030[106] was adopted in June 2021, aimed at further harmonizing the education policies with ongoing labor market trends and EU standards.[107] It envisages support for green and digital transitions in education and training and recognizes the importance of environmental education and plans to have this subject introduced as an extracurricular activity within formal education at different levels. Serbia has made good progress in improving its skills framework. In 2018, the National Qualifications Framework for Serbia was adopted for identifying, creating, and classifying qualifications in accordance with demands of the labor market, lifelong learning, science, and society in general.[108]

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[102] See The GCF's "Advancing Medium and Long-Term Adaptation Planning in the Republic of Serbia Project" (NAP), administered through the UNDP, at https://atlas-klime.eko.gov.rs/eng/about.

[103] World Bank. 2022a. "Serbia—Ready 2 Respond: Emergency Preparedness and Response Assessment". Country report, Washington, DC.

[104] European Commission. 2019. Instrument for Pre-accession Assistance (IPA II) 2014–2020: Republic of Serbia—EU for Civil Protection and Disaster Resilience Strengthening. Action summary report, Brussels.

[105] eKapija. 2023. "Six Scenarios for Greenhouse Gas Emissions: Strategy of Low-Carbon Development of Serbia Adopted." eKapija.com, https://www.ekapija.com/en/news/4276609/six-scenarios-for-greenhouse-gas-emissions-strategy-of-low-carbon-development-of; UNDP (United Nations Development Programme). 2021. "The First Dialogue on Serbia's Climate Change Adaptation held in Belgrade". UNDP Serbia page, March 31, 2021. https://www.undp.org/serbia/news/first-dialogue-serbias-climate-change-adaptation-held-belgrade.

[106] See Strategy for the Development of Education and Upbringing in the Republic of Serbia until 2030, at https://dualnok.gov.rs/en/dokumenta/strategy-for-the-development-of-education-and-upbringing-in-the-republic-of-serbia-until-2030-official-gazette-of-rs-no-63-2021/.

[107] UNDP (United Nations Development Programme). 2021. "The First Dialogue on Serbia's Climate Change Adaptation held in Belgrade." UNDP Serbia page, March 31, 2021. https://www.undp.org/serbia/news/first-dialogue-serbias-climate-change-adaptation-held-belgrade.

[108] ETF (European Training Foundation). 2021. "National Qualifications Framework – Serbia". Policy report, Turin.

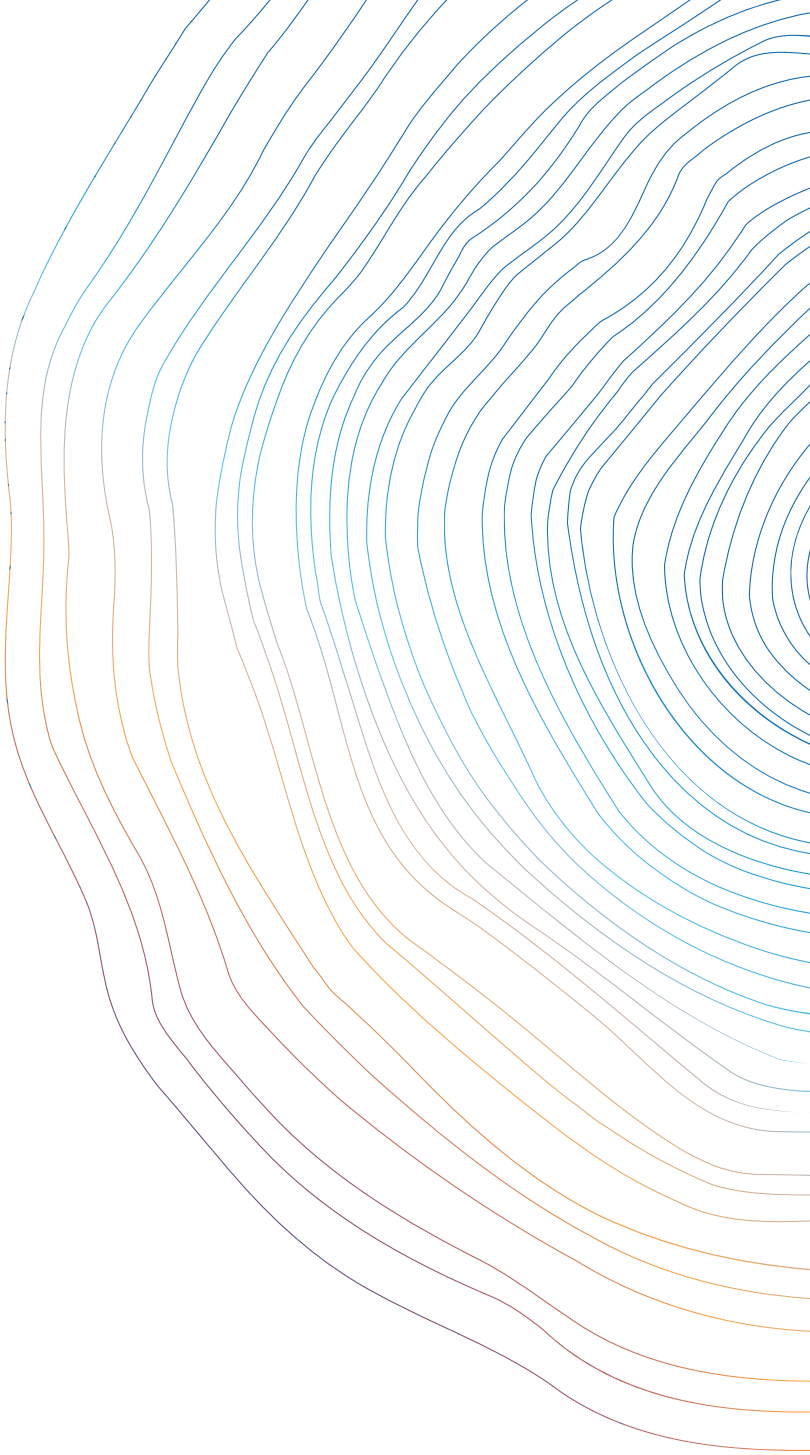
Despite the recognition of the green transition within major strategic documents, the focus on the promotion of green skills and green jobs is just in its early stage. The role of reskilling and upskilling in climate change adaptation is becoming increasingly recognized, but it needs to be operationalized more efficiently. Serbia's National Strategy of Sustainable Development does not mention green or environmental jobs, but the Actions Plans for implementing the of the Employment Strategy of the Republic of Serbia 2021–2026[109] do include provisions to research "green jobs" in the Serbian labor market. There is no official monitoring of green jobs. The Employment Strategy also highlights that the country still lacks a nationally agreed-upon definition of green jobs, which should be adopted as soon as possible in accordance with the joint United Nations Environment Program-International Labour Organization's definition, in order to encourage green job creation and statistical monitoring of their number.

There is also a lack of funds for the integration of climate change adaptation measures into national and subnational strategies and policies. Most of the current policies and budget allocations across diverse sectors in Serbia inadequately address climate change adaptation with a predominant focus on emergency response rather than proactive measures. Limited awareness exists regarding available national and international financing options, and LSG units often overlook establishing contingency reserves for natural disasters since there are no legal obligations to do so.[110] The government, particularly the Ministry of Finance, perceives climate change financing as the sole responsibility of the ministry in charge of environmental protection. Serbia heavily depends on EU pre-accession funds and bilateral and multilateral sources to finance climate-related interventions. There are no specific funds to support sectoral adaptation measures, neither are methodologies, procedures, nor guidelines to underpin such and integrative process of mainstreaming climate change adaptation (CCA) into sectoral budgetary planning,[111] but the Action Plan of the National Adaptation Program anticipates the development of such methodologies, guidelines, and procedures.

[109] See Employment Strategy of the Republic of Serbia 2021–2026, at https://socijalnoukljucivanje.gov.rs/wp-content/uploads/2021/08/Strategija_zaposljavanja_u_Republici_Srbiji_2021-2026_engleski.pdf.

[110] World Bank. 2022a. "Serbia—Ready 2 Respond: Emergency Preparedness and Response Assessment". Country report, Washington, DC.

[111] GCF (Green Climate Fund). 2019. "Readiness and Preparatory Proposal with United Nations Development Programme (UNDP) for Republic of Serbia: Adaptation Planning." GCF, Incheon.



Chapter 3

Mitigation risks and opportunities

An energy system modeling analysis was carried out as part of the WB6 CCDR to assess sectoral decarbonization pathways for the economies of Serbia and the other WB6 countries. The analysis aimed to develop possible decarbonization scenarios and compare them to a reference scenario to highlight how much the energy systems will have to transform to reach net zero GHG emissions by 2050 and provide policy makers with recommendations on how this can be achieved, with a focus on short-term actions.

The analysis relied on the KINESYS-WB6 (Knowledge-Based Investigation of Energy System Scenarios for the WB6) model, a global energy system model based on TIMES (The Integrated MARKAL-EFOM1 System) and applied to the WB6. KINESYS-WB6 explicitly covers GHG emissions from fuel combustion and fugitive emissions from fossil fuel extraction and transportation. In order to set economy-wide GHG emissions reduction targets to model quantity-constrained scenarios, projections from official government strategies (especially the NECPs) were used for the sectors not included in the KINESYS-WB6 model to set targets for the energy-related sectors. The main scenarios modeled included the following: (1) the Reference scenario (RS), an unconstrained least-cost development scenario - this scenario is incompatible with the WB6 countries' aspirations of EU integration and their existing climate change commitments, but it provides a comparable baseline across the six countries for the decarbonization scenarios described below.; (2) the net zero emissions scenario (NZE), in which GHG emission constraints are imposed to achieve economy-wide net zero by 2050; (3) the net zero emissions scenario with higher growth (NZE-HG), which is similar to the NZE but assumes higher GDP growth rates for the WB6, countries; and (4) the carbon pricing scenario (CPS), a price-constrained scenario in which the WB6 countries are assumed to adopt an emissions trading scheme (ETS) that covers all sectors of the economy with an allowance price in line with the European Commission's projections for the EU ETS price in a net zero by 2050 scenario. Further details on the modeling approach and assumptions are presented in the main report and the mitigation background note accompanying the CCDR.

3.1. RS achieves limited progress on climate change mitigation

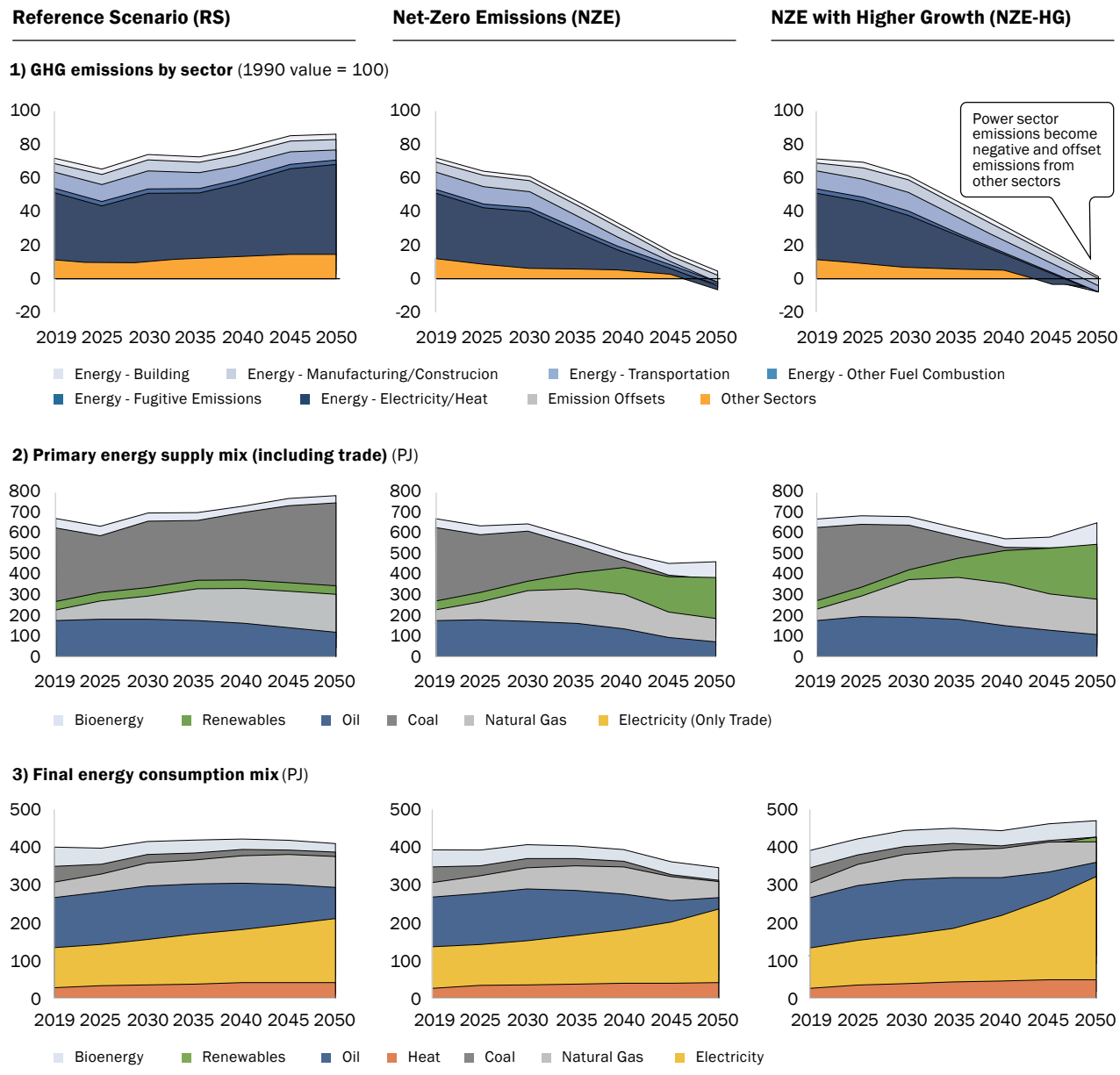
In the RS, Serbia's economy-wide GHG emissions (that is, including sectors outside the model scope) would increase in the long term and reach about 69 $MtCO_2eq$ in 2050 (only 15 percent lower than 1990 emissions. See figure 3.1, row 1). The country's energy mix would remain relatively unchanged over the next decades, with a limited level of penetration of RE sources. The primary energy supply mix would continue to be dominated by fossil fuels (see figure 3.1, row 2). In 2050, coal would still account for about 50 percent of the total primary energy supply, in line with today's value. Natural gas would play a bigger role than today, increasing from about 8 percent of the total primary energy supply in 2019 to 24 percent in 2050. Bioenergy (that is, biomass and biofuels) and renewables (mainly hydro, solar, and wind) would slightly decrease from about 13 percent of the total primary energy supply in 2019 to 10 percent in 2050.

In the power sector, coal and natural gas generation would meet most of the incremental demand for electricity, as expanding RE generation would not be as viable from an economic point of view. As shown in figure 3.2, coal generation would increase from 24 TWh in 2019 to 31 TWh in 2050, and coal would still account for almost 60 percent of total generation in 2050. Natural gas would reach 18 percent of total generation in 2050, compared to about 1 percent in 2019. These results are driven by the favorable economics of electricity generation from unabated coal and natural gas, due to the availability of domestic lignite reserves and the relatively easy access to existing international gas pipelines. Under this scenario, solar photovoltaic (PV) and wind would be economically viable only to a limited extent and their penetration levels would remain extremely low (about 5 percent of total generation). Similarly, hydropower capacity would remain essentially flat.

Although it represents the least-cost development pathway under no external constraints, the RS is not a viable scenario for a sustainable development of Serbia's energy sectors, as it would not eliminate the existing negative externalities and it would be incompatible with their aspirations of EU integration and their existing climate change commitments. The results of the RS are driven by the fact that lignite-fired generation remains relatively competitive overtime with its mostly fully depreciated generation fleet.

However, significant negative financial and non-financial impacts that were not quantified in the model would arise from delaying the transition. First, prolonged reliance on coal would continue causing severe air pollution challenges and exacerbate the environmental and health impacts of coal mining and generation. Second, it would have energy security implications, especially in light of the recent episodes of coal supply disruptions and the increasing difficulty procuring financing for investments in coal mining and power plants. Third, it would hamper the competitiveness of the economy in terms of job creation and attractiveness for foreign direct investment and financing from international financial institutions. Lastly, the lack of progress on coal phase-out would be incompatible with EU integration and the commitments the country has made with the Sofia Declaration.

FIGURE 3.1. System-wide indicators across the RS, NZE, and NZE-HG scenarios for Serbia



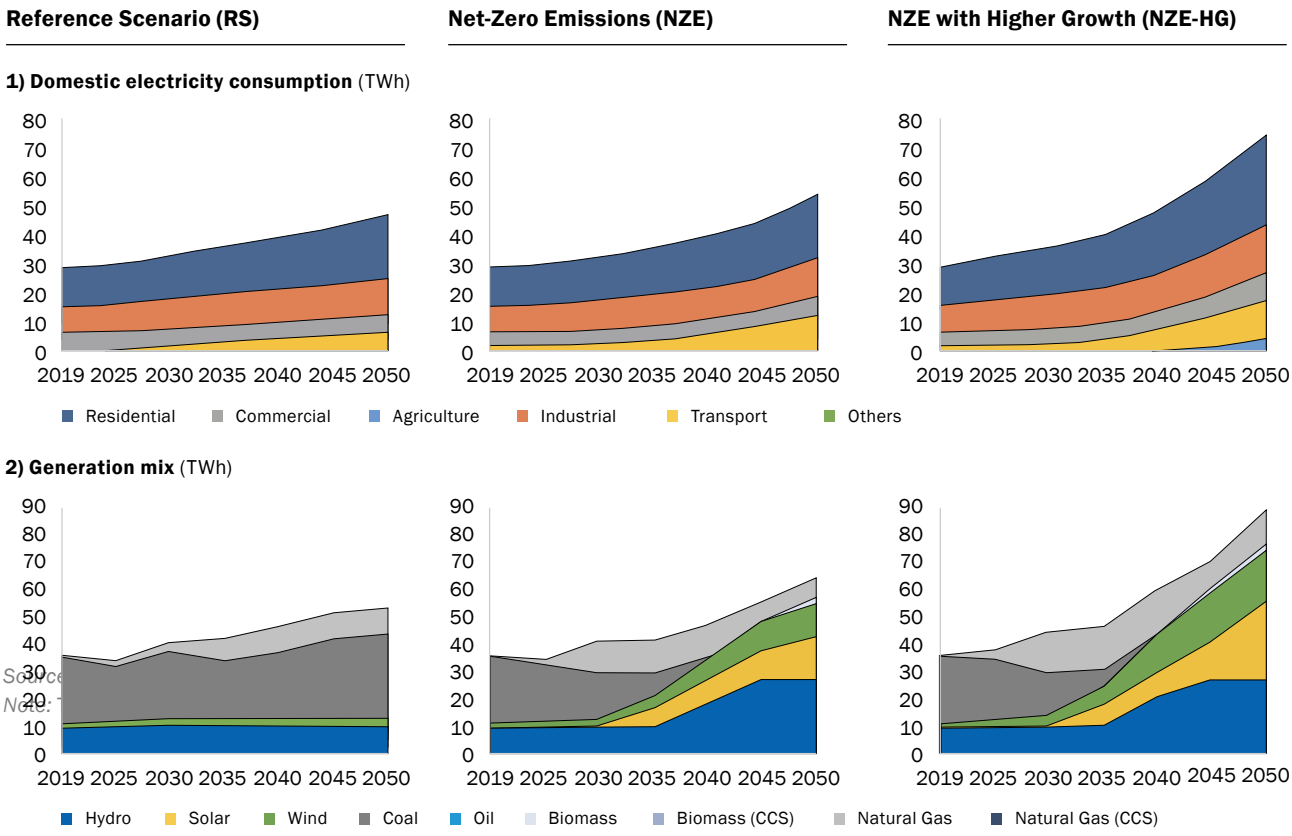
Source: World Bank analysis 2024.
Note: 1) Includes sectors not covered by KYNESIS-WB6, that is, agriculture, waste, LULUCF and IPPU. 2) "Electricity" refers to the consumption of electricity in end-use sectors, while "renewables" refers to the direct use of RE in end-use sectors. 3) PJ = Petajoule.

The comparison of the unconstrained evolution of GHG emissions in the RS with the projections of the scenario "with existing measures" (WEM) defined in Serbia's NECP highlights a certain lack of ambition in the definition of the WEM targets. Serbia's energy-related GHG emissions resulting from the unconstrained least-cost energy sector development defined in the RS would be 57.7 $MtCO_2eq$ in 2050, while the WEM target from the NECP is higher, at 61.0 $MtCO_2eq$ for the same year. This suggest that the definition of the WEM scenario in the country's NECP is not particularly ambitious and does not represent an actual constraint on the development of Serbia's energy sector.

3.2. Radical energy system transformation is required to achieve net zero by 2050

Achieving economy-wide net zero GHG emissions by 2050 would require a significant expansion of investments to achieve negative emissions in the power sector and capture IPPU and energy-related industrial emissions. In the net zero emissions (NZE) scenario, it was assumed that nonenergy-related emissions from the agriculture, waste, LULUCF, and IPPU sectors (excluded from the model scope) would decrease from 8.8 $MtCO_2eq$ in 2019 to 1.5 $MtCO_2eq$ in 2050, which corresponds to an 80 percent reduction. As a result, for the country to achieve economy-wide net zero in 2050, energy sector emissions (those included in the model scope) would have to become negative and reach −1.5 $MtCO_2eq$ to offset nonenergy-related emissions.

FIGURE 3.2. Power sector indicators across the RS, NZE, and NZE-HG scenarios for Serbia



Source:
Note:

In the power sector, in a least-cost net zero scenario, natural gas would be needed as a transition fuel in the short-to-medium term to support the coal phaseout. Coal generation would be fully phased out by 2040. To support the decommissioning of coal plants while ensuring the reliability of the power system and the adequacy of supply, Serbia would have to build significant additional natural gas capacity. By 2030, in the NZE, the country would have to install 2.4 GW of gas-fired capacity (compared to less than 0.5 GW in 2019). Interestingly, this value is not much higher than what would be needed in the RS (1.9 GW), although in the

RS, this value would be reached only in the late 2030s. This highlights the fact that Serbia should pursue a significantly larger penetration of natural gas in power generation regardless of its climate goals. In any case, achieving this level of penetration of natural gas would require increasing imports twofold compared to today by 2030–35, which would require careful planning.

In the longer term, hydropower, wind, and solar would be the main electricity sources in Serbia and the role of natural gas would be diminished. In the NZE, solar PV, wind, and hydro capacities would be scaled up significantly after 2035. With the phaseout of coal and the phasedown of natural gas, the balancing of intermittent solar and wind generation would be provided mainly by hydro and battery storage. The share of RE in total electricity generation would increase from about 30 percent in 2019 (mostly coming from hydro) to 90 percent in 2050 (see figure 3.2, row 2). To achieve this, Serbia would have to install about 13.6 GW of solar and 5.2 GW of wind capacity by 2050, compared to less than 2 GW of the two sources combined in the RS. At the same time, by 2050, the country would have to install about 4.5 GW of additional hydro capacity, including 700 MW of additional pumped storage hydro capacity. Power sector emissions would decrease from about 32.6 $MtCO_2eq$ in 2019 to −1.9 $MtCO_2eq$ in 2050. As a result of the accelerated deployment of renewables in the NZE, electricity generation and supply costs would be about 60 percent higher than in the RS in the short to medium term, but this increase would be limited to about 40 percent in the longer term. Assuming that these costs are fully passed onto customers, the increase in retail tariffs would be of a similar magnitude. While these tariff increases could be mitigated by the shift to liberalized wholesale markets and increased regional integration, the country would need to manage them carefully, by assessing their impacts on the population and businesses and implementing social security measures targeting lower-income and vulnerable consumers.

The least-cost pathway to achieving net zero by 2050 would require significant EE improvements and the large-scale use of electricity and zero-carbon energy carriers in end-use sectors. As shown in figure 3.1. row 3, in 2050, final energy demand in the NZE would need to be about 16 percent lower than the demand in the RS in the same year, or about 13 percent lower than in 2019. Achieving this target would require ambitious policies to support EE improvements across all sectors. At the same time, the final energy mix would be significantly different in the NZE compared to the RS: in 2050, almost 60 percent of final energy demand would be met by electricity (especially in the transport and heating sectors), compared to about 40 percent in the RS, while oil and oil products would account for less than 10 percent of final energy demand, versus 20 percent in the RS. Zero-carbon energy carriers (that is, biofuels, biomass, and biogas) would support the decarbonization of hard-to-abate sectors (for example, specific transport segments) and would account for about 10 percent of final energy demand in 2050 in the NZE, compared to 5 percent in the RS.

In the NZE, GHG emissions from the transport sector could be abated by almost 80 percent by adopting a three-pronged strategy consisting of demand reductions (Avoid), the shift of demand to more sustainable modes (Shift), and the adoption of more energy-efficient vehicles running on cleaner fuels (Improve). "Avoid" strategies (for example, integrated land use planning to reduce travel distances, digital accessibility, and remote working when possible) could help reduce total passenger transport demand in 2050 by 5 percent in the NZE, compared to the RS, with most of the reduction accounting for urban transport. Additional policies and incentives could support the shift of the residual demand for transport services from more polluting means of transportation to less carbon-intensive ones. In 2050, private vehicles would account for 68 percent of motorized passenger transport activity in the NZE, compared to 82 percent in the RS, while public road transport and rail would account for 32 percent of passenger transport activity (compared to 18 percent in the RS).[112] Rail and inland water transport combined would also account for 38 percent of freight transport activity in 2050 (compared to 26 percent in the RS). However, the bulk of GHG emissions reductions in the transport sector would have to come from "Improve" strategies. The specific energy consumption (the amount of energy required per vehicle-km) would have to improve substantially for both passenger and freight transport and be 45–65 percent lower in 2050 than in 2019, depending

[112] Excluding the share of active mobility (walking and cycling), which is assumed to capture up to 4 percent of the passenger car demand by 2050 in the NZE.

on the transport segment. By 2050, the penetration of electricity and biofuels in the fuel mix would be greatly increased. In the passenger transport segment, electricity would account for about two thirds of total fuel energy demand. Passenger cars would be mostly electrified (85 percent of the total stock).[113] In the freight transport segment, electricity and biofuels would account for almost 50 percent of total fuel energy consumption, while traditional petroleum fuels would still account for the rest. In addition, a more efficient use of trucks by increasing the average payload (up to 15 percent more by 2050 in the NZE, compared to the RS) would significantly reduce the specific energy consumption by ton-km by allowing for the use of high-capacity vehicles and leveraging logistics digitalization for asset sharing and optimization of operations.

The decarbonization of the buildings sector would require EE improvements on top of the RS, combined with higher levels of electrification of heating demand and the switch to cleaner heating sources. The implementation of EE measures could reduce primary energy demand for space heating in the buildings sector by more than 25 percent in 2050 in the NZE, compared to the RS. Coal and oil products used for space heating would be almost completely phased out by 2045, while the share of biomass in total final energy demand for space heating would drop from around 50 percent in 2019 to about 15 percent in 2050. Natural gas-based heating would be expanded in the medium term together with the increase in gas in the power generation mix, but its use would then decrease as electrification increases. By 2050, natural gas would account for less than 10 percent of the total energy demand for space heating, while district heating and electricity would collectively account for around 75 percent of the total.

Decarbonization options for the industrial and energy transformation sectors would include EE, the replacement of coal and oil with natural gas for heat production, carbon pricing, the electrification of low-temperature industrial processes, and the adoption of carbon capture and storage (CCS). The implementation of EE measures could reduce energy demand in these sectors by 5 percent in 2050 in the NZE, compared to the RS. In the industrial sector, in the NZE, coal and oil products would have to be replaced by natural gas and electricity, and after 2045, CCS would become economically viable (unlike in the RS) and would be implemented to capture industrial GHG emissions. By 2050, CCS could remove about 6 $MtCO_2eq$ per year of industrial process emissions, corresponding to about 10 percent of Serbia's total GHG emissions today. A carbon price could complement other decarbonization options for the industrial sector. Revenues generated from this fee could also help meet decarbonization investment needs and support Just Transition policies for communities and sectors—though more work is needed on the optimal revenue recycling options. If the scope was extended to CBAM sectors, this would also reduce exposure to CBAM (as importers can deduct the effective domestic carbon price from their CBAM compliance obligations). The CPS modeling scenario in the CCDR (results are presented in the regional report) demonstrates how carbon pricing can help speed up the decarbonization trajectories for WB6 economies, including a faster coal phaseout. Recent modeling carried out by the EnC also highlights how a carbon price can help drive RE expansion, particularly across a common regional electricity market.[114]

Significant decarbonization efforts in the nonenergy sectors such as, waste and agriculture (not included in the modeling exercise previously described) would be crucial to achieving economy-wide net zero GHG emissions in a cost-effective manner. Stepping up GHG emissions reduction efforts in these sectors can reduce the need to resort to decarbonization solutions with a higher abatement cost in energy-related sectors. Serbia should focus on reducing direct methane emissions from the waste and agriculture sectors and improving the carbon sink potential of forests. Methane is a potent GHG, with a global warming potential (that is, the capacity to absorb infrared thermal radiation and warm up the atmosphere) that is about 30 times that of CO_2. It also contributes to the formation of ground-level ozone, a dangerous air pollutant.[115]

[113] The share of electric cars in the total stock is higher than the share of electricity in the fuel mix because of the significantly higher fuel efficiency of electric vehicles compared to internal combustion engine vehicles.

[114] EnC (Energy Community). 2021. "A Carbon Pricing Design for the Energy Community". Final study report, Vienna.

[115] UNEP (United Nations Environment Programme) and CCAC (Climate and Clean Air Coalition). 2021. "Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions". Assessment report, Nairobi.

The establishment of a well-performing waste management system would be essential to curb methane emissions and to make the waste sector more resilient to climate-related shocks. These emissions would continue to increase in the absence of action. To reduce emissions from the waste sector, priority should be given to increasing waste collection, minimizing open dumping and uncontrolled landfilling, managing landfill gas, and diverting organic waste from landfills. This should be accompanied with measures to integrate sector development; minimize, and separate waste; increase, and improve treatment; and improve sector governance, especially with regard to the availability and predictability of operational financing. Waste management also brings other positive environmental and health outcomes, such as the reduction in soil and marine pollution (including from plastics) and better local health and environmental outcomes. Better waste management also accelerates economic development by improving access to public services, helping to create jobs, and improving livability. In addition to reducing methane emissions, better managed waste would reduce significant health hazards for vulnerable populations, as shown in Box 3.1.

BOX 3.1. Coal ash landfills and waste disposal sites in high flood risk and high landslide risk areas: health hazards for minority communities

Landfills near Obrenovac Municipality in Belgrade were washed out in the 2014 floods, which led to a spread of dangerous illegal wastes (containing dangerous organic waste and hazardous chemicals such as benzene, toluene, and xylene) into groundwater and nearby water bodies. The most vulnerable people that were affected by water contamination were those groups that engaged in agriculture (primarily fruit and vegetable growing) and minority communities such as Roma, who used to collect and sell coal left in the abandoned mines. As per the national census 2011, 2 percent of the population in the Obrenovac Municipality live in informal settlements without proper access to clean drinking water and basic sanitary facilities.[116] In Grocka Municipality, where the Vinca landfill is situated, multiple landfill fires and an earthquake in 2014 affected the vulnerable people living in the vicinity of waste disposal sites. Landfill fires and earthquakes contaminated the Danube River, and it caused health problems for people living in informal settlements near the waste sites consuming contaminated water and air.[117]

Methane emissions from agriculture would also have to be actively monitored and reduced. The main sources of agriculture emissions emanate from livestock production, including cattle and small ruminants, and relate to enteric fermentation, manure left on pasture, and poor manure management. In the agriculture sector, methane emission reduction measures can include improving the genetic makeup of the animals (through breeding), optimizing animal feeding, establishing a system of safe disposal of animal byproducts, and improving manure and pasture management systems.

In an optimistic growth scenario, Serbia would have to make additional efforts to achieve economy-wide net zero targets. In 2050, Serbia's GDP in the NZE-HG is assumed to be almost two times the GDP in the NZE and RS, which would correspond to a similar increase in the demand for services. However, efforts to further improve EE could lead to an increase in final energy demand of just about 40 percent compared to the NZE. In addition, in the NZE-HG, meeting the decarbonization targets would require resorting to higher levels of penetration of cleaner technologies across all sectors. For example, by 2050 Serbia would have to install about 24.0 GW of solar capacity (compared to 13.6 GW in the NZE) and 8.3 GW of wind capacity (compared to 5.2 GW in the NZE). In the NZE-HG, electricity generation and supply costs would be just slightly higher than in the NZE in the medium to long term.

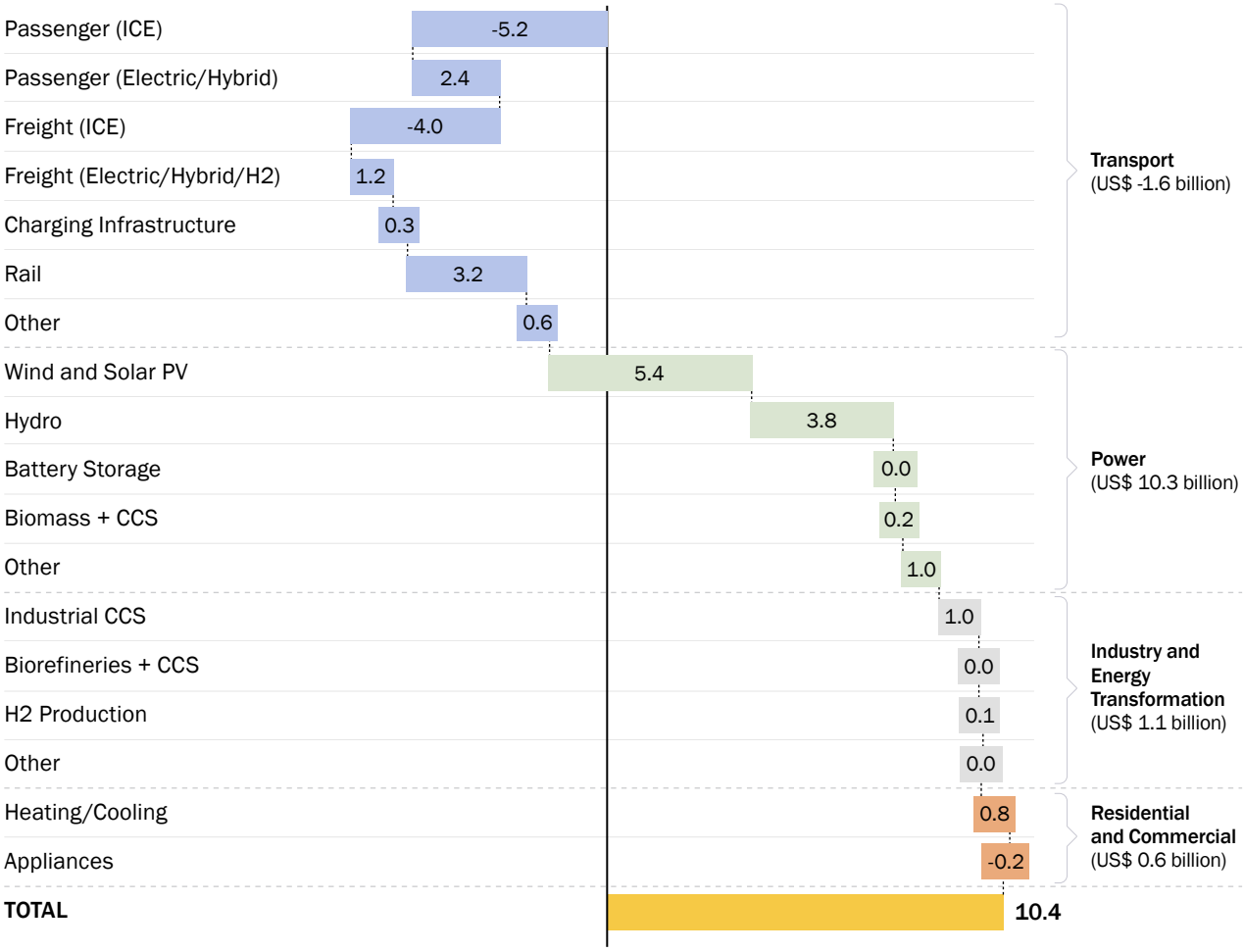
[116] Ubavin, Dejan, Nikola Maoduš, Srdjan Kovacevic, and Bojan Batinic. 2015. "Risk assessment of landfill in Serbia based on flooding potential." Paper presented at the 7th PSU-UNS International Conference on Engineering and Technology (ICET), Phuket, June 19–20.

[117] Heidegger, Patriczia, and Katy Wiese. 2020. "Pushed to the Wastelands: Environmental Racism Against Roma Communities in Central and Eastern Europe". Report, European Environmental Bureau, Brussels.

3.3. Incremental investments needed for decarbonization.

Overall, compared to the RS, in the NZE scenario, Serbia would need to invest an additional US$10.4 billion (in 2020 US$ terms) in the energy system until 2050 (expressed at present values) to achieve economy-wide net zero, equivalent to about 1.6 percent of GDP on average. These investments are incremental to the investments required in the RS, which amount to US$180.8 billion (in 2020 US$ terms) until 2050 (also expressed at present values).[118] Until 2030, the investments required in the NZE and RS would be similar, which highlights the fact that in the short term, efforts should be directed toward laying the groundwork for the creation of an enabling environment for the subsequent scale-up of investments in the following decades. It is estimated that 87 percent of the investments could come from the private sector (including Households). However, the higher investment required would be at least partially compensated by lower operating costs, estimated at −0.7 percent of GDP per year on average through 2050.

FIGURE 3.3. Discounted investment gap (difference between NZE and RS) until 2050 by subsector, US$ billion



Source: World Bank analysis 2024.
Note: CCS = carbon capture and storage; H2 = hydrogen; ICE = internal combustion engine; PV = photovoltaic.

The lion's share of the incremental investment until 2050 would go to the power sector. The incremental investment by 2050 (US$10.4 billion in 2020 US$ terms) is composed of positive and negative incremental investments in the power sector (US$10.3 billion in 2020 US$ terms), industry and energy transformation

[118] It is worth noting that investments for the RS do not include maintenance and rehabilitation investments required to maintain the existing coal generation fleet for longer than in the NZE, which could be substantial.

sector (US$1.1 billion in 2020 US$ terms), transport sector (US$1.6 billion in 2020 US$ terms), and the residential and commercial sectors (US$0.5 million in 2020 US$ terms). Figure 3.3 shows the breakdown by subsector. In the power sector, the incremental investment would ramp up after 2030, and most of it would be directed toward the scale-up of wind, hydro, and solar PV capacities. On the other hand, in the NZE, investments in the transport sector would be lower than in the RS thanks to the implementation of "Avoid" strategies to reduce demand and "Shift" strategies to support the change to collective modes of transport (for example, buses and trains), which would reduce the need for private vehicles.

The energy transition would be even costlier in absolute terms in the NZE-HG (as a larger economy corresponds to higher levels of energy demand), but the required investments would be similar than in the NZE in terms of share of GDP. In the NZE-HG, to achieve economy-wide net zero, Serbia would need to invest US$229.0 billion (in 2020 US$ terms) in the energy system until 2050 (compared to US$190.4 billion (in 2020 US$ terms) in the NZE), all expressed at present values. However, in the NZE-HG, the incremental investments (calculated compared to a different reference scenario in which GDP growth is the same as in the NZE-HG) would correspond to about 1.7 percent of GDP on average until 2050, in line with the value for the NZE.

3.4. Human capital and labor market transformations will be critical for decarbonization

The green transition will require significant retraining in Serbia, beyond just the high-polluting sectors. Transitioning to greener forms of production, distribution, and consumption can affect the labor market positively or negatively. The effects go beyond the most polluting industries (for example, coal mining) as significant transformations will be seen in other occupations (for example, mechanical engineering). This requires investment in retraining and upskilling to remain productive in each occupation, or to move to another occupation with similar skill requirements. The extent of this reskilling depends on the gap between the current skills and the future skills required. Reskilling and upskilling can be considered short-term investments, but shifting demand for labor requires longer-term investments to enhance the human capital needed for Serbia to reach net zero by 2050. This means structural reforms will be necessary in the education system.

A green transition requires a comprehensive reform of education and training systems. Taking advantage of green growth opportunities could lead to significant changes in occupational standards and skills needs. Education must provide students with the skills and competencies needed in the current and future labor markets and should be supported by active labor market policies to reskill and upskill persons affected by the green transition. Given the sizeable proportion of the labor force at risk and with significant needs for retraining, it becomes critical for Serbia to start adapting its education system from early learning to the technical and vocational education and training and higher education levels so that the education systems produce green skills ready for the new economy.

The skills impact on the Serbian economy will go beyond just brown industries, with 16.5 percent of the workforce requiring upskilling or retraining in the medium run. Approximately 5.5 percent of jobs are in the brown industry, but the green transition will affect approximately one out of six workers in the entire labor force due to changes in technology or business models. Currently 223 thousand workers are employed in occupations for which a high percentage of jobs will need retraining and for which the skills gap is large and are therefore most at risk.[119] Missing the required investments in retraining and upskilling will put individuals at risk of unemployment and firms at risk of missing growth opportunities due to a lack of adequate workforce (Figure 3.4).

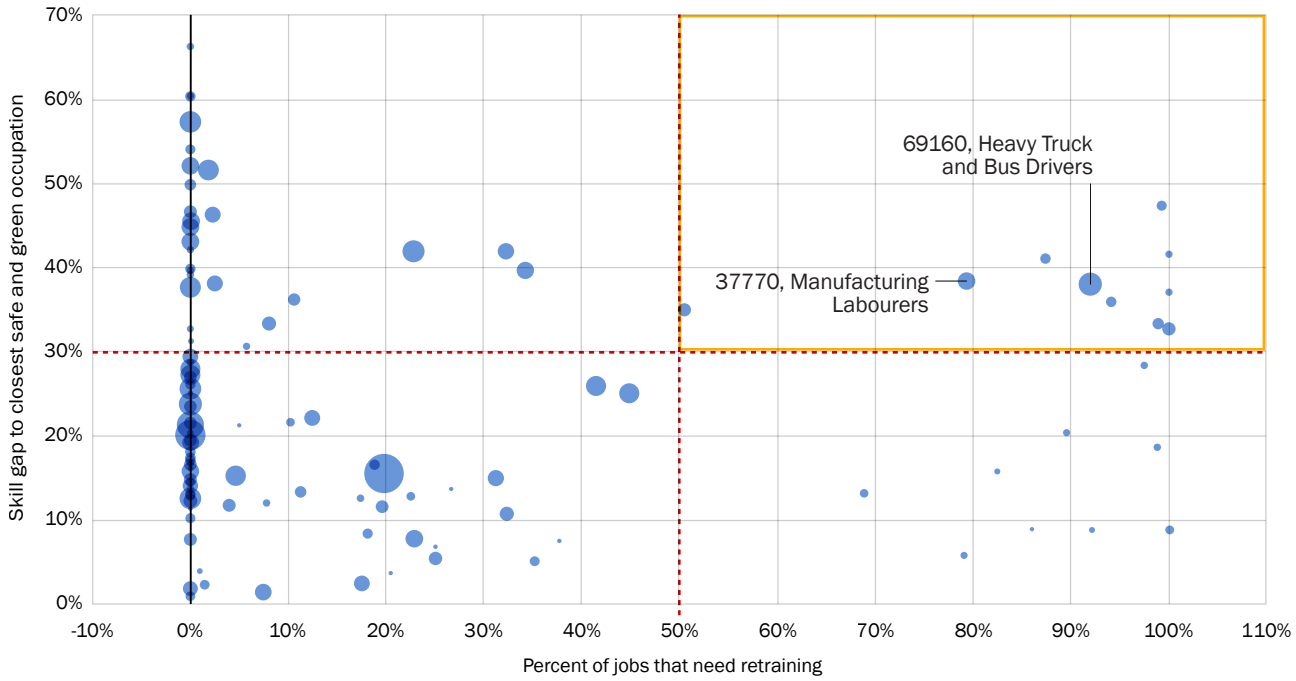
[119] These occupations are classified in the O*Net model and include: wood treaters, cabinet-makers, and related trades workers; other craft and related workers; metal processing and finishing plant operators; rubber, plastic, and paper products machine operators; food and related products machine operators; wood processing and papermaking plant operators; other stationary plant and machine operators; heavy truck and bus drivers; manufacturing laborers; and other elementary workers.

Addressing the skills gaps for workers in occupations "at risk" will require large investments. The transition costs in each occupation "at risk" depend on the size of the skills gap—how similar their skills are to the ones required in the closest occupation in terms of skill set. On average, workers in affected occupations will need to acquire about one quarter of the total skills required to transition to a green occupation. At the same time, they may transition to safe occupations that aren't green but will remain relevant for the economy.

The most important skills needed for the transition surround cognitive abilities and knowledge in STEM—science, technology, engineering, and mathematics. Developing these skills requires long periods of time, as opposed to physical, psychomotor, or sensory abilities. Other skills, such as complex problem solving, critical thinking, or equipment maintenance are also needed, while gaps in social skills are of second order. To facilitate this change, active labor market policies (ALMP) supporting on-the-job training or upskilling for unemployed people will not be sufficient and need to be complemented with long-term education and training reforms. This also requires adjustments on the supply side of training provision, including training for adult workers, with an increasing role for the private sector to play. Our estimates show that the cost of retraining and reskilling of the most "at risk" workers for Serbia may reach up to US$507 million if they are retrained into safe occupations, and up to US$1.77 billion if they are retrained into green occupations.

For climate change mitigation, green technologies must be absorbed, adapted, and developed to the local needs and circumstances. Catching-up economies do not operate at the technology frontier, but their economic growth rate depends upon institutional and technological advancements that bring them closer to more developed economies.[120] Technology absorption refers to the acquisition, development, assimilation, and utilization of technological knowledge and capability by firms and other entities from external sources. Successful technology absorption entails mastering specific technologies, adjusting them to local needs, and creating rich knowledge spillovers, which can then lead to further innovations. Development and deployment of green technologies requires skills acquisition to be complemented with other relevant resources and cross-sectoral partnerships. Collaboration between public and private sectors in research, development, and innovation should be promoted and co-financed.

FIGURE 3.4. Occupations and number of workers that need retraining (yellow area shows the most affected)



Source: Garrote, Gukovas, and Makovec 2024; Data from Labor Force Survey of Serbia 2021.

[120] Lee, Jeong-Dong, Keun Lee, Dirk Meissner, Slavo Radosevic, and Nicholas S. Vonortas. 2021. "Technology Upgrading and Economic Catch-Up Context, Overview, and Conclusions." In The Challenges of Technology and Economic Catch-up in Emerging Economies, edited by Jeong-Dong Lee, Keun Lee, Dirk Meissner, Slavo Radosevic, and Nicholas S. Vonortas, 1–34. Oxford: Oxford University Press.

3.5. Successful green transition will require an evolution of the role of the state

It is essential to reevaluate the role of the state in the economy through SOEs or other BOS with a focus on enhancing performance, right-sizing state presence, and enhancing corporate governance. In order for SOEs or BOS to contribute to adaptation and mitigation, governments will need to address their performance issues as part of a reform package that should also streamline the state presence, particularly in competitive markets where private operators are better suited to deliver services. This prevents WB6 countries from spending public funds on climate action where, in fact, the private sector should step in.

Decarbonizing Serbia's economy will require climate action plans that build on a comprehensive picture of the state footprint across the economy. SOEs and BOS react differently (or delayed) to market-based policy measures (for example, carbon pricing or taxation) as they are not profit-maximizing. A careful assessment of their behavior under the envisaged EU ETS is therefore required, or alternative options need to be considered (for example, integrating climate objectives into SOE and BOS corporate investment objectives). BOS are also important employers in Serbia, for example, in the energy sector (coal and generation); therefore, transition pathways and supporting measures to climate action need to factor in jobs they provide. From an adaptation point of view, the relatively high share of BOS in climate-vulnerable sectors across WB6 countries suggests a high risk of exposure to the negative effects of climate change. This needs to be reflected in integrated DRM plans and prudent fiscal planning to anticipate cases where climate disasters require governments to fund recovery and adaptation investments.

Chapter 4

Economic impact and opportunities

Economic impact analysis was carried out as part of the WB6 CCDR to assess the economic and distributional impacts of the pathways presented in the earlier sections. The analysis assessed the economic impact of climate-intensified damages and the economic and poverty impacts of decarbonization pathways using the macrostructural model with climate change module (CC-MFMOD) developed by the World Bank as well as the Carbon Price Assessment Tool (CPAT), developed jointly by the World Bank and the International Monetary Fund (IMF). Based on this analysis, the chapter also identifies financing needs and structural and regulatory issues that need to be addressed to capitalize on the need for adaptation and mitigation, by investing in a greener and more productive economy. While increased and more diversified trade is an integral part of any strategy for growth and for resilience, especially for the Western Balkans, this section also points out opportunities in green value chains that could be further explored.

4.1. Macroeconomic impact

4.1.1. Impact of adaptation risks on the economy

Serbia is susceptible to significant economic damages from climate change. In a macroeconomic analysis limited to only three kinds of hazards the largest impact on the economy came from riverine floods, followed by heat stress and the droughts.[121] See Table 4.1. top panel. The three hazards are modeled to affect the economy through separate channels. Riverine floods affect the economy through damages to infrastructure. Droughts affect the production of maize and wheat crops. Heat stress affects labor productivity in agriculture and industry. Given the analysis of only three hazards, the combined damages to economy presented in table 4.1 inherently underestimate the total potential damages from climate change that Serbia could face.[122] Damages, or losses, are measured as a percent reduction in GDP from the baseline.

- **For Serbia, the three hazards (heat, drought, and floods) under representative concentration pathway (RCP) 2.6 lead to a loss of 17.8 percent of GDP in 2050;** the greatest part of the loss comes from riverine floods. Higher RCPs (representing warmer and drier climates) result in lower damages from floods due to lower riverine flood risk. Under RCP 8.5, GDP in 2050 is expected to be 14.7 percent lower than the baseline GDP for that year; floods alone lead to a 13.2 percent drop in 2050 GDP.
- **Under optimistic growth (not shown in table 4.1), the combined losses under RCP 2.6 come to 21.2 percent of 2050 GDP while under RCP 8.5 they come to in come to 17.8 percent of 2050 GDP;** the results are due to the destruction caused by flooding (given the somewhat greater capital intensity of the optimistic growth scenario) and the relatively lesser degree of labor heat stress.
- **While the impact of climate change on riverine floods declines with a warmer climate, flash floods extremes are still likely to be significant due to higher volatility in precipitation and the impact of heat stress will increase with higher emissions, as will the impact from droughts.** In all RCP scenarios, the impact of damages worsens with time; this is because the probability of occurrence for rare events increases in the future. Importantly, this modeling approach does not accurately capture the actual impact of hydrological extremes due to a focus on average risk metrics and climate-data uncertainties.

[121] This approach was chosen because projections for damages and consequently for adaptation investments were available through 2050.

[122] With the CC-MFMOD, damages from climate change adversely affect household income, and in turn, fiscal revenues and public consumption, as well as profits. These, in turn, affect investment and lead to further reductions in economic output. Damages constitute a supply-side shock, leading to increased marginal costs, further exacerbating suppressed economic activity and reducing wages. When wages recover, the vicious circle is broken, and GDP also recovers.

TABLE 4.1. Economic impacts from climate change under trend growth

Real GDP % deviation from baseline*	RCP 2.6			RCP 4.5			RCP 8.5		
Without adaptation investments									
	2030	**2040**	**2050**	**2030**	**2040**	**2050**	**2030**	**2040**	**2050**
Combined	-6.08	-12.76	-17.76	-5.38	-11.38	-16.10	-4.98	-10.48	-14.70
Heat	-0.19	-0.39	-0.59	-0.32	-0.65	-0.97	-0.42	-0.86	-1.29
Drought (wheat & maize)	-0.32	-0.39	-0.41	-0.30	-0.44	-0.72	-0.31	-0.40	-0.44
Riverine Floods	-5.60	-12.08	-16.90	-4.79	-10.42	-14.64	-4.28	-9.36	-13.18
With adaptation investments									
	2030	**2040**	**2050**	**2030**	**2040**	**2050**	**2030**	**2040**	**2050**
Combined	-4.81	-10.40	-14.64	-4.04	-8.81	-12.51	-3.57	-7.82	-11.17
Heat	-0.10	-0.23	-0.37	-0.17	-0.39	-0.64	-0.24	-0.54	-0.90
Drought (wheat & maize)	-0.05	-0.07	-0.08	-0.06	-0.08	-0.11	-0.05	-0.07	-0.08
Riverine Floods	-4.66	-10.14	-14.25	-3.82	-8.39	-11.84	-3.29	-7.26	-10.28

Source: World Bank analysis based on inputs from JBA, IIASA and CIMA
Note: RCP = representative concentration pathway. (*) The changes in the level of GDP or output are equivalent to changes in GDP per capita as the population figure is the same with and without the climate damage.

Adaptation investments can reduce output losses. An exercise was undertaken to model the impact of adaptation investments through 2050 based on a top-down approach (i.e. based on an economy-wide coefficients, without detailed sector and sub sector nuances as was done in chapter 3). The modeling exercise is discussed in the WB6 Regional Climate and Development Report.

- Based on the modeling results of the three climate hazards, adaptation investments amounting to about 2.35 percent of GDP a year through 2050 would lead to a combined loss of 14.6 percent of 2050 GDP under RCP 2.6 and to a combined loss of 11.2 percent of 2050 GDP under RCP 8.5, both under trend growth (see table 4.1, bottom panel).
- Under optimistic growth (not shown in table 4.1), adaptation investments amounting to about 2.43 percent of GDP a year through 2050 would lead to a combined loss of 17.6 percent of 2050 GDP under RCP 2.6 and to a combined loss of 13.6 percent of 2050 GDP under RCP 8.5.

As modeled, the benefit cost ratios of these investments under both trend and optimistic growth are close to one, pointing out the importance of the design of adaptation packages. It should also be noted that the GDP losses lower bound estimates as only three hazards are considered and some positive impacts of protection measures are not captured. Alternative estimates of initial investment needs from a comprehensive sectoral investment program, already presented in chapter 3, would cost about US$359 million annually, or US$9.5 billion, through 2050. Such an investment package could yield 25–75 percent reduction in damages depending on the sector and hazard[123] and could bring BCRs between 2 and 10, based on estimates from the literature. [124] The literature suggests that investing in the modeled sectors in actions such as tree plantings, infrastructure protection, early warning systems, and shifting work hours, can reduce the adverse impact of climate change on GDP.

[123] This reduction in damages would then translate into a reduction in GDP losses, growth opportunities, and co-benefits that have not been modeled here.

[124] This bottom-up exercise was undertaken based on expert knowledge and national policy documents from the region. However, sufficient detail is not available to model the investment costs and the benefits to the economy in a macroeconomic structural model (CC-MFMOD) through 2050.

Adaptation investments are expected to affect the fiscal balance due to higher frequency and intensity of natural hazards. The fiscal impact of damages from climate change (without adaptation actions) will depend on the government's response function to changes in revenues and is only useful for illustrative purposes as all governments are expecting to react to climate change. A modeling run without an adaptation response showed generally modest changes in deficits and debts (though the results vary by year and for trend and optimistic growth). However, the fiscal impact of the adaptation package discussed above, 2.35 percent increase in investment annually under trend growth (table 4.1) or 2.43 percent increase in investment annually under optimistic growth, can have huge implications for public debt, increasing it by half or nearly doubling it depending on the RCP and the growth scenario. The takeaway is that climate change will require policies to incentivize behavioral changes and adaptation investments by the private sector and households. in the absence of these policies, the burden of adaptation investment on the public sector can be unsustainable.

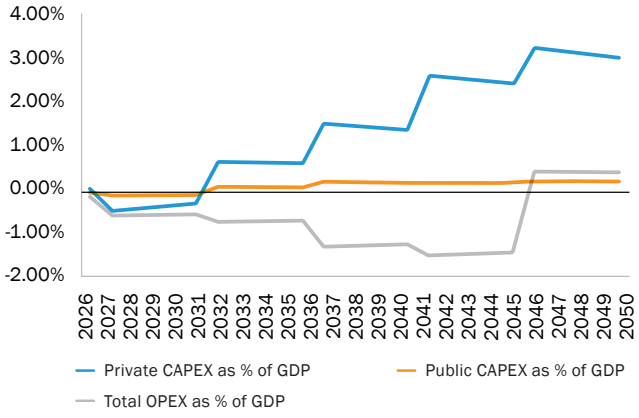
The current account is expected to improve, primarily due to an improvement in trade balance. This result holds for the no adaptation and with adaptation scenarios. It is due to reduced domestic demand (as incomes fall) and subsequently lower imports. As a result, a small positive current account deviation is anticipated over the years, with deviations from the baseline ranging from approximately 6 to 5 percent of GDP across the three RCPs scenarios under no adaptation and 4 to 3 percent of GDP with adaptation under trend growth. Optimistic growth yielded slightly larger current account improvements.

While not climate related, Serbia can expect to suffer from exposure to earthquakes. With medium risk exposure to earthquakes, output is expected to reduce by at least 1.2 percent by 2030, 2.8 percent by 2040, and 4.0 percent by 2050 under trend growth and slightly more under optimistic growth. The modeling approach cannot fully capture actual extreme events which cause significant output loss and loss of life. Acknowledgement of the risks posed by earthquakes is important because the resulting economic costs, including fiscal costs, would be borne by the same budgetary entities (firms, households, and government) that bear the damages from climate change.

4.1.2. Impact of mitigation on the economy

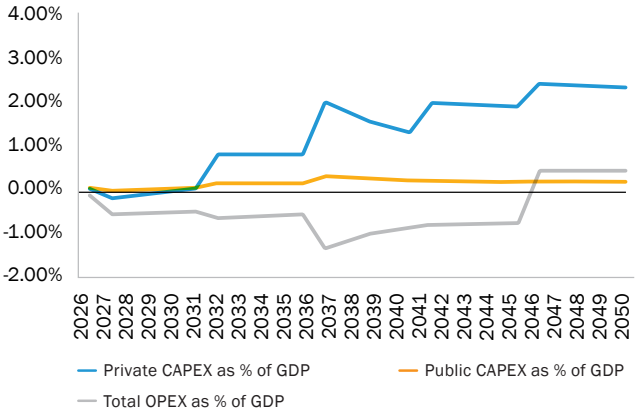
Reaching the net zero target by 2050 can be achieved within the potential growth of the economy. Under both trend growth and optimistic growth scenarios, Serbia is able to effectively achieve the same level of per capita income under both the NZE scenario and the RS. In fact, the decarbonization impact on domestic output is modest, relative to the significant emissions reduction, as GDP per capita is only 0.44 percent lower in 2050 compared to the RS scenario under trend growth and 0.40 percent lower in 2050 under optimistic growth. See Annex D for a discussion of the trend and optimistic growth scenarios.

FIGURE 4.1. Incremental investment (public and private) and operating expenses (in percent of GDP) under trend growth



Source: World Bank analysis based on TIMES model.
Note: CAPEX = capital expenditure; GDP = gross domestic product; OPEX = operating expenses.

FIGURE 4.2. Incremental investment (public and private) and operating expenses (in percent of GDP) under optimistic growth



Source: World Bank analysis based on TIMES model.
Note: CAPEX = capital expenditure; GDP = gross domestic product; OPEX = operating expenses.

The NZE scenario will require an average of 1.6 percent of GDP per year in additional investment over the RS scenario under trend growth or an additional 1.4 percent of GDP per year in additional investment under optimistic growth. The investment is through 2050 and is backloaded (Figures 4.1 and 4.2). Serbia's increase in capital expenditures (CAPEX) over time is largely driven by an increase in investment in power generation utilities, energy, and industrial CCS. This reflects several factors: investment in grid infrastructure or capacity expansion to meet growing energy demand; the adoption of RE sources and clean technologies; and investment in CCS technology in the industrial sector. Conversely, there is a reduction in energy consumption in the transport and residential sectors. The drivers behind this include a technological shift to clean sources such as electric vehicles and heat pumps that are more energy-efficient and have lower emissions than conventional transportation and heating.

FIGURE 4.3. Incremental impact on macroeconomic aggregates of the NZE over the RS, under trend and optimistic growth

Source: World Bank analysis using MFMOD based on TIMES model, transport model, and CPAT.
Note: CAB = Current Account Balance; GDP = Gross Domestic Product.

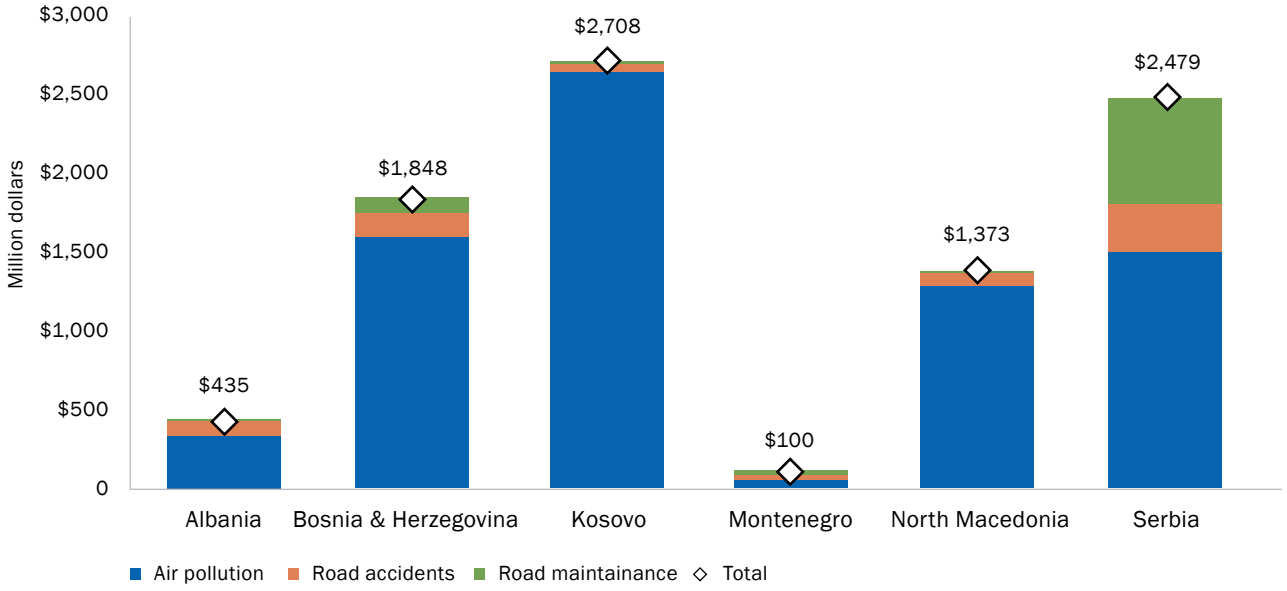
Operating expenses (OPEX) in the energy sector are much lower under NZE with a reduced reliance on fossil fuel inputs. Fossil fuels such as coal, oil, and natural gas witness a gradual decline over time as the economy decarbonizes. These fuels are traditionally prevalent in energy production, heating, and transportation, but are often associated with significant expenses in fuel procurement and adverse

environmental consequences. However, trade values for RE sources such as biomass, geothermal, hydro, solar, and wind are positive, signifying a notable shift towards cleaner and more sustainable energy sources.

The incremental impact on the fiscal balance and public debt in the NZE scenario closely follows the investment profile, albeit with a notable divergence in the current account balance (Figure 4.3). Capital investments are backloaded; just under 90 percent are expected to be made by the private sector. In the early years, although there is an incremental reduction in energy investment in the NZE relative to the RS, the overall impact on GDP is positive as investment is diverted to other sectors. As existing capacity is replaced with new capacity, the net operational expenses are negative in the beginning of the projection period (largely wing to savings from fuel imports, but these become positive by 2050. The incremental capital expenditure in Serbia's energy sector is concentrated in outer years, with significant investments in power utilities required to replace existing capacity. There are two key factors at play in the macro impact analysis: first, the government bears about 10 percent of the increased energy system investment; and second, the transition towards cleaner energy sources results in reduced fuel imports. The net result is an adverse net effect on fiscal revenue and overall GDP. The deteriorating external account after 2040 (Figure 4.3 top left) is primarily driven by reduced exports demand.

The transition the NZE is expected to yield many co-benefits for Serbia. Figure 4.4 shows the co-benefits from the NZE transition for the Western Balkans. For most countries the largest co-benefits come from the reduction in air pollution. Additional benefits come the transport sector, notably reduced mortality from road accidents and decreased costs associated with road maintenance. For Serbia, the co-benefits that come from road accidents and road maintenance are the largest the region (in USD terms). The net-zero transition anticipates a 4 percent reduction in air pollution mortality attributed to fossil fuels and biomass by 2030, with a 41 percent drop expected by 2050, compared to the Business as Usual (BAU) scenario across the six countries.

FIGURE 4.4. Present value of externalities in 2023 (flows until 2050, discount rate of 6%) in 2021 $US million



Source: World Bank analysis using MFMOD based on TIMES model, transport model, and CPAT.

Like other Western Balkan countries, Serbia will need to create fiscal space and improve efficiency of public spending. While Serbia's public debt was about 52 percent of GDP in 2023, the country will face significant investment needs for adaptation and mitigation. Both needs will likely motivate a change in the mix of public investment and potentially require additional public investment, should fiscal space permit. The public sector's response needs to be three-fold. First, adopt policies that mitigate the economic and social impact of climate change by incentivizing private sector and household action (i.e. zoning, mandatory insurance, developing financing instruments, carbon pricing, incentives for research and innovation, etc.).

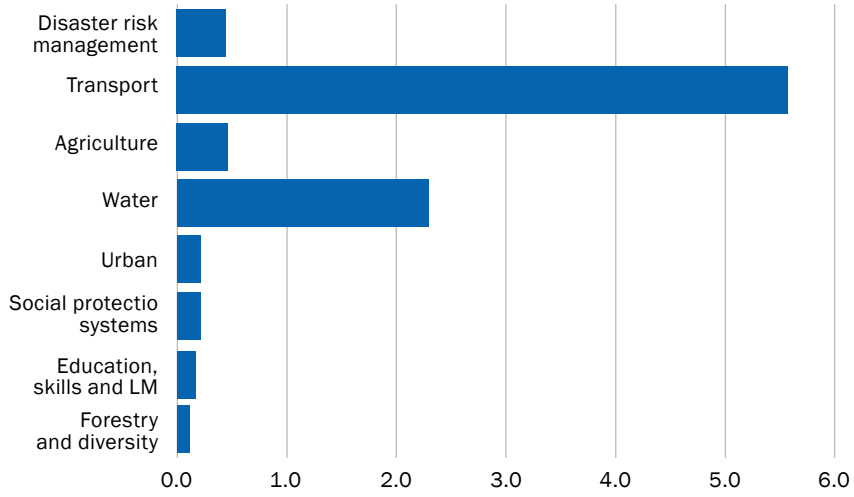
Second, review and strengthen efficiency of existing programs. Third, increase fiscal space and create buffers by bolstering domestic revenue mobilization through. This would allow Serbia to actively monitor and manage fiscal risks from climate change.

4.2. Financing needs and sources

4.2.1. Investment needs for adaptation and mitigation

The previous sections provided an assessment of the macroeconomic impact of climate change, the cost and impact of adaptation needs, and investment needs for a net zero transition by 2050. While previous sections presented investment needs in terms of differences from baseline scenarios, this section also presents absolute amounts, which allows better gauging of the financing needs and investment opportunities.

FIGURE 4.5. Adaptation investments 2025–50 (US$ bn)



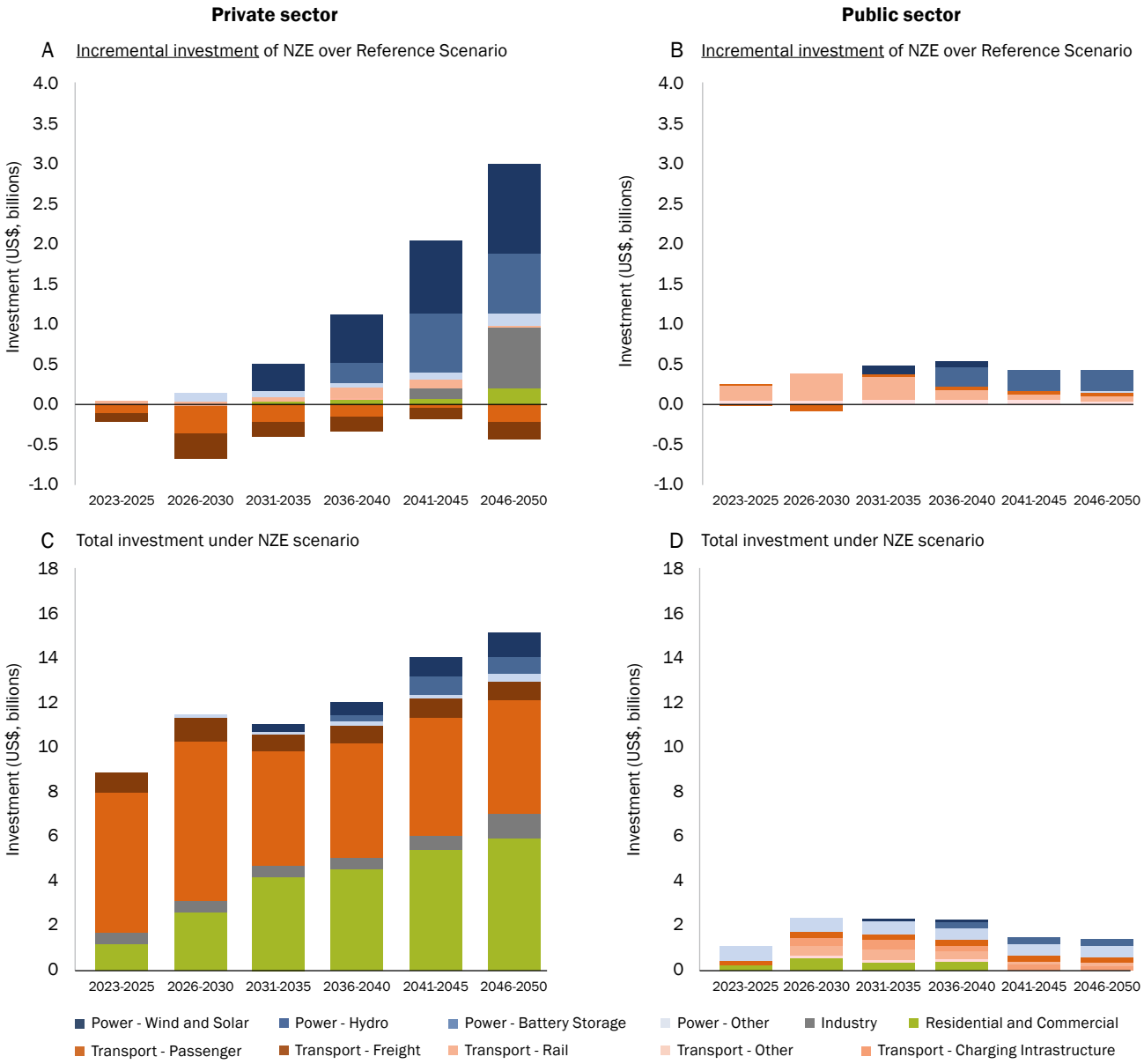
Source: Annex table B.1.

Serbia's incremental annual adaptation (from three hazards only) and mitigation investment needs come to 2.3 percent and 1.6 percentage points of GDP respectively for 2025-2050. The estimates come from the two separate modeling exercises reported in the preceding sections. They relied on the same GDP baseline and were run for trend growth and optimistic growth scenarios. The adaptation modeling exercise based on investments to mitigate the three hazards only (riverine floods, drought impact on maize and wheat, and labor heat stress) and represents a top-down approach (Section 4.1).1 suggests average annual incremental investment rates of 2.4, 2.4, and 2.3 percentage points of GDP for 2025-30, 2031-40, and 2041-50 respectively. The mitigation exercise suggests average annual incremental investment rates of -0.3, 1.2, and 3.1 percentage points of GDP for 2025-30, 2031-40, and 2041-50 respectively. The incremental investment rates that emerge from the analysis in this report for Serbia are significant. The adaptation investments are equally distributed in the investment horizon while the mitigation investments are back loaded. Serbia's incremental investment needs for adaptation are higher than the Western Balkan's average of 1.3 percentage points of GDP per year and are somewhat lower than the Western Balkans average for mitigation, which is 1.9 percentage points of GDP for 2025-50.[125]

For adaptation, the bottom-up approach discussed in chapter 2 estimated adaptation investments came to about US$9.3 billion through 2050, or US$381 million annually. Figure 4.5 shows the sectoral breakdown of total adaptation investment. The largest needs are in transport and water, though investments will be needed in all areas presented in the figure. Average annual investment needs (as percent of GDP) come to about 0.4-0.6 percent of GDP annually, depending on timing of spending. As previously noted, policy makers face some choice over who covers the cost—the public or the private sector. The adaptation investments are incremental, additional to any planned investments.

[125] The results from the current adaptation and mitigation exercises cannot be added for two reasons. First, the adaptation results refer to shares of GDP from a smaller economy than the mitigation exercise. Second, a joint modeling exercise, while extremely complex, would have included interactions of adaptation and mitigation variables that could have altered the adaptation and mitigation investment needs. Nevertheless, looking at the two results in tandem is instructive for showing the scale of additional investments needed.

FIGURE 4.6. Absolute (NZE Scenario) and Incremental (NZE versus Ref Scenario) Investments in US$ Billion*



Source: World Bank analysis using MFMOD based on TIMES model, transport model, and CPAT.
Note: * Numbers represent undiscounted annual investment, averaged over the period.

For mitigation, the NZE scenario under trend growth requires total public and private investment of USD 365.6 billion between 2026–50 (in 2020 US$, not discounted). Chapter 3 (Figure 3.3) showed the discounted investment gap between NZE and RS investments at the sector level through 2025 in discounted US$. A temporal breakdown of the undiscounted investment differences, presented in figure 4.6 top row shows that the incremental government investment (top right) is largely concentrated in rail transport and power (hydropower, solar, and wind energy). By contrast, the incremental private investment (Figure 4.6 top left) is backloaded and largely concentrated in RE (solar, wind, and hydropower), though industry investment increases strongly by the end of the period. Looking at total investment under the NZE scenario, Figures 4.6 (bottom row) show that the private sector is expected to do most of the investment (US$323.12 billion or 88.4 percent), while public sector investment accounts for 11.6 percent (US$42.48 billion). The major investment tickets by sector between 2026 and 2050 include transport (US$181.35 billion or 49.6 percent of the total, 90.8 percent private, and 9.2 percent public), for residential and commercial buildings (US$119.45 billion or 32.7 percent, 94.2 percent private, and 5.8 percent public) and power (US$47.38 billion or 13.0 percent, 60.6 percent private, and 39.4 percent public). Importantly, the areas for investment between the public and private

sector are expected to differ, with residential and commercial buildings being a common interest. The private sector is expected to focus on EVs, freight transport, RE, and industry, while the public sector is expected to focus on power transmission and distribution, rail transport, charging infrastructure, and hydropower.

4.2.2. Green finance

Serbia has several options for adaptation investments, but these require it to strengthen its capacity to access EU and international donors, to access the private sector, and to build better capacity in the public sector to assess risks and to access financing instruments. Analysis suggests that national authorities currently lack the tools to assess their financial needs for adaptation and to access the resources required.[126] Thus, Serbia will need to step up its capacity to access international donors and private investment, and the public sector will have to play its role. In particular:

- **At the international level, financial support from the EU and other donors for climate actions could be further utilized to promote adaptation and sustainable economic development.** The Sofia Declaration on the Green Agenda for the Western Balkans, the new Growth Plan, and the EU Adaptation Strategy all aim to increase international climate finance for adaptation.[127] For Serbia specifically, the EU for Green Agenda in Serbia initiative supported by the EU and Switzerland is a mechanism for identification and implementation of innovative programs for the five pillars of the Green Agenda. The Economic and Investment Plan also provides a long-term investment package that will mobilize up to €9 billion to support green transition and climate actions in the Western Balkans, with the potential to attract an additional €20 billion investment in climate actions with the crowding-in of private investors.[128] In addition, international financial institutions (IFIs) such as the European Bank for Reconstruction and Development (EBRD) and European Investment Bank, as well as other funds such as the Adaptation Fund, the Green Climate Fund, and the Special Climate Change Fund have also deployed billions of dollars in adaptation and could be leveraged further.
- **At the private sector level, commercial banks and firms have much to contribute.** Many Serbian micro, small, and medium enterprises have already engaged in greening their businesses and have ongoing or planned green investments in EE, waste management, and water or air pollution reduction.[129] As for commercial banks, green banking in Serbia currently focuses mostly on RE sources, EE, and sustainable transport, so it is important to enhance investment in areas such as climate resilience and waste management.[130] Adopting EU market guidelines and joining international platforms can also help. For instance, the Coalition of Finance Ministers for Climate Action has "mobilizing climate finance" as one of its principles and provides member countries guidelines in "mobilizing private sources of finance toward climate action in their capacity as finance ministers, and by complementing central banks and market regulators."[131] Research shows that there is a growing market for climate adaptation that could be worth US$2 trillion annually within the next five years.[132]

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[126] Alfthan, Björn, Elmedina Krilasevic, Sara Venturini, Samir Bajrovic, Matthias Jurek, Tina Schoolmeester, Pier Carlo Sandei, Harald Egerer, and TiinaKurvits. 2015. "Outlook on Climate Change Adaptation in the Western Balkan Mountains". Vienna, Arendal, and Sarajevo: United Nations Environment Programme, GRID-Arendal, and Environmental Innovations Association.

[127] European Commission. 2021. "Forging A Climate-Resilient Europe—The New EU Strategy on Adaptation to Climate Change." Strategy Note, Brussels.

[128] Balkan Green Energy News. 2021. "EU Expects Western Balkan Countries to Offer Quality Projects for Financing under € 9 Billion Plan." *Balkan Green Energy News*, September 30, 2021. https://balkangreenenergynews.com/eu-expects-western-balkan-countries-to-offer-quality-projects-for-financing-under-eur-9-billion-plan/.

[129] Behrens, Arno, Milan Lakicević, Vladimir Krušković, Zoran Pavlović, Žarko Petrović, Antoine Avignon, Stevan Pechitch, and Slobodan Perović. 2021. "Scaling-Up Green Finance for the Private Sector in Serbia in the Post-Pandemic World." Study report, European Union and United Nations Development Programme, Brussels and New York.

[130] Behrens, Arno, Milan Lakicević, Vladimir Krušković, Zoran Pavlović, Žarko Petrović, Antoine Avignon, Stevan Pechitch, and Slobodan Perović. 2021. "Scaling-Up Green Finance for the Private Sector in Serbia in the Post-Pandemic World." Study report, European Union and United Nations Development Programme, Brussels and New York.

[131] The Coalition of Finance Ministers for Climate Action See "About the Coalition" page at https://www.financeministersforclimate.org/.

[132] Randall, Timothy, Jens Sedemund, and Wiebke Bartz-Zuccala. 2023. "Private Investment for Climate Change Adaptation – Difficult to Finance or Difficult to See the Finance?" Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science, Commentary, March 16, 2023. https://www.lse.ac.uk/granthaminstitute/news/private-investment-for-climate-change-adaptation-difficult-to-finance-or-difficult-to-see-the-finance/.

- **At the national level, public financing schemes and budgetary planning for adaptation need to be enhanced.** The government should allocate adequate financial sources to support adaptation, identify the responsibilities of relevant institutions, and mainstream climate into budgetary planning at national and municipal levels. Initial efforts to mainstream climate change into investment planning and budgeting were done. Disaster risk financing also needs to be enhanced to strengthen the country's financial resilience to climate disasters and yield substantial benefits in terms of reducing the level of government liabilities. Financial institutions can also support private investments in climate-related or environmental projects through the issuance of green bonds. In 2021, Serbia issued its first sovereign green bond of 1 billion € in 2021, which was used in financing and refinancing in the areas of RE, EE, sustainable water management, pollution prevention and control, protection of the environment and biodiversity and sustainable agriculture.[133]

Traditional bank loans are the main source of funding for private sector projects in Serbia. While Serbia can access external capital markets on reasonable terms, Serbian firms are not making use of the corporate bond markets for their financing needs. Instead, traditional bank loans remain the primary source of financing for private sector projects in otherwise bank-dominated financial system.[134] The terms and interest rates offered by commercial banks to firms working with low-carbon innovations are not favorable, mainly due to internal lack of capacity within banks to evaluate technological risk, deterring green investment.[135] The Serbian government offers various grants and subsidies, especially for projects that align with the country's EE and RE goals. This includes incentives for solar and wind energy projects, as well as subsidies for EV purchases and building retrofits for EE.

Climate-focused PPPs could be used to leverage private investment on low-carbon infrastructure. Serbia has developed a comprehensive PPP regulatory framework that is governed by multiple pieces of legislation.[136] However, the PPP framework does not apply to all sectors and not all projects are treated uniformly. For instance, the legal framework excludes some ICT projects, water and irrigation, and some ground transportation projects, among others.[137] Given the lack of homogeneity, Serbia would benefit from implementing a centralized, climate-focused, multisectoral PPP strategy, aimed at maximizing mitigation and adaptation impacts on key sectors, including power, transport, and building.

Serbia is attracting private investment on renewables through auctions. Serbia did its first RE auction for wind and solar power in August 2023 using a 15-year contract for difference scheme. The Government of Serbia received 16 offers for a combined capacity of 816 MW, way beyond the allocated quota of 450 MW.[138] Based on the energy tariffs offered,[139] the Government of Serbia is expecting to receive a revenue of several million euros per year from these auctions.[140] The successful auction process shows a clear interest by the private sector to invest in solar and wind power in Serbia.

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[133] World Bank. 2022d. "Western Balkans Regular Economic Report, No.22, Fall 2022: Beyond the Crises". Washington, DC.

[134] World Bank. 2019. "Republic of Serbia: Capital Market Development." Technical Note, World Bank, Washington, DC.

[135] Behrens, Arno, Milan Lakicević, Vladimir Krušković, Zoran Pavlović, Žarko Petrović, Antoine Avignon, Stevan Pechitch, and Slobodan Perović. 2021. "Scaling-Up Green Finance for the Private Sector in Serbia in the Post-Pandemic World." Study report, European Union and United Nations Development Programme, Brussels and New York.

[136] Serbia's PPP framework is comprehensive but fragmented. It includes the PPP and Concessions Law (from 2011 and updated in 2016), a Decree on the Supervision of the Implementation of Public Contracts on PPP (2013), a Decree on Granting Concessions in Phases (2017), a Methodology for Assessing the Value-for-Money in Comparison to Invested Amounts in a PPP (2013), and a Rulebook on PPP Registry (2013). In addition, Serbia has several other laws that are relevant for PPPs, such as the Public Procurement Law (2012 and 2015), Investment Law (2015 and 2018), and the Public Utilities Law (2011, 2016 and 2018).

[137] IMF (International Monetary Fund). 2023. "The Future of PPPs in the Western Balkans". https://www.imf.org/-/media/Files/Publications/WP/2023/English/wpiea2023031-print-pdf.ashx

[138] Government of Serbia, Ministry of Mining and Energy. 2023. "First Market Premium Auctions for Green Megawatts Completed." Ministry news page, August 2023. https://www.mre.gov.rs/vest/en/306/first-market-premium-auctions-for-green-megawatts-completed.php.

[139] The lowest price offered was €64.48 per MWh for wind power and €88.65 per MWh for solar power.

[140] Government of Serbia, Ministry of Mining and Energy. 2023. "First Market Premium Auctions for Green Megawatts Completed." Ministry news page, August 2023. https://www.mre.gov.rs/vest/en/306/first-market-premium-auctions-for-green-megawatts-completed.php.

Serbia is well positioned to attract foreign direct investments linked to the EV global value chain. The country has a rich history of automotive production and experience in producing almost all parts of a vehicle. In particular, the number of manufacturers in the automotive sector has increased significantly since the arrival of FIAT in the early 2010s. World-leading firms in the areas of tire manufacturing, wiring harness assembly, and automotive electronics are present in Serbia, staffed by engineers from Serbian technical universities. The country is in a good position to attract investment from the major European automakers planning to expand their EV offerings in the coming years, as well as from international manufacturers of EV parts.

Guarantees can boost lending capacity and crowd in significant private sector financing for climate activities in Serbia. Some international banks operating in Serbia are using capital optimization guarantees against the risk of expropriation of mandatory reserves. The guarantee reduces the regulatory risk-weighting applied to mandatory reserves at the consolidated level, freeing up capital for new lending. Moreover, credit enhancing guarantees have also been very useful to enhance the terms of private sector financing to the sovereign in support of adaptation projects in the country. By incorporating climate resilience key performance indicators in the projects, lenders can ensure that the infrastructure being built is sustainable.[141] Going forward, political risk insurance including capital optimization guarantees, and credit enhancement guarantees could be used for public and PPP projects to mobilize significant cross border investments, deepen the credit markets and to foster green finance in Serbia.

To address challenges and gaps within the institutional framework, capacities for fund management should be enhanced and sustainable financing mechanisms established. Better oversight can be achieved by strengthening financial management and control in administrative units responsible for managing funds. This includes engaging professionals with expertise in banking, project finance, and public finance management to improve fund management capacities. Ad hoc support schemes should be avoided and continuous financial support mechanisms should be established to ensure sustainability. Developing and disseminating financing schemes that have a multiplier effect will facilitate greater dissemination of funds and maximize their impact. Additionally, a phased approach to financial support provision can be implemented, allowing more experienced end users to maximize the benefits of funding opportunities.

4.3. Structural and regulatory framework Issues

4.3.1. Private investment and financial sector structural issues

Serbia can shift to higher growth rates by addressing several structural challenges. This path requires concerted effort towards bolstering private sector investment.[142] Higher investment rates could be achieved by reforming the financial sector to better serve small enterprises and startups; enhancing labor skills through quality education and training; and fostering competition and innovation. Expanding investment also requires improved infrastructure and improved regulatory frameworks (by simplifying regulations, curbing corruption, and promoting transparency). Moreover, Serbia can unleash competition and growth thereafter in several markets by reducing state intervention and preferential treatment of SOEs. This relates primarily to some of the key industries such as energy, transport, telecommunications, pharmaceuticals, and professional services. These reforms collectively represent a transformative agenda that can unlock Serbia's full economic potential. See Box 4.1 on whether the net zero transition can be a path to high income status.

Moving forward, the country needs to develop its capital markets and adopt a sustainable finance framework. Green bonds are playing a central role in financing RE projects worldwide.[143] However, capital

[141] A good case study in this area is the six-lane, 112-kilometer dual-carriageway tolled motorway currently being built in a low-level flood plain along the West Morava River Valley. For this project, MIGA has issued guarantees to several EU commercial banks for their loans to the Serbian's Ministry of Finance, facilitating the financing for one of the largest ongoing infrastructure projects in the country. See the press release at https://www.miga.org/press-release/miga-adds-support-serbias-motorway-project.

[142] See World Bank, 2019. "Serbia Country Economic Memorandum -Serbia's New Growth Agenda". https://www.worldbank.org/en/country/serbia/publication/serbia-new-growth-agenda.

[143] IEA (International Energy Agency). 2023. "World Energy Investment 2023". https://www.iea.org/reports/world-energy-investment-2023

markets in Serbia are shallow and relatively underdeveloped. The only market segment that functions comparatively well is the government bond market.[144] The first sovereign green bond of €1 billion was issued in September 2021, following Serbia's implementation of the green bond framework in August 2021.[145] While the first sovereign green bond is having only a marginal impact on the financing of RE, future issuance (especially from private sources) could provide significant funding for wind and solar energy.[146] Fostering the issuance of corporate green bonds will require strengthening the local capital markets and aligning local financial sector policies with the EU Sustainable Finance Framework. The adoption of a green taxonomy and an environmental, social, and governance reporting framework, while fostering the development of a solid institutional investor base, are key steps to scale up green finance.

Building the EV market in Serbia requires a clear policy framework. The market and regulatory framework for EVs in Serbia are still in their infancy. The evidence shows that policy requirements are an important driver for the adoption of EVs by firms, especially during the early years.[147] Typical policies include fuel economy and pollutant standards, zero-emission vehicle mandates, and deadlines for the phaseout of internal combustion engine vehicles, among others.[148] In addition to adopting a clear policy direction, the government needs to provide economic incentives for both EV purchase and charging infrastructure investment to create enough momentum for the market to take off. In the particular case of Serbia, the growth of the EV market can generate positive spillovers for the manufacturing sector linked to the EV value chain.

BOX 4.1. CAN THE NET ZERO TRANSITION BE A PATH TO HIGH-INCOME STATUS for the WB6?

The energy and macro modeling approaches in this report aimed to make a direct comparison of the energy system costs and its macro impact between the net zero scenario and the RS for the same level of energy demand. This ensured that the comparison was made for the same size of the economy and the same GDP growth rates.* The results, which include externalities from lower pollution, show that about half of the WB6 economies can achieve net zero emissions without compromising their per capita growth rate level relative to the RS. This result holds for both trend growth and optimistic growth scenarios.

However, a net zero transition can have a longer-term impact on GDP growth through increased trade, investment, and finance, contingent on structural reforms and country specific conditions. The potential longer-term impact is not modeled in this or the regional report but can be expected to materialize as higher trade, investment, and financing opportunities would very likely result in a higher GDP growth rate, provided that the prerequisite structural reforms are made to increase potential GDP. Country-specific conditions such as technological capabilities, access to resources, and preferences can also play determining roles. The context for these opportunities is the EU's commitment to achieving net zero emissions by 2050. To support this goal, the EU Green Deal, the Western Balkans Growth Plan, and CBAM are in place. In contrast to the opportunities presented under the net zero transition, under RS countries could face penalties in their economic relation with the EU as their emissions targets are inconsistent with EU policy goals. These penalties could not only come through the CBAM but also through reduced investment and finance opportunities.

To capitalize on the energy transition, the WB6 will need to increase their productivity. Middle-income countries are able to transition to high-income countries by improving their productivity. The World Development Report (WDR 2024) looks at the transition from upper middle income to high income status and makes several important points. First, while in early stages of development, when countries are far from the technological frontier, investments contribute significantly to economic growth, while in the middle stages of development, infusion of technologies (adoption and diffusion of technologies created elsewhere) makes an increasingly large contribution to growth alongside investment, and in the later stages of development, homegrown innovation plays the largest role in improving productivity. An economy's technological frontier can be pushed forward by infusion and innovation brought by new entrants into the market, as well as by incumbents

[144] World Bank. 2019. "Republic of Serbia: Capital Market Development." Technical Note, World Bank, Washington, DC.

[145] Government of Serbia. 2021b. "Green Bond Framework." Strategy Note, Belgrade.

[146] Government of Serbia. 2024. "Serbia Green Bond Report". Consultant report, Belgrade.

[147] IEA (International Energy Agency). 2023. World Energy Investment 2023. https://www.iea.org/reports/world-energy-investment-2023

[148] IEA (International Energy Agency). 2023. World Energy Investment 2023. https://www.iea.org/reports/world-energy-investment-2023

(including SOEs). Second, a combination of carbon pricing and support programs would encourage the adoption of lower carbon technologies and spur competition through infusion and innovation, as long as markets are competitive. Energy efficiency gains will lower costs for households and businesses. Third, incumbents, which often seek to preserve their dominant status in a market, can be disciplined through competition policies. SOEs, as incumbents, can be encouraged to innovate through shareholder action, governance or regulatory actions. Existing market leaders can only maintain their market share if they adapt to current incentives, such as finding more efficient ways to use and produce energy in the power and transportation sectors. Entrants and incumbents can be incentivized, as necessary, with subsidies for infusion and innovation. The implication for the energy transition of the WB6, where SOEs play a significant role in each economy, is that energy markets need to be contestable, using programs and policies to incentivize this competition. Furthermore, the ECA Companion Report to the WDR (2024, forthcoming) notes that the transition to net zero needs to be based on (i) continued economic transformation, (ii) integration into global markets and value chains to bring in more energy efficient technology, regulations on energy efficiency, and the introduction of renewables. Implementation of a strong reform agenda is needed to meet these objectives. For an overview of the interplay between climate change and SOEs in Serbia see Section 4.3.2.

* The analysis was undertaken for two sizes of an economy, one that grew at trend growth and one that grew at optimistic growth.

4.3.2. Managing the role of the state and its implications for financing the climate transition

Businesses of State (BOS) play a significant role in high GH emitting sectors, posing a range of challenges for financing and coordinating Serbia's mitigation agenda.[149] BOS are particularly prominent in power generation (62 BOS or 51 percent of all BOS in high-emitting sectors) and in transport (30 BOS or 25 percent), but they are also present in other sectors that emit high levels of GHGs, including crop and animal production (Figure 4.7a). About 60 percent[150] of BOS in high-emitting sectors operate in competitive markets, where the private sector is likely better suited to deliver services. In power generation, most BOS are district heating plants (66 percent), half of which are owned by municipalities and other subnational entities. Almost all of these district heating plants (95 percent) are non-corporatized. Similarly, half of BOS in the distribution of natural gas are owned by municipalities or subnational entities and 75 percent are not corporatized. A significant share of these heating plans (37 percent) and natural gas distributors (25 percent) are loss-making. In addition, some important majority-held BOS (that is, SOEs) in the power sector—such as EPS and Srbijagas, the state-owned natural gas provider—incurred significant financial losses during the energy crisis of 2021 and 2022, with adverse repercussions on public finance.[151] In transport, almost all BOS (91 percent) are not corporatized and 29 percent of them are unprofitable.

The large state footprint in the power and transport sectors poses a range of challenges to the financing of Serbia's mitigation agenda. The fact that a large share of BOS in high-emitting sectors are non-corporatized (55 percent) and are often subordinated entities of municipalities (23 percent)—many of which unprofitable (30 percent)—may entail challenges for Serbia's mitigation agenda in terms of coordination and finance (Figure 4.7b). With such a decentralized ownership structure, mandating BOS to implement climate mitigation objectives may be difficult as most of them do not report to a centralized agency. It is also unlikely that these BOS will have the cash-flows for the required mitigation investments, neither will they be able to access capital markets as many of them are not corporatized and may not have credit ratings. Important for the design of the country's mitigation strategy, BOS in high-emitting sectors are also significant job providers with 2.0 percent of all formally employed, second highest after Bosnia and Herzegovina with 4.7 percent. Most jobs are in power generation which still relies heavily on fossil fuel: 70 percent of Serbia's electricity production relies on lignite coal which is a serious pollutant and major GHG emitter. The BOS that dominates

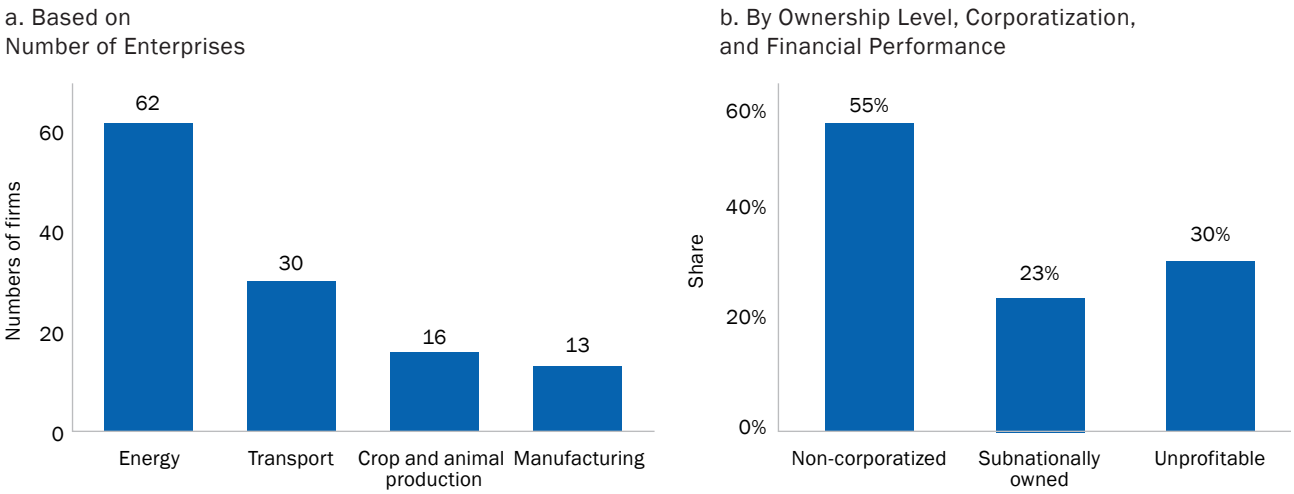
[149] Businesses of State (BOS) are enterprises with at least 10 percent government ownership. BOS correspond to a broad definition of SOEs. BOS and SOEs are used interchangeably in this report.

[150] They generate 14 percent of all BOS revenues in high-emitting sectors and providing 17 percent of jobs.

[151] Pontara, Nicola. 2023. "Reforming Serbian State-Owned Enterprises May Unleash Growth and Investments." *NIN* magazine, November 30, 2023.

power generation in Serbia and supplies power to most consumers in the country, EPS, also mostly owns the mines in the two major coal basins, Kolubara and Kostolac, through subsidiaries. This vertical integration of coal supply and power generation, paired with considerable labor provision, required careful consideration for the country's Just Transition pathway.

FIGURE 4.7. Distribution of BOS in high-emitting sectors in Serbia



Source: World Bank Global Business of the State (BOS) database, 2019 data.

For a successful adaptation and mitigation strategy, the government of Serbia will need to address these issues as part of a SOE-BOS reform package. Such reform efforts should continue the country's efforts of streamlining (rightsizing) the state presence across the economy, particularly in competitive markets where private operators are better suited to deliver services. This prevents Serbia from spending public funds on climate action where, in fact, the private sector should step in. For BOS in natural monopoly or contestable markets, reforms should aim at increasing performance; achieving full cost recovery; and improving efficiency, transparency, and corporate governance, all of which should help build resilience for future shocks. The centralized ownership and management system embedded in the Ministry of Economy, which was recently introduced by Serbia's new Law on SOEs Management (adopted in September 2023), can be expected to facilitate the coordination and may ease the anchoring of climate objectives in the SOE-BOS mandates. However, a prerequisite for this to be effective would be that the newly created ownership and management system for SOEs also encompass BOS in the energy sector, which are currently excluded. A Just Transition away from coal will have to factor in the many jobs BOS hold in coal mining and associated power generation.

To attract private investments based on a business environment that is conducive from a legal, regulatory, and competition point of view, markets, particularly energy markets, must offer a level playing field between BOS and private actors. which requires careful market liberalization and regulation. Enabling a shift toward increased investment in RE implies allowing third parties to access the transmission and distribution networks often owned and controlled by state-owned utilities. Such access needs to be granted as regulated tariffs so that private investors in renewables can sell directly to eligible customers without discrimination.[152] The Law on the Use of Renewable Energy Sources (adopted in April 2021)[153] spells out the rules for grid connection as a crucial segment of the project development of any energy facility.[154]

[152] All Western Balkan countries demonstrated their commitment to adopting EU legislation on energy and climate, including carbon pricing, but as BOS are not profit-maximizing, they may not fully engage in ETS.

[153] Official Gazette of the Republic of Serbia, No. 40/21 and 35/23.

[154] Đurašković, Jovan, Milena Konatar, and Milivoje Radović. 2021. "Renewable energy in the Western Balkans: Policies, developments and perspectives." Energy Reports 7 (Supplement 5): 481–490. https://doi.org/10.1016/j.egyr.2021.07.104.

4.3.3. Public investment management

PIM is widely recognized as a promising tool to reduce GHG emissions as it can enable public investments to be planned and implemented in a more climate-friendly way.[155] PIM defines the legal and institutional framework for public investment preparation, selection, implementation, reporting, and evaluation. It could also provide a mechanism for ensuring a shift towards a more climate-friendly public investment portfolio that aligns with—and contributes to—a government's commitments to GHG emissions reduction.

Some initial steps toward a more climate-friendly PIM were made recently. Amendments to the legislative framework for PIM in Serbia—the Decree on Capital Projects Management—were made in December 2022 to incorporate climate and other environmental aspects to the PIM cycle. The 2022 amendment includes reference to climate and environmental considerations throughout the entire pre-implementation stage of the PIM cycle—project identification, preselection, appraisal and review, prioritization, and selection.

However, by themselves, the latest adjustments of the PIM framework will not suffice in enabling the government to fully ensure climate-smart PIM. Four key issues will need to be addressed:

- **First, the national policy framework for addressing climate change is still evolving.** Although the Law on Climate Change was passed in 2021, the key strategic documents in the field of mitigation and adaptation, the Low Carbon Development Strategy and the National Climate Change Adaptation Plan are yet to be adopted.
- **Second, the amendments to the PIM Decree were introduced in an incomplete legal framework covering only a fraction of public investment activity in the country, which also limits the reach of the climate change-related shifts.** Many types of public investment projects are exempted from key parts of the Decree: projects deemed to be of "national interest," which is the case for most significant infrastructure projects; PPPs; security-related projects; and project below €5 million in size.
- **Third, several pre-implementation procedures are not unified, and the institutional roles and responsibilities of the decree are not optimally designed.** Notably, the project identification form (PIF), which is the equivalent of a project concept note, is reviewed for strategic relevance by the Ministry of European Integration, but only shared with the Ministry of Finance and Ministry of Environmental Protection for information, preventing them from having a direct review role at this stage. Also, the review of appraisal (prefeasibility and feasibility studies) takes place in different parallel procedures depending on whether the project requires a construction permit and whether an environmental impact assessment is required. The lack of clarity increases the risk that the review, including the climate-related elements, is not comprehensive or does not apply a level playing field for different projects.
- **Fourth, key aspects of the Decree are yet to be implemented, notably the strategic relevance assessment of the PIFs by the Ministry of European Integration, which is currently not functional beyond the EU-financed projects.** For the climate-related amendments, the underlying rules, templates, and forms have not yet been adjusted to reflect these changes. No comprehensive methodology exists to guide officials in the transition.

4.4. Growth opportunities with export development and EU accession

The Serbian government has continued to declare EU membership its strategic goal.[156] Since the opening of Serbia's accession negotiations in January 2014, 22 out of 35 chapters have been opened, including all chapters in cluster 1 on the fundamentals and all chapters in cluster 4 on the Green Agenda and sustainable connectivity. Two chapters have provisionally been closed. In June 2021, Serbia accepted the revised

[155] World Bank. 2023a. "Serbia: Climate Change Considerations for Public Investment Management (PIM) - Rapid Assessment and Recommendations to Inform Ongoing Policy Development".

[156] European Commission. 2023. "State of the Energy Union Report 2023". Progress report, Brussels.

enlargement methodology. The overall pace of negotiations will continue to depend, in particular, on the pace of rule of law reforms and on the normalization of Serbia's relations with Kosovo. Serbia continued to implement the Stabilization and Association Agreement between Serbia and the EU.

As a candidate country for EU membership, Serbia needs to not only align domestic policies with the EU's legislation, but also prepare to avoid negative impacts of the CBAM.[157] The EU has recently introduced a CBAM on selected imported goods, to commence in a phased manner in 2024.[158] The EU is Serbia's main trading partner, so the CBAM could have major implications for export competitiveness and market access for several industries, given that the emissions intensity of Serbia's production processes is 2.5 time higher than the EU average. Based on Serbia's 2021 exports structure, 5 percent of its exports would be covered by the CBAM, with this proportion possibly increasing if the CBAM is extended to indirect emissions and/or other sectors.[159]

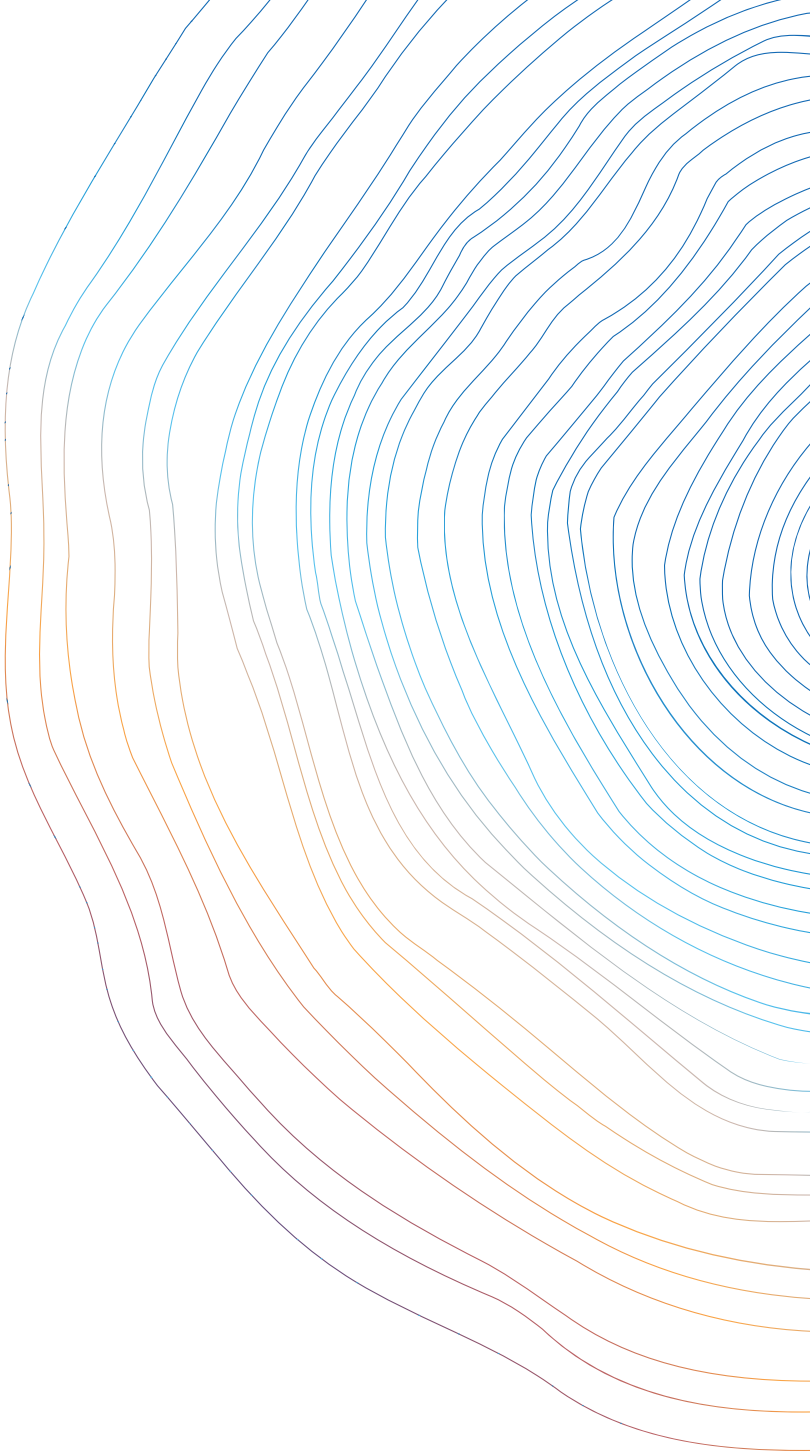
Environmental fiscal reforms could provide a useful response not only to the CBAM, but would help to initiate a shift towards greener production and consumption. This would mean adopting reforms to existing energy and environmental taxes and excises with a medium-term focus on preparations for the introduction of carbon pricing. These reforms could incentivize a shift away from polluting and climate-damaging technologies towards the adoption of more environmentally friendly technologies. In addition, adopting a carbon price would generate fiscal revenue that could be used to incentivize investments in new, more productive economic sectors with lower carbon intensity, leading to positive GDP impacts. Finally, carbon pricing would incentivize low carbon transition across many more sectors than the CBAM.

Reinvesting the proceeds of carbon pricing in innovation and education would help to accelerate the transition to greener and more resilient growth. If the revenues generated through broader carbon pricing reforms were reinvested in innovation and education, this could facilitate both significant positive economic and structural transformation and improved environmental conditions. The carbon-intensive sectors of Serbia's economy currently contribute to only 20 percent of GDP, 10 percent of exports, and 3 percent of total employment. The imposition of domestic carbon pricing in these sectors could incentivize many businesses to shift to new technologies and to develop the necessary skills to participate in cleaner, more knowledge-intensive economic activities. Where cleaner sectors are able to absorb the labor and capital released from carbon-intensive industries and unlock new markets, this could have a positive impact on employment.

[157] See Annex E for an assessment of GHG competitiveness and CBAM impact.

[158] On October 1, 2023, the CBAM entered into application in its transitional phase, with the first reporting period for importers ending January 31, 2024.

[159] World Bank. 2022c. "Supporting Serbia's Transition to Greener and More Resilient Growth: Policy and Institutional Reforms". Policy report, Washington, DC.



Chapter 5

Conclusions and recommendations

The following table highlights recommended policy actions and investments, with an associated prioritization, split by policy area. The urgency and ease of implementation of actions have been marked as high (●●●), medium (●●○), or low (●○○). The EU tag highlights actions that are aligned with the legal obligations already undertaken by Serbia within the EU accession process or based on their membership to the Energy Community.

Policy actions	Investments	Prioritization
Policy area: Resilience and adaptation		
RA1: Disaster risk management (DRM)[160]		
▪ Improve the institutional and legislative framework for climate change adaptation (CCA) and DRM by: implementing the legislation and technical standards to enhance the protection and climate resilience of critical infrastructure; promoting the integration of adaptation into national and local planning and development; and enhancing the legal basis of CCA decision-making and implementation in prioritized areas including agriculture, forestry, water resource management, and biodiversity. EU ▪ Enhance DRM and CCA financing by establishing a centralized authority for DRM funding and developing budgetary protection instruments at the local level to enhance disaster and climate risk financing. EU ▪ Improve access to data and information across institutions to ensure DRM mainstreaming across sectors. EU	▪ Enhance climate and disaster resilience of critical infrastructure through reinforcing, retrofitting, or rebuilding fire stations to ensure their resilience, uninterrupted functionality, accessibility, and energy security and efficiency: and improving the disaster and climate resilience of critical infrastructure and public buildings, including schools and hospitals. EU ▪ Improve climate data and information management through: enhancing data collection and information management systems on damage and loss resulting from natural disasters and climate change; and developing a digitalized platform and approach for climate change vulnerability assessments. EU ▪ Enhance the operational structure and capacity for wildfire suppression, especially for aerial firefighting and for operations in the mountainous areas. EU ▪ Enhance forecasting and climate awareness through upgrading forecasting capabilities and early warning systems at the national level, particularly along the Morava River; and organizing information campaigns to inform households, farmers, and businesses about possible risks and the importance of being properly insured. EU ▪ Prioritize flood risk protection investments based on short-term and medium-term flood protection investment plans. EU ▪ Implement heat adaptation measures such as shading and air circulation systems. EU	Urgency ●●● Ease of implementation ●○○
RA2: Urban		
▪ Enhance climate-resilient urban planning through the integration of climate and disaster resilience into city-level strategic documents and plans. EU ▪ Ensure sufficient human, organizational, and financial resources on green urban planning. EU	▪ Enhance financial resilience at city level through investing in the improvement and continuous maintenance of barriers around economic assets and population clusters in key fluvial cities with insufficient own financial capacities. EU ▪ Enhance disaster and climate resilience of CIs through infrastructure modernization and retrofitting and the implementation of sustainable, low-carbon, and resilient public infrastructures in urban areas. EU ▪ Enhance waste management by improving data collection tools and technologies as well as waste collection and treatment infrastructure upgrades. EU	Urgency ●●● Ease of implementation ●●●

[160] Disaster risk management and urban climate adaptation measures are mostly linked to the following EU legislation and strategies:
Legislation: European Climate Law (https://climate.ec.europa.eu/eu-action/european-climate-law_en), Directive on the resilience of critical entities (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L2557)), Eurocode building codes (https://eurocodes.jrc.ec.europa.eu/policies-standards/en-eurocodes-and-related-standards#the-european-standardisation-system). and other relevant construction laws (such as the revised Energy Performance of Buildings Directive EU/2024/1275 and the revised Energy Efficiency Directive EU/2023/1791), Floods directive (https://www.eea.europa.eu/themes/water/interactive/by-category/floods-directive) UCPM legislation (https://civil-protection-humanitarian-aid.ec.europa.eu/what/civil-protection/eu-civil-protection-mechanism_en).
Strategies, frameworks, programs and best practice networks: EU Adaptation Strategy (https://climate.ec.europa.eu/eu-action/adaptation-climate-change/eu-adaptation-strategy_en), EU Disaster Resilience Goals (https://civil-protection-humanitarian-aid.ec.europa.eu/what/civil-protection/european-disaster-risk-management/european-disaster-resilience-goals_en), EU Mission Adaptation to Climate Change (https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/adaptation-climate-change_en), EU level technical guidance for adaptation of buildings (https://susproc.jrc.ec.europa.eu/product-bureau/sites/default/files/2023-04/Technical%20Guidance%20adapting%20buildings.pdf).
The measures particularly support progress on areas presented in Chapter 27 Environment of the acquis (https://neighbourhood-enlargement.ec.europa.eu/enlargement-policy/glossary/chapters-acquis-negotiating-chapters_en).
The EU tag indicates that these measures are directly or indirectly linked or go beyond requirements included in EU legislation or strategies.

Policy actions	Investments	Prioritization
RA3: Water		
▪ Implement the Water Management Strategy until 2034 and related action plans. (EU) ▪ Strengthen water governance by adopting the newly drafted Water Law, formulating and implementing associated regulations, and clarifying roles and duties of water-related institutions. ▪ Establish a regulatory body for water services. ▪ Set effective tariffs for water services based on the cost-recover principle. ▪ Finalize and adopt the newly developed River Basin and Flood Risk Management Plans.	▪ Invest in strengthening institutional capacities at all levels of water management. ▪ Invest in sustainable water and wastewater treatment facilities to reduce the high levels of nonrevenue water (NRW) in the water supply systems to increase resilience and to increase the currently low levels of wastewater treatment. ▪ Invest in the implementation of the Programs of Measures of the River Basin and Flood Risk Management Plans once adopted.	Urgency ●●● Ease of implementation ●●○
RA4: Forestry and biodiversity		
▪ Reforest with climate resilience and adaptive capacity considered. ▪ Increase areas of protection and national parks. ▪ Consider climate change scenarios in the forestry strategies.	▪ Create an ecosystem monitoring structure for sustainable management of commercial species and potential spread of invasive species.	Urgency ●●● Ease of implementation ●●○
RA5: Agriculture		
▪ Reduce the direct payments envelope in favor of rural development (for example, advisory, farm extension services, and research and development [R&D]). ▪ Support a policy shift to increase the use of decoupled farm support combined with cross-compliance (where farmers are encouraged and supported to comply with high EU standards) to promote the adoption of sustainable and resilient farming practices. ▪ Improve the targeting of rural development policies and provide incentives for technical change and innovation. This includes addressing regional and size disparities, supporting younger farmers with entrepreneurial potential, as well as making medium-scale producers more efficient. ▪ Address the land fragmentation issues and promote land consolidation to create larger, more productive, and efficient farm units. ▪ Consider climate change scenarios in the agriculture strategies.	▪ Improve the country's irrigation and drainage system. ▪ Stimulate PPPs and resilient investments. The rural development budget could significantly increase its focus on the sustainable management of natural resources as well as green and resilient agricultural diversification, including promoting investments in climate resilient agrifood value chains, organic farming, and farm and agrifood processing innovations. Support the implementation of climate-smart agriculture practices that can mitigate the impact of GHG emissions from farms. ▪ Invest in measures to improve access to credit and farm enlargement. ▪ Support farmers to make production decisions based on competitive advantage, increasing farm investment, production specialization, adoption of climate-resilient farm innovations, and shifting land use toward high-value production. ▪ Develop Serbia's Agriculture Knowledge and Information Innovation System based on stronger cooperation between the private and public sectors and promote climate-smart agriculture investments. Aligning the knowledge agenda with climate resilience and improved access to agroclimatic information will further improve the sustainability of investments.	Urgency ●●○ Ease of implementation ●○○
RA6: Transport		
▪ Integrate climate adaptation considerations, like hazard exposure, asset vulnerability, and asset criticality, into the asset management function and the asset management systems across modes, for roads and highways above all, but also for railways, ports, airports, and other transport-related facilities. This will require a step change in the coverage, granularity, accuracy or upkeep, and decision-making readiness of subsectoral databases and data gathering practices. »	▪ Conduct a climate-informed, resilience-enhancing infrastructure retrofitting program for highly exposed and highly critical road sections, rail links, and key nodes and facilities across the existing national transport network. ▪ Invest in resilient infrastructure for the new assets that will be necessary to decarbonize and grow Serbia's transportation sector, including railways (including rolling stock), waterways, charging infrastructure, and active mobility infrastructure. ▪ Use current performance-based contracts for road infrastructure maintenance as pilot programs to test and confirm resilience-enhancing approaches that could be scaled up. »	Urgency ●●○ Ease of implementation ●○○

Policy actions	Investments	Prioritization
» ▪ Inform capital and preventive maintenance expenditure decision-making in infrastructure with risk-based probabilistic assessments, like simulations, and use these to derive optimal and sequenced investment pathways subject to budgetary and physical constraints. ▪ Update engineering design standards to embed minimum levels of climate resilience delivered through agreed-upon, evidence-based standard climate resilience interventions.	» ▪ Define separate budgetary allocation for climate adaptation of infrastructure. ▪ Invest in complementary equipment and tools beyond asset management software, to include monitoring and inspection vehicles, and right size government staffing assigned to the key data gathering and inspection, planning, budgetary, and oversight functions.	
RA7: Education, skills, and labor markets		
▪ Reform education and training systems to prepare the flow and stock of workers with skills needed for new jobs by increasing the links between the education and training system and the labor market, including through more private sector involvement. ▪ Develop national plans for fostering green values, attitudes, and behaviors from an early age and throughout the education and training system. ▪ Decarbonize education delivery and adapt school infrastructure to climate change; create modern learning environments. ▪ Promote science and R&D to adapt to climate change. ▪ Reform the regulatory framework financing and the design of upskilling and reskilling programs to expand the opportunities for lifelong learning, including on the job. ▪ Assess the fit of current labor regulations and tax and benefit systems to balance the flexibility needed for firms to adapt to economic changes with the protection of workers.	▪ Invest in the conditions needed for more labor market–responsive and larger scale training (regulatory framework, curricula, teachers or instructors, infrastructure, and equipment). ▪ Invest in green school infrastructure—energy-efficient buildings and compact structures—and embed energy-efficient technology in the curriculum to foster climate education (as part of DRM and urban policies). ▪ Invest in R&D and innovation to facilitate adaptation to a green economy. ▪ Strengthen mechanisms (for example, skills development funds) co-led by the private sector to support reskilling and upskilling at a larger scale. ▪ Develop tools for a labor market observatory to periodically identify changes in skills demand associated with the greening of the labor market. ▪ Invest in labor mobility schemes to support the geographical reallocation of jobs and workers.	Urgency ●●● Ease of implementation ●○○
RA8: Social protection systems		
▪ Modify legislation to allow the FSA program to expand coverage to additional people in response to disasters and climate impacts and strengthen one-off financial assistance to rapidly respond to localized shocks in a transparent manner. ▪ Align social protection, DRM, and climate change legislation to recognize the role of social protection in supporting adaptation; strengthen the use of early warning systems to inform a scaling-up of social protection programs; and enable disaster risk financing or prepositioned resources to be channeled through these programs to directly reach affected people. ▪ Develop labor income protection systems, including for informal workers, to respond to a likely increase in job-related shocks.	▪ Support dedicated outreach by the social protection systems to poor and vulnerable communities to ensure their understanding of the benefits that are available to bolster climate adaptation. ▪ Invest in social protection delivery systems to enable a quick identification of people in need of support and their enrollment and payment, backed by robust grievance mechanisms. This includes: investments in the interoperability of social protection information systems with other government databases to allow for rapid identification of eligibility, investments in social registries, where appropriate, and the establishment of standard operating procedures to ensure system capacity during disasters, supported by capacity building and staff training. ▪ Establish and finance a contingency budget that will fund the expansion of social protection systems when shocks occur. ▪ Invest in efforts to better understand the individual and household-level impacts of disasters and climate impacts, including through the tracking of damage and losses.	Urgency ●●● Ease of implementation ●●○

Policy actions	Investments	Prioritization
RA9: Health system		
▪ Improve data sharing with other sectors on surveillance and monitoring of emerging diseases and climate health emergencies. ▪ Create plans for health system response to health emergencies (include climate-related ones). ▪ Continue structural reforms in the health sector (including organizational, financial, and human resources) to respond to climate-related health emergencies and changes in burden of disease with support to Just Transition in view. EU	▪ Establish technical, legislative, and organizational prerogatives for robust connections between public health and veterinary and other agricultural authorities for disease monitoring and surveillance. ▪ Based on developed plans, make strategic investments in predetermined health facilities to strengthen response to climate-related hazards and other health emergencies, including infrastructure adaptation measures and enabling them to rapidly expand bed capacity and mobilize additional staff. ▪ Provide capacity building of health staff and investments in health facilities to respond to changes in disease burden and to support green transition and related migrations.	Urgency ●●● Ease of implementation ●●○
Policy area: Decarbonization and mitigation		
DM1: Energy pricing		
▪ Complete the liberalization of the electricity and natural gas markets and strengthen regulatory institutions. EU ▪ Maintain cost-reflective electricity tariffs to ensure the long-term financial viability of the power sector. EU ▪ Increase fuel levies and other environmental taxes to EU levels. EU ▪ Strengthen targeted social protection measures in parallel to price reforms. EU ▪ Deploy instruments for carbon pricing, with revenue recycling to help vulnerable and low-income groups. EU		Urgency ●●● Ease of implementation ●●○
DM2: Power sector		
▪ Develop spatial plans for identifying priority zones for RE development. EU ▪ Prepare a pipeline of RE projects with clear timelines and support schemes. EU ▪ Strengthen planning capacity for grid integration of RE (both at the transmission and distribution level). EU ▪ Develop the legal and regulatory framework for battery storage. EU	▪ Develop and implement national transmission grid modernization programs to enable the grid to integrate renewable electricity. EU ▪ Support investments in hydropower rehabilitation. ▪ Support investments in battery storage. ▪ An additional ~2.5 GW of hydropower (including pumped storage hydro) could be economically viable by the end of the 2030s. Given that the construction phase can be long for hydro projects, it would be advisable to launch these projects (for example, the Bistrica pumped storage hydropower plant) in this decade. ▪ Support investments led by the private sector based on competitive selection processes (for example, RE auctions) in solar and wind capacities. ▪ An additional ~2 GW of gas-fired capacity would be needed in the short term (until 2030) to phase down coal generation and achieve the 2030 GHG emissions targets.	Urgency ●●● Ease of implementation ●●○
DM3: Transition away from coal		
▪ Develop a framework for the repurposing of the Resavica coal mines (including labor and social mitigation measures and land rehabilitation), taking into account local communities indirectly affected by the closure.	▪ Provide support to projects for the rehabilitation of closed mines and reskilling of workers.	Urgency ●●● Ease of implementation ●○○

Policy actions	Investments	Prioritization
▪ Develop a framework for the repurposing of the EPS coal mines (including labor and social mitigation measures and land rehabilitation), taking into account local communities indirectly affected by the closure.	▪ Organize pilot projects to support job creation in select coal communities ahead of the closure of the coal mine. ▪ Strengthen public employment services, increase the offer of upskilling or retraining for occupations in demand, and invest in active labor market policies (ALMP) in coal-affected areas.	Urgency ●●○ Ease of implementation ●○○
DM4: Transport sector		
▪ Transition to concession-based models for public transport where providers are paid based on indicators of service delivered (performance-based contracts), aiming to improve service and accelerate the switch to e-buses. Increase bankability of bus concessions through standardization at national and regional levels. ▪ Improve coordination of rail freight traffic at the corridor level. ▪ Introduce fuel efficiency standards for vehicles and tighten second-hand import regulations. EU ▪ Introduce carbon-differentiated vehicle taxation to incentivize the adoption of cleaner vehicles. ▪ Improve governance and enforcement of emission testing in roadworthiness inspections. EU ▪ Introduce regulatory requirements for early electrification of highly utilized fleets (for example, buses, taxis, car-sharing, and public fleets). ▪ Establish a clear policy framework for the deployment of charging infrastructure, facilitating private sector participation. ▪ Prioritize collective and active mobility over private motorized transport in urban and metropolitan areas.	▪ Finance pilot projects to start developing EV charging infrastructure along main corridors. ▪ Support low-interest finance for the early e-mobility transition of highly utilized fleets. ▪ Introduce dedicated infrastructure for exclusive circulation of public transport vehicles along key urban corridors. ▪ Invest in continuous, integrated, and safe nonmotorized transport infrastructure (cycling).	Urgency ●●● Ease of implementation ●●○
▪ Introduce minimum regulatory requirements for the rollout of publicly accessible EV charging points, gradually converging with those of the EU Alternative Fuels Infrastructure Regulation for both light and heavy-duty vehicles. EU ▪ Introduce low-emission zones with gradual and growing levels of restriction over time. ▪ Introduce parking management strategies to discourage private car use and recover public space (including controlled parking zones and parking charges). ▪ Explore alternative financing schemes for urban mobility, such as land value capture for transformative projects. ▪ Expand private sector participation in infrastructure, services, and emerging transport modes (for example, Mobility as a Service and urban logistics) through PPPs. ▪ Improve market orientation of transport operators and encourage private participation. ▪ Reform state-owned transport enterprises, enable their access to finance, appoint professional boards of directors, and divest state-owned enterprises of noncore business activities. EU	▪ Invest in improved public transport, pedestrian, and cycling accessibility to low-emission zones. ▪ Support, with decreasing participation over time, the roll-out of publicly available charging infrastructure for electric mobility. ▪ Upgrade and expand the infrastructure at border-crossing points on critical transport corridors within WB6 to achieve fully functioning one-stop-shops between WB6 and EU neighbors. EU	Urgency ●●○ Ease of implementation ●●○

Policy actions	Investments	Prioritization
▪ Introduce gradual phaseout of internal combustion engine (ICE) vehicles among new registrations.	▪ Revitalize and expand rail infrastructure through investment, improving service quality and competitiveness for both passenger and freight transport. Expand core rail network to be compliant with Trans-European Transport Network standards by 2035, as per the Western Balkans Sustainable and Smart Mobility Strategy (for example, Corridor X connecting east to west through Serbia, Serbia-Montenegro railway, and Serbia-Kosovo-North Macedonia railway). This would enable a gradual shift from private road transport to rail for both passenger and freight.	Urgency ●●○ Ease of implementation ●○○
DM5: Residential and commercial sector		
▪ Enhance energy efficiency (EE) standards for buildings and reinforce compliance. (EU) ▪ Develop a roadmap for sustainable heating.	▪ Provide incentives for EE and distributed RE in private buildings, including electrification of heating through heat pumps and installation of rooftop solar PV systems.	Urgency ●●● Ease of implementation ●●●
DM6: Industry		
▪ Enhance EE standards for industry and reinforce compliance. (EU)		Urgency ●●● Ease of implementation ●●●
	▪ Provide incentives and selected pilot investments for industrial CCS and green hydrogen production.	Urgency ●●○ Ease of implementation ●○○
DM6: Education, training, and skills		
▪ Retrain current workers to adapt to the transition. ▪ Support mitigation studies and research activities, including scientific research on decarbonization and absorption (forestry, nature preservation, and so on). ▪ Implement the measures listed in RA7. Many of them will facilitate not only adaptation but also mitigation and decarbonization.	▪ Invest in upskilling and reskilling to improve employability of the labor force, mitigate climate change in key sectors of the economy, and retrain the most vulnerable towards safe or green occupations. ▪ Invest in R&D in the area of mitigation. ▪ Implement the investments listed in RA7. Many of them will facilitate not only adaptation but also mitigation and decarbonization.	Urgency ●●○ Ease of implementation ●○○
Economic management, financial, and growth		
EF1: Macroeconomic Stability		
▪ Pursue fiscal policies focused on low and decreasing fiscal deficits over the medium-term to deliver sustainable debt levels. ▪ Maintain fiscal buffers to better manage uncertainty while balancing support to priority policies and investments. ▪ Manage fiscal risks, including from natural disasters, to adequately plan for it in the medium-term expenditure framework, in order to contain impact on public debt.	▪ Strengthen economic modeling and climate modeling capacities ▪ Enhance the quality and accuracy of the medium-term macroeconomic framework to better reflect climate considerations in the Fiscal Strategy. (EU) ▪ Deepen and expand fiscal risk assessments that include impacts from natural disasters and climate change. ▪ Include climate-related contingent liabilities (explicit and implicit) in budgets and fiscal projections to be better prepared when they occur. ▪ Strengthen the institutional capacity to implement fiscal rules. (EU)	Urgency ●●○ Ease of implementation ●●○

Policy actions	Investments	Prioritization
EF2: Fiscal Reforms (mix of support programs and taxes to incentivize adaptation and mitigation)		
▪ Remove explicit subsidies in the energy system. ▪ Scale up social safety nets to provide comprehensive support for vulnerable populations during times of economic transition and changes to the climate. ▪ Reduce tax expenditures and increase broad-based revenue mobilization to create fiscal space for adaptation and mitigation needs (support programs, investments). ▪ Develop policies and support programs to mitigate the impact of climate shocks and stressors by incentivizing resilience in investment, urban and municipal planning, and behaviors. ▪ Develop policies and support programs to facilitate the energy transition by incentivizing research and development (including adoption) of green technologies. ▪ Invest in public infrastructure to support the integration of new technologies in electricity grids, public transport, broadband, recycling, planning of cities, etc. ▪ Introduce carbon pricing mechanisms, such as carbon taxes or cap-and-trade systems, to internalize the costs of emissions and drive businesses to reduce their carbon footprint; along with recycling mechanisms to ensure sustainable funding for climate change mitigation and adaptation programs. ▪ Use part of carbon tax revenues to support social and economic programs for those affected by climate change or to incentivize changes (revenue recycling). ▪ Develop risk sharing/reduction programs through guarantees, long-term contracts based on the government's convening power for co-financing.	▪ Enhance analytical capacity and strengthen institutions to deliver fiscal reforms. ▪ Enhance institutional capacity in revenue administration. ▪ Enhance outreach to stakeholders affected by climate change to tailor support programs.	Urgency ●●○ Ease of implementation ●●○
EF3: Public Finance Management and SOE-BOS mgmt..		
▪ Strengthen public investment management by concluding the national policy framework, strengthen procedures and institutional roles. ▪ Systematically integrate climate objectives in SOE-BOS investment decision processes through the recently established central management entity; and for the energy sector, through direct mandating. EU ▪ Institutionalize climate risk assessment to ensure both public and private sectors actively consider and prepare for challenges posed by future climate change impacts; and that fiscal risks from SOE-BOS are integrated into the country's fiscal risk assessment. ▪ Introduce green public procurement (GPP) standards as obligatory for the public sector. ▪ Introduce climate proofing for planning of all capital investments. ▪ Introduce carbon pricing and recycling mechanisms to ensure sustainable funds for climate action and helping vulnerable and low-income groups.	▪ Strengthen analytical capacity and institutional ability to deliver public financial management reforms. ▪ Develop and implement robust climate budgeting and tracking mechanisms to monitor the effectiveness of climate-related spending and enhance transparency in resource allocation. ▪ Prioritize investments in low-carbon and resilient infrastructure projects to promote sustainability and climate resilience. ▪ Develop subnational planning and budgeting capacities and revenue collection modalities. ▪ Introduce and implement climate budget tagging. ▪ Develop a disaster risk financing plan, which considers risk layering and regional pooling, to manage contingent liabilities and protect.	Urgency ●●○ Ease of implementation ●●○

Policy actions	Investments	Prioritization
EF4: Climate Financing		
▪ Develop an enabling environment for green finance. Adopt a Sustainable Finance Framework, in alignment with the EU regulation. Develop a green taxonomy, implement financial disclosure standards, and adopt international benchmarks for the issuance of GSS bonds. ▪ Mobilize green financing through the issuance of debt instruments. ▪ Promote green financing by creating incentives for both private and public investments in green projects, sustainable technologies, and climate-resilient businesses. ▪ Promote the adoption of climate insurance across multiple sectors. ▪ Strengthen the public-private partnerships and concession policy framework to facilitate and streamline investments in green and climate-resilient projects. ▪ Develop the market for green bonds. ▪ Develop the Green Equity Fund. ▪ Consider mechanisms that allow quick financial response to disasters and access to social protection payments.	▪ Invest in green bonds issued by governments, municipalities, and corporations to finance environmentally friendly projects. ▪ Invest in measures to mitigate climate change impact on the financial sector to increase resilience and reduce risk premiums associated with climate related events. ▪ Develop and deepen local capital markets to support the issuance GSS bonds and trading in secondary markets.	Urgency ●●○ Ease of implementation ●●○
EF5: Financial Sector Regulatory and Supervision Framework		
▪ Employ event or scenario-based stress tests to evaluate climate-related risks comprehensively to assess their potential impact on financial institutions and the broader financial system. ▪ Develop guidelines for integrating climate risk into risk management, governance structures, disclosure practices, and supervisory scoring models and approaches to ensure consistent and thorough assessments. ▪ For financial sector and private sector update accounting and auditing legislation to capture exposure to climate risks	▪ Invest in the development and deployment of advanced risk assessment and compliance monitoring tools that can identify potential violations and emerging climate-related risks in financial institution. ▪ Establish a comprehensive national strategy and roadmap for green finance. ▪ Set up capital requirements for climate risks to ensure that financial institutions maintain adequate capital buffers to absorb potential losses stemming from climate-related events.	Urgency ●●○ Ease of implementation ●●○
EF6: Resilient and Sustainable Growth		
▪ Provide policy certainty for investors in climate responsive sectors, by regularly updating them on adaptation and mitigation policies and plans. ▪ Strengthen contestability in the economy, especially for sectors that are critical to respond to climate change; ensure regulatory frameworks are in place. ▪ Capitalize on policies and support programs to incentivize investment in adaptation and mitigation (see EF2). ▪ Re-evaluate the role of SOEs to ensure they actively contribute to country climate goals, by strengthening governance and management practices, removing subsidies, and fostering participation in competitive markets or contestable markets. Support SOEs in programs where private sector is supported (i.e. for technology adoption or diffusion) but ensure SOEs do not inhibit entry or contestability, or benefit from unfair advantages. »	▪ Develop an open data system to track adaptation and mitigation challenges, making it valuable for consumers, entrepreneurs, and investors. For energy, provide detailed information on grid capacity and demand, particularly addressing price uncertainty, to inform energy and infrastructure planning. ▪ Appraise entrepreneurs, especially SMEs, on evolving needs for energy efficiency and for adaptation action. ▪ Promote training programs for green jobs to prepare the workforce for sustainable employment opportunities and the transition to a green economy. ▪ Enhance the EV supply chain by developing skills, improving regulations, and supporting SMEs through targeted programs. ▪ Develop R&D and support the commercialization and transfer of technologies specifically aimed at climate change solutions.	Urgency ●●○ Ease of implementation ●●○

Policy actions	Investments	Prioritization
» ▪ Adopt an economy-wide approach to the Just Transition ensuring reforms are in place (i.e. human capital improvement, market contestability, business environment) to capitalize on adaptation and the green transition. ▪ Prepare in advance for the advent of CBAM through the use of cleaner energy. ▪ Identify and leverage areas where Western Balkan economies have a comparative advantage in environmental goods and green product manufacturing and could become part of the green global value chains. ▪ Ensure policies for skills development, regulatory improvements, and SME capabilities are aligned to supporting green growth.		
Intitutional readiness for climate action		
IR1: Organization		
▪ Strengthen the mandate of the National Climate Change Committee (NCCC) by introducing obligatory review of policy documents, increase frequency of meetings, and structure the work to enable NCCC's advisory role. ▪ Ensure overarching coordination of climate change agenda from the Prime Minister's office; ensure that divided sector responsibilities do not hamper coordination. ▪ Introduce a mechanism for vertical coordination and cooperation with LSGs to enhance their work as agents of change	▪ Allocate sufficient financing to ensure that the line ministries, subnational governments, and other relevant institutions have adequate staff to deal with climate change and continue increasing their technical capacities. EU ▪ Set up a capacity building or training plan and introduce climate change training modules for public administration workers.	Urgency ●●● Ease of implementation ●●○
IR2: Planning		
▪ Enact National Energy and Climate Plan (NECP) aligned with EnC targets (including 2050 net zero target). EU ▪ Introduce an obligation to prepare inventories and set GHG emission reduction targets for LSGs. ▪ Support the development of Just Transition action plans by affected LSGs in cooperation with energy industry.		Urgency ●●● Ease of implementation ●●●
IR3: Accountability and citizen engagement		
▪ Set up a committee for climate change in the parliament. ▪ Introduce a clear mandate for the Serbia Audit Institution (SAI) for the implementation of a climate policy. ▪ Facilitate citizen engagement and participation in the development of climate-related policy and legislation.	▪ Enhance platforms and mechanisms to enable public access to reliable information on climate change.	Urgency ●●● Ease of implementation ●●●

Annex A. Climate Change Institutional Assessment: Key findings

BOX A.1. Climate Change Institutional Assessment (CCIA) methodology

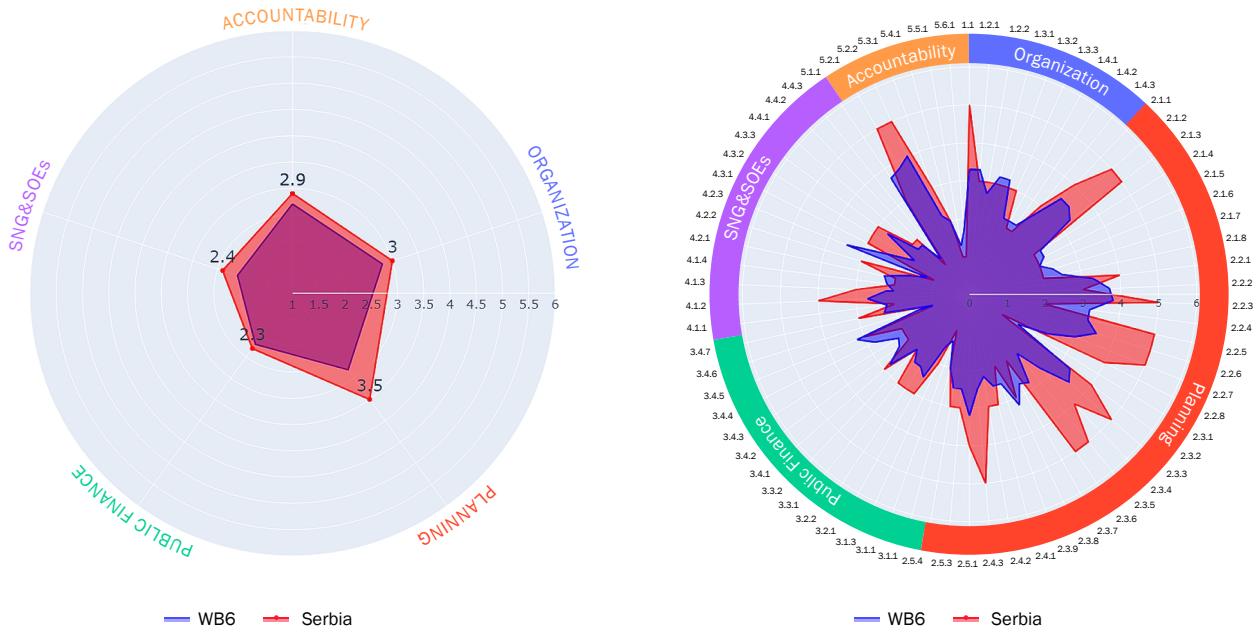
Country institutional capabilities are critical for reaching medium- and long-term climate action results. A Climate Change Institutional Assessment (CCIA) helps prioritize and sequence measures to enable countries to meet their climate change mitigation/de-carbonization and Adaptation and Resilience (A&R) objectives. The institutional performance is assessed by examining the suitability of the institutional framework to plan, implement, and sustain a credible and long-term commitment to increasing ambitious climate change policies over multiple political cycles. The assessment covers the functional pillars for organization, planning, public finance, subnational governments (SNG)/state-owned enterprises (SOE), and accountability.

The Climate Change institutional capabilities of the Western Balkans have been assessed by applying a maturity benchmarking framework. The quantitative benchmarking covers 74 indicators across the five CCIA pillars. The indicators can be read in both level terms, as well as relative to comparator countries (including EU-27 illustrations, such as Austria). The indicators are measured in overview terms of nascent, emerging, and established); and they are further detailed within the bands of innocent/aware, developing/competent, and optimizing/excellent. These maturity scores should not be read as objectives in their own right but rather in terms of how they contribute to climate change action outcomes.

The level of ambition in terms of climate mitigation or A&R is subject to a range of results metrics, including institutional abilities and actions. In the planning pillar, the CCIA captures the priorities and sequencing for climate action for both mitigation and adaptation. Climate change mitigation ambitions may be reflected in key climate action strategies and policy documents. These include objectives for GHG emissions reductions/net zero by 2030 and 2050, as well as shifts away from fossil fuels to low-carbon energy sources. The expectations for green transition trajectories—and consequently the institutional demands required for these whole-of-economy structure transformations—will depend on current baselines. A&R outcomes are subject to more diverse metrics, including expected changes in adverse climate exposure. In many cases, it still should be considered in terms of prospective loss and damage risks mitigated due to a range of proactive measures over time (including information, insurance and social protection measures, building standards, and land use planning).

The CCIA Country Reports explore in more depth the institutional measures likely to enhance and sustain climate action ambitions, ability, and actions. The CCIA dialogues identify relative strengths and possible binding constraints to deliver climate change action across the medium (2030) and longer terms (2050). These include ambitions—both for mitigation as well as for an articulation of climate A&R risks— and revealed abilities and actions to address these credibly across regional, national, and local levels. The CCIA recommendations also note the sectoral diversity that current mitigation and A&R challenges represent across the countries' socioeconomic structures. Institutional development recommendations are consequently organized by highlights across the five CCIA pillars. Figure A.1 depicts the country institutional capacities for climate change action compared to the WB6, split by the five CCIA pillars. Table A.1 provides highlights of achievements and gaps by pillar.

FIGURE A.1. CCIA Serbia benchmarking by pillar summary, indicators



Sources: World Bank CCIA, Western Balkans (forthcoming); D4C National Climate Actions Strategies and Policies Database (2023).

Figure A.1 summarizes the CCIA results for Serbia, benchmarked to the WB6 average. While the **Planning pillar** articulates Serbia's relatively high levels of commitment and awareness of key adaptation and mitigation agenda items, a key challenge will be to muster the ability and actions to realize these in practice. The policy framework—including the Law on Climate Change, Low-Carbon Development Strategy (LCDS), National Adaptation Plan, and draft National Energy and Climate Plan (NECP)—reflects the commitment and results in the Planning pillar having the highest average score. However, the level of ambition is constrained by the high carbon intensity of the economy, and the alignment with EU and Energy Community (EnC) targets is yet to be achieved. The ability reflected under the **Organization pillar** is in an emerging stage: it is necessary to strengthen the existing structures to be able to implement the planned climate policies and achieve the targets. The other pillars demonstrate less progress, with majority of indicators in the **Public Finance and SNG-SOE pillars** rated as nascent. Accountability for climate action is emerging, with established mechanisms for stakeholder participation, but parliament and state audit oversight are still not in place.

TABLE A.1. CCIA pillar highlights

	Achievements	Gaps
Organization	▪ Established Climate Change Unit at the Ministry of Environmental Protection with groups for mitigation and adaptation ▪ Established Climate Change Group in Ministry of Agriculture, Forestry and Water Management ▪ Established National Climate Change Committee (NCCC)	▪ Divided responsibilities with Ministry of Mining and Energy in charge of climate change in energy sector. ▪ NCCC not meeting regularly and with more coordination function.
Planning	▪ National Adaptation Program ▪ Low-Carbon Development Strategy ▪ Risk registry ▪ Digital Climate Atlas	▪ NECP is not enacted. ▪ Net zero target is missing. ▪ Climate change scenarios are not considered in sector strategies.

	Achievements	Gaps
Public finance	▪ The introduction of tracking expenditures for climate responsive capital expenditures is ongoing. ▪ Climate informed public investment management (PIM) is emerging. ▪ Green bond framework established and collected €1 billion in September 2021	▪ No green public procurement (GPP) in practice ▪ No carbon pricing ▪ No sustainable national climate finance
SNGs and SOEs	▪ Local self-governments (LSGs) have obligations related to energy management, waste management, and disaster risk management (DRM). ▪ Subnational governments (SNGs) have to align their planning documents with the objectives of the national adaptation program. ▪ Elektroprivreda Srbije (EPS) has committed to the development of a decarbonization plan in accordance with NECP and climate risk reporting in accordance with recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD).	▪ Subnational strategic plans for climate action are not obligatory. ▪ No emission reduction targets for the SNGs. ▪ Lack of sustainable finance for climate action on local level.
Accountability	▪ Mechanisms for stakeholder consultations	▪ Role of independent expert advice is not regulated in the Law on Climate Change. ▪ Irregular Parliament oversight. ▪ State Audit Institution (SAI) not reviewing climate action.

Source: Gallop et al. 2021.

Annex B. Assessment of adaptation needs

The following table provides undiscounted costing details of the measures prioritized in the policy table. It includes the narrative by sector. Both the policy and investment measures are denoted with an alphanumeric code corresponding to each measure in the policy table. These estimates are more comprehensive than the adaptation estimate done by hazard exercise that was part of the macro modeling (see Macroeconomic impact in chapter 4) due to the limitations of said modeling exercise. Following the table is a description of the challenges, methodological issues, and semantic choices made in the endeavor to develop a coherent narrative on adaptation based on quantitative estimates.

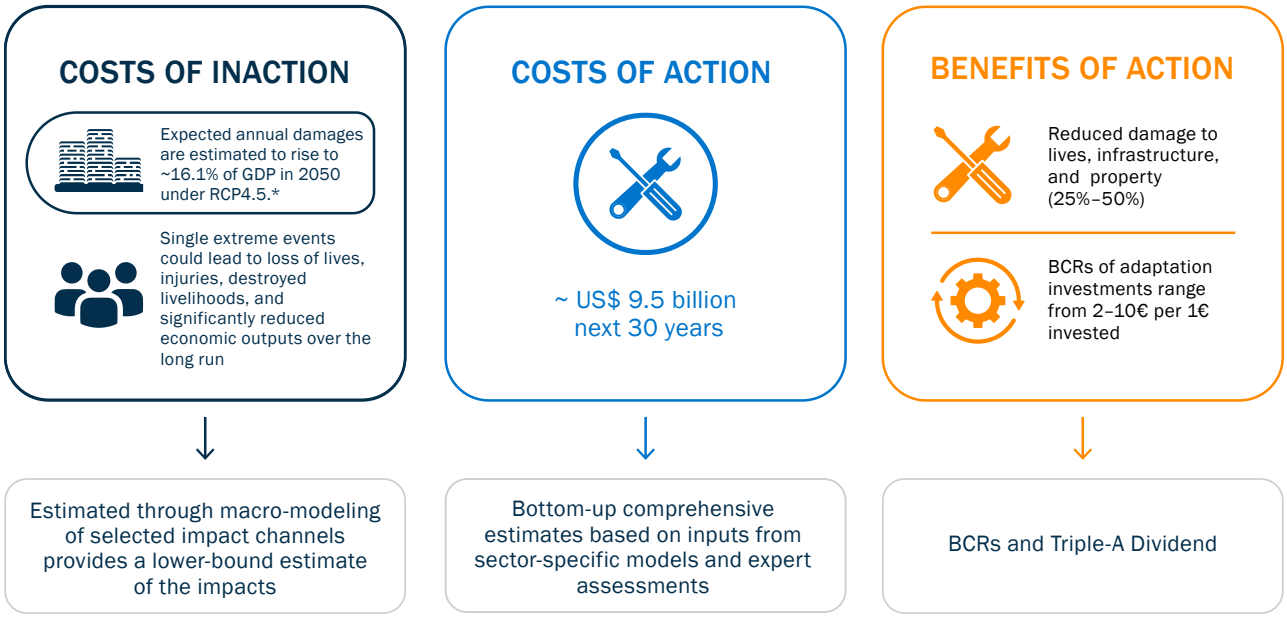
TABLE B.1. Estimate of adaptation needs

Policy Area	Total cost (2020 US$)	Total Cost (€)	Estimate
RA1: DRM	444 million	417.6 million	RA1.1 ~ €1.5 million 1. Implement the legislation and arrangements to secure critical infrastructure—Serbia World Bank Ready 2 Respond investment plan (US$150,000), ~ €137,110 2. Based on cost estimate from Albania National Adaptation Plan, €653,200 3. Complete and fully implement the legislative framework with emphasis on missing bylaws, World Bank R2R investment plan (US$775,000) ~ €708,400
			RA1.2 Cost inspiration from estimates for enhancing financial preparedness to climate change in the Albanian National Strategic document. (US$100,000 to engage company), ~ €1million
			RA1.3 Develop and implement disaster management information system (DMIS) and geomatics, World Bank Ready 2 Respond investment plan (US$2,232,000), €2 million
			RA1.4 If in Romania for around 90 education buildings the cost is US$121 million and for 35 fire stations €142 million, Serbia overall can be €160 million (because it is less populated than Romania so assuming fewer fire stations and education buildings). Calculated the unit cost based on Romania and then calculated for 60 education buildings and 20 fire stations in Serbia.
			RA1.5 Cost inspiration from Bosnia and Herzegovina's National Adaptation Plan, ~ €0.5 million
			RA1.6: Based on cost estimate for the disaster risk management investment plan proposed in the World Bank R2R report for Serbia, €2 million
			RA1.7 €4.6 million 1. Forecasting and early warning systems—World Meteorological Organization South-East European Multi-Hazard Early Warning Advisory System Project: (US$2.4 million), ~ €2.2 million 2. Implement an information campaign on risks and insurance—World Bank R2R investment plan (US$2.62 million), ~ €2.4 million
			RA1.8: Based on total investment for the World Bank Project Sava and Drina River Corridors Integrated Development Program for flood prevention and risk reduction in cross-border area in Serbia, €146 million
			RA1.9: Analysis conducted for WB6 heat, climate change adaptation measures cost, €100 million
RA2: Urban	345.54 million	325 million	Based on experience reviewing previous projects costing €202 million + €123 million for waste management. Inspiration from the 2020-2030 Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina, "Providing a waste treatment system with the collection and use of landfill gas–80 million BAM" (with consideration that Serbia urban population is three times that of Bosnia and Herzegovina)
RA3: Water	2.23 billion	2.1 billion	RA3.7 From Water Global Practice assessments: Investment needs of €2.1 billion to reduce non-revenue water (NRW) levels from current 42 percent to EU average of 25 percent

RA4: Forestry and diversity	112.3 million	105.6 million	RA4.1 According to Serbia-drafted National Adaptation Plan, a total of €7.5 million was allocated for the 18,000 ha of forests in the Republic of Serbia between 2004–13. With an annual cost of €0.833 million, it will be €22.5 million from between 2023–50
			RA4.2 According to Serbia-drafted National Adaptation Plan, for the functioning of public enterprises established for the management of the category of a national park (according to financial statements shown in the Information Bulletin of the public enterprise National Park Tara and public enterprise Fruska Gora, 2015), it is necessary to allocate almost €3 million per year. €81 million between 2023–50
			RA4.3 Calculation inspired by cost estimates for the Swedish Forestry sector from World Bank (2024),[161] ~ €2.1 million
RA5: Agriculture	457.18 million	430 million	RA5.5 According to Serbia-drafted National Adaptation Plan, a total area of about 86,000 hectares over the next 10 years is recommended for the construction of an irrigation system. The cost of the construction of irrigation systems varies from US$2,626 to US$11,489 per ha for gravity systems, and from US$3,471 to US$15,373/ha for pressure systems, while estimated costs for the two project areas in Serbia range from €3000-5000 per ha. Using the €3000- €5000 per ha unit cost and multiplying with the total 86,000 ha of land, the total cost of the construction of an irrigation system is estimated to be €258 – €430 million ~ €430 million
RA6: Transport	5.44 billion	5.12 billion	Retrofitting program ~US$670 million (€617 million) through end-2030 + cost of investing in new resilient infrastructure and maintaining existing and new assets: ~US$4.9 billion (€4.5 billion) through end-2030 Combined aggregate cost of ~1.3 percent of GDP per year through end-2030.
RA7: Education, skills and labor markets	175.32 million	165 million	RA7.7 [€9 million to €27.2 million] range provided by other global practice colleagues, ~ €27.2 million
			RA7.9 [€5.8 million to €11.6 million] range provided by other global practice colleagues, ~ €11.6 million
			RA7.10 [€15 million to €102.9 million] range provided by other global practice colleagues, ~ €102.9 million
			RA7.11 [€2.5 million to €5 million] range provided by other global practice colleagues, ~ €5 million
			RA7.12 [€8 million to €18.2 million] range provided by other global practice colleagues, ~ €18.2 million
RA8: Social protection systems	223.17 million	210 million	RA8.4 Estimated by Social Protection Global Practice colleagues, €500,000
			RA8.5 Estimated by Social Protection Global Practice colleagues, €2 million
			RA8.5 Estimated by Social Protection Global Practice colleagues, €206.9 million
			RA8.6 Estimated by Social Protection Global Practice colleagues, €500,000
RA9: Health system	55.43 million	52.13 million	RA.9.1 Estimated by Health, Nutrition, and Population Global Practice colleagues, US$400,000 ~ €357,100
			RA9.2 Estimated by Health, Nutrition, and Population Global Practice colleagues, US$500,000 ~ €446,340
			RA9.3 Estimated by Health, Nutrition, and Population Global Practice colleagues, US$2 million ~ €1.785 million
			RA9.4 Estimated by Health, Nutrition, and Population Global Practice colleagues, US$5.2 million ~ €4.462 million
			RA.9.5 Estimated by Health, Nutrition, and Population Global Practice colleagues, US$30.3 million ~ €27.05 million
			RA9.6 Estimated by Health, Nutrition, and Population Global Practice colleagues, US$20 million ~ €17.854 million

[161] World Bank. 2024. "Climate Adaptation Costing in a Changing World - Valuing Climate Adaptation Helps us Orient our Compass Toward Effective and Resilient Pathways (English)". Washington, D.C. World Bank Group. http://documents.worldbank.org/curated/en/099062624153536206/P179070128460a0c7187d01fc21c8f9bcda

FIGURE B.1. Summary of adaptation investment narrative



Source: World Bank analysis
Note: GDP = gross domestic product, RCP = representative concentration pathway, BCR = benefit-cost ratio.
* The macroeconomic model yields annual estimates for damages based on the expected annual loss from each climate hazard. The expected damages are projected to grow over time, reflecting increasingly unpredictable and volatile climate conditions. Combined damages from the drought impact on maize and wheat, heat stress on labor productivity, and riverine floods, are estimated to be 16.1 percent of GDP under RCP 4.5 in 2050 for Serbia.

The business of modeling the effects of climate change—whether shocks or slower-moving stressors—on gross domestic product (GDP) is tricky. Thus, the estimates provided are grossly undervalued. Why? The channels via which impacts take place are difficult to account for in an exhaustive way. Further, exceedance probability (EP) curves carry large uncertainties (stemming from uncertainties in climate and exposure data especially when projected and the difficulty of calibrating vulnerabilities) and propagating these through macro-modeling exercises is prohibitive for this Country Climate and Development Report (CCDR). For instance, while overall flooding risks are expected to fall in the Western Balkans, the incidence of flash floods is expected to rise. Even though this is understood, propagating the joint uncertainty in impacts is already too expensive. More generally, modeling fails to capture the impacts of certain extreme events. Wildfires are a case in point—historical data quickly become sparse as one goes back in time, impact channels are multifaceted and seldom understood, and projection of the hazard is yet to be tested. Modeling the impacts at a yearly level is next to impossible for nonlinear climate shifts (for example, the hydrological cycle) whose dynamics are not yet fully captured in climate models and yield large uncertainties—once again, expensive to propagate. Finally, this CCDR demonstrates how climate hazards interact and compound. Yet, models can best capture dynamics critical to a given climate hazard, missing the complexity of the links. Modeling an example of future with compound shocks is possible, but capturing the breadth of uncertainty accounting for correlated risk is next to impossible at this stage. With examples from the region and literature reviews that provide some information on the direction and magnitude of the uncertainties and the way certain hazards may interact, the CCDR provides some avenues to think through the enormity of the costs of inaction (Figure B.1) and hints of solutions to deal with the matter of uncertainty, including better data collection.

This estimate is based on a comprehensive bottom-up approach (Figure B.1) with a clear and verifiable methodology, which brings huge value to clients grappling with similar issues. Note that a large portion of these investments is in hard infrastructure and this cost could be reduced by developing more detailed feasibility studies, combining investments (EE or energy efficiency and seismic), and improving building codes for higher standards to avoid retrofitting that is generally more costly. Also, some of these are

development investments that are essential in any case for the expansion of sectors, the economy, and society (water systems efficiency, irrigation schemes, social protection schemes, and so on.). The benefits of these investments, grounded in reality, are only very partially captured by the macro-modeling, which used estimates by hazard rather than by sector and is partial due to current limitations of the modeling framework. Besides, positive impacts of investments on growth and employment and co-benefits are not fully captured by the macro-modeling exercise. Therefore, in this report, we have a lower-bound estimate in terms of the costs of inaction, a lower-bound estimate in terms of the positive impact of adaptation action on GDP from the macro-modeling, and a more comprehensive cost of action estimate.

Benefits of Action—The Triple-A Dividend

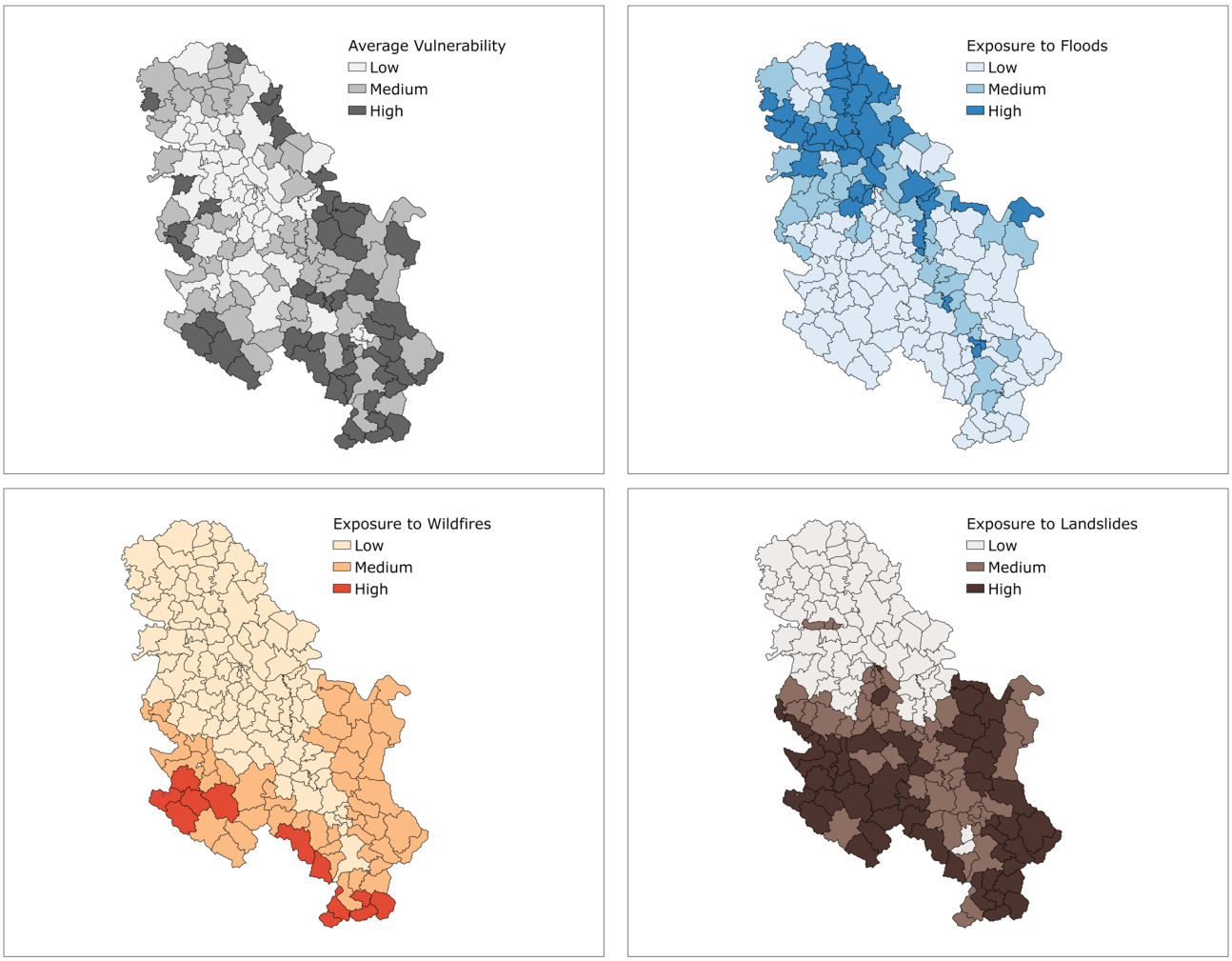
Investing in adaptation can yield substantial social, economic, and environmental benefits (Figure B.1). Such benefits could be expressed through the Triple-A Dividend. The Triple-A Dividend framework reconciles perspectives from the humanitarian, environmental, and economic fields (Figure 2.2). It identifies three types of benefits: ***avoided*** losses and lives saved during a disaster or climate event; ***accelerated*** economic potential as a result of stimulated investments and bolstered economic activities due to the reduction in background climate and disaster risks; and ***amplified*** social and environmental co-benefits of adaptation investments.

The urgency of the action framework could also be applied to specific sectors, for which the costs of inaction (that is, damages) numbers are available linked to specific hazards. This exercise could be useful for sector-specific or ministry-level dialog.

Please note that the estimates are for 2050 only, except for costs of action that are between now and 2050, and for RCP 4.5 only. The benefits of action in figure B.1 are not fully captured by the macro-modeling exercise, which only considers certain channels and does not properly account for accelerated economic potential and co-benefits.

Annex C. Exposure to hazards and socioeconomic vulnerability on the municipal level

FIGURE C.1. Overlapping vulnerabilities in Serbian municipalities



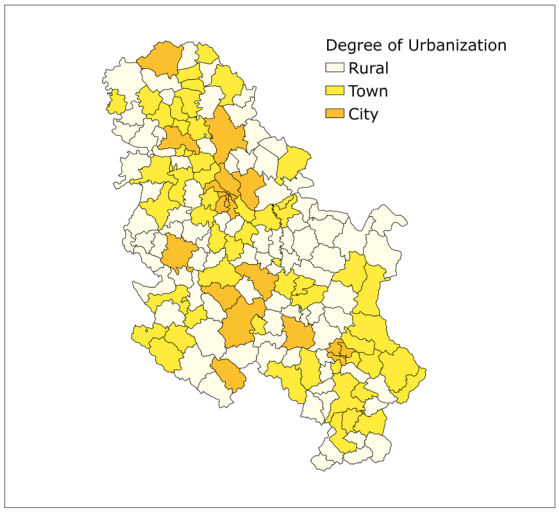
Sources: World Bank analysis 2023, SORS Census 2022, GHS-POP R2023A, OpenStreetMap, JBA, CIMA, ELSUS v2.
Note: Average vulnerability is measured as the arithmetic mean of 1–4 scores assigned to each municipality based on the quartiles of the distributions of: population growth or decline from 2000 to 2020, access to markets, unemployment rate deviation from urban or rural country average, share of population with secondary education, average net earnings. High flood exposure indicates a municipality's average raw depth of half a meter or higher for a flood event (fluvial or pluvial), with a 1 percent yearly probability of occurrence. Low exposure indicates a depth of less than 20 cm for a similar event. High wildfire risk represents an average municipality score of 3 or higher based on CIMA's wildfire hazard grid assigning to each 100x100 m cell a score from 1 (very low) to 6 (very high). High landslide risk is similarly defined as an average municipality score of 3 or higher based on the ELSUS v2 landslide hazard grid, which assigns to each 200x200 m cell a score from 1 (very low) to 5 (very high). For both wildfires and landslides, low risk is defined as an average below 2.

TABLE C.1. The most highly exposed municipalities ranked from highest to lowest exposure, by hazard type

Vulnerability	Bujanovac, Bojnik, Žagubica, Dimitrovgrad, Babušnica, Bela Palanka, Knjaževac, Svrljig, Bosilegrad, Gadžin Han
Floods	Palilula (Beograd), Čoka, Titel, Bač, Novi Kneževac, Novi Sad, Novi Bečej, Apatin, Sremski Karlovci, Surčin
Wildfires	Trgovište, Bosilegrad, Vranjska Banja, Medveđa, Bujanovac, Prijepolje, Čajetina, Priboj, Nova Varoš, Kuršumlija
Landslides	Babušnica, Niška Banja, Priboj, Brus, Gadžin Han, Ivanjica, Bela Palanka, Ljubovija, Kuršumlija, Trgovište

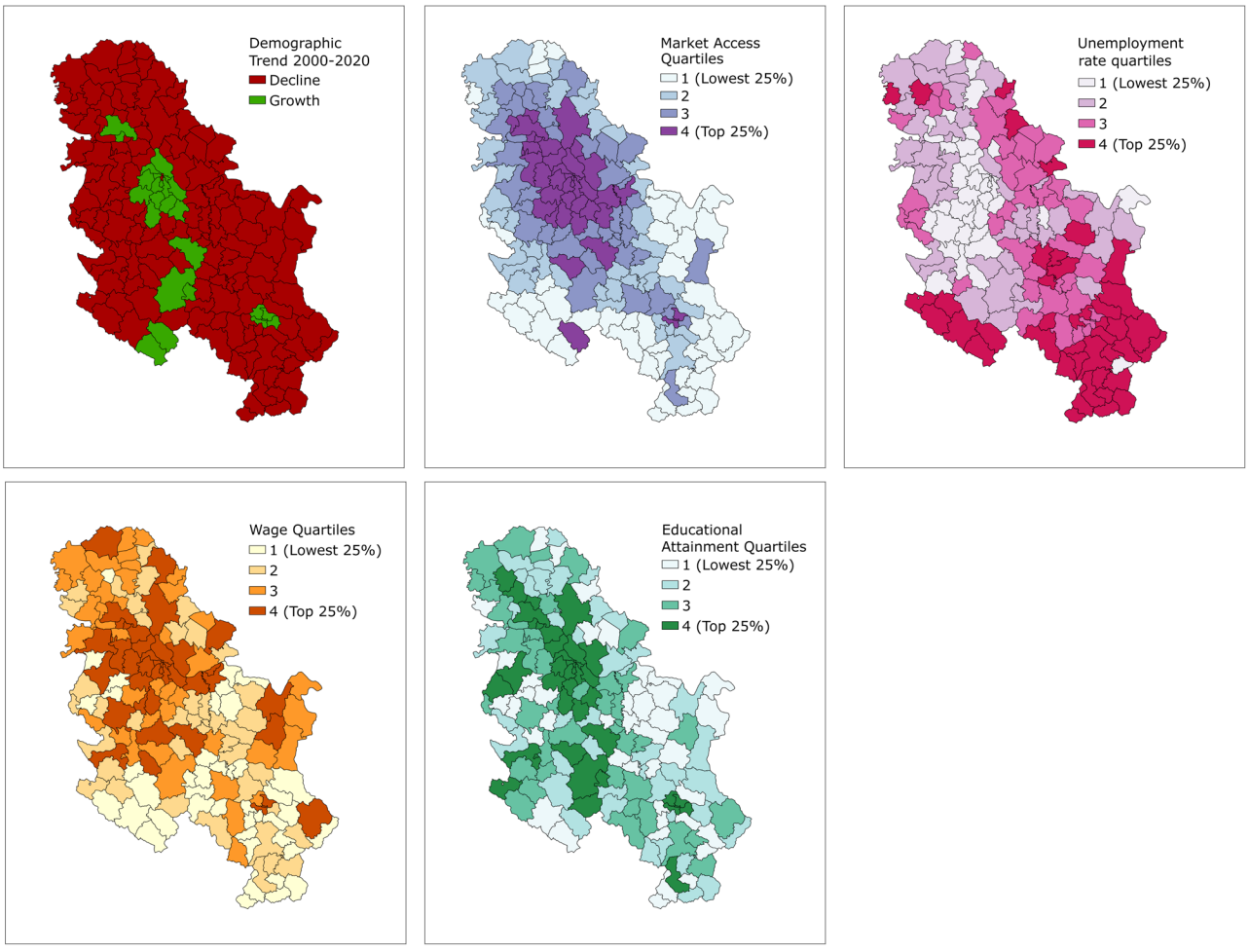
Sources: World Bank analysis 2023, SORS Census 2022, GHS-POP R2023A, OpenStreetMap 2023, JBA, CIMA, ELSUS v2.
Note: Includes socioeconomic vulnerability.

FIGURE C.2. Degree of urbanization of Serbian municipalities



Sources: World Bank analysis 2023, GHS-POP R2023A.
Note: Classification based on the European Commission's Degree of Urbanization methodology applied to the GHS 1 km² population grid. Cities are areas where more than 50 percent of the population lives in an urban center (contiguous areas with a minimum density of 1,500 inhabitants per km² and a minimum population of 50,000 inhabitants). Towns are areas that do not meet the city classification thresholds where more than 50 percent of the population lives in urban clusters (contiguous areas with a minimum density of 300 inhabitants per km² and a minimum population of 5,000 inhabitants).

FIGURE C.3. Determinants of socioeconomic vulnerability



Sources: World Bank analysis 2023; SORS Census 2022; GHS-POP R2023A; OpenStreetMap 2023.
Note: The figure shows the distribution of individual determinants of the average vulnerability measure in Table C.1. Market access is measured as the population potential using the routing distance in km from the centroid of the municipality to all urban areas (identified using the European Commission's definition of urban clusters) in 2020, restricted to only markets in the same country. The distribution of unemployment is based on the difference between the local unemployment rate and the average country level unemployment rate, computed separately for rural and urban areas to account for underlying differentials in unemployment due to rural-urban migration. Educational attainment refers to the share of the population with secondary education. Wage refers to average net earnings in RSD from the 2022 Census.

Annex D. Macro model, growth scenarios and detailed mitigation results

A structural macroeconomic model (MFMod) was used to model the impact of climate change on GDP and to assess its macroeconomic implications. It models key variables in the economy such as national accounts, the balance of payments, labor markets variables, and financial sectors. The model estimates the economic and behavioral determinants of economic variables. The relationships are consistent with economic theory and the observed dynamics of the economy. The model traces the interactions between climate change and economic activity. The model was used to explore the impact of global climate scenarios selected (RCPs 2.6, 4.5 and 8.5) on each WB6 economy and to simulate aggregate economic effects of mitigation and adaptation investments in each economy through to 2050.

The "Trend growth" and "optimistic growth" were two growth scenarios used to assess the impact of climate change on the Western Balkan economies. Trend growth is a business-as-usual scenario, extending historical policy trends into the projection horizon to 2050. Growth is driven by production factors that are close to historical realizations; they ensure continuity of labor supply, investment, and productivity over the forecast horizon. Population projections are taken from the UN and follow the notion that all countries in the region face a long-term population decline due to aging and outmigration. Optimistic growth is built on the assumption that the convergence rate with EU per capita income will double by 2050 (relative to trend growth) due to accelerated structural reforms and increased access to EU funds for countries in the Western Balkan region. Structural reforms would boost productivity, close governance and institutional gaps, improve market competition and support private sector participation, and such reforms can help address labor market challenges and improve investment outcomes for the region. In addition, the transition to a low-carbon economy may itself lead to higher productivity and potential growth in the long-run. Reform efforts can be further supported with pre-accession funds that are becoming increasingly available to support the aspirations of the Western Balkan countries to join the EU. Table D.1 shows assumptions for the trend and optimistic growth scenarios for all the WB6 economies.

TABLE D.1. Average annual GDP growth rates, 2025–50

	Albania	Bosnia and Herzegovina	Kosovo	Montenegro	North	Serbia	WB6
Trend growth	1.5	2.2	2.6	1.7	1.5	1.7	1.9
Optimistic growth	3.2	4.4	4.0	4.1	4.2	4.0	4

Source: World Bank analysis

The macroeconomic impact of climate change was assessed relative to a baseline. Each of the two growth scenarios was used to separately assess the impact of climate damages and adaptation investments, on the one hand, and mitigation efforts, on the other. For adaptation, the analysis looked at three specific damages, riverine floods, drought impact on maize and wheat production, and heat stress and its impact on GDP (and other macroeconomic variables) under the 3 RCPs, relative to historical occurrences of the damages. The historical occurrences comprised the baseline. The results in the report are presented as differences from the baseline.

For the macroeconomic impact of mitigation, the reference scenario (RS) was used as a baseline. For each growth scenario, a reference scenario (RS) level of energy demand was assessed, with commensurate levels of energy system investments. In addition, for the same level of energy demand, the net zero (NZE) scenario was developed, with commensurate levels of energy system investments, as output from the energy sector model. For each growth scenario, the incremental cost of the NZE scenario relative to the RS was assessed. Investment needs from the energy model were input into the macro model. The benefit of this approach is that it provides a comparison of the macroeconomic impact of the net zero transition for the same level of GDP (and energy demand) as the RS. The drawback of the approach is that it does not quantify higher order effects of a net zero transition, such as the development of new sectors or of additional exports, given the availability of the greener economy. Such higher order effects can be significant if they are accompanied by reforms that alleviate structural bottlenecks.

Analysis of the macroeconomic impact of mitigation found small impacts of the net zero scenario on GDP per capita. Table D.2 shows the differences in GDP per capita growth rates and the level of GDP per capita between the net zero and the RS for the six economies. Two findings are apparent. First, the differences between the two growth scenarios are small. Second, whether the impact is positive or negative for most countries depends on the year under consideration. The driver for the difference is largely the timing of the additional investments needed under the mitigation scenario and any need to replace existing capacity with new generation capacity. For the average growth rate of the WB6, one-half of the countries has a positive growth rate difference between the net zero and the RS for 2030 and 2040, although most have a negative difference in 2050. The levels of GDP per capita turn negative early in the projection horizon, but in most cases, the difference is less than one percent of GDP.

TABLE D.2. Real GDP per capita: differences between NZE and RS scenarios 2030, 2040 and 2050

Differences in growth rates (percentage points)						
	Trend growth			**Optimistic growth**		
	2030	**2040**	**2050**	**2030**	**2040**	**2050**
Serbia	-0.001	-0.003	-0.027	-0.004	0.057	-0.005
WB6 Avg.	-0.013	-0.057	-0.170	-0.011	-0.125	-0.176
Differences in levels (percent difference between NZE and RS)*						
	Trend growth			**Optimistic growth**		
	2030	**2040**	**2050**	**2030**	**2040**	**2050**
Serbia	0.223	0.103	-0.436	0.203	0.083	-0.397
WB6 Avg.	-0.189	-0.360	-0.535	-0.352	-0.583	-0.603

* The changes in the level of GDP per capita are equivalent to changes in the level of GDP or output as the population figure is the same in the NZE and RS scenarios; these terms are used interchangeably in the report when discussing the level impact of the transition.
Source: World Bank.

Annex E. Greenhouse gas competitiveness and CBAM impact

GHG competitiveness

This section looks at the GHG competitiveness of Serbia. Greenhouse gas, covering CO_2, CH_4, N_{20} and F-gas, categorizes emissions in three groups. Scope 1, scope 2, and scope 3. Essentially, scope 1 are those direct emissions that are owned or controlled by a company. Scope 1 emissions arise directly from owned or controlled sources, such as fuel combustion for onsite boilers and operation of company vehicles. On the other hand, scope 2 and 3 indirect emissions are a consequence of the activities of the company but occur from sources not owned or controlled by it. Scope 2 covers indirect emissions from the generation of purchased energy, heat, steam or cooling. For example, the emissions caused when generating the electricity that we use in our buildings would fall into this category. Scope 3 emissions encompasses all other indirect emissions that occur in a company's value chains. An example of this is when we buy, use and dispose of products from suppliers. Scope 3 emissions include all sources not within the scope 1 and 2 boundaries.

The largest export sector in Serbia records electrical equipment, the sector's GHG emission intensity is at the lower end compared to other sectors (Figure E.1). Serbia emits 1.2 KG of GHG per dollar of electrical equipment exports. And carbon emissions account for about 70 percent of GHG emissions intensity of the sector. The most GHG intensive sector and the second largest export sector is electricity, recording 8 KG/USD. The key reason of this high intensity is that 70 percent of electricity production in Serbia relies on low-quality lignite coal, while the rest is generated in hydropower plants.[162] In Serbia, carbon emissions play a greater role in intensifying GHG emissions from exports than non-CO_2 emissions in the main export sectors.

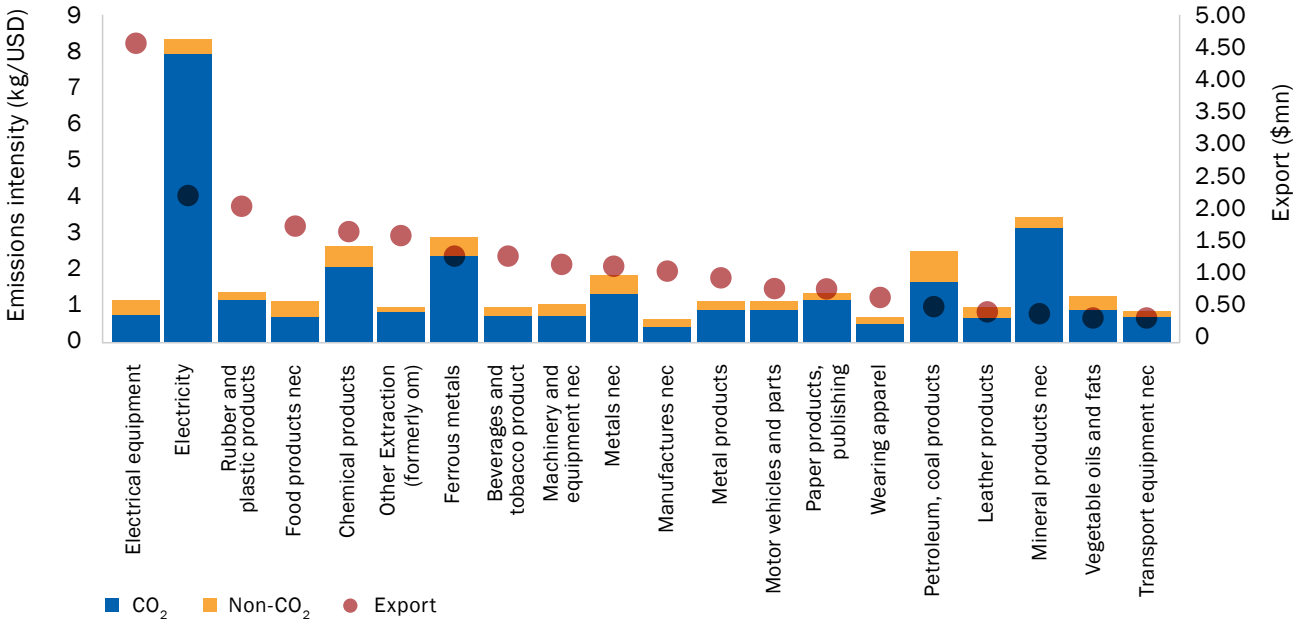
Serbia's carbon intensity in key export sectors largely consists of indirect emissions from energy generation (scope 2) and from suppliers' inputs (scope 3) (Figure E.2). With the exception of a few sectors, including electricity, indirect emissions play a major role in carbon emission intensity, suggesting that Serbia's exports rely on fossil fuels, while at the same time the country's export activities are deeply integrated into global value chains.

Meanwhile, Serbia's methane intensity in key export sectors is mainly attributed to indirect emissions from suppliers' value chains (Figure E.3). Among 20 export sectors, petroleum and coke products is most methane intensive, recording 0.8 KG/USD.

Serbia's carbon competitiveness is a lot weaker than global exporters' in Serbia's top 5 export sectors (Figure E.4). Serbia's leading exports is electrical equipment, which records 1.2 kg/USD. While China, the global exporter in electrical equipment, registers slightly lower intensity (1.1 kg/USD). The biggest difference between Serbia and global exporters can be seen in the electricity sector. Serbia is more carbon-intensive than Germany. This is due to the fact that Serbia generates most of its electricity from coal (70 percent) and hydropower (30 percent).

[162] CEE Bankwatch Network. 2022. "The energy sector in Serbia". https://bankwatch.org/beyond-fossil-fuels/the-energy-sector-in-serbia#:~:text=Serbia%2C%20with%20a%20population%20of,is%20generated%20in%20hydropower%20plants.

FIGURE E.1. GHG emissions intensity of exports in top 20 export sectors



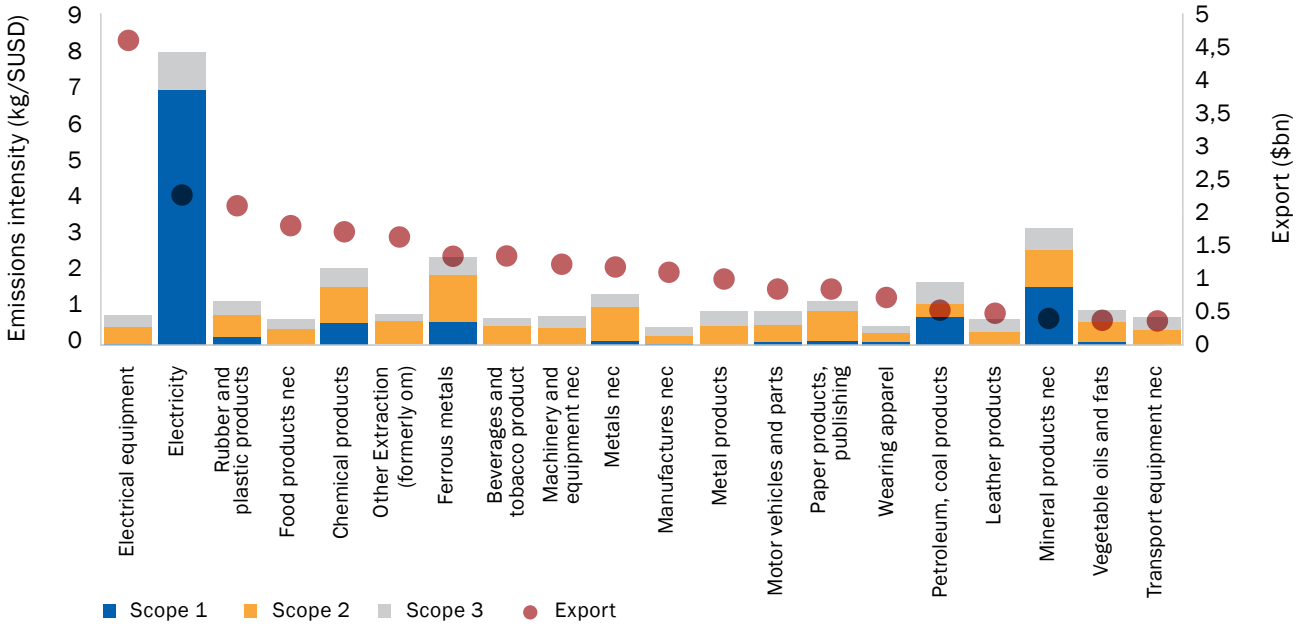
Sources:

Chepeliev, M., and Corong, E. 2022. "Revisiting the environmental bias of trade policies based on an environmentally extended GTAP MRIO Data Base." Center for Global Trade Analysis, Purdue University.

Chepeliev, M., Aguiar, A., Farole, T., Liverani, A., and van der Mensbrugghe, D. 2022. "EU Green Deal and Circular Economy Transition: Impacts and Interactions." Paper presented at the 25th Annual Conference on Global Economic Analysis (Virtual Conference). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6607

WITS mirror data. 2024. https://wits.worldbank.org/countryprofile/en/country/wld/year/ltst/summary

FIGURE E.2. Carbon emissions intensity of exports, by scope



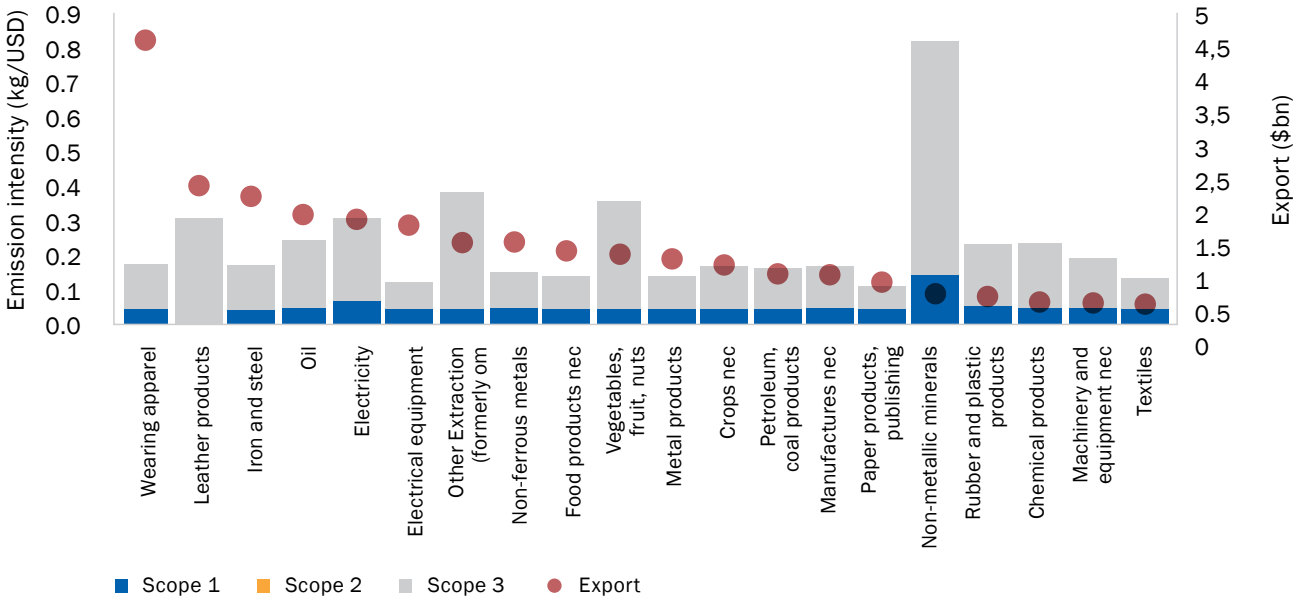
Sources:

Chepeliev, M., and Corong, E. 2022. "Revisiting the environmental bias of trade policies based on an environmentally extended GTAP MRIO Data Base." Center for Global Trade Analysis, Purdue University.

Chepeliev, M., Aguiar, A., Farole, T., Liverani, A., and van der Mensbrugghe, D. 2022. "EU Green Deal and Circular Economy Transition: Impacts and Interactions." Paper presented at the 25th Annual Conference on Global Economic Analysis (Virtual Conference). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6607

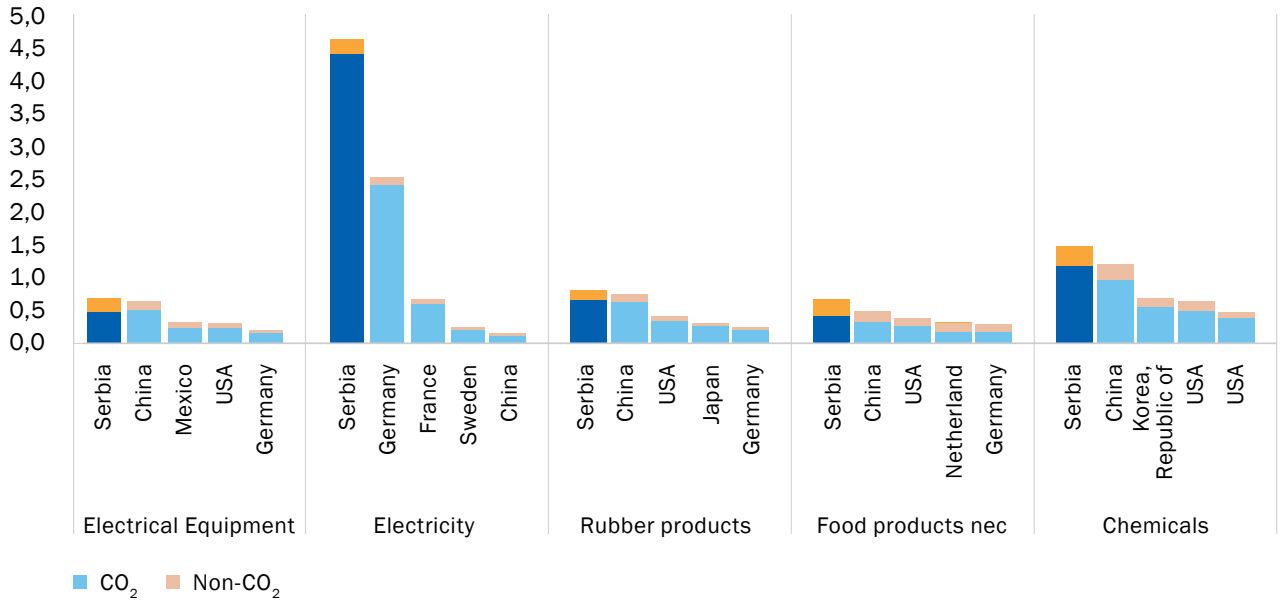
WITS mirror data. 2024. https://wits.worldbank.org/countryprofile/en/country/wld/year/ltst/summary

FIGURE E.3. Methane emissions intensity of exports, by scope



Sources:
Chepeliev, M., and Corong, E. 2022. "Revisiting the environmental bias of trade policies based on an environmentally extended GTAP MRIO Data Base." Center for Global Trade Analysis, Purdue University.
Chepeliev, M., Aguiar, A., Farole, T., Liverani, A., and van der Mensbrugghe, D. 2022. "EU Green Deal and Circular Economy Transition: Impacts and Interactions." Paper presented at the 25th Annual Conference on Global Economic Analysis (Virtual Conference). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6607
WITS mirror data. 2024. https://wits.worldbank.org/countryprofile/en/country/wld/year/ltst/summary

FIGURE E.4. Country comparison: greenhouse gas emission intensity of key export sector (kg/USD)



Sources:
Chepeliev, M., and Corong, E. 2022. "Revisiting the environmental bias of trade policies based on an environmentally extended GTAP MRIO Data Base." Center for Global Trade Analysis, Purdue University.
Chepeliev, M., Aguiar, A., Farole, T., Liverani, A., and van der Mensbrugghe, D. 2022. "EU Green Deal and Circular Economy Transition: Impacts and Interactions." Paper presented at the 25th Annual Conference on Global Economic Analysis (Virtual Conference). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6607
WITS mirror data. 2024. https://wits.worldbank.org/countryprofile/en/country/wld/year/ltst/summary

EU Carbon Border Adjustment Mechanism (CBAM)

The EU Carbon Border Adjustment Mechanism (CBAM) could have a significant impact on the competitiveness of developing countries that mainly export these goods to the EU. The CBAM will enter into force on January 1, 2026, after a transition period starting in October 2023. The CBAM covers iron and steel, aluminium, cement, fertilizer and electricity, and requires the purchase of CBAM certificates that report direct and indirect carbon emissions of these goods.

CBAM exposure index is measured by multiplying the export share by the embodied carbon payment per dollar of export to the EU (the exporter's emission intensity times USD 100 per ton carbon price). This index represents potential CBAM cost for exporters. The Relative CBAM Exposure Index[163] is designed to identify countries with the excess of carbon emissions to the EU average. It recognizes cost changes in the EU market, where EU producers also bear emissions costs, enabling relatively clean exporters to gain competitiveness despite the requirement to purchase certificates. A negative index indicates relatively clean exporters may gain competitiveness in the EU market. The aggregate relative index represents the trade-weighted relative exposure across all CBAM products. However, the GTAP dataset provides aggregate sectors with a different composition of products, as well as underlying emission intensities. Variation in product composition can affect the index more than differences in emission intensity of production processes at the product level. (e.g. fertilizer in chemical and cement in non-metallic minerals).

Serbia is identified as highly exposed to the EU CBAM. Serbia's electricity stands out high exposure to the CBAM in both absolute and relative term (Figure E.5). This is due to country's high carbon emissions intensity and high trade exposure in electricity (Table E.1). Also, its energy generation is sourced by fossil fuels, particularly coal. As Figure E.6 shows, Serbia's Scope 2 emissions intensity is very high in four sectors, with the exception of electricity. CBAM covers Scope 1 emissions in the iron and steel and aluminum sectors, so Serbia can avoid a large cost increase in complying with CBAM. However, there is an urgent need for Serbia to decarbonize its export sectors to reduce the negative impact of CBAM.

FIGURE E.5. Serbia's CBAM exposure Index

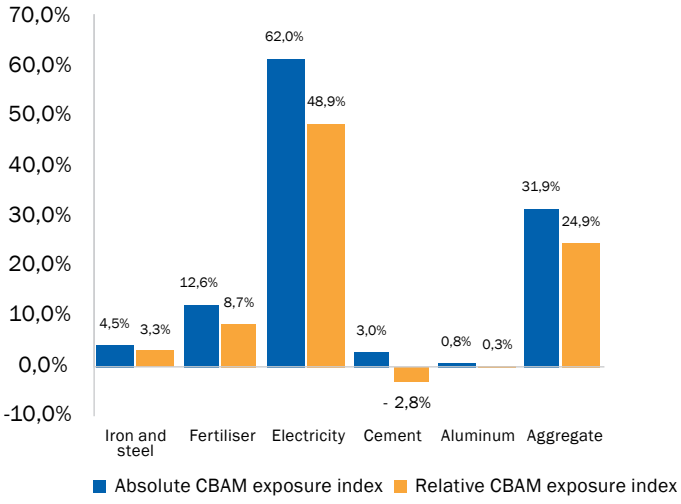
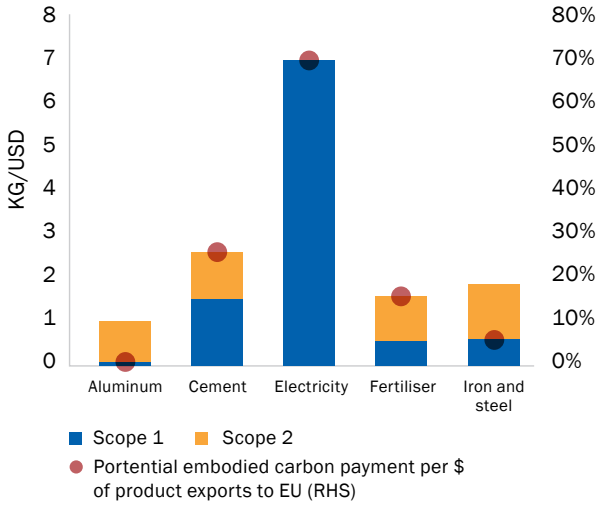


FIGURE E.6. Serbia's carbon emissions intensity



Sources:

Chepeliev, M., and Corong, E. 2022. "Revisiting the environmental bias of trade policies based on an environmentally extended GTAP MRIO Data Base." Center for Global Trade Analysis, Purdue University.

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NOTE: emissions intensity of EU average is based on GTAP 10 database and 2019 export data while emissions intensity of Serbia is based on GTAP 11 database and 2022 export data.

[163] Detailed methodology is found here: https://www.worldbank.org/en/topic/trade/brief/technical-note-for-the-cbam-exposure-index

TABLE E.1. Carbon emissions intensity and exports of CBAM products to EU in Serbia

	Carbon emissions intensity (kg/USD)	Exports to EU ($mn)	Exports to EU (% of product exports to world)
Aluminum	0.097	376.2	81%
Cement	2.567	1.7	12%
Electricity	6.952	2,017.7	89%
Fertilizer	1.595	225.8	79%
Iron and steel	0.617	1,268.9	73%
CBAM	n/a	3,890.2	81%

Note: N/a: not applicable.

Sources:

Chepeliev, M., and Corong, E. 2022. "Revisiting the environmental bias of trade policies based on an environmentally extended GTAP MRIO Data Base." Center for Global Trade Analysis, Purdue University.

Chepeliev, M., Aguiar, A., Farole, T., Liverani, A., and van der Mensbrugghe, D. 2022. "EU Green Deal and Circular Economy Transition: Impacts and Interactions." Paper presented at the 25th Annual Conference on Global Economic Analysis (Virtual Conference). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6607

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