BULGARIA'S CLIMATE MITIGATION GOALS, CHALLENGES, AND POLICY OPTIONS[1]

A. Introduction

1. Climate change is a macro-significant challenge. Emerging studies suggest that unmitigated global warming could have significant adverse impacts on capital stock, productivity, and human mortality over the long term.[2] Mitigating greenhouse gas (GHG) emissions could potentially reduce these economic costs significantly.

2. Decarbonization efforts will enhance the welfare of Bulgarian and increase energy security. Despite progress, Bulgaria still suffers from the highest GHG emissions intensity per GDP in the EU. Its continued decarbonization efforts are needed to foster a more sustainable growth and contribute to global goals of reducing GHG emissions. Implementing well-designed mitigation policies could also provide a welcome support to the recovery from the pandemic crisis, which is facing strong headwinds because of the spillovers from the war in Ukraine. The war and the ensuing decision by Gazprom to suspend gas delivery to Bulgaria have also made ensuring energy security an immediate priority, an objective that accelerating green transition will help achieve.

3. Bulgaria's climate mitigation strategy, emission targets and implementation framework have been guided by EU's commitment to the Paris agreement. In 2015, the EU committed to reducing greenhouse gas (GHG) emissions by 40 percent by 2030 compared to 1990 as its Nationally Determined Contributions (NDC) under the Paris agreement. The EU's policy framework operationalizes this commitment through two instruments: the European Union's Emissions Trading System (ETS) for energy and industry sectors; and the Effort Sharing Agreement/Regulation (ESR) that sets targets for GHG emissions reduction for non-ETS sectors for member states. Under the latter regulation, Bulgaria is committed to no increase in GHG emissions in non-ETS sectors by 2030 compared to 2005.[3]

4. Furthermore, Bulgaria is committed to contributing to the more ambitious goals set at the EU level since the Paris agreement. In December 2020, the EU submitted its updated and enhanced NDC that aims at reducing emissions by at least 55 percent by 2030 in order to make the EU carbon neutral by 2050 (European Green Deal).[4] In July 2021, the European Commission (EC)

[1] Prepared by Hajime Takizawa and Iglika Vassileva.

[2] See Feyen et al. (2020) for assessment of the impact of unmitigated global warming without adaptation and benefits of mitigating GHG emissions for the EU.

[3] Annual monitoring of the GHG levels in Bulgaria is available in the National GHG Emission Inventory Reports on the website of the Bulgarian Environmental Executive Agency. Up-to-date information on Bulgaria can be also found at the website of European Climate Adaptation Platform Climate-ADAPT.

[4] See the European Commission's website, A European Green Deal.

unveiled its policy proposals to meet the 55 percent emissions reduction target (EU Fit for 55).[5] The Bulgarian government subsequently declared in the Glasgow Climate Change Summit in November 2021 that it was committed to fulfilling its role in achieving these European goals. Details of policies under EU Fit for 55 are still subject to discussion and need to be legislated by European Parliament before taking effect.[6]

5. The EC's REPowerEU plan, unveiled in May 2022, aims to ensure energy security and reaffirms EU's commitment to green transition. The plan aims to reduce Russian energy import dependency and achieve full independence before 2030. In addition to diversifying energy supply and improving connectivity within Europe, the plan seeks to reduce gas and oil consumption by 5 percent through a public awareness campaign. Importantly, it increases the EU's target for renewable energy generation from 40 to 45 percent of total energy production by 2030. This would also offset the impact of the decision by many member states—including Bulgaria— to use more coal in the near-term to adjust to spillovers from the war in Ukraine. With this higher target for renewables and regulatory measures to improve the energy efficiency of buildings and enhance product sustainability, GHG emissions target in 2030 remains unchanged relative to Fit for 55. The report includes measures to promote additional solar, green hydrogen and biomethane gas.

6. The Recovery and Resilience Plan (2022, RRP) is providing a fresh impetus to Bulgaria's climate mitigation efforts. Bulgaria heavily depends on local lignite coal in producing electricity, which significantly contributes to Bulgaria's high GHG emissions intensity. While the environmental benefits of phasing out coal are clear, a wide range of policies and investments are needed to manage an orderly transition in Bulgaria's energy mix and to mitigate its socio-economic impact on regions economically dependent on coal mining, coal-fired thermal power plants (TPPs), and related industries. Bulgaria's RRP spells out plans to reduce the use of coal-fired TPPs and suggests an indicative deadline of 2038 to complete the transition away from coal.

7. This paper reviews recent GHG emission trends, summarizes the authorities' emission reduction targets and plans, and discusses policy options to achieve them. Section B benchmarks Bulgaria against the EU-27 average for GHG emissions. Section C reviews the authorities' GHG emissions reduction targets, strategy, and plan. Section D assesses the authorities' strategy and plan and discusses supplementary policy options. Section E provides conclusions.

B. Recent GHG Emissions Trends

8. Bulgaria made progress in reducing GHG emissions. Emissions per-capita declined by 28 percent between 1990 and 2019, close to the degree of emissions reduction in EU-27 (32 percent on average, Figure 1). Bulgaria's emissions level remains 15th in the EU in per capita terms. The electricity and heating sector, which is covered by EU ETS, contributed most to the decline (Figure 2). Factors behind the decline include: changes in economic structure (shrinking share of the energy

[5] See the European Commission's press release on European Green Deal.

[6] European Council provides up-to-date information on EU Fit for 55 on its website.

intensive sectors); declining share of energy produced in coal-fired TPPs and increasing shares of hydro and nuclear power; efficiency gains (e.g., through energy efficiency measures in the residential sector); and gradual shift from solid and liquid fuels to natural gas in energy consumption. The share of renewable energy sources (RES) in the electricity and heating sector has steadily increased (Figure 3).[7] In contrast, emissions from transport sector, which is not covered by the ETS, have been increasing steadily (Figure 4), with car transport emissions recording the fourth highest growth rate in the EU from 1995 to 2017 and freight transport emissions registering the second highest growth rate over the same period (IMF, 2020b). Rising distance traveled has more than offset a decline in emissions per distance traveled.

Figure 1. Bulgaria and EU-27: GHG Emissions Per Capita, 2019

(In tons of CO2 equivalent)

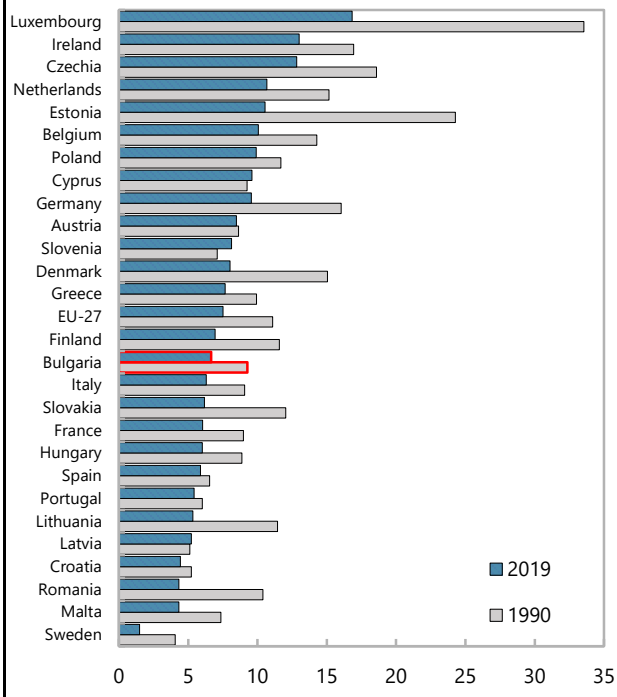
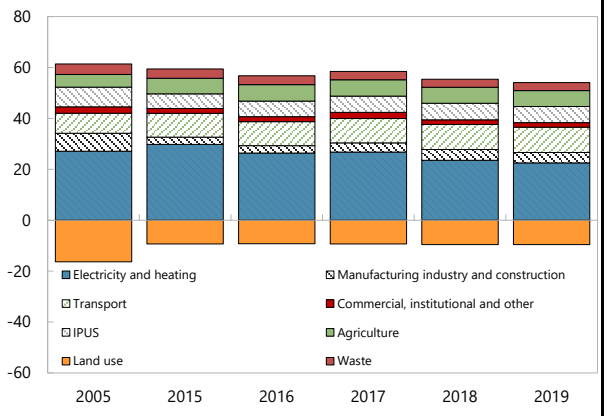


Figure 2. Bulgaria: GHG Emissions by Economic Sectors, 2005–19

(In megatons of CO2 eq per year)

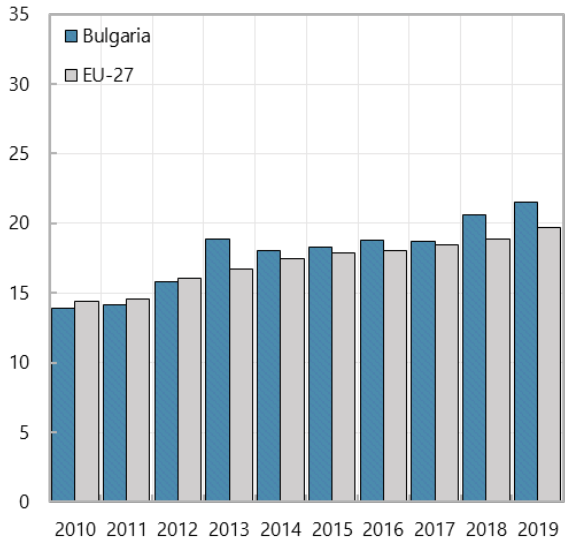


Sources: European Energy Agency (EAA); and Fund staff calculations.

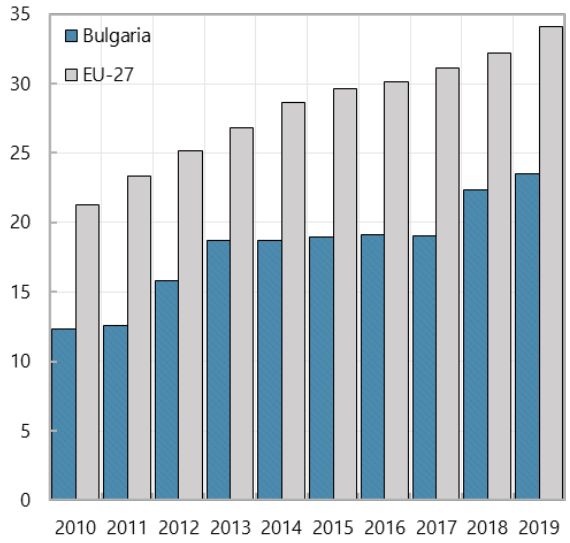
[7] The share of the renewable energy in total gross final energy consumption in Bulgaria (20.6 percent) is higher than the EU average (18.9 percent), as RES is much more widely used in heating and cooling in Bulgaria. Fiscal incentives were catalyst for the increase in electricity production from RES.

Figure 3. Bulgaria: Share of Renewable Energy in Gross Final Energy Consumption, 2010–19
(Percent)

Renewable Energy Sources, Total Economy

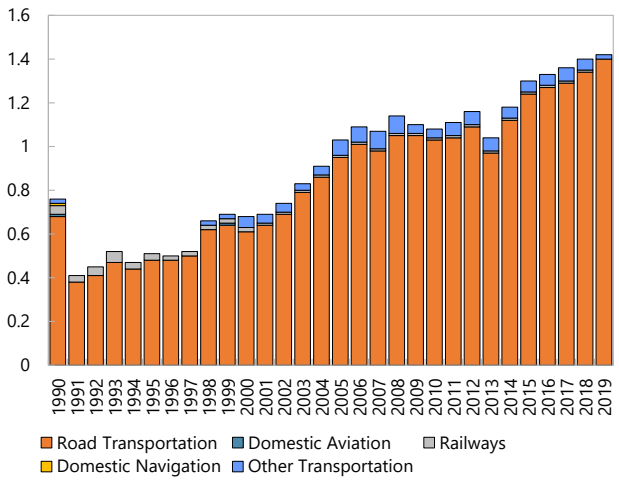


RES in Electricity



Sources: Eurostat.

Figure 4. Bulgaria: GHG Emissions in Transport, 1990–2019
(In tons of CO2 equivalent)



Sources: EEA.

9. However, Bulgaria still suffers from the highest GHG emissions *intensity* in EU, reflecting its economic structure and high within-sector energy intensity (Figure 5). The intensity of GHG emissions in the production of electricity and heating, transport, and oil refinery is significantly higher than the EU-27 average (Figure 6). In addition, Bulgaria's economic structure itself is skewed toward these energy-intensive sectors (Figure 7). Their share in the gross value added in 2019 stood at around 14 percent compared to 11 percent for the EU-27.[8]

Figure 5. Bulgaria: GHG Emissions per GDP, 2019

(In tons of CO2 equivalent/million euros)

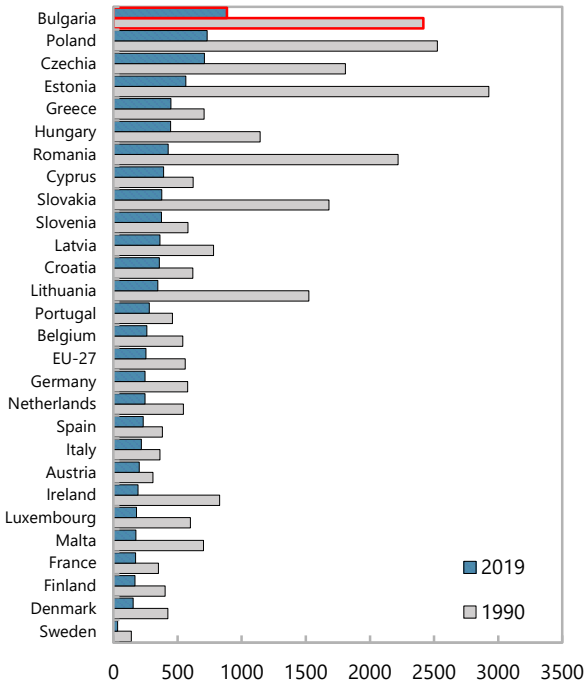
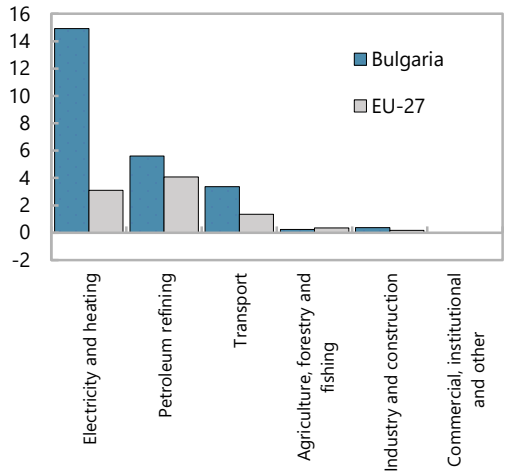


Figure 6. Bulgaria and EU-27: GHG Emission Intensity per Gross Value Added by Economic Sectors, 2019

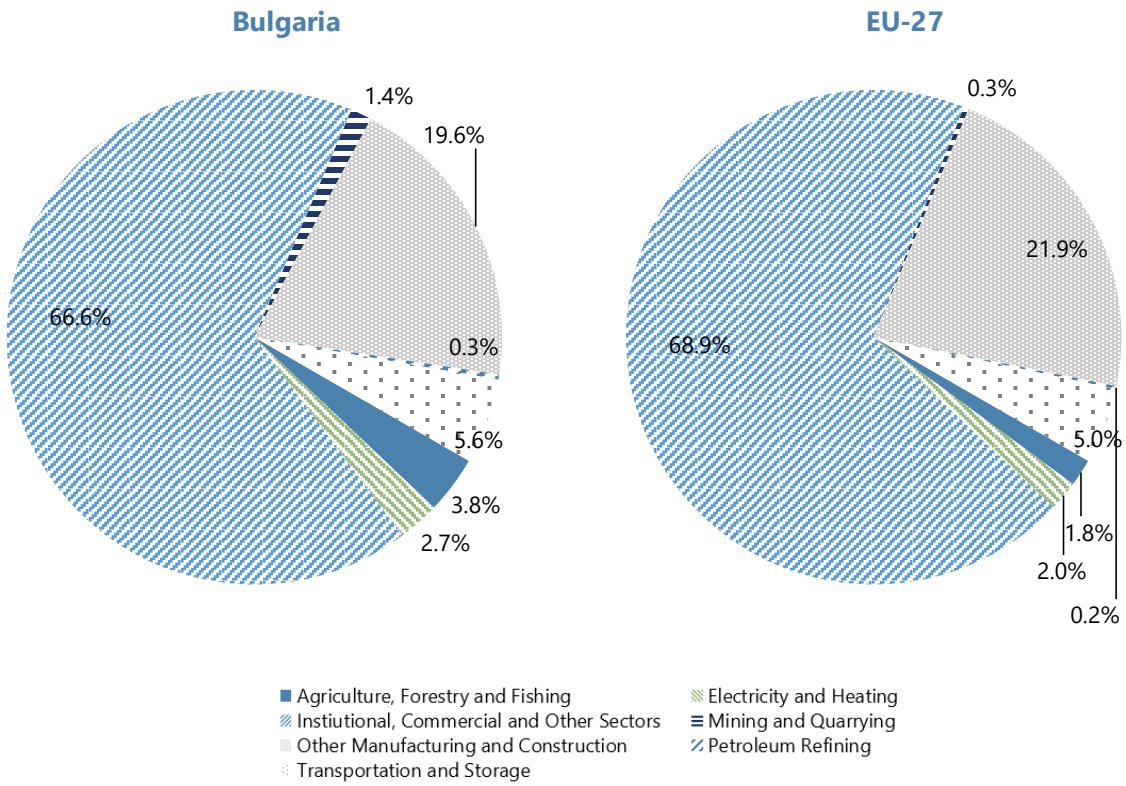
(In kilotons of CO2 equivalent/million euros)



Sources: European Energy Agency (EAA); Eurostat; and Fund staff calculations.

[8] Shares are calculated for the following sectors: mining and quarrying, selected manufacturing (paper and paper products, chemicals and chemical products, rubber and plastic products and other non-metallic mineral products, basic metals, and electricity, gas, steam and air conditioning supply) and transportation. The share of chemical and chemical products for the EU-27 is not available for 2015 and subsequent years and is assumed to have remained the same since 2014.

Figure 7. Bulgaria and EU 27: Gross Value Added (GVA) by Sectors, 2019
(In percent share of current prices GVA)

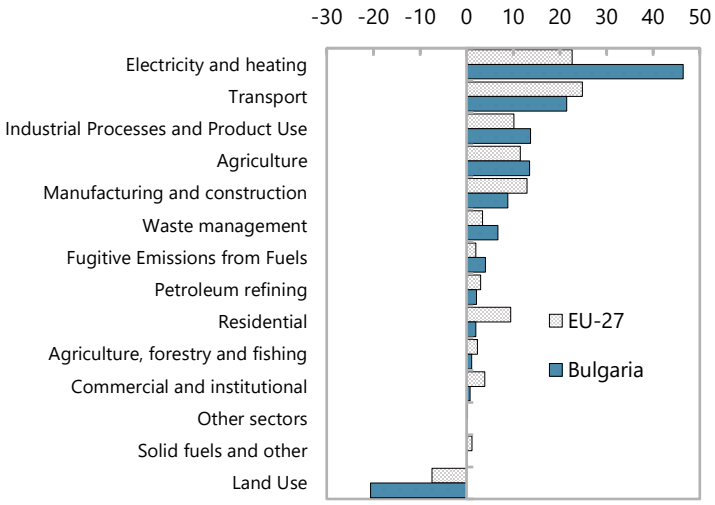


Sources: Eurostat; and Fund staff calculations.

10. Electricity, heating and transport contribute most to GHG emissions (Figure 8). This partly reflects geographical and legacy issues. Bulgaria remains saddled with inefficient brown assets in electricity and heating as well as other sectors. Coal is abundant locally and has been used for electricity generation for decades. Indeed, coal-fired TPPs account for the bulk of the GHG emission in electricity generation as its share in electricity production (in ton of oil equivalent) is more than twice the EU average (Figure 9). Bulgaria is also saddled with low efficiency housing stock, and the average age of its motor vehicle stock is old.

11. In sum, Bulgaria faces three main challenges. GHG emissions trends indicate that three factors contribute the most to Bulgaria's high emissions: (i) the heavy reliance on coal for energy source; (ii) an economic structure skewed toward energy-intensive sectors; and (iii) within-sector energy efficiency, measured by carbon intensity per value added, which is higher than the EU average.

Figure 8. Bulgaria and EU-27: Share of Economic Sectors in Total GHG Emission, 2019[1]

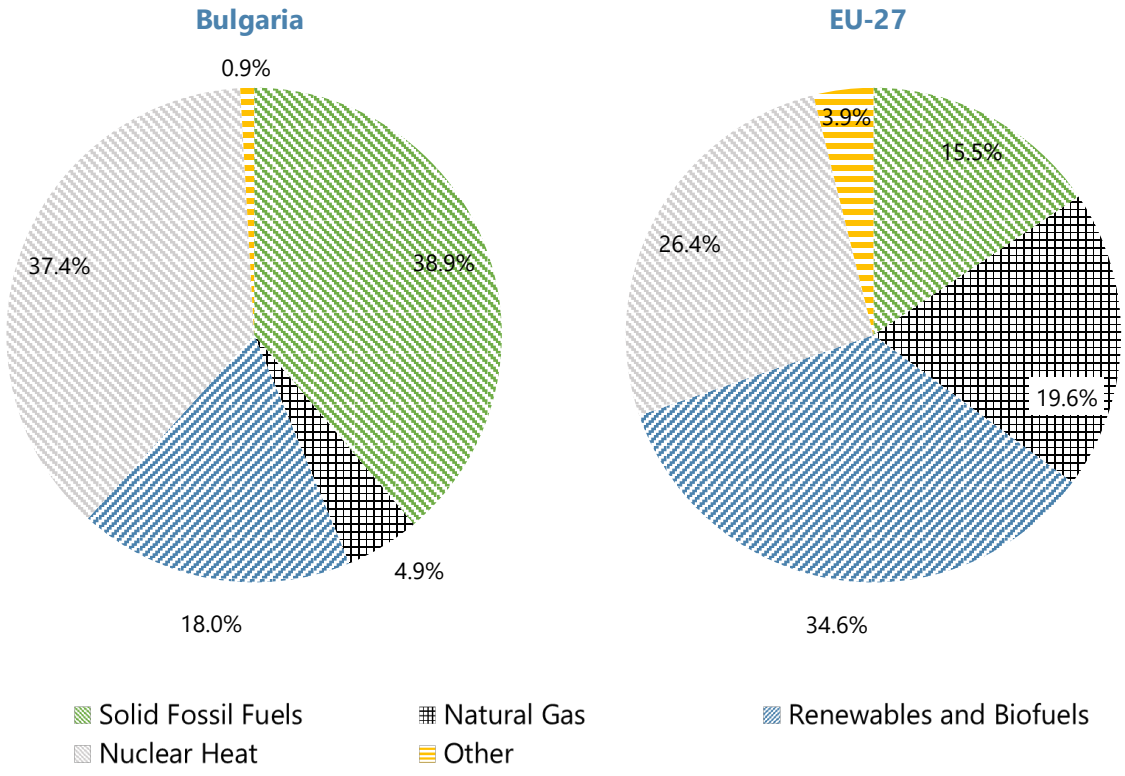


Sources: EEA; and Fund staff calculations.

[1] The energy sector represents the combustion of fuels and fugitive emissions and includes the following sectors: electricity and heating, petroleum refining, manufacturing and construction, transport, commercial and institutional, residential, and solid fuels.

Figure 9. Bulgaria and EU 27: Electricity Production by Sources of Energy, 2019

(In percent, based on kiloton of oil equivalent)



Sources: Eurostat; and Fund staff calculations.

C. Authorities' Decarbonization Strategy

12. Bulgaria ambitions to significantly reduce GHG emissions. Bulgaria's climate mitigation strategy and targets were previously discussed in the Integrated National Energy and Climate Plan 2020–30 (INECP, 2020a, Box 1) and Strategy for Sustainable Energy Development in Bulgaria until 2030 with a Horizon up to 2050 (Strategy, 2020b). The EU subsequently adopted more ambitious targets than the one underpinning the INECP and Strategy. The government committed in November 2021 to fulfilling its role in achieving the EU's targets for reducing GHG emissions by 55 percent by 2030 and achieving net carbon neutrality by 2050. More recently, the government laid out concrete policy measures aimed at reducing GHG emissions in the RRP, which will be supported by substantial EU grants. With the recent REPowerEU plan and Bulgaria's immediate priority to guarantee its own energy security, the authorities' concrete plans are likely to evolve further.

13. Bulgaria's decarbonization strategy focuses on three areas. It comprises changing the energy supply mix, increasing energy efficiency of buildings, and reducing the carbon intensity of the transport sector over the medium-term. Some key policies in turn are discussed in detail along with policy measures in sectoral plans and strategies. Policies are also being prepared and adjusted, including to reflect evolving EU policies such as the EC's approval in principle in February 2022 to change the EU taxonomy to classify nuclear and gas as green energy. Some aspects, including regarding the possible construction of new nuclear capacities and how coal-fired power will be decommissioned over time, remain to be further specified.[9]

14. Furthermore, carbon pricing is implemented through the EU ETS mechanism. The EU introduced 'cap and trade'-based Emission Trading System (ETS) in 2005, creating a market mechanism to provide incentive to reduce emissions in the most cost-effective manner. It covers large companies in, energy, energy-intensive industries and civil aviation (flights within the European Economic Area) and is one of EU's main tools to reduce emissions. The carbon price in the EU has been continuously, and more recently rapidly rising, reaching above EUR80 per ton in May 2022 (Figure 10).

15. The RRP lays out many concrete measures to support the strategy. Some of these measures complement the INECP where specificities were needed. Other measures override previous ones in the INECP and imply greater GHG emissions reduction. Overall, the RRP broadly keeps the principles of Bulgaria's decarbonization strategy intact and aims at reducing dependence on coal use, investing in RES, promoting the renovation of older buildings, and investing in green transport system and railway (Box 2). A large portion of the funds is to be used for investment in RES and electricity storage facilities and to incentivize investment in energy efficiency of buildings. The RRP targets an increase in the share of renewables in gross final energy consumption to 26 percent in 2024 (from 21.6 percent in 2019) and a 10 percent cumulative decline in both the energy and the carbon intensities of the Bulgarian economy during 2021-24. It also commits Bulgaria to a binding target of a decline in GHG emissions from electricity production by 40 percent by 2025 from its 2019 level (to be verified in 2026).

[9] The government is considering an investment in new nuclear reactors that could start service in 2028-30.

Figure 10. Bulgaria and EU-27: ETS Prices, 2008–2022

(Euro per ton)

Sources: Bloomberg Finance L.P., Haver, and IMF staff calculations.

Box 1. Bulgaria: Integrated National Energy and Climate Plan (INECP), 2020–30

As other EU member states, Bulgaria prepared the INECP in 2019 to outline its climate mitigation targets and policies through 2030. The main strategies on the supply side of the energy include: reducing the use of coal as energy source; expanding nuclear capacities; and increasing investment in and use of RES energy (solar, geothermal and biofuels); and increasing the use of natural gas. The demand-side strategy focuses on improving energy efficiency of buildings and promoting low/no carbon transportation mode (public transport, electric vehicles). Key targets for 2030 include (i) no net increase in GHG emissions in non-ETS sectors compared to 2005, in line with the EU Effort Share Regulation on binding annual GHG emission reductions, (ii) a national target for the share of renewable energy in gross final energy consumption of 27.1 percent; and (iii) specific targets for energy efficiency. It discusses the authorities' existing and planned sectoral policies and programs to facilitate progress toward the targets (e.g., an existing program to support building renovations for energy efficiencies, financed by a regular EU program).

The INECP presents GHG emissions projections through 2030 under two different assumptions. One projection is based on (only) existing policies and measures including at the EU level, while the other reflects additional planned policies and measures. EU member states, including Bulgaria, are required to update report these projections periodically. However, neither projection in the latest submission reflects more recent developments, including measures in Bulgaria's RRP, updated plans on nuclear facilities, and most recent developments of EU-level policies including Fit for 55 and REPowerEU.

16. Policies to help achieve long-term carbon reduction continue being developed. The RRP envisages establishing an Energy Transition Commission and developing a roadmap to climate neutrality. The RRP also commits to phasing out coal-fired TPPs by 2038 at the latest. Specific

mechanisms to achieve this commitment are to be developed by the Energy Transition Commission. The indicative timeline for coal phase-out is more ambitious than previously envisaged in the INECP.

17. Bulgaria has access to multiple sources of funding to help finance the large investment needs required to fulfil its decarbonization plan. The INECP estimated investment needs to EUR 42.7 billion over 2021-30, equivalent to about two thirds of Bulgaria's 2021 GDP. Almost three quarters of this amount was for energy efficiency of household buildings (EUR 11.8 billion), construction of additional nuclear capacity (EUR 10 billion) and transport (EUR 9 billion). Green transition investments in the RRP (EUR 3.7 billion) fills a part of these needs. The policy measures envisaged in the INECP are eligible for external financing from multiple sources, including the EU Multiannual Financing Framework for 2021-27, Invest EU, Modernization Fund, EEA grants and EIB financing, and the EU's Resilience and Recover Facility which supports the RRP. National public and private financing are also expected. Translating envisioned policies into more specific measures are key to ensuring the effectiveness of the spending and avoid unnecessary costs.

Box 2. Bulgaria: Green Transition Measures in Bulgaria's Recovery and Resilience Plan

Bulgaria's RRP aims at accelerating the use of RES and hydrogen, improving energy efficiency, and promoting sustainable mobility. To this end, a large portion of RRF resources is allocated to green transition investments. Key measures and investments include:

Bulgaria. Green Transition Investments in RRP—Share in Total RRP Resources (Percent)

Rehabilitation of residential, non-residential buildings	16.4
Infrastructure for storage of electricity from RES (baterries)	11.6
Construction of a minimum of 1.4GW RES and batteries	4.9
Financing for renewable energy projects and green solutions for households and SMEs	4.9
Purchase of new railway rolling stock	4.5
Development of geothermal energy sources	2.5
Extension of Sofia metro	1.4
Other	7.4
Total	53.7

Sources: Bulgaria's RRP; and IMF staff calculations.

I. **Reduction of GHGs from the power sector**. A cap on CO2 emissions from coal-fired TPPs will be applicable beginning 2026, while a clear mechanism for phasing out coal-fired TPPs by 2038 at the latest will be developed. Some of coal-fired power plants with poor environmental records will be closed. The country's three largest TPPs will continue functioning in the near term. One state-owned TPP will be preserved until 2038 at the latest to ensure energy security but will be used only to cover seasonal peak demand. Other two privately-owned TPPs, which are under contracts with a state-owned electricity company to balance the regulated electricity market in favorable terms, will see the contracts expire in 2024 and 2026, respectively.[1] They will be subjected to market competition and will be required to achieve specific carbon-emissions targets.

II. **Installation of electricity storage facilities**. Batteries to store electricity from RES (with a total energy capacity of 6GWh, will be installed across the country. The facilities are to be operational by mid-2026.

III. **Increase in production and use of RES**. Grants to support the installation of 1.4GW RES by end-2025 will be provided. One third of investment costs will be financed from RRF and the remainder is expected to come from private sources.

IV. **Exploring geothermal energy**. Exploratory drilling will be conducted and a pilot plant for geothermal energy use constructed.

Box 2. Bulgaria: Green Transition Measures in Bulgaria's Recovery and Resilience Plan (Concluded)

V. **Improvement in energy efficiency in the transport sector**. Exiting infrastructure will be repaid/upgraded; urban and railway transport will be developed; deployment of electric and hybrid cars will be promoted through tax incentives; bans on imports of high-emission vehicles will be introduced.

VI. **Renovations of residential and non-residential buildings**. Funding for renovation to improve energy efficiency will be provided to augment an existing EU-financed program.

VII. **Promoting green hydrogen technology**. A national roadmap for development of hydrogen technologies will be developed and a scheme to support pilot projects for production of green hydrogen and biogas will be put in place.

The RRP also lays out reforms to complement green investments.

- **Electricity market liberalization**. The authorities to liberalize the retail market by 2025 (see Box 3). Integration of the Bulgarian market with other Balkan markets will be pursued. Criteria for "energy poverty" will be developed to inform retail market liberalization.
- **Reduction of administrative burden**. Procedures for RES electricity producers to do transactions with consumers will be simplified. Administrative burden will be reduced for businesses and households to undertake renovation projects.
- **Smart grid**. Systems and processes of the grid operator will be upgraded to better integrate RES facilities.
- **Just transition**. Establish a state-owned enterprise for Conversion of Coal Region (CCR) to acquire assets of coal mining and energy companies and carry out reclamation activities. Prepare sites for new economic activities in the coal dependent region. CCR to hire workers from mining industry. The project will be financed by the Just Transition Fund.

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[1] The two coal-fired TPPs account for about 40 percent of Bulgaria's installed coal capacity. Electricity producers of certain capacity are required to sell the electricity on the electricity exchange market. However, part of Bulgaria's energy market remains un-liberalized and these two coal-fired TPPs have long-term electricity purchase contracts with the state-owned electricity company in preferential terms to meet the needs of the regulated market. The commitment to not extending the expiring contracts is in line with the EU regulation that prohibits payments to legacy generation capacity emitting more than certain amount of CO_2 of fossil fuel origin under capacity service, beginning July 2025. While coal-fired TPPs can still sell electricity on the electricity exchange, rising prices of carbon emissions imply that they will likely not be economically viable (See TRACER, 2021). In May 2022, one of the two plants was ordered to shut for violation of air quality standards for an unspecified period. Furthermore, the European Court of Justice ruled in May 2022 against Bulgaria for systemic pollution with sulfur dioxide from coal plants, including these two plants. Remedial actions are now required.

Box 3. Bulgaria: Retail Electricity Market

Part of Bulgaria's electricity markets remains mainly under government control. The state-owned electricity company (NEC) is the monopoly buyer of electricity for the retail market. Retail electricity prices for households are regulated and have been kept at low levels. NEC purchases electricity to meet the needs of the regulated market from state-owned nuclear and coal-fired TPPs and from two large privately-owned coal-fired TPPs at guaranteed prices and some power plants that have to sell certain quantities to NEC as required by the national regulatory authority to balance the market. The NEC often faces an operating deficit, as it cannot always fully pass its costs to consumers which results in implicit fiscal subsidies. It made losses for several years until 2020.

D. Policy Options

18. Multiple policy tools are available to address Bulgaria's main climate mitigation challenges. Rising prices of CO2 emissions weigh on the economic viability of coal-fired TPPs and free allowances to the manufacturing sector are being phased out fast. A recent spike of prices of hydrocarbon resources is a reminder that decarbonizing economy could bring long-term economic benefits. Phasing out coal will also bring better health outcome and could reduce fiscal costs in the long run as accompanying retail electricity market deregulation should help reduce implicit subsidies (Box 3). Substantial investment is needed to reduce reliance on coal and to increase efficiency in transport and buildings. In addition, greater use of price-based policy measures and adjusting incentives through regulation and fiscal instruments could complement the effort to lower coal dependence and energy intensity of the economy in less distortionary ways. However, implementing such measures will likely pose transitional challenges. Phasing out coal use will have an adverse socio-economic impact on regions dependent on coal mining and coal-fired power plants, while the liberalization of retail electricity market will have a distributional impact.

19. The authorities' plan, if fully implemented, could make a meaningful contribution to Bulgaria's GHG emissions reductions. GHG emissions in Bulgaria have declined in recent years to levels that are well below the updated projections of INECP 2020–30 (Figure),[10] led by the electricity and heating sectors as the share of RES in these sectors has steadily increased (Section B). Staff's simulation based on IMF's Carbon Price Assessment Tool (CPAT) suggests that the declining trend of emissions could continue in the near term even if no measures are taken (business as usual scenario), reflecting the recent sharp rise in energy prices and carbon prices in the EU ETS (Figure 11). However, if no measures are taken, GHG emissions are projected to start rising again once energy prices begin tapering reflecting projected economic growth, even if the current elevated price level of carbon emission rights in EU ETS is maintained going forward.[11] The authorities'

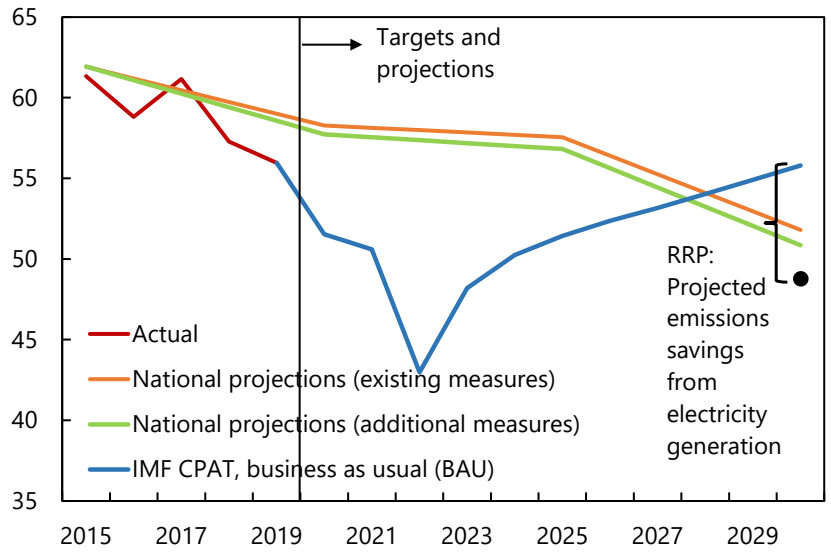
[10] EU member states' 2021 updated projections of GHG emissions available at European Environment Agency's website.

[11] The CPAT is designed to help quantify the emissions, fiscal, and economic welfare impacts of carbon pricing and other carbon mitigation policies. The calculation assumes EUR75 per ton in 2022, close to the current prevailing price, and no changes in real terms in subsequent years. See IMF (2019b) for details.

investment policies aim at increasing alternative energy sources to substitute for coal in electricity production as well as slowing the pace of increase in demand for energy. If the measures in the RRP are implemented and the targeted 40 percent reduction of GHG emissions in the electricity sector compared to its 2019 level by 2025 is achieved, the reduction will translate into a 15 percent reduction of GHG emissions compared with the IMF staff's business as usual scenario.[12]

20. The planned retail electricity market liberalization could further reduce GHG emissions through strengthened price signals. Rising carbon prices and EU regulation will likely render the current retail electricity system increasingly difficult to sustain. The current retail market structure also prevents carbon prices from being reflected in electricity prices. The authorities' plan to liberalize the retail market is conducive to decarbonation efforts as it would allow carbon prices that are embedded in ETS to be transmitted to retail consumers, which in turn would strengthen incentives for reducing carbon emissions in an efficient manner.[13] It would also reduce implicit fiscal costs and encourage less carbon intensive electricity generation. However, it would exacerbate the problem of energy affordability facing vulnerable households, if not accompanied by mitigating measures (see below).

Figure 11. Bulgaria: GHG Emissions Projections, 2020–30
(Megatons of CO2 eq per year)



Sources: Bulgarian authorities; European Environment Agency; and IMF staff projections.

21. Prospects for emissions reduction in the non-ETS sectors are uncertain. GHG emissions in transport, a key component of non-ETS sectors, have been increasing in both absolute and

[12] Estimated savings are derived from a staff estimate of GHG emissions in the electricity sector based on Bulgaria's energy balance and widely used technical coefficients. Staff's separate tabulation of individual investment projects in RRP suggests a potential for broadly similar savings.

[13] See IMF (2019a) and IMF (2020a) for the full discussion of the carbon pricing.

intensity terms (Section B). While the authorities plan to invest in low carbon mode of transportation including railway and inner-city transport,[14] rising income levels, a key contributor to emissions in the transport sector, will likely continue adding upward pressure on emission levels (Figure 12). Fit for 55, if approved, would extend the ETS to transport and buildings and could help dampen emission growth in these sectors. At the same time, efforts could be strengthened to support investment for less carbon intensive means of transportation.[15] For vehicle transport, raising the environmental tax further, particularly the transport tax that remain low compared to other countries, is a policy option. However, the scope to do so might be limited as the overall environmental tax is already relatively high in Bulgaria, reflecting high energy tax (including fuel for transport) (Figure 13). Enhancing fiscal incentives for ownership of low carbon emission vehicles (e.g., through feebates or tax credits) are potentially another policy instrument. The authorities' continued support for building renovation will help reduce direct primary energy consumption in buildings and complements efforts to lower emissions from electricity and heating industry by reducing demand for heating.

Figure 12. Bulgaria: GHG Emissions Projection for Transport, 2019–30 (Megatons of CO2 eq per year)

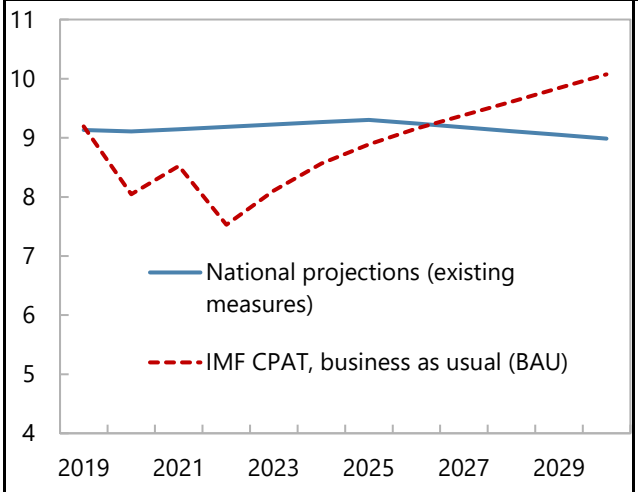
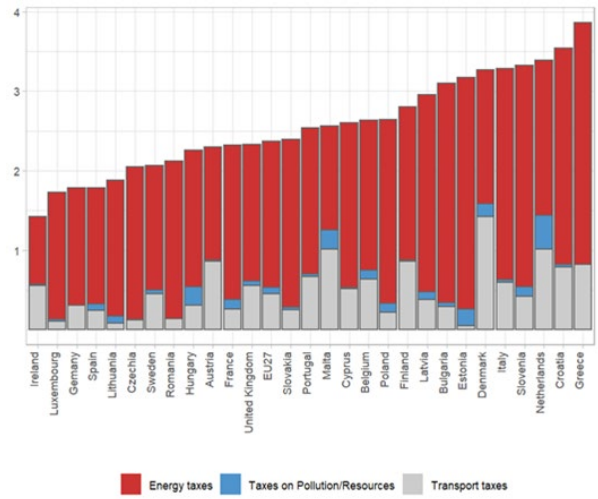


Figure 13. Bulgaria: Environment Tax Revenues, 2019
(Percent of GDP)



Sources: Eurostat; and Fund staff projections.

22. The authorities' plan faces implementation risks. Given Bulgaria's access to EU funds (NGEU and other instruments) and its fiscal space, financing is not likely a pressing binding constraint. However, discussions on energy policies are still evolving at the EU and national levels to

[14] Bulgaria's Integrated Transport Strategy until 2030 envisages sizeable reduction of the vehicles using conventional fuels in the urban areas, shift of the freight road transport for distances over 300 km to other, more sustainable modes of transport, completion of the European high-speed railway network by 2050, connection of all airports to the railway network and other.

[15] This, of course, should be complemented by lowering emissions intensity in the electricity sector.

reflect changing circumstances (e.g., fit for 55 and REPower EU), and more work is needed for some investment decisions (nuclear energy). There is also a risk that large investment projects are subject to implementation delays, as evidenced by challenges in absorbing EU funds in the past. Some investment projects involve new technologies, the efficiency and effectiveness of which remains to be fully tested (e.g., geothermal energy, small-scale nuclear units, large-scale deployment of batteries).

23. Once the current high energy prices subside, greater use of carbon prices would complement the authorities' strategy. Carbon prices in Bulgaria have been underpriced from the perspective of improving economic welfare. IMF (2020a) illustrated that domestic environmental benefits of an introduction of nationwide carbon prices in Bulgaria would by far exceed the domestic costs measured by changes in consumer and producer surplus in fossil fuel markets. Indeed, Bulgaria's welfare gains would be the largest in the EU, reflecting its high dependence on coal. Higher carbon prices provide incentives for large GHG emitters to invest in green energy and efficiency gains in the most cost-effective manner, while also mobilizing additional revenues that can be used for funding green transition projects or alleviating distributional impacts. Households would also internalize the costs when they make consumption decisions. These incentives would help reduce the reliance on carbon intensive energy, increase efficiency in transport and building, and reallocate resources to less carbon intensive and higher productivity sectors.

24. An illustrative scenario highlights the potential benefits of economy-wide carbon prices but also points to some short-term economic costs. The scenario assumes that an economy-wide carbon tax (a form of carbon price) of EUR10 per ton of CO2 is introduced (on top of existing carbon prices in European ETS) in 2023, when international energy prices are projected to decline as assumed in the April 2022 WEO. It is assumed that the tax is further raised by about EUR10 per year through 2027. Under this assumption, the CAPT model indicates that 13 percent of GHG emissions could be reduced annually by 2030 compared to a counter-factual scenario with no policy measures (Figure 14).[16] Additional carbon tax revenues are assumed to be recycled in increased transfers, although other policy measures such as higher public investment and other current spending are also possible. Real GDP growth could be lower by some ½ percentage point compared to the counter-factual scenario in the peak impact year, but GDP growth is projected to recover to the baseline by 2030. Reduction of air pollution, transport co-benefits and climate benefits are estimated to outweigh economic costs.

25. An economy-wide carbon tax would reduce household consumption and affects poorer households more than the wealthier, without mitigating measures. The illustrative scenario suggests that the carbon tax, in itself, would lead to lower household consumption, both directly through higher electricity prices and indirectly through higher costs embedded in other goods and services. Furthermore, in percent of consumption, poorer households would be more impacted by price changes than wealthier households, primarily due to the direct impact of higher electricity prices. Consumption of households in the first decile could be reduced by 3 percent.

[16] The results depend on many assumptions, including international energy prices and the pace at which renewables for electricity generation can be scaled up.

However, there is large uncertainty about the size of the impact of the carbon tax. An alternative estimate using a different model (Appendix I) points to much smaller impacts across income deciles. Nevertheless, the result that poorer households are affected the most still holds. This reflects much higher shares of expenditures for electricity by poorer households and the high GHG emission intensity of electricity generation. The analysis in Appendix I also finds that the average impact in Bulgaria is much larger than in the EU-27.

26. Mitigating measures for vulnerable households should accompany higher carbon taxes. Energy affordability is an important policy challenge in Bulgaria,[17] despite regulated low household electricity prices. The authorities are planning to quantify the prevalence of energy poverty in the country. Additional carbon taxes could exacerbate the affordability problem as some of the costs would be passed to retail consumers, particularly when the retail market is liberalized. Some available tools include structuring electricity tariffs in a way to minimize the impact on the energy-poor and using additional fiscal revenues arising from carbon taxes to alleviate the impact in a targeted way. There is even a potential to make lower income households better off with a targeted recycling of the additional carbon revenues. Indeed, an illustrative scenario of recycling all revenues from carbon taxes for cash transfers suggests that the impact on the poorer households can be more than offset and the impact made progressive post transfers.

27. Phasing out the use of coal could have a severe impact on coal-dependent communities. While the employment share of the coal-mining industries is relatively small in the country as a whole, it is high in coal-dependent regions. For example, jobs that are both directly- and indirectly-related to coal mining and coal-fired TPPs is roughly estimated above 20 percent of the employed in the coal-producing Stara Zagora District.[18] The regions would face a disproportionately large economic and social impact locally if coal mines and TPPs close. The state energy holding company estimates that employment could shrink by about 12 percent in the district if TPPs in the region were closed and by more than 40 percent in some local municipalities.[19]

28. The risk of large-scale job losses in coal-dependent regions calls for early adoption of policies that support diversification of local economies and reallocation of resources. Cross-country evidence suggests that well-planned policies that are implemented early in the process could help mitigate the transition costs for coal-dependent economies.[20] Already, the authorities plan to hire workers from mining industry to carry out land restoration work and prepare the mining sites for new economic activities, with support from the EU's Just Transition Fund.[21] At the same time, active labor market policies including job (re)training, placement service and mobility support

[17] The EC defines energy poor as "inability to keep home adequately warm" (Energy poverty).

[18] The calculation is an approximate because some employees (those counted in the numerator in the ratio) may be commuting from districts in vicinity. More broadly, weights of GHG emitting industries are high in the Stara Zagora, Kiyustendil and Pernik regions which would be most severely affected.

[19] "Current outlook of the Coal Regions in Transition Initiative", 2020, EC.

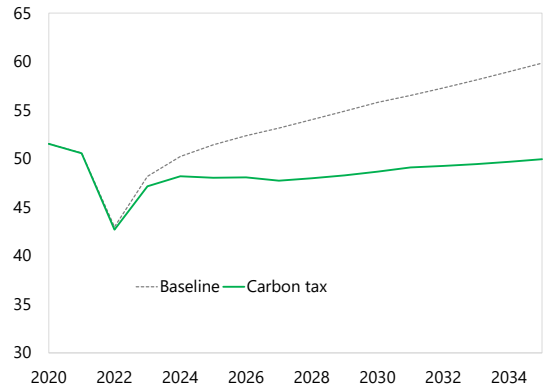
[20] See TRACER (2020a, b) and World Bank (2018, 2021) for cross country experiences.

[21] For the US, Austin et al. (2018) document that increasing labor demand appears to have greater effects on employment in areas where not working has been historically high and suggest that subsidizing employment in such areas could reduce the rate of not working.

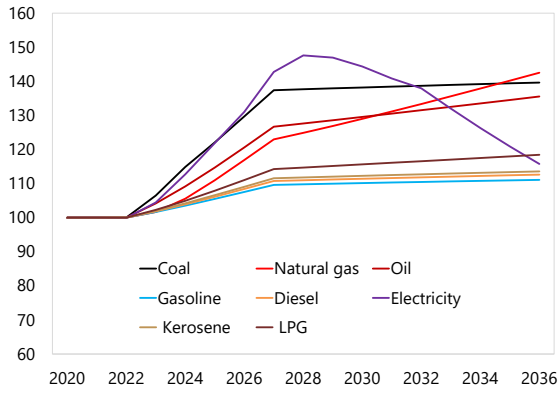
should be stepped up to encourage and enable both intra- and inter- region job mobility. Temporary income support can help alleviate the hardship of displaced workers and could encourage continued participation in the labor market. Supplementing lost local tax revenue should also be considered to maintain essential services during the transition.

Figure 14. Bulgaria: Carbon Price Assessment Tool Simulation Results for EUR50 per ton of CO2 eq. Carbon Tax by 2027, 2020–35

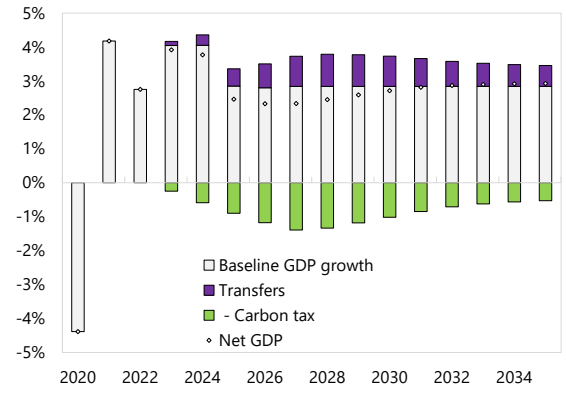
GHG Emissions



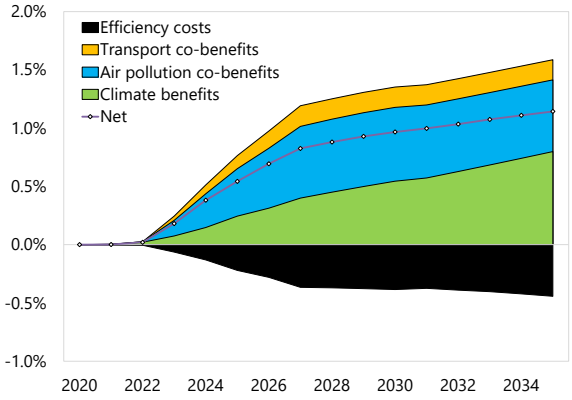
Energy Price Changes Induced by Carbon Tax (baseline = 100)



Net Impact of Carbon Tax on GDP Growth Rates 1/



Total Monetized Welfare Benefits of Carbon Tax 2/



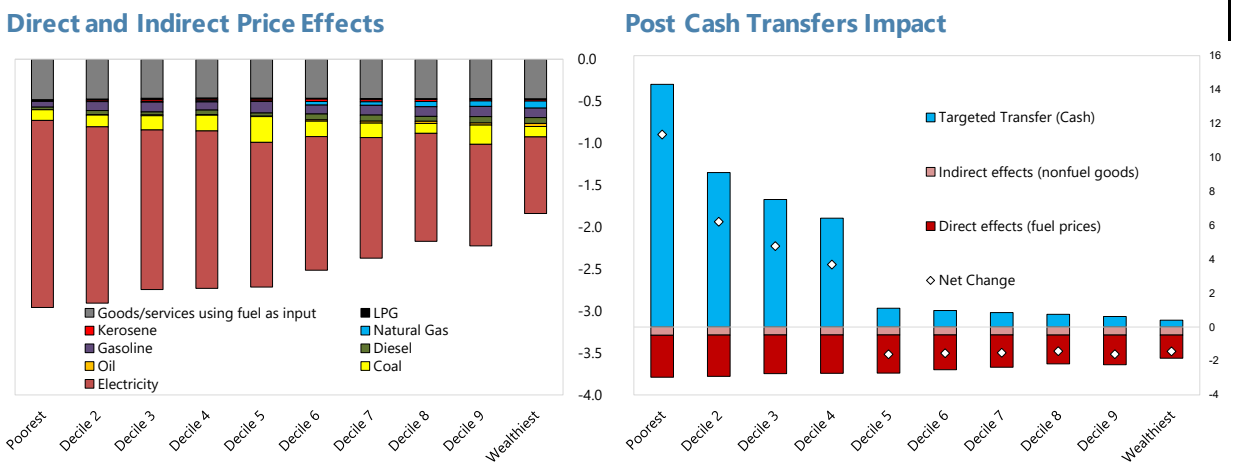
Sources: IMF staff projections.

1/ Shows estimated impact on projected GDP growth rates from tax plus revenue-recycling.

2/ Shows monetized net welfare benefits. Economic costs are deadweight losses from the tax before revenue recycling.

Figure 15. Bulgaria: Relative Mean Consumption Effect of EUR30 per ton CO2 Eq. Carbon Tax, 2025

(Percent of consumption)



Sources: IMF staff projections.

29. Higher carbon prices could lead to carbon leakage in Bulgaria. Bulgaria's geography (outermost location in the continental EU) and its energy intensive economic structure make it vulnerable to carbon leakage and erosion of economic competitiveness. The carbon border adjustment mechanism (CBAM) that has been proposed to come into effect in 2026 by the EC could mitigate the risk of leakage to some extent. However, free emission allowances under the ETS are slated to start being reduced once CBAM comes into effect as the EC regards it as an alternative mitigation measure to free allowance.[22] Higher carbon prices will put a premium on policies aimed at accelerating Bulgaria's productivity growth.

E. Conclusion

A broad set of policy tools should complement each other to sustain Bulgaria 's green transition efforts. Concerns about energy security and the current levels of international energy prices (including for EU ETS permits) have strengthened the EU's green transition efforts. Steadfastly implementing planned investments and reforms will be key to rebalancing Bulgaria's energy mix from hydrocarbon to cleaner sources. When international energy prices subside, a greater role could be given to price-based policy tools, including carbon prices applicable to a large part of the economy, to maintain incentives for investment and consumption behavior compatible with GHG emissions reduction targets. At the same time, mitigating measures for vulnerable households and policies to support coal-dependent regions will be needed.

[22] European Commission (2021).

Appendix I. Alternative Estimate of Distributional Impact of Carbon Tax

1. Incidence of higher carbon prices on households can be estimated using a partial equilibrium approach. This appendix follows the approach used in earlier studies (Coady, 2006; Batini et al., 2020) and offers an alternative estimation tool to the CPAT. It implicitly assumes that factor prices remain constant, intermediate and final demand are not affected by changes in output prices, and there is no technological progress or efficiency gains.

A. Methodology

- **Estimation of incidence**

Each production sector maximizes their profit in perfect competition, therefore:

$$p_j Y_j - \sum_i q_i A_{ij} - w_j L_j - r_j E_j = 0$$

Where p_j is the producer price in sector j, Y_j is the output, q_i is the final consumer price in sector i, A_{ij} is the intermediate consumption of product i in sector j, w_j and L_j are the labor remuneration and quantity supplied, respectively, r_j is the final price of energy in sector j and E_j is the input of energy in sector j.

If we divide by Y_j we will obtain:

$$p_j = \sum_i q_i a_{ij} + w_j l_j + r_j e_j$$

Where $a_{ij} = \frac{A_{ij}}{Y_j}$ are the technical coefficients showing the quantity of product i, needed to produce a unit of the product j, $l_j = \frac{L_j}{Y_j}$ is the labor input per unit of output and $e_j = \frac{E_j}{Y_j}$ is the energy intensity of sector j.

If we introduce a change in the carbon tax τ, it will not have impact on the factor cost w_j by assumption and will only be applied to the domestically produced goods and services. Therefore, in matrix form we will have:

$$\frac{\partial p_j}{\partial \tau} = \frac{\partial q}{\partial \tau} \alpha a_{ij} + \frac{\partial r_j}{\partial \tau} e_j,$$

where α is a diagonal matrix, which contains on its main diagonal the share in total supply in the economy that is domestically produced.

As no additional changes in the taxes of products are assumed, the change in the producer price as a result in higher carbon tax $\frac{\partial p}{\partial \tau}$ would be equal to the change in the final price $\frac{\partial q}{\partial \tau}$. Therefore, if I is a $n \times n$ identity matrix, the above equation can be rearranged as follows:

$$\frac{\partial q}{\partial \tau} = \frac{\partial r}{\partial \tau} e(I - \alpha A)^{-1},$$

where the matrix $A = \{a_{ij}\}$ represents the matrix of technical coefficients.

In percentage changes, the above equation can be re-written as:

$$\frac{\partial \dot{q}}{\partial \tau} = \frac{\partial \dot{r}}{\partial \tau} \Sigma (I - \alpha A)^{-1},$$

where $\Sigma = \frac{r}{q} e = \left[\frac{r_1 E_1}{q_1 Y_1}, \ldots, \frac{r_n E_n}{q_n Y_n}\right]$ denotes the vector of energy intensities by sectors in value terms.

Finally, if household welfare is proxied by its consumption, then the incidence on the households can be expressed as:

$$\frac{\partial U_h}{\partial \tau} = \omega_h (1 - \beta)' \frac{\partial \dot{q}}{\partial \tau},$$

Where ω_h is a vector of shares the goods and services in the consumption basket of household h and β denotes the share in total use in the economy that is exported.

- **Calculation of changes in price of energy inputs.**

The final energy price r_j in sector j is calculated as a weighted sum of the producer price of the energy sources s_k and the carbon tax τ, which is levied depending on the GHG emission intensity ξ_k of the each of available energy sources.

$$r_j = \sum_{k=1}^{m} \theta_{kj} (s_k + \tau \xi_k)$$

The weights θ_{kj} are calculated, based on the share of final consumption of energy from source k in the production in sector j, taken from the energy balances of by countries and sectors.

Therefore, the percentage change in the energy price r_j as a result of the change in carbon tax would be:

$$\frac{\partial \dot{r}}{\partial \tau} = \frac{\sum_{k=1}^{m} \omega_{kj} \xi_k}{r}$$

The GHG emission intensity ξ_k of each energy source are assumed to be as shown in Table 1. They are based on standard assumptions, which can be found in UNECE (2021)[1], for example.

Table 1. Bulgaria: Technical Assumptions About the GHG Emission Intensity of Various Energy Sources.

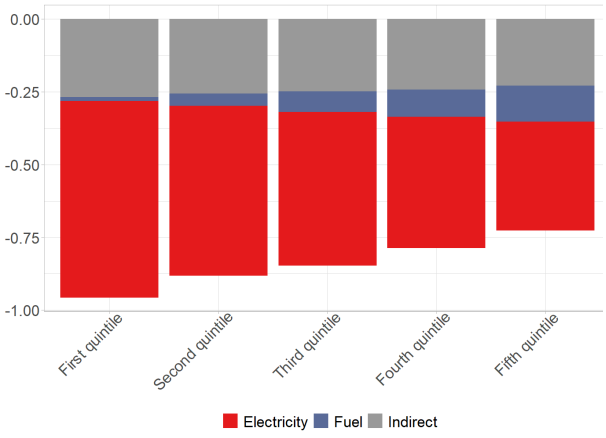
	Coal	Natural Gas	Crude oil	Renewables	Nuclear	Other
CO_2 intensity (t CO2/ MWh)	1.000	0.430	0.250	0.020	0.005	0.000

Sources: UNECE (2021); and IMF staff calculations.

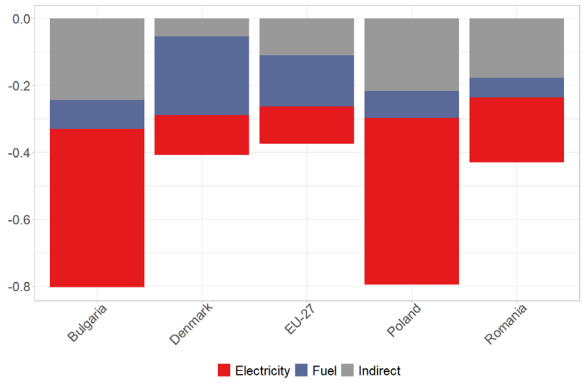
B. Analysis for Bulgaria

2. Higher carbon prices are found to adversely affect household welfare, with a greater impact to lower income households. To gauge the impact of introducing a carbon tax on households, the impact of an increase in carbon tax by EUR 30 per ton of CO_2 eq. is estimated. Results indicate that higher carbon prices will have adverse impact on household welfare in Bulgaria, both directly through higher electricity prices and indirectly through higher costs embedded in other goods and services. Furthermore, an analysis of the incidence of carbon pricing on households by quintiles finds that the impact is larger for lower income households when measured in household consumption, primarily owing to the larger direct impact of the increased electricity prices. This reflects much higher shares of expenditures for electricity by lower-income groups and the high GHG emission intensity of electricity generation.

Bulgaria: Household Incidence of EUR30 per ton of CO2 eq. Carbon Tax
(Percent of household consumption)



Bulgaria: Selected EU Countries. Household Incidence of EUR30 per ton of CO2 eq. Carbon Tax
(Percent of household consumption)



Sources: Eurostat; EEA; NSI; and IMF staff calculations.

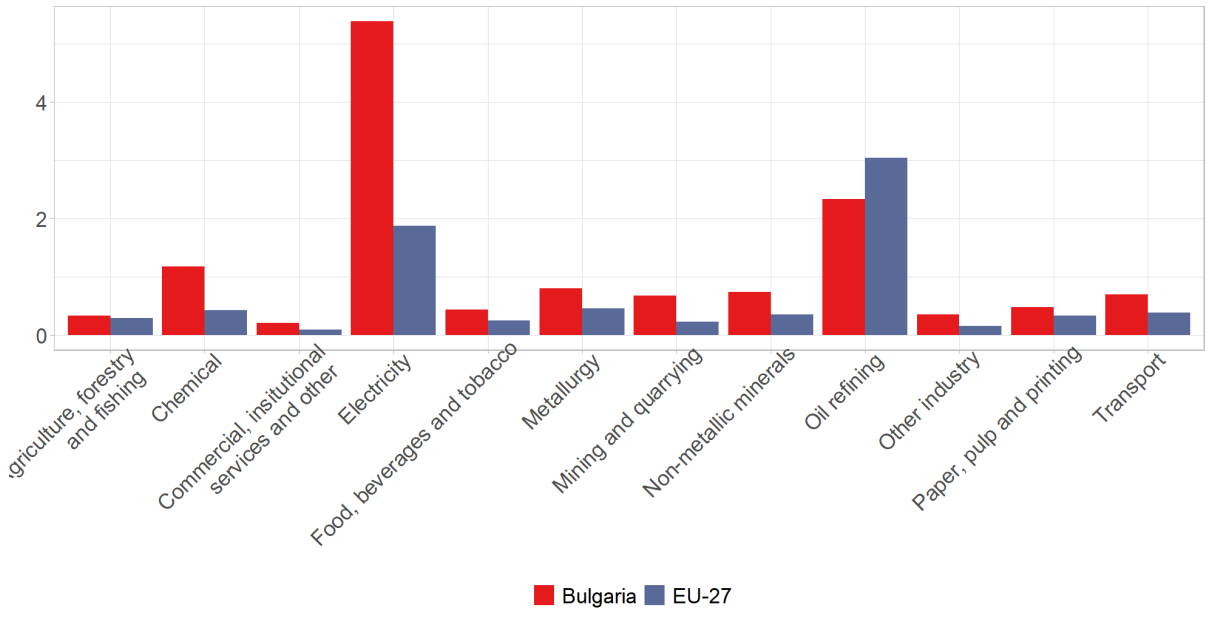
[1] The assumption about the energy intensity of crude oil is not given in UNECE (2021), but all sources show that it is in the range of 250 g CO2 eq per kWh, see for example here.

3. The impact in Bulgaria could be larger than in many EU member states. Staff estimates that the impact on household consumption in Bulgaria is higher than that in EU-27 on average and selected other EU member states and is comparable only to that in Poland. This reflects Bulgaria's high carbon intensity in electricity generation as well as in the whole economy. Both Bulgaria and Poland heavily rely on GHG emissions-intensive solid fuels for electricity generation (around 80 percent of total energy used for electricity generation in Poland, 41 percent in Bulgaria, and about 20 percent in the EU-27 on average). Furthermore, energy intensity of Bulgaria's economy is around 2.3 times higher than that of the EU-27 on average and around 3.5 times than that of a green economy such as Denmark.

4. Estimated final price increases resulting from higher carbon tax are greater in Bulgaria compared to EU-27. Estimating final price increases is a way to assess the energy intensity of the Bulgarian economy and its effect on the incidence of higher carbon taxation on households. The impact in Bulgaria is higher in all sectors, except in oil refining. The differences are most striking in electricity generation and chemical industry and are also large in transport and food manufacturing.

Bulgaria and EU-27: Estimated Final Price Increases from EUR30 per ton of CO2 eq. Carbon Tax

(Percent)



Sources: Eurostat; EEA; NSI; and IMF staff calculations.

References

Austin B., E. Glaeser and L. Summers, 2018, "Jobs for the Heartland: Place-Based Policies in 21st-Century America", Brookings Papers on Economic Activity.

Batini N., I. Parry and P. Wingender, 2020, "Climate Mitigation Policy in Denmark: A Prototype for Other Countries", IMF Working Paper WP/20/235, International Monetary Fund.

Coady D., M. El-Said, R. Gillingham, K. Kpodar, P. Medas, and D. Newhouse, 2006, "The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka," IMF Working Paper WP/06/247, International Monetary Fund.

European Commission, 2020, "Assessment of the final national energy and climate plan of Bulgaria", Brussels, 14.10.2020, Commission Staff Working Document (2020) 901 final.

European Commission, 2021, "Proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism", Brussels.

European Commission, 2022, "REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition," Press Release.

Feyen et al., 2020, "Climate Change Impacts and Adaptation in Europe", JRC PESETA IV final report.

IMF, 2019a, Fiscal Monitor.

IMF, 2019b, "Fiscal Policies for Paris Climate Strategies—From Principle to Practice", IMF Policy Paper.

IMF, 2020a, "EU Climate Mitigation Policy."

IMF, 2020b, "Sectoral Policies for Climate Change Mitigation in the EU."

Republic of Bulgaria, 2020a, Integrated Energy and Climate Plan of the Republic of Bulgaria, 2021–2030.

Republic of Bulgaria, 2020b, Strategy for Sustainable Energy Development in Bulgaria until 2030 with a Horizon up to 2050.

Republic of Bulgaria, 2022, National Recovery and Resilience Plan.

TRACER, 2020a, "Best Practice Report on Labor Markets, Social Issues and Tourism", Deliverable 2.4, Smart strategies for the transition in coal intensive regions, project no. 836819.

TRACER, 2020b, "Best Practice on Financing the Transition from Coal in European Coal Regions", WP2 – Task 2.3/D 2.3, Smart strategies for the transition in coal intensive regions, project no. 836819.

TRACER, 2021, "Projections for the transition to 2030/2050 in the target Regions."

United Nations Economic Commission for Europe, 2021, "Life Cycle Assessment of Electricity Generation Options", available at: https://unece.org/sites/default/files/2022-01/LCA_final-FD_0.pdf.