



**Institute for Energy Economics
and Financial Analysis**

No Economic Case for New Lignite Plant in Bosnia and Herzegovina

Solar and Wind Offer Safer Returns and Cleaner Power

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Contents

Key Findings.....	4
Executive Summary.....	5
Introduction	6
European Energy Transition Continues Despite a Small and Temporary Resurgence of Coal	
Power Generation	6
Decarbonisation in the Western Balkans.....	9
Decarbonisation in Bosnia and Herzegovina	10
Existing Gacko I and Proposed Gacko II	13
Methodology: Approach to Analysis.....	14
Findings on Gacko II: Financial Performance	15
Carbon Pricing Puts Gacko II at High Risk of Becoming a Stranded Asset Very Early in Its Life	15
Modelling a Realistic Portfolio With RES Alternatives	18
Solar PV and Onshore Wind Developments Offer Safer, Higher Returns and Cleaner Power	
for BiH	18
Risks and Financing: Gacko II Would Be Vulnerable Throughout Its Lifetime	19
Financing and Insuring New Coal Projects Are Increasingly Difficult and Risky	19
Power and Carbon Prices.....	21
Incentives and Regulatory Trends: Evolution of Markets Favour New RES Over Coal	21
Further Considerations on Risk.....	22
Counterpoint: Incentives, Financing Opportunities Provide a Distinct Advantage to New RES	
Installations, While Laws and Regulatory Environment Pose Risks	23
Conclusion	24
Appendix	25
Annex 1: Investment Assumptions and Valuation Results	25
Annex 2: Detailed Modelling Assumptions.....	25
Annex 3: Methodology and Select Inputs for the Integrated RES Portfolio Analysis	28
Annex 4: Study Limitations.....	29
Annex 5: Discussion of future power and carbon prices	29
About IEEFA.....	32
About the Authors.....	32

Figures and Tables

Figure 1: EU-27 Year-on-year Change in Electricity Generation for 2022	7
Figure 2: January 2023 Europe Coal Phase-out Status.....	8
Figure 3: Existing and Planned Coal and Lignite Projects in Europe.....	8
Figure 4: Progress Against 2020 Electricity Generation Targets.....	10
Figure 5: Emissions From Power Generation in BiH	10
Figure 6: Recent Power Generation and Emissions Intensity of Output in BiH.....	11
Figure 7: BiH Regularly Generates an Energy Surplus.....	12
Figure 8: Recent Progress in RES New Generation in BiH.....	13
Table 1: Summary of Main Assumptions by Scenario	14
Figure 9: NPV Performance by Scenario.....	15
Figure 10: Net Income and EBITDA, €, Selected Scenarios	17
Figure 11: Conceptual Illustration of Modelling a Portfolio With RES Alternatives	19
Table 2: Summary of Assumptions and NPV Performance, by Scenario.....	25

Key Findings

There is no economic case for building a new lignite-fired power plant at the proposed Gacko II site in Republika Srpska, Bosnia and Herzegovina.

Carbon pricing in particular will cause the plant to be cash-flow negative early in its life, if not from day one.

A better solution would be to invest in onshore wind and utility-scale solar power in the region, which offer safer returns and cleaner power.

Much of this analysis can be replicated and applied to other similar sites in Bosnia and Herzegovina and across the Western Balkan region.



Executive Summary

An IEEFA analysis confirms there is no economic case for building a new lignite-fired power plant at the proposed Gacko II site in Republika Srpska (RS), Bosnia and Herzegovina (BiH). Gacko II will not be profitable and would quickly become a stranded asset under several scenarios and even with generous assumptions that favour lignite generation. High power prices should not be used as justification for the project, since these are not expected to persist and will also benefit alternative plants.

It is hard to see who would finance or insure such a project given its economic and environmental profile, even if the project is supported for political reasons. China, until recently active in financing coal projects, has already been pulling away from foreign coal investments.

A better solution would be to invest in new onshore wind and utility-scale solar photovoltaic (PV) power generation in the region, which offer safer and improving returns, quicker construction and cleaner power. These are proven technologies with competitive costs and limited performance risks. A portfolio of wind and solar PV would also benefit from access to finance committed to renewables energy solutions (RES) and a likelihood of supportive policies in the future.

By contrast, a new lignite power plant in BiH will take longer to build and will be heavily exposed to future adverse policies. Carbon pricing in particular will cause the plant to be cash-flow negative early in the life of the asset. The recently affirmed European Union Carbon Border Adjustment Mechanism (CBAM) means that this could occur as early as 2026—before the new plant becomes operational. Losses would ultimately be borne by taxpayers.

Many of the findings of this analysis can be replicated and applied to other similar sites in BiH and across the Western Balkan region. All six Western Balkans nations (WB6) have committed to fully decarbonising their economies by 2050.

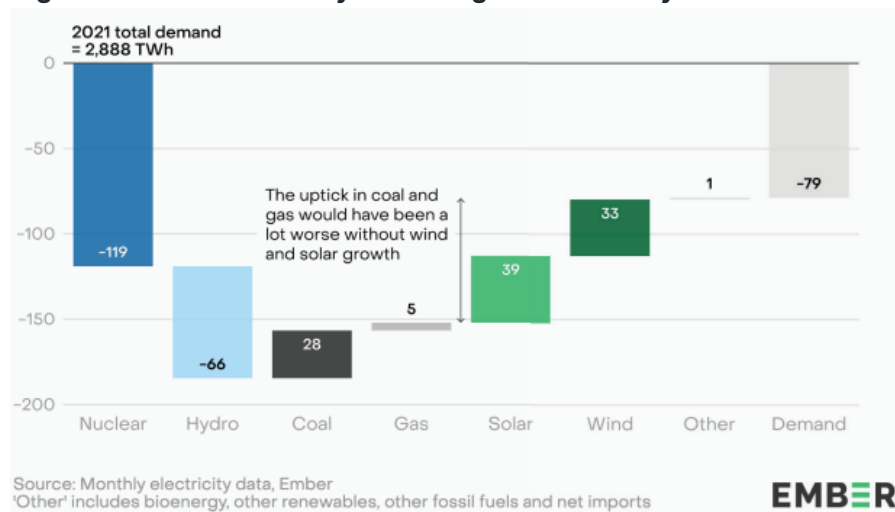
Introduction

In recent years, the effects of climate change have become more apparent across Europe. The European Union (EU), United Nations (UN), and even the International Energy Agency (IEA), which once supported fossil fuel development, have all called for urgent changes to the production and consumption of energy. Through the European Green Deal approved in 2020, the EU has set out on a legally binding path to climate neutrality by 2050, including its “Fit for 55” package to reduce emissions from 1990 levels by at least 55% by 2030. The package includes various policies and funding to help EU member states meet their goals.

During the last 18 months, post-pandemic recoveries and supply chain issues followed by the Russian invasion of Ukraine have led to a dramatic rise in the price of fossil fuels and wholesale electricity. As well as causing widespread disruption and liquidity issues for energy companies, it has exposed the vulnerability of nations that depend heavily on fossil-based energy imports from a single or small number of suppliers. As a result, energy policy is increasingly being driven by a need for countries to transition from fossil fuel dependence to a more sustainable economy, powered primarily by a mix of renewable energy technologies. Unlike in the past, today’s transition is occurring as much for energy security and affordability reasons as it is for environmental sustainability.

European Energy Transition Continues Despite a Small and Temporary Resurgence of Coal Power Generation

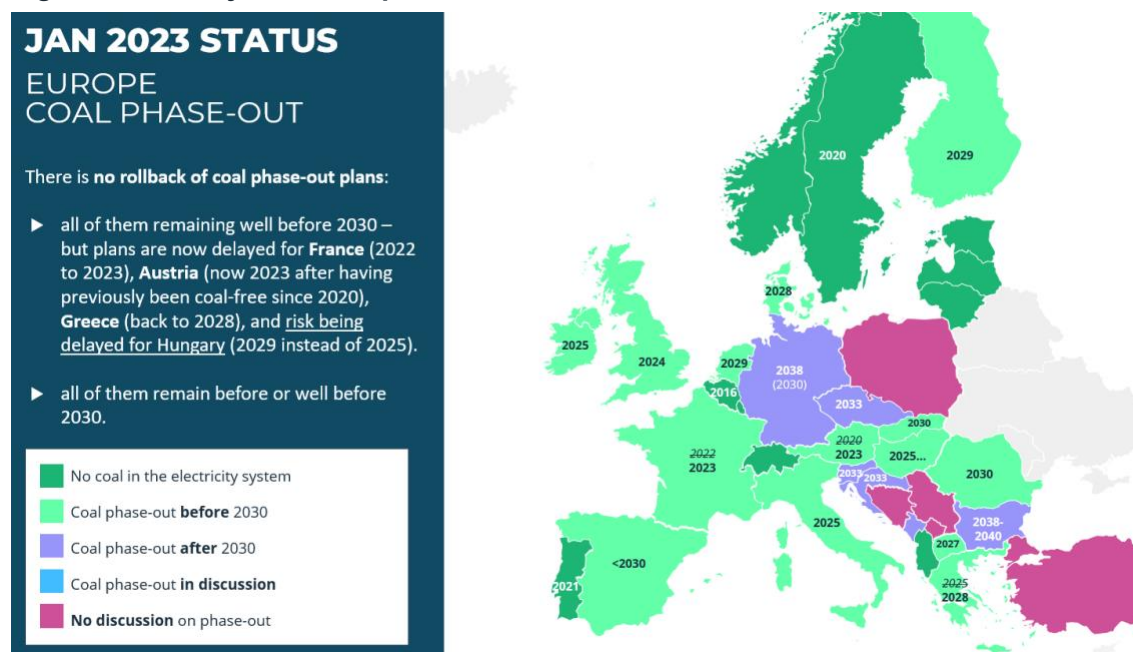
Over the last year, in addition to gas and coal prices being driven to exceptional levels by the ongoing geopolitical crisis, Europe has had to deal with lower-than-expected power generation from hydro and nuclear assets, largely due to record-breaking heat waves and droughts. While these circumstances have caused some countries to use more coal power than previously planned, measures to increase coal power production have been short term in nature. Meanwhile, power generation from solar and wind has continued growing to help cover the shortfall. The overall trend away from coal and lignite remains strong.

Figure 1: EU-27 Year-on-year Change in Electricity Generation for 2022 (terawatt-hours)

Source: Ember European Electricity Review 2023.

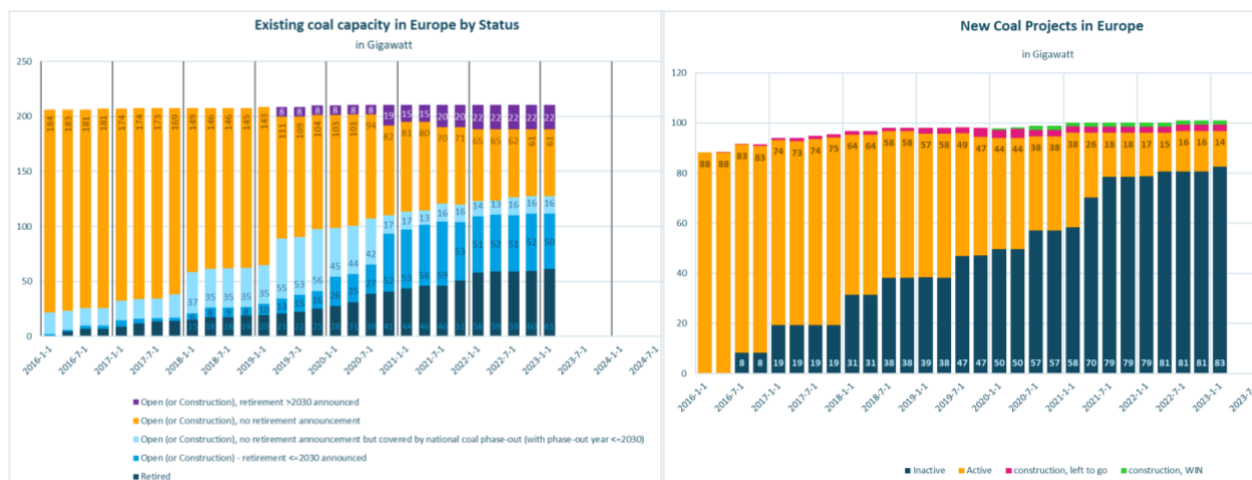
For example, some countries announced plans to temporarily increase the output of their coal fleet (Netherlands); postpone closures of coal plants by one to three years (Germany, France, UK); activate reserve capacity (Germany); and even to prepare retired plants for operation (Austria). However, in these cases, the power plants will **still be retired this decade and most in the next few years.**¹

¹ Europe Beyond Coal Database. September 5, 2022.

Figure 2: January 2023 Europe Coal Phase-out Status

Source: *Europe Beyond Coal*.

Since January 2016, more than half of Europe's coal and lignite fleet has been scheduled for retirement, while the pipeline of new coal projects has shrunk dramatically in line with increased difficulties to secure financing for projects.

Figure 3: Existing and Planned Coal and Lignite Projects in Europe

Source: *Europe Beyond Coal*; Data includes EU27, UK, Western Balkans and Turkey.

Decarbonisation in the Western Balkans

In November 2020, leaders of the WB6 met and signed the Sofia Declaration on the Green Agenda for the Western Balkans, which made numerous commitments to align the region with the ambitions and initiatives of the EU Green Deal. One of the pledges was a commitment to work towards climate neutrality by 2050 and to set 2030 energy and climate targets in line with the Energy Community framework and EU law. For example, BiH has since promised that 43.6% of its energy will come from renewable sources by 2030. There was also an agreement to continue alignment with the EU Emissions Trading Scheme (ETS) and work towards the introduction of carbon pricing in the region.²

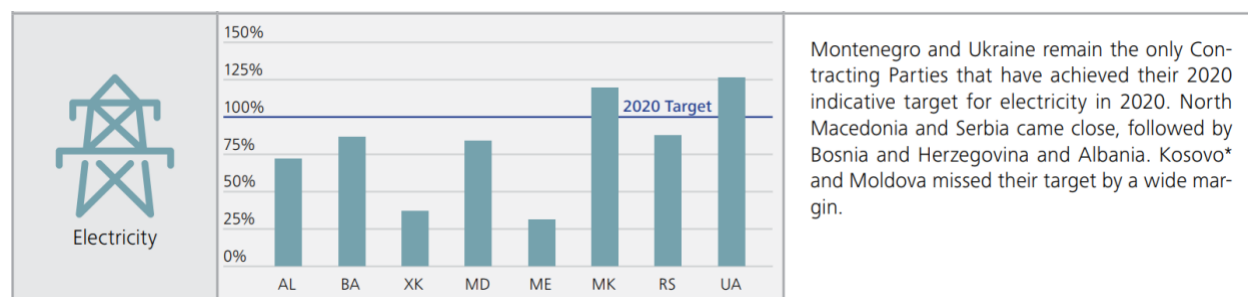
In July 2021, the European Commission proposed a Carbon Border Adjustment Mechanism (CBAM) as part of a comprehensive legislative effort to reduce net domestic greenhouse gas (GHG) emissions, as well as to encourage international suppliers to the EU to decarbonise their activities. The CBAM is seen as a key element to avoid carbon leakage risks for European industry. On Dec. 13, 2022, the European Council and European Parliament reached a political agreement on the implementation of the new CBAM. It will initially apply to certain imports that include cement, iron and steel, aluminium, fertilisers, electricity and hydrogen. Under the agreement, CBAM will begin its transitional phase on Oct. 1, 2023, and will require importing companies to report embedded GHG emissions. After Jan. 1, 2026, the permanent system will enter into force and importers will have to pay for an appropriate number of CBAM certificates, with prices based on EU ETS allowances in euros per tonne of carbon dioxide (CO₂) emitted. Unless countries introduce a system for carbon pricing, the power sector will have to bear the full impact of CBAM measures. This means that countries in the Western Balkans effectively have less than three years before CBAM takes effect. A recent study highlighted that if the WB6 implemented their own carbon pricing—even with a moderate carbon price of €50 per tonne—they could collect about €2.8 billion annually to spend on a just and sustainable energy transition.³ Although the full details of CBAM have not been implemented yet, the message is clear: To the extent that WB6 countries and their industries want to become an integral part of the EU, highly polluting generation technologies must be phased out.

Even so, WB6 power system decarbonisation is generally proceeding slower than intended. According to the Energy Community Secretariat, *“the contracting parties of the Energy Community continue to punch below their weight when it comes to the uptake of energy from renewable sources. Effective de-risking mechanisms such as reliable support schemes for renewables and liquid day-ahead and intraday markets are needed to mitigate the high capital costs in the region and boost investments in renewables. The new Renewable Energy Directive (REDII) adopted in the Energy Community extended the deadline for reaching the 2020 renewables target until the end of 2021. Given the lack of progress in 2021, it remains to be seen whether the one-year extension will result in all Contracting Parties meeting the target”*.⁴

² Regional Cooperation Council. [Sofia Declaration on the Green Agenda for the Western Balkans](#). November 2020.

³ Bankwatch. [The Western Balkan power sector: between crisis and transition](#). December 2022.

⁴ Energy Community. [EC Secretariat's Energy Transition Tracker](#). July 2022.

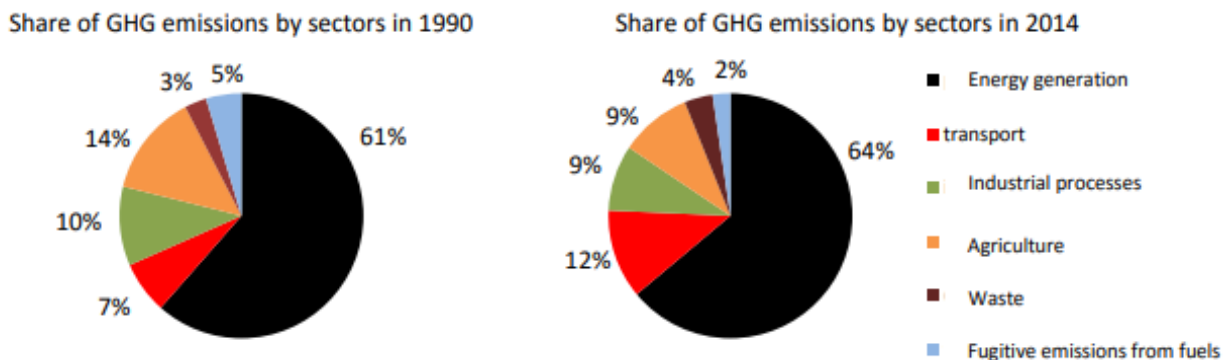
Figure 4: Progress Against 2020 Electricity Generation Targets

Source: Energy Community Secretariat.

Decarbonisation in Bosnia and Herzegovina

As a signatory to the Paris Agreement and a member of the Energy Community, BiH must submit nationally determined contributions (NDCs) to climate change mitigation. According to the NDC submitted in April 2021, BiH committed to reduce greenhouse gas (GHG) emissions from 1990 levels by approximately one-third by 2030, and approximately two-thirds by 2050.⁵ (When compared to 2014 levels, these targets become approximately 13% and 55%, respectively.) The 2030 target was recently superseded by the Energy Community Clean Energy Package, which includes a net 41% GHG emissions reduction for BiH by 2030.⁶

Since energy generation is by far the largest contributor to emissions in BiH, the reduction cannot be achieved without a phaseout of lignite-fired power production and an appropriate increase in generation from renewable energy sources. Senior executives from state-owned utilities, such as Elektroprivreda Republike Srpske (ERS), are well aware of this.⁷

Figure 5: Emissions From Power Generation in BiH

Source: UNFCCC, *Nationally Determined Contribution of Bosnia and Herzegovina*, April 2021.

⁵ UNFCCC. [Nationally Determined Contribution of Bosnia and Herzegovina](#). April 2021.

⁶ Energy Community. [Clean Energy Package](#). December 2022.

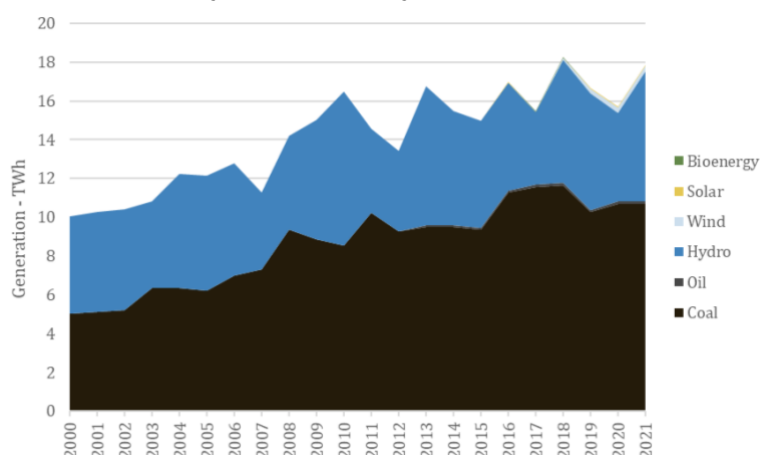
⁷ Balkan Green Energy News. [Petrović: Republic of Srpska targets 1 GW of renewables by 2029](#). March 2022.

The importance of the energy transition is echoed by BiH's regulator SERC in its most recent annual report: "In the forthcoming period, it is necessary to continue the alignment of energy legislation with the European Union *acquis*, integrated development of energy and climate policies and implementation of the energy sector reform in Bosnia and Herzegovina."⁸

Today, BiH generates most of its electricity from coal and hydropower. At the turn of the century, they each contributed about 5 terawatt-hours (TWh) annually. Over the last 20 years, coal-fired power generation has doubled, producing about 11 TWh in 2020 and in 2021.

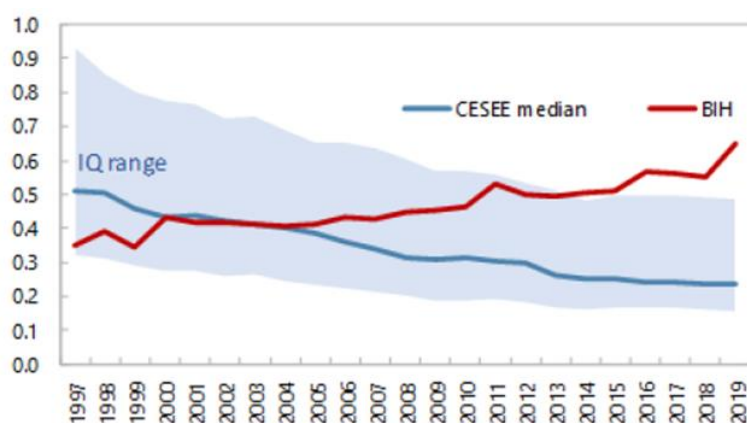
Figure 6: Recent Power Generation and Emissions Intensity of Output in BiH

Annual Electricity Generation by Source, Bosnia and Herzegovina 2000-21



Source: Ember.

Emissions Intensity of Output – Mt of CO₂ per GDP PPP Dollars



Source: International Monetary Fund.

Note: IQ range = interquartile range.

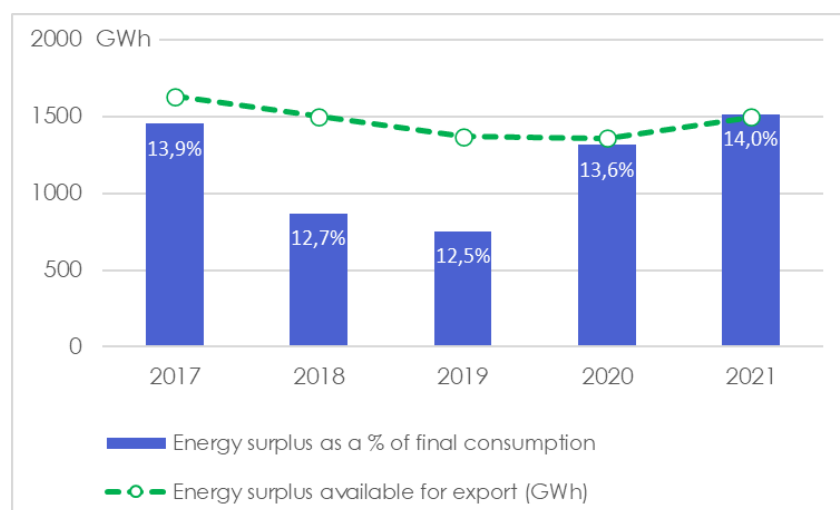
Note: CESEE stands for Central Eastern and South Eastern Europe.

⁸ BiH SERC. [Annual Reports 2021](#). February 2023.

Although this has covered the significant growth in demand over the period, from 10 TWh to 17 TWh, it has also meant that unlike in other countries in central and southeastern Europe, emissions intensity in BiH has increased, widening the gap with the rest of Europe.

BiH is a power exporter. As can be seen in the chart below, BiH has consistently generated an energy surplus during the past five years. Security of supply should not be an argument to continue investing in fossil fuel generation and hindering growth in RES.

Figure 7: BiH Regularly Generates an Energy Surplus



Source: IEEFA, SERC data.

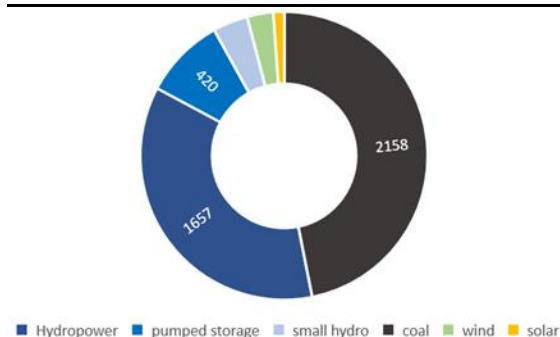
In 2021, BiH exported the most electricity of the Energy Community countries, with net exports of approximately 4.8 TWh. Historically, a large portion of BiH power exports have been to the EU, sold at higher prices than the domestically regulated prices. Its electricity sales are expected to be taxed via importing companies under the EU CBAM from 2026, unless BiH is able to meet a number of legislative criteria that are required for exemption. This could involve market coupling with an EU country, and would have to include, at minimum, a domestic carbon pricing system.⁹

Aside from hydropower, other generation technologies including wind, solar and bioenergy have begun to provide a minor contribution in recent years. However, the total amount of installed renewable energy remains insufficient.

⁹ Energy Community Secretariat. [Energy Transition Tracker](#). July 2022.

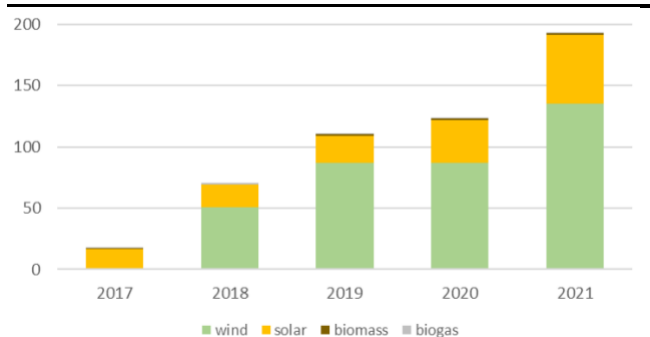
Figure 8: Recent Progress in RES New Generation in BiH

Overall Installed Power Generation in BiH



Source: IEEFA, SERC data.

Installed RES Power Generation (excl. hydro) in BiH



Source: IEEFA elaboration on SERC data.

A 2022 study led by Agora Energiewende shows that a coal phaseout in the Western Balkans by 2040 is technically feasible at no additional costs if embedded in a transitional strategy that aims at full decarbonisation. The study concludes that full decarbonisation of the power sector by 2045 would actually save money compared to a fossil baseline scenario, noting that *“transitioning to clean energy will cost the region 15 percent less than replacing aging lignite power plants with new coal or fossil gas.”*¹⁰

Existing Gacko I and Proposed Gacko II

Gacko I is a 300-megawatt (MW) thermal power plant owned and operated by ERS that entered service in 1983. It is one of five coal-fired thermal power plants in BiH and is located next to the Gacko mine, which supplies it with 1.8 million tonnes of lignite each year. Various plans for a new unit, Gacko II, to replace Gacko I, have circulated for more than a decade. Several memoranda of understanding (MoU) have been announced with Chinese companies since 2015 to explore the option of financing and constructing a new 350MW unit, but plans eventually have been shelved. In August 2022, in response to security concerns triggered by the war in Ukraine, the RS Government in BiH announced that Czech company Witkowitz was considering investing €521 million in the construction of Gacko II. However, it is not clear if that interest has progressed. We assume it is still being considered and have conducted the following analysis.¹¹

¹⁰ Agora Energiewende. [Western Balkan countries can decarbonise their power systems by 2045 - and save money](#). October 2022.

¹¹ Global Energy Monitor. [Gacko Thermal Power Plant](#). November 2022.

Methodology: Approach to Analysis

We conducted a case study based on the proposed 350MW Gacko II lignite plant in BiH. We used a discounted cash flow (DCF) approach to value the proposed project. We modelled Gacko II using a number of assumptions on its capital expenditures (capex), its operational expenditures (opex) and its technical characteristics (such as efficiency, size and lifetime). We then made assumptions on the returns that investors would reasonably expect from such a project (e.g., the weighted average cost of capital or WACC) and assumptions on the revenue and cost evolution throughout the life of the asset (such as discount rate, power prices and carbon prices). Our main assumptions are summarised in Table 1. A more detailed description of methodology and assumptions can be found in the Appendix.

Table 1: Summary of Main Assumptions by Scenario

		BASE CASE	Best specs & carbon 2036 start	ALT base case - high prices, 2026 carbon start	ALT base case - full ETS
NPV & WACC					
WACC	%	7%	5,5%	7%	7%
NPV @ WACC	EUR mIn	-583	-15	-163	-672
Construction					
Capex	EUR mIn	525	473	525	525
Capacity at completion	MW	350	350	350	350
Fixed and variable O&M costs					
Fixed O&M	€ / MW/ year	50000	45000	50000	50000
Variable O&M	€/ MWh	4,8	4,3	4,8	4,8
Carbon intensity	tCO2/ MWh	1,0	1,0	1,0	1,0
Fuel cost	€/ GJ	3,0	1,8	3,0	3,0
Energy efficiency	%	40%	42%	40%	40%
Costs and revenues					
Carbon price start	Year	2030	2036	2026	2030
Carbon price scenario		Medium	Medium	Medium	High
Carbon start scenario		Gradual	Gradual	Gradual	Full
Power price scenario		Medium	Medium	High	High
Power price floor	Sensitivity	Yes	Yes	No	No

Source: IEEFA.

Financial outputs from the modelling include earnings before interest, tax, depreciation and amortization (EBITDA), net income and net present value (NPV). We conducted our DCF analysis using several scenarios for the construction and operation of Gacko II. We also compared the standalone DCF valuation for Gacko II with a portfolio of solar PV and onshore wind generation. We present our findings on Gacko II and the alternative RES portfolio in the next section.

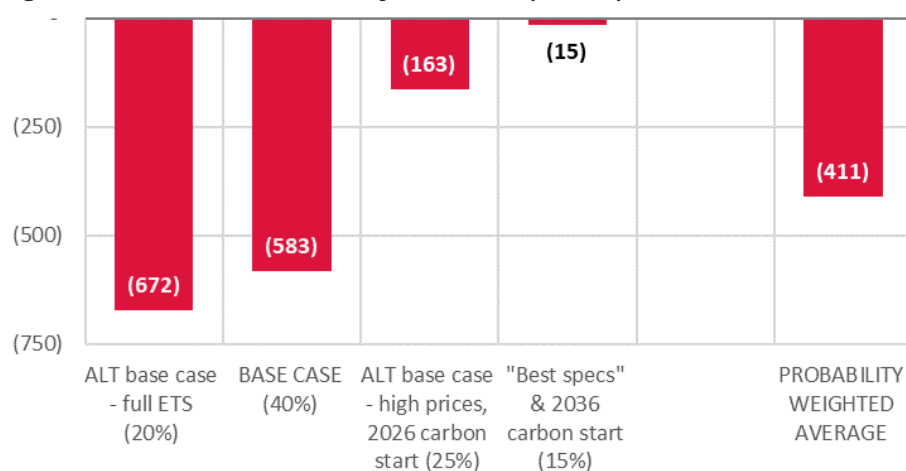
We did not include any modelling of gas-fired power plant alternatives. The lack of existing gas infrastructure in most parts of BiH, coupled with high and volatile gas prices, make it an unlikely scenario given the associated risks and timelines.

Findings on Gacko II: Financial Performance

Carbon Pricing Puts Gacko II at High Risk of Becoming a Stranded Asset Very Early in Its Life

DCF modelling suggests that even under the most favourable assumptions, Gacko II is a non-starter. A 2023 final investment decision (FID), uncertain but assumed in our base case, would mean no commissioning before January 2028. At most this would leave only two years of “carbon cost-free” cash flows for the project, in the (unlikely) event that BiH manages to secure a CBAM exemption until 2030. If no exemption is obtained, then carbon costs would be active immediately upon commissioning. Adding carbon costs has a clear negative impact on the project. Figure 9 displays the NPV by scenario.

Figure 9: NPV Performance by Scenario (EURm)



Source: IEEFA.

The base case and its two 'ALT' alternatives differ in terms of what power or carbon prices are assumed for the life of the asset. The base case assumes a gradual phase-in of carbon prices coupled with high (but not the highest) power price levels.

In the “high prices” scenario, Gacko II captures the highest power prices and benefits from gradually increasing carbon prices (starting in 2026), while the “full ETS” scenario sees Gacko II capturing lower (but not the lowest) power prices and bearing the impact of a full ETS from 2030.

Even the “Best specs” & 2036 carbon start scenario fails to exhibit a positive NPV for the project, resulting in a small loss. This scenario adopts optimistic technological specifications and assumes

that carbon prices do not become a part of BiH's power market until 2036. We note this would require the EU to provide significant exemptions to BiH and is highly unlikely, especially given the recent CBAM agreement that targets importers paying for carbon emissions as early as 2026.

The probability-weighted NPV value depicted in the chart above should be considered as an illustrative value, since the probabilities assumed for the scenarios shown are subjective. That said, we note that it is impossible for the probability-weighted NPV to be positive, given that none of the scenarios contemplated are positive in present value terms.¹² Unless Gacko II project developers were able to benefit from a set of extremely positive assumptions—beyond what we are generously assuming in our modelling exercise—it is most likely that their project will fail to show a positive NPV or a positive rate of return.

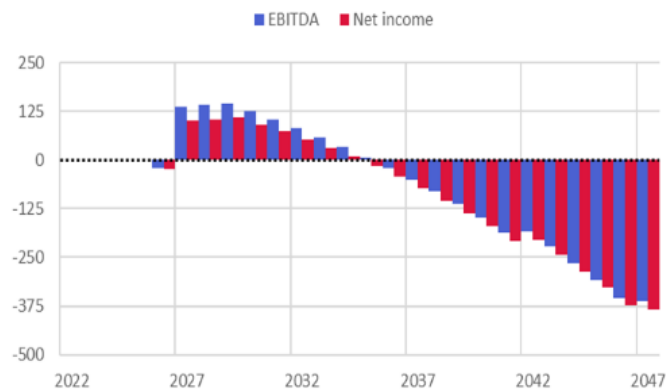
In summary:

- It takes a long time to build an asset like Gacko II (we assume four years from 2023). By then, we expect that current high power prices, which are a result of ongoing geopolitical conflict and elevated gas prices, will largely have subsided.
- Carbon costs under different integration timing and price level scenarios all contribute in a negative and material fashion over the life of the asset. This is true even for scenarios that envision a gradual or delayed phase-in of a carbon price. Although partial exemptions and mitigations are always possible, based on the recent agreement between the European Council and European Parliament, a CBAM for the power sector would equal the EU ETS allowance price level by Jan. 1, 2026.
- It would take sustained electricity prices (or some form of subsidy) at very high levels simply to avoid losses, in present value terms, for the project.

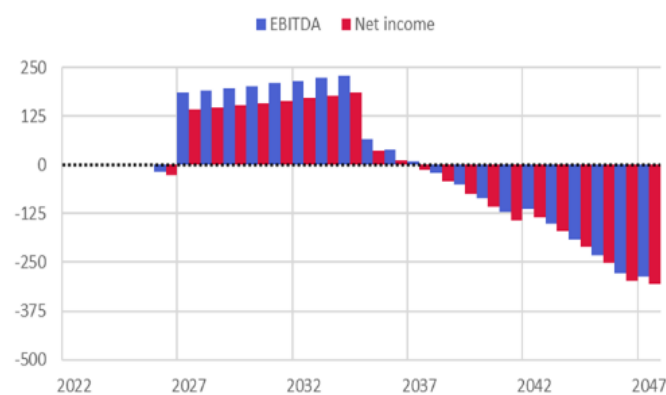
¹² Current forward markets confirm this trend (see Annex 2 for further detail on this).

Figure 10: Net Income and EBITDA, €, Selected Scenarios

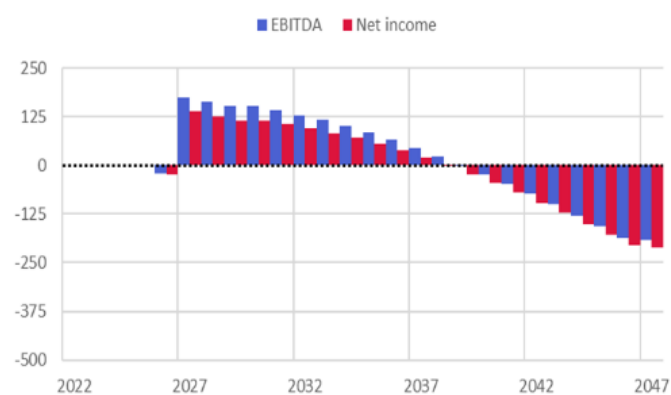
Base Case – NPV = -583 EURm



Best Specs & 2036 Carbon Start – NPV = -15 EURm



ALT Base Case - High Prices, 2026 Carbon Start – NPV = -163 EURm



Source: IEEFA elaboration; all euro figures in millions.

The impact of carbon pricing can be seen on the charts above. Once introduced, carbon pricing strongly decreases EBITDA and net income, ultimately turning both metrics negative. The difference in NPV by case is primarily driven by the magnitude and duration of positive cash flows while carbon pricing is absent.

Modelling a Realistic Portfolio With RES Alternatives

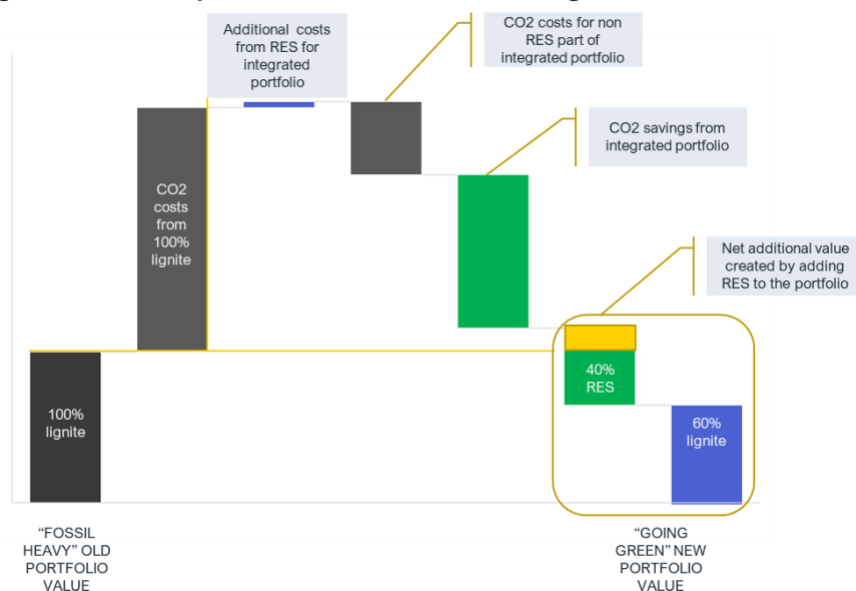
Solar PV and Onshore Wind Developments Offer Safer, Higher Returns and Cleaner Power for BiH

We calculate that a permitted RES portfolio comprising 115 megawatts (MW) of solar and 115 MW of wind would cost €264 million (about half the cost of building Gacko II); take less time to build than a brand new lignite power plant; and produce power roughly equal to 40% of the existing Gacko I output for 2021 (1.5 TWh). The envisioned portfolio would include roughly 35% solar PV and 65% onshore wind in energy terms. While the definition of what is “realistic” in this context can be subjective, we note that we tailored our portfolio based on the potential for growth of the existing RES sector in BiH (see Figure 8). The size of the RES alternative portfolio we propose has been anchored to the size of similar installations in BiH (some of which are existing and some of which are planned). We have aimed to be reasonable and conservative in our assumptions, underplaying the exponential growth that renewables have shown globally since 2000.¹³

We start with LCOE estimates for solar PV and onshore wind in BiH, and we estimate the costs of continued coal and new renewables generation. We then sum the expected cash outlays from 2025 to 2045. We derive the present value of these costs using an assumed 3% discount rate.

The integrated “going green” portfolio could save more than 20 million tons of CO₂ (and the associated costs) over a 20-year period.

¹³ IEA. [Renewables 2022](#).

Figure 11: Conceptual Illustration of Modelling a Portfolio With RES Alternatives

Source: Acousmatics.

A portfolio of large-scale solar PV and onshore wind could materially contribute to the economics of RiTE Gacko, while benefitting from existing financing opportunities and being positively exposed to new policies. A larger proportion of RES in the portfolio would result in bigger savings by not having to pay for emitted carbon.

Risks and Financing: Gacko II Would Be Vulnerable Throughout Its Lifetime

Financing and Insuring New Coal Projects Are Increasingly Difficult and Risky

It is difficult to see who would finance a new coal project in BiH. While BiH has not joined the countries currently sanctioning Russia, the larger nation historically has not financed coal projects in the region. Chinese investment would seem the most obvious way to finance Gacko II, but even that is looking increasingly unlikely. In September 2021, the Chinese government and Bank of China announced they would no longer support the construction of new coal power plants overseas. Instead, in the same speech at the UN General Assembly, President Xi Jinping said that “China will step up support for other developing countries in developing green and low-carbon energy, and will not build new coal-fired power projects abroad.”¹⁴

¹⁴ UN General Assembly. [Statement by President Xi Jinping](#). September 2021.

We note that potential Chinese financing for the Ugljevik power plant in BiH was recently withdrawn after this announcement. Sunningwell International, one of the main project companies, clarified the situation in a public statement: *“The EPC contract for Ugljevik was signed between CNEEC and Sunningwell Int'l Ltd, and initially it was considered that the project could be financed by Chinese financial institutions. However, after the decision of the Chinese top leaders to stop financing coal fired power plants abroad, CNEEC informed Sunningwell about this decision. Since then, we are exploring other alternative sources of the financing the project.”*¹⁵

Chinese financing can also come with conditions attached that may be detrimental to the recipient. But the lack of regulatory requirements means they can seem attractive to governments in Central and Eastern Europe (CEE). According to a June 2022 Peace for Asia report: *“China-backed initiatives, unlike European funding, do not require structural reforms. Many of the projects are awarded without tenders, without the inclusion of anti-corruption measures and are not based on an evidence-based cost / benefit assessment. China often finances investments, for example in lignite-fired power plants or transport corridors, which are not aligned with the strategic priorities of the countries and which are not commercially viable in the current situation. Financing takes the form of (intergovernmental) loans, which, while not subject to regulatory constraints, can include the mandatory use of Chinese contractors, labour and equipment.”*¹⁶

Projects involving Chinese state-owned enterprises can carry legal risks, with construction contracts being signed despite faulty environmental impact assessments (EIAs) and/or related legal challenges. One such example is Serbia's Kostolac B3 lignite power plant, which is currently under construction. An October 2021 report by Just Finance noted: *“The Export-Import Bank of China (China Eximbank) and the Chinese regulators signed off a loan for the project, despite it having an incomplete EIA that failed to include critical aspects of expanding a coal mine that [was] situated between and close to nearby villages; the construction also began without a valid construction permit.”*¹⁷

Insurance is another key component of coal projects that is becoming harder to obtain. Since 2017, 41 insurance companies have committed to end or restrict underwriting for coal projects.¹⁸ Within the EU, power utilities in coal-dependent countries like Germany, Czechia and Poland are having to look harder and pay more for insurance coverage. For example, Czech utility CEZ was forced to find alternative insurance arrangements in 2021, shortly after announcing its first coal phase-out plan, although further details were not given.¹⁹

¹⁵ Sunningwell International. [Company response](#). January 2022.

¹⁶ Peace for Asia. [China's coal investments in the Balkans: The environmental and financial implications](#). June 2022.

¹⁷ Just Finance. [Adding Coal to Fire](#). October 2021.

¹⁸ [Insure Our Future](#).

¹⁹ Reuters. [CEZ finds alternative as insurers pull cover from coal plants](#). June 2021.

Power and Carbon Prices

Even if Gacko II were to obtain financing, the long-term outlook for the economics of coal plants is generally unfavourable, and the timing is bad.

Any plant that comes online after 2028 is unlikely to benefit from the current high power prices. At the same time, it will incur extra costs during construction (2023-28) because of ongoing inflation of raw materials and industrial production costs caused by post-pandemic supply chain issues, ongoing geopolitical conflicts and the ending of central bank expansionary policies.

It is also likely that the new plant would immediately be faced with crippling carbon costs. So besides poor economics, the project would be extremely vulnerable to changing prices and policy.

For Gacko II, misplaced expectations of power prices continuing at high levels, strong disincentives for pollution, and low and decreasing costs for renewables are particularly damaging. A further detailed discussion of expected future power and carbon prices is included in the appendix.

Incentives and Regulatory Trends: Evolution of Markets Favour New RES Over Coal

Disincentives for Fossil Plants Make It More Expensive to Operate Compliant Assets and Maintain Mine Efficiency

Building a new plant like Gacko II would require several types of incremental costs compared to building and operating RES, including:

1. Substantial capital expenditures for both pollution abatement equipment at the plant and infrastructure overhaul/mine maintenance investments and to ensure production and transport of lignite.
2. Increased operating and maintenance costs and additional ongoing capital investments due to the need to comply with evolving environmental legislation.
3. Additional costs for decommissioning at the end of the plant's life.

All else being equal, increased capex and operating costs of production would contribute to hamper already weak project economics.

The Long-term Evolution of Power Systems Will Penalise Baseload, Inflexible Resources Like Gacko II

Beyond 2040, helped by efficient market design and regulation, we expect declining costs and the accelerating adoption of new energy technologies to profoundly affect the power market in BiH. Research from the Brattle Group, among others, highlights the ongoing trends of decarbonisation, decentralisation and digitalisation of electricity markets.²⁰

Decarbonisation entails replacement of output from “emitting” resources (such as coal plants) by renewable resources, which today have decreased capital costs and have extremely low variable costs. Decentralisation means a shift away from large, centralised power plants that serve inelastic demand. Digitalisation will continue acting as an accelerator of trends by affecting consumption, increasing efficiency and the flexibility of demand, and enabling the provision of energy and grid services.

As a consequence of these trends, markets will continue to experience much lower energy prices during low demand periods as well as lower average prices. Conversely, higher peak prices, driven by volatility, scarcity pricing, and demand response or storage will reward fast-response, low variable cost resources. This evolution will negatively affect baseload, inflexible resources.

What we see in the EU and other advanced markets today will become a reality in BiH. It is only a question of when—not if—time will run out for multi-decade coal power projects like Gacko II.

Further Considerations on Risk

Cost of Capital and Energy Demand Risks

All investors want to be compensated for risk, and different investors have different risk appetites. For investors in energy projects, a solid investment case is built on stable cash flows, as well as an assumption of rising power demand. Both assumptions may be flawed in the case of Gacko II.

New lignite plants face unique downside risks. Examples include tougher air pollution regulations, a coal phaseout, or a halt to financing or insuring projects by financial institutions. All have already begun occurring across Europe. Such risks are not mutually exclusive, meaning they can occur at the same time and will increase the project’s cost of capital. In addition, projects are particularly vulnerable to adverse events occurring in the early years of operation, given the expected worsening economics over the asset’s lifetime.²¹

²⁰ Brattle. [Net Zero Market Challenges](#). September 2022.

²¹ We expand on this concept, in the Appendix, making reference to standard financial theory.

There is also a general trend in Europe for a decoupling of energy demand and economic growth, as a result of advances in energy efficiency, growth in the less energy-intensive service economy, and growth in renewable energy. If it continues, the trend will force Gacko II developers to sustain the additional combined impact of a shorter life, lower load factors and power prices than originally planned. When considered over the project's investment timeline (Gacko II, if built, would be expected to be online for at least 25 years), these factors severely impair the project's value.

Counterpoint: Incentives, Financing Opportunities Provide a Distinct Advantage to New RES Installations, While Laws and Regulatory Environment Pose Risks

In May 2022 the European Commission published the REPowerEU Plan, a reaction of EU energy policy makers to current energy market disruptions caused by Russia's invasion of Ukraine. REPowerEU is a plan for saving energy, producing more clean energy and diversifying European energy supplies. The European Commission estimates that REPowerEU would require over €200 billion worth of additional investments through 2027.

EU policies will attempt to introduce binding reduction targets for the industrial sector, consumption targets for green hydrogen, amended sustainability criteria and the promotion of renewable power purchase agreements (PPAs), as well as an increased role for certificates of origin.

The measures envisioned by EU policy makers will provide ample opportunities for clean energy projects, offering additional financing avenues and speeding the green energy transition. The EU developments will result in another boost for developing renewable energy projects and related financing in the CEE region.

The main hurdle for the development of RES does not come from project economics themselves, but from the lack of an appropriate and stable but dynamic regulatory framework (meaning quick permitting, transparent and minimal bureaucracy, dispatch priority, long-term concessions and certainty over feed-in-tariff or other revenue-stabilising mechanisms). In particular, the potential delays in the permitting phase and the absence of a stable framework for long-term PPAs are the main factors hindering quicker and more material RES development in BiH. For example, while prices on electricity markets remain at elevated levels, PPA pricing is still far lower. The gap between high merchant prices and lower current PPA levels makes hedging expensive, affecting project economics for RES developers.

Recent news coming from BiH is encouraging, but the country is only at the beginning of its transition path and must continue enabling the growth of renewables with a clear, effective and durable set of market and regulatory arrangements.²²

²² Balkan Green Energy News. [Investors eye concessions in Republic of Srpska for 2,000 MW in solar power](#). February 2023.

Conclusion

The proposed Gacko II project, like other similar projects across the Western Balkans, faces a host of severe obstacles and risks that make it a bad idea for investors, developers and ultimately taxpayers:

- **Poor project economics.** Even under the most heroic set of favourable assumptions, DCF modelling exposes Gacko II as a non-starter that would struggle to meet required investment returns over its lifetime.
- **Large exposure to unfavourable policy outcomes and financial risks, in addition to economic and technical risks.** It has become increasingly difficult to finance and insure coal operations in recent years. The trend is expected to continue. Pursuing Gacko II would be acting in the opposite direction of strong and established policy trends. We note three types of policy intervention that are governing the green transition—and all are acting against coal, including subsidies for green projects; penalties (polluter-pays principle, carbon pricing, tightening environmental standards); and outright bans on coal/lignite generation, albeit with a gradual phase-out.
- **Competition from RES.** Strong competition from viable energy alternatives, which also benefit from easy access to financing and favourable policy trends, is a major obstacle for Gacko II. We show that an RES portfolio of similar cost can deliver substantial amounts of energy at much reduced risk.

Although we do not model alternative investments in detail, we do compare a set of alternatives that are projected towards a cleaner and healthier future. We conclude that such alternatives—in addition to being good economics—are likely to be rewarded by existing and future policies at the EU level. Current power sector trends of decarbonisation, decentralisation and digitalisation support this.

Appendix

Annex 1: Investment Assumptions and Valuation Results

We summarise our main assumptions by scenario and NPV findings in Table 2 below.

Table 2: Summary of Assumptions and NPV Performance, by Scenario

		BASE CASE	Best specs & carbon 2036 start	ALT base case - high prices, 2026 carbon start	ALT base case - full ETS
NPV & WACC					
WACC	%	7%	5,5%	7%	7%
NPV @ WACC	EUR mln	-583	-15	-163	-672
Construction					
Capex	EUR mln	525	473	525	525
Capacity at completion	MW	350	350	350	350
Fixed and variable O&M costs					
Fixed O&M	€ / MW/ year	50000	45000	50000	50000
Variable O&M	€/ MWh	4,8	4,3	4,8	4,8
Carbon intensity	tCO ₂ / MWh	1,0	1,0	1,0	1,0
Fuel cost	€/ GJ	3,0	1,8	3,0	3,0
Energy efficiency	%	40%	42%	40%	40%
Costs and revenues					
Carbon price start	Year	2030	2036	2026	2030
Carbon price scenario		Medium	Medium	Medium	High
Carbon start scenario		Gradual	Gradual	Gradual	Full
Power price scenario		Medium	Medium	High	High
Power price floor	Sensitivity	Yes	Yes	No	No

Source: IEEFA.

Annex 2: Detailed Modelling Assumptions

Commodity Prices

We use forward market curves as of Oct. 7, 2022, for Central and South East European power prices (2023-25), and EU Allowances (EUAs, 2023-30). We note that the forward curve for power is in strong backwardation: It exhibits a significant rise at the front, with longer dated futures being traded at much lower levels. This reflects a strong premium on prices for nearby delivery, a consequence of the current energy and geopolitical crisis. Conversely, the forward curve for EUAs is in contango, with longer dated futures trading at higher prices than nearby dated ones, and implying a market-perceived tightening of the supply-demand balance for EUAs.

Beyond the values expressed by the forward curves, and given the extreme price levels reached in the ongoing energy and geopolitical crisis, we opted to use summary measures for the starting point of our scenarios. We either use median prices (calculated from June 2019 to October 2022, comprising 840 observations), or average prices, or the top 35% of all traded prices over the same period to capture the possibility of structurally higher prices (this is the assumption for our base case). In line with Agora-2022, we assume a phased-in carbon price for BiH generators, with WB6 carbon prices being fully equal to EU ETS ones by 2050, and we use TYNDP2022 guidelines for future price levels. We assume lignite prices at 3 €/GJ in line with Miljevic 2019, and accounting for delivery to the power plant. For our “best specs” scenario, we assume lignite prices at 1.8 €/GJ in line with recent estimates from TYNDP2022 guidelines for Group 2 countries (which includes BiH). We further assume a 25% inflation link for escalating lignite costs.

In the base case DCF model, values for power prices, fuel and emission costs beyond 2023 (power), and beyond 2030 (carbon) are assumed to escalate at 3% annually. This is in line with IMF’s estimate of medium-term real GDP growth for BiH.

Operational Assumptions

We discount gross thermal generating capacity by 15%, to take account of conversion to net generation and availability. We use average efficiency and carbon intensity for lignite based on Agora-2022. We assume that efficiency and carbon intensity remain the same through the life of the asset.

For solar PV and onshore wind, we use location specific solar irradiation and wind speed data published in the World Bank’s Global Solar and Wind Atlas, to derive a load factor of 18% and 34%, respectively. We also cross-check these with recent results from solar and wind installations in BiH to ensure feasibility.

To account for wear and tear, we apply a 0.25% per year degradation factor to all electricity generation across all technologies.

Financial Assumptions

We use a weighted average cost of capital (WACC) of 7%, in line with Agora-2022. We test a few different capital structures, from a minimum 15/85 debt to equity ratio, to a maximum 65/35 debt to equity ratio, yielding WACC estimates ranging from 5% to 7%. We use BiH’s corporate tax rate of 10%.

We generally benchmark fixed and variable operating and maintenance (O&M) costs to recent research by Agora-2022. The regular cycle of required best available technology (BAT) air pollution upgrades (known as “BREF”) applies only to existing plants for the time being. However, we believe that the Energy Community will soon move to require BREF compliance for new plants (this is already “recommended,” but it does not yet have a firm date for mandatory compliance). Since we

assume Gacko II to start in 2028, we assume its variable operating costs to reflect compliance with BREF.

We use Miljevic 2019 assumptions for capex, and we assume 5% cost overruns (debt-financed). These assumptions are more favourable to new lignite than the equivalent ones from Agora-2022 and match the August 2022 press release from the Bureau of Public Relations of the Government of the Republic of Srpska (RS).²³ We assume a linear depreciation period of 25 years for new-build capex. We assume all capex is phased over four years, with an FID occurring in early 2023, and commissioning in early 2028.

Calculation Method and Risk-related Considerations

We focused on a new plant of 350MW, as detailed in the original feasibility study for Gacko II (2016) and in the recent press release from the Bureau of Public Relations of the Government of the Republic of Srpska (RS).

We used a discounted cash flow (DCF) approach to value the proposed Gacko II new lignite power plant project. According to standard DCF methodology, the value of a project (asset) is determined by its capacity to generate future cash flows for the company. The most common approach in DCF analysis is the WACC valuation method, which forecasts free cash flows to the firm and discounts them at the weighted average cost of capital (WACC).

For our valuation of the proposed Gacko II new lignite power plant, we additionally focused on EBITDA (earnings before interest, tax, depreciation and amortisation) as an estimate of free cash flow. We did not consider depreciation expenses, tax expenses or changes in working capital requirements. We discounted yearly EBITDA values at a rate of 7% to assess the power plant in present value terms. EBITDA is a function of sales minus variable operating and maintenance costs and contributions to fixed costs.

Financial theory categorises risks into two generic types: Systematic risk (also known as market risk) and idiosyncratic risk (a risk that is unique to the asset). Systematic or market risk relates to risk that cannot be eliminated through diversification. Standard discount rate techniques measure the extent of exposure to systematic risk. Conversely, asset-specific risks are not included in standard discount rates. Idiosyncratic risk can require specific adjustments outside of standard discount rate assessments. Within DCF analysis, it is common to account for idiosyncratic risk either through a premium on standard discount rates or via a separate cash flow or valuation haircut. Cash flow or valuation haircuts attempt to provide a “best estimate” (probability weighted) forecast of cash flows that accounts for potential downside outcomes related to idiosyncratic risks.²⁴

²³ Energy Community. [Analysis of Direct and Selected Indirect Subsidies to Coal Electricity Production in the Energy Community Contracting Parties](#). March 2019.

²⁴ Brealey Myers Allen Edmans. [Principles of Corporate Finance, 14th Edition](#). 2023.

We do not implement a valuation haircut in our DCF analysis. Yet we maintain that while both RES assets and fossil fuel assets would be subjected to market risks (e.g., an economic recession), only fossil fuel assets would be subjected to the risk of additional, more stringent and specifically targeted environmental regulations. DCF results ought to be even lower for Gacko II compared to RES alternatives. Other idiosyncratic risks we identified for Gacko II and similar assets include financial risk, operational risk, and legal risk.

Annex 3: Methodology and Select Inputs for the Integrated RES Portfolio Analysis

We use the Weiss-Murphy approach to compare the carbon emissions and total system costs of slower vs. accelerated renewables deployment scenarios.²⁵

We start with the levelized cost of energy (LCOE) calculation for new solar PV and onshore wind in BiH, and we use several estimates for the running costs of existing fossil fuel (ranging from 50 to 60 €/MWh, a conservative estimate). We assume that by 2040, building new RES will have the same levelized cost as running existing coal/lignite, implying a 1.5% annual reduction in RES costs.

We benchmark our capex and opex assumptions to IRENA and Agora-2022.²⁶ We assume a load factor of 34% for onshore wind and 19% for solar PV. We use a WACC of 7%. We build a “going green” portfolio of roughly 65% wind and 35% solar PV (energy basis), for a total of 230 MW, capable of generating 0.6 TWh annually.

We compare its costs to a business-as-usual (BAU) “fossil-heavy” scenario. We add the expected cash outlays for 20 years for either scenario, from 2025 to 2045. We derive the present value of these costs using an assumed 3% discount rate.

The BAU “fossil-heavy” scenario means continuing to generate with a 100% lignite portfolio (we ignore the contribution of hydro in this analysis since we want to compare coal/lignite and new RES). We calculate a present value for costs under the BAU “fossil-heavy” scenario of €1.17 billion.

The “going green” scenario represents the present value costs of switching to a large percent (at least 35%) of RES in the next couple of years. It is a boundary estimate, since ours is a simplified analysis. It is slightly higher than the corresponding cost for the BAU scenario, and it is equal to €1.21 billion. This is no surprise, given that we do not consider the sunk capital costs of existing lignite. However, under such a scenario, several key risks would be mitigated, such as fuel price and regulatory risks.

²⁵ Jurgen Weiss, Dean Murphy. “Hurry or Wait: Pacing the Rollout of Renewable Energy in the Face of Climate Change Risk”. The Brattle Group white paper. Available on demand.

²⁶ IRENA. [Renewable Energy Market Analysis Southeast Europe 2019](#).

Next, we incorporate our identified key risks/uncertainties, namely carbon prices. Regarding carbon prices, we estimate a present value for carbon costs under the BAU “fossil-heavy” scenario of €1.9 billion. We assume a carbon intensity of 1 ton CO₂/megawatt-hour, and we use the same carbon price forecasts as we used in our base case DCF analysis, derived from Agora-2022 and TYNDP 2020 scenarios. We conservatively assume that carbon costs only start being paid in 2030.

The cost of carbon is an additional cost only to the BAU “fossil-heavy” scenario, since RES do not have to pay carbon costs. We calculate that the integrated “going green” portfolio (60% lignite, 40% RES) will save more than 20 million tons of CO₂ (and the associated costs) over a 20-year period. A larger proportion of RES in the portfolio will lead to savings from not having to pay for carbon.

Annex 4: Study Limitations

This study incorporates (but does not model) reasonable, standard assumptions about the operation of the power grid in BiH and the further development of its electricity market, cross-border electricity trade, and growth in peak consumption. We do not model abnormal conditions that may include low hydro production, heat waves or other climate change-related extremes, such as those experienced in Europe during summer 2022. Our study will tend to understate the value of operating “firm,” less-weather-dependent resources such as Gacko II in these extreme situations. We do not consider grid investment costs required as renewables penetration increases. Since BiH has negligible installed non-hydropower RES capacity today, we believe the amounts of RES proposed in this study can be built without substantial transmission upgrades. Further, this study does not account for possible increasing costs of developing solar and wind as the lowest-cost/best site opportunities are used up in BiH, but we do not believe these costs to be material. Finally, we do not dynamically account for interactions between different commodities, such as the impact of higher carbon prices on power prices.

Annex 5: Discussion of future power and carbon prices

Future Power Prices

The current context is extraordinary. High energy prices will not last forever, and are expected to decrease to lower levels by the end of this decade. In this context, CO₂ is an exception. Carbon prices will continue to be high because the EU’s decarbonisation efforts will not go away, and may become even more ambitious.

There are several reasons why we believe high power prices will eventually subside, even if this will take several years:

- As noted by the Bruegel Institute and others, record high energy prices partly stemmed from the “profound energy supply-demand imbalance in the context of the bounce back of global energy

demand after the peak COVID-19 crisis... As almost all fuels are affected, short-term fuel-switching supply elasticities are close to being exhausted.”²⁷

- European efforts to reduce Russian gas dependence are focused largely on securing alternative sources of supply, and increasing non-gas forms of power generation. These measures are having a meaningful impact, but it will take some time to make the shift and so reduce exposure to global gas and coal prices.
- French nuclear generation availability was at historical lows in 2022, which increased pressure on power prices across the region, since France is usually a major power exporter.
- Efforts are underway to decouple power markets from the price of fossil gas, which was the main single driver of last year’s record high power prices. If implemented, this could significantly reduce European power prices.

In short, the long build period for a project like Gacko II means that the plant is unlikely to benefit from the current high electricity prices, once it is commissioned towards the end of the decade.

Future Carbon Prices

EU policies have brought about national policies designed to reduce emissions (coal and lignite phaseouts). This has reduced the power sector’s ability to balance the EU ETS market, creating a larger role for industrials. Even if the phase out of coal and lignite is delayed because of geopolitical events, there are two reasons why CO₂ prices will likely be sustained.

First, as the market commences to price-in the European Commission’s proposals for more ambitious EU-wide targets (potentially resulting in a significant reduction in the surplus of EUAs in the market out to 2030), prices will be supported. Second, to the extent that more ambitious targets are reaffirmed once the current crisis fades away, this will tighten the number of EUAs available to compliance players over Phase 4. It stands to reason that compliance players in the CO₂ market, especially industrials, will be more reluctant to sell any surplus holdings they might have in the future, tightening the market and contributing to sustaining CO₂ prices.

To the extent that BiH aims to integrate into the EU, it cannot escape some form of carbon pricing if it wants to export its power to the EU market. For reference, Agora-2022 calculates that with a carbon price of €50 per ton, the annual system costs for BiH would exceed €500 million, based on 2020 emissions.²⁸ We note that EU-ETS allowance prices averaged more than €80 per ton in the first 10 months of 2022.

With EU CBAM, the BiH power sector could be exposed to the EU ETS allowance price level as early as 2026, and this would undoubtedly have disastrous effects for lignite power. Although it is possible

²⁷ Bruegel Institute. [A grand bargain to steer through the European Union’s energy crisis](#). September 2022.

²⁸ Agora Energiewende. [The EU’s Carbon Border Adjustment Mechanism: Challenges and Opportunities for the Western Balkan Countries](#). January 2022.

that carbon prices could settle lower at periods (e.g., European stability reserve interventions), the effects of ongoing policies are expected to sustain carbon prices at high levels. The set of policies implemented by the EU will not relent in pushing fossil fuel generation out of the picture, whether via carbon prices or other measures.

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