The Potential for Sustainable Biomass in the Romanian Energy Sector

Activity 7: Diagnostics analysis of coal-fired power/ thermal/ cogen plants in Romania

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Description of the activity: We will do a comprehensive analysis of existing coal-fired power plants in Romania and what is their potential for fuel switching and performance improvement. We will examine the structure of thermal power plants based on coal in Romania, technological improvements in thermal power plants in Romania performed in the past years and their efficiency, as well as do a gap analysis between the current state of coal-fired power plants in Romania vis-a-vis climate reduction targets and in accordance to the latest legislation on coal phaseout. Last but not least, we will explore solutions for increasing the energy efficiency in thermal power plants in Romania, through fuel switching, in order to achieve the new EU climate targets.

1. International context

Coal has played a detrimental role in global economies across decades, as it provided stable and relatively cheap energy for industries and individuals. However, growing awareness of adverse environmental effects has led to an international consensus regarding the urgent need for its rapid phaseout. Therefore, transitioning from coal is not only essential to combat climate change but also to enhance air quality and support sustainable development.

The urgency surrounding the phaseout of coal is rooted in its substantial contributions to greenhouse gas emissions. Coal-fired power plants are among the primary sources of carbon dioxide (CO2) emissions, a key driver of global warming.

In response to the alarming consequences of climate change, countries across the globe have committed to curbing their carbon emissions, with the phaseout of coal emerging as a pivotal step. In 2015, the adoption of the Paris Agreement marked a historic global pledge to restrict global warming to well below 2 degrees Celsius above pre-industrial levels. Numerous signatory nations have incorporated coal phaseout as a fundamental component of their climate action strategies. Two years later, in 2017, the "Powering Past Coal Alliance" coalition was established to accelerate the phaseout of unabated coal power and support affected workers and communities. To deliver on these promises, many nations are focusing on renewable energy sources to replace coal in their energy portfolios. However, dedicated attention has also been given to switching to other, less-polluting fuels for thermal generation, such as gas or biomass.

Despite the global consensus on the necessity of coal phaseout, several challenges hinder progress, which ought to be considered in any transition – from coal to renewables, or from coal to gas/biomass:

- **Energy Security** – Baseload generation is often considered a "backbone" energy supply in energy markets, as it offers predictable and reliable energy production.
- **Economic Concerns** - Coal mining and power generation have historically been major employers in various regions.
- **Political Resistance** - Sometimes, political interests have slowed down or obstructed coal phaseout initiatives, as social and economic issues (related to jobs and security of supply) have emerged from the coal phaseout process.
- **Technological challenges** – Oftentimes, shifting to cleaner energy sources often entails substantial infrastructure investments, technological advancements, and sometimes grid enhancements.
    - Less infrastructure upgrades are needed in case of fuel switching, from coal to gas or coal to biomass.

Phasing out coal capacities – either by converting them for less polluting fuel sources or by replacing them with cleaner generation solutions – brings numerous benefits. The reduction in CO2 emissions resulting from coal phaseout significantly contributes to global efforts to combat climate change, while also resulting in reduced incidents of respiratory illnesses and premature deaths linked to air pollution.

2. Coal generation in Romania

Coal generation has supported Romania's economic activities for many decades. As the 2022 Energy Policy Group report shows, after the fall of the communist regime, Romania has recorded a drop in the total energy demand, derived from the closure of energy-intensive industries. While the total energy generation declined, coal generation has been constant over the years.

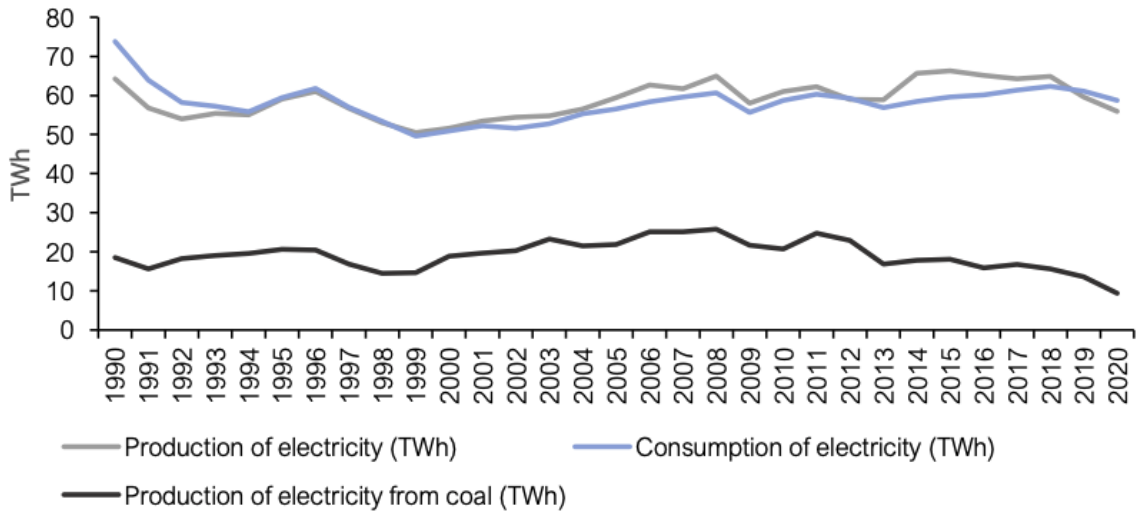

Figure 1 Total electricity supply/demand and coal-generated electricity (Source: EPG - Phasing out coal in Romania)

The first wave of renewable generation deployment started in 2013 and has led to a significant decrease in the share of coal-generated electricity. As a result, the number of coal-powered units has decreased, leading to a lower availability generation capacity (see below).

As a result of this trend, but also considering the pressure of the European carbon pricing mechanism (EU ETS), the CO2 emissions associated with electricity production have decreased from 32 MtCO2, in 2007, to 9,14 MtCO2, in 2021, a drop of 71%.

However, Romania's coal-fired generation fleet is very old, with operational ages ranging from 36 to almost 60 years. In this context, and considering technological upgrades and refurbishments made or planned, the technical and environmental viability of these units is limited.

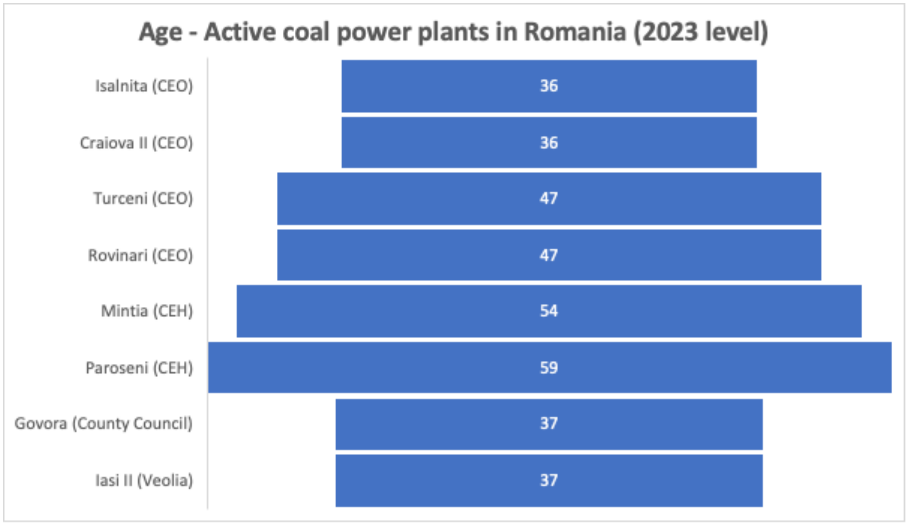

Figure 3 Age of active coal power plants in Romania (2023) (Source: Europe Beyond Coal database)

The Europe Beyond Coal database (retrieved in September 2023) showcases 3.98 GW installed capacity in still active coal power plants in the country, out of which 2.69 GW in lignite units (Turceni, Rovinari, Govora, Isalnita, Craiova II).

The CO2 emission level shows, once again, the poor environmental performance of these generators (Figure 4). However, an analysis over the previous years (Figure 5) reveals a significant decrease in coal capacity emissions, mostly due to lower load factors (thus, lower utilization, also related to lower energy demand, especially in COVID-19 years) and some technological upgrades and refurbishment processes.

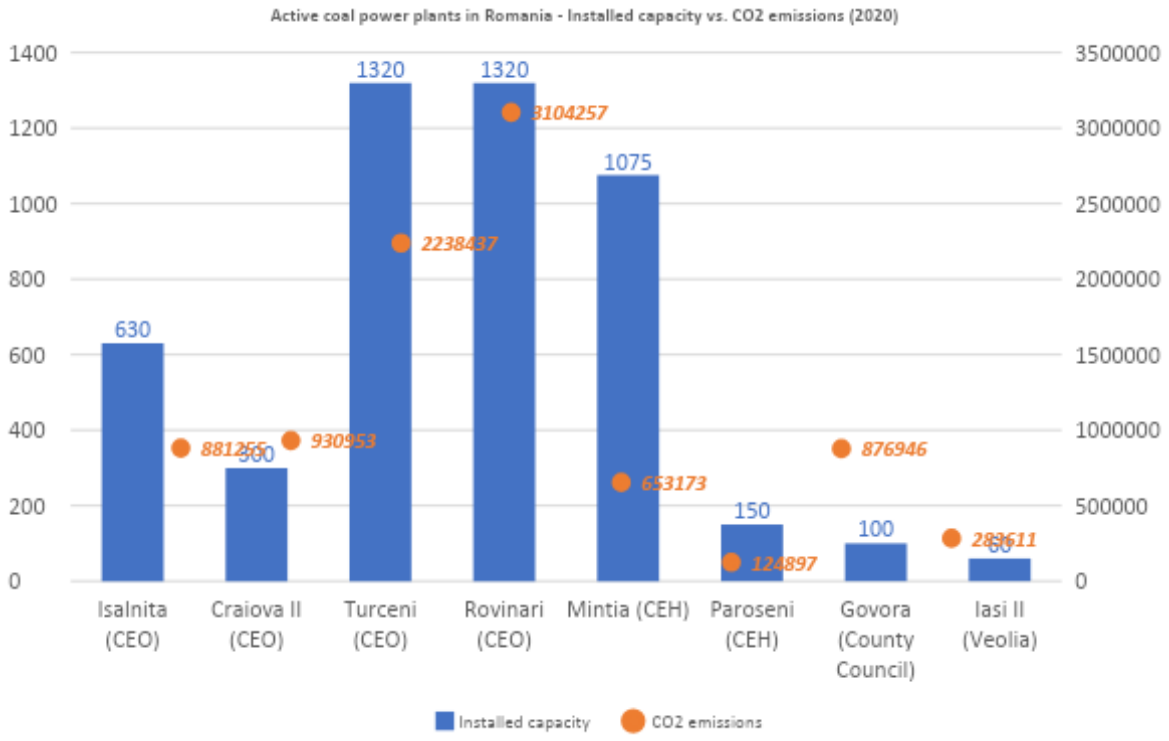

Figure 4 Installed capacity versus CO2 emissions, focus on 2020 (Source: Europe Beyond Coal database)

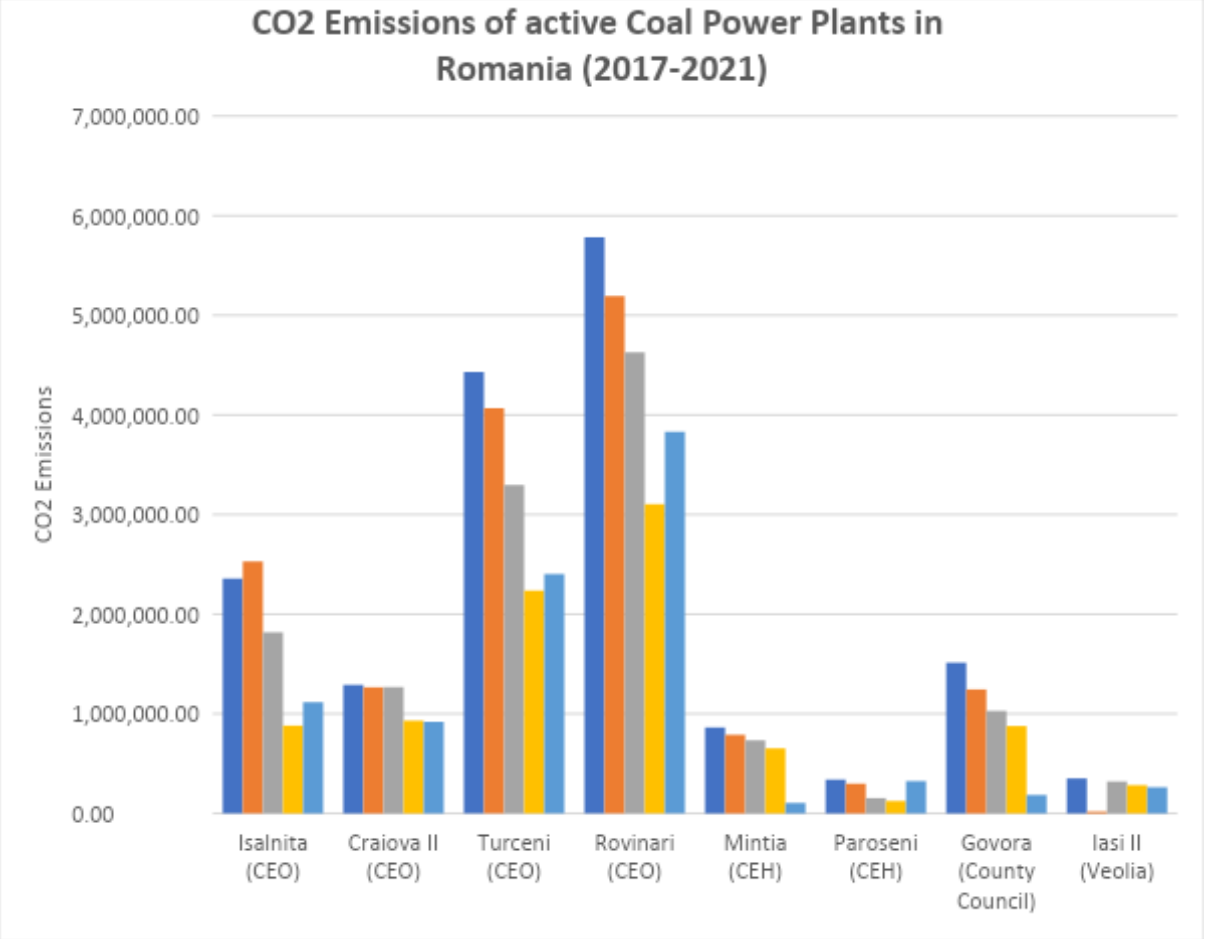

Figure 5 – Evolution of CO2 emissions for still active Coal Power Plants (Source: Europe Beyond Coal database)

An analysis issued by Bankwatch Romania, also revealed alarming levels of SO2, NOx, and PM limits, highlighting the risk of non-compliance (Figure 6).

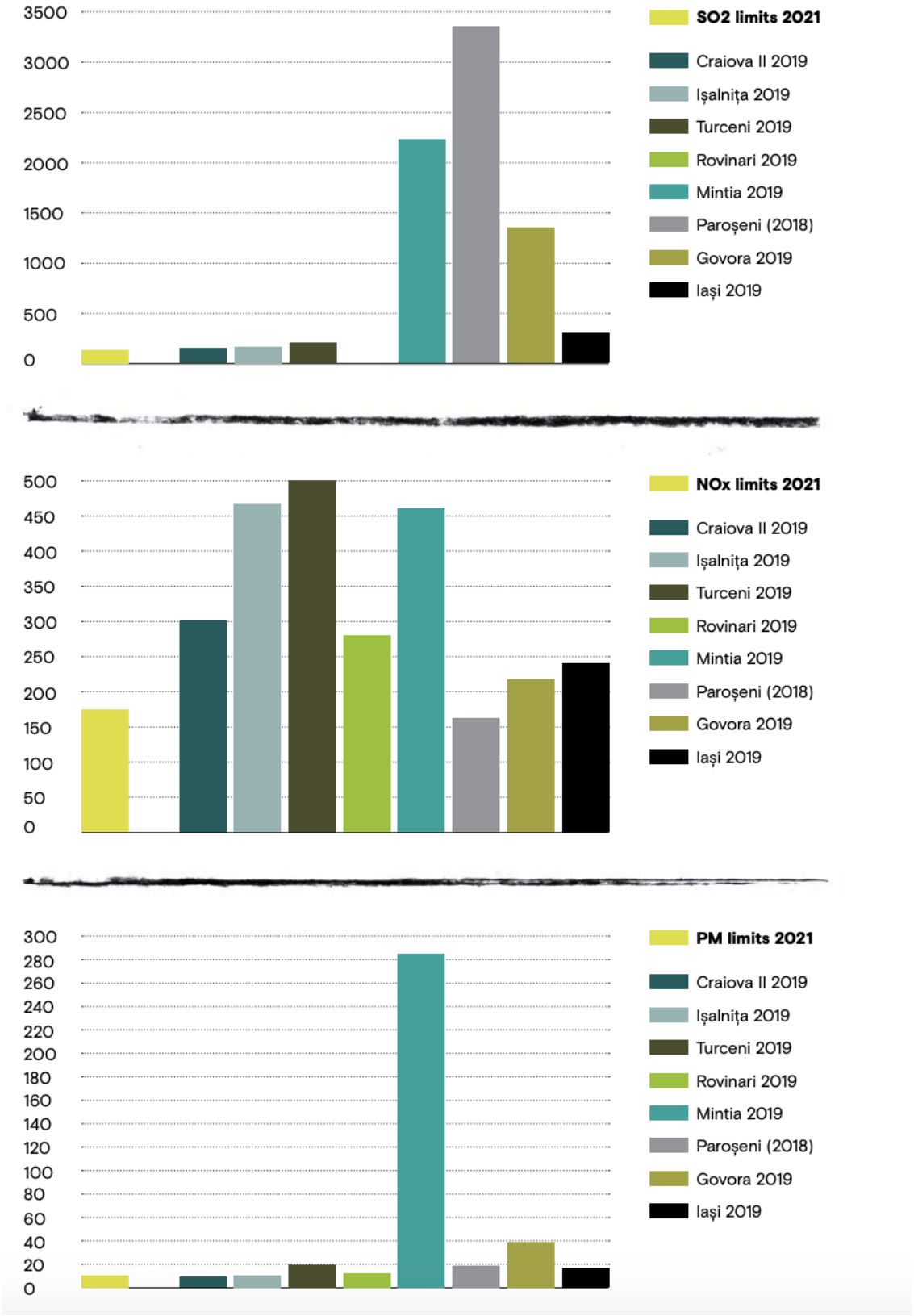

Figure 6 SO2, NOx, PM limits for active Coal Power Plants (Source: Bankwatch - Coal in Romania)

2.1 Analysis of the main coal generation units

Complexul Energetic Hunedoara (CEH)

CEH is the main operator of hard coal-based capacities, managing the power plants from Paroseni (150 MW) and Mintia (1050 MW). The nature of the hard coal generated multiple financial issues for the state company's management. In addition, as also the case for other coal producers, the struggles to comply with environmental standards and to purchase the EU ETS allowances led to the need for state intervention.

Nevertheless, the company was declared insolvent in 2019. As a result, the generating units in Mintia were closed in 2021 and the unit was one year later sold to Mass Global Energy Rom, under the provision to invest a minimum of 800 MW of gas-fired generation and renewable production, by 2027.

As previously highlighted, **Paroseni** (150 MW) is the oldest coal-based thermal power plant in Romania. The 2021 Bankwatch Romania report highlighted that although the unit provides cogeneration (electricity and heating), it had various downtimes for heat generation, as some of the municipalities have disconnected from this heating source.

The company, which employed 305 employees in 2020, has been exploring various possibilities for the future, including conversion from coal to gas, as well as coal-to-biomass.

Complexul Energetic Oltenia (CEO)

CEO is the biggest coal-based electricity generator, with 4 lignite power plants – Craiova II, Isalnita, Rovinari, Turceni – with a total installed capacity of 3570 MW.

Given the struggles to operate and pay for its emission certificate under the EU's ETS, and despite the ultimate goal of the European emission scheme, considering its vital role in the

energy mix, CEO benefited from subsequent support from central authorities. Additionally, regulated balancing market ancillary services also brought stable and predictable revenues.

The most significant direct help was given in 2020 when a state aid rescue loan of EUR 251 million was approved by the European Commission. In exchange, the Commission requested a restructuring plan, which would include a gradual phase-out. After various versions were discussed, a final version was approved by the European Commission, in 2021, for the 2021-2026 period. It included:

- By 2026, the existing 2060 MW coal capacity will be replaced by: 1325 MW of CCGT capacities (combined cycle gas turbine), operational by mid-2026; 735 MW of solar PV by 2024; 9.9 MW of micro-hydropower by 2023.
- Reorganization of current operations, including staff reductions and early retirements.
- Environmental works, which will aim to limit CO2, NOx, SO2 emissions, dust from flue gases.
- Financial stability provisions, including the management of bank loans or the establishment of special purpose vehicles (SPV) for implementing investments.

The successful implementation of the plan would lead to costs of EUR 3.94 billion, for the 2021-2026 period. Out of this, EUR 1.76 billion represents the financial support offered by the government, while the Modernization Fund would bring an additional EUR 895.3 million, according to an Energy Policy Group report.

2.2 Other thermal generation units (coal and gas)

Similar issues related to financial losses and the incapacity to pay for emission allowances have been recorded at **CET Govora**. Following an insolvency process, started in 2016, a restructuring plan was issued, which envisaged the replacement of existing coal-fired units with high-efficiency cogeneration gas plants and a new biomass plant. Lacking funds, the plan was not implemented by 2023 (as initially planned) and the plan was delayed to 2025.

CET Iasi, on the other hand, received EUR 3.4 million, in 2018-2019, as state support to continue its activities, according to Bankwatch Romania. The unit provides heating for Iasi

municipality and according to the same Bankwatch report, which references various media articles, the power plant records losses of LEI 23 million per year.

Electrocentrale Bucuresti is the largest heat producer in Romania and in Bucharest (providing 90% of the demand), functioning under the joint ownership of the Ministry of Energy (97.51%) and Romgaz (2,49%). Between 2016 and the spring of 2023, the company was in an insolvency process.

The company manages four ***gas-fired*** cogeneration units (CTE Bucuresti Vest, CTE Progresu, CTE Bucuresti Sud, CTE Grozavesti) and produced 1.562.000 MWh (electricity) and 4.183.300 MWt (thermal) in 2022.[1]

According to the company's data, Electrocentrale Bucuresti invested a total of 126.800.000 lei (2016-2021) in upgrading its units, bringing the current emission level in compliance with environmental standards from 2021. It also plans additional investments in the future.

[1] Data provided by Electrocentrale Bucuresti S.A.

3. Coal-fired power plants conversion to biomass-based energy generation. Is fuel switching an option?

Converting coal power plants to biomass power plants has been seen as an opportunity, as it can entail – depending on the source of the biomass - lower negative externalities. Additionally, in comparison with coal, biomass can be replenished through sustainable forestry and agricultural practices. To this end, and by diversifying the mix of fuels, biomass utilization can also increase energy security.

A conversion process from coal-fired power plants to biomass-generated energy can preserve jobs in the operational side of the power plant, but can even create jobs in forestry, agriculture, biomass supply chains, or the operation of biomass facilities.

Ongoing research and development are looking into improving the efficiency and environmental performance of biomass power plants, including through bioenergy with carbon capture and storage (BECCS) solutions. The coal-to-biomass conversion can leverage existing infrastructure, reducing the capital costs associated with building entirely new facilities, a major advantage considering the capital-intensive energy infrastructure of today.

However, some challenges ought to be considered.

- First, the sustainable supply of biomass feedstock must be thoroughly assessed to avoid deforestation and competition with food crops.
- Second, while there are clear advantages of benefiting from the existing technological coal-firing infrastructure, the biomass' lower energy density still calls for upgrades to existing technologies.
- Third, although a long-term cost-benefit analysis may show the advantages of biomass utilization – in comparison to coal usage – the initial investment can be substantial. Therefore, access to capital for this type of investment and/or subsidies support availability may need to be considered.

In Romania, an adjusted coal phase-out plan needs to be developed, following the increasingly ambitious EU objectives for 2030 and beyond. Moreover, given the relatively poor technical efficiency of the coal generation units in Romania, the decreasing costs for renewable technologies, as well as the increased price of emission allowances, coal-fired electricity generators are becoming less of a solution for the Romanian energy sector.

For these reasons, fuel switching – especially involving massive investments in gas-fired generation – needs to be carefully considered given the emission projections (less than coal generation, but still significant) and the increasing costs of gas. A miscalculation of the switching scale may lead to stranded assets in just a few years.

In this context coal-to-black-pellets transformation can represent a viable alternative solution, providing a sustainable sourcing of fuel and the needed upgrades to the existing infrastructure. As detailed in the "Paroseni Case Study" section of the report, while this conversion can bring emission reductions, the main challenge is related to fuel availability in the medium/long run. Additionally, while this would represent an improvement from an environmental point of view, the EU ETS scheme would eventually affect biomass generation's costs to the level where these solutions may become commercially uncompetitive in wholesale markets.