The reference development pathway of the Macedonian energy sector highlights the important role that lignite and hydro power play in the power sector, each accounting for 40% of total capacity in 2021. In 2030, this dominance continues, although hydro has a higher share due to the retirement of some of the existing lignite plants.
Three sensitivity runs of the MARKAL-Macedonia energy system model have been undertaken to explore the importance of these technologies to the system, considering that their resource may be reduced with time: (1) Reducing the availability of lignite from domestic mines by 50% in 2030 (with limited capacity of imports), (2) Removing three large hydro options, which account for 310 MW in the business-as-usual case, and (3) Both of the above restrictions.
The reduction in lignite availability is estimated to lead to additional overall system costs of 0.7%, compared to hydro restrictions at only 0.1%. With both restrictions applied, the additional costs rise to over 1%, amounting to 348 M€ over the 25 year planning horizon. In particular, costs are driven up by an increasing reliance on electricity imports. In all cases, the total electricity generation decreases, but import increases, which leads to a drop in capacity requirements. In both, the lignite and the hydro restricted cases, it is primarily gas-fired generation and imports that “fill the gap”.
The total installed capacity for electricity generation in Macedonia is 1,591 MW with a maximal annual production of around 7,900 GWh. Major producers of around 6,500 GWh annually are the thermal power plants (TPP), which have an installed capacity of 1,010 MW and out of which 800 MW are using domestic lignite. With an installed capacity of 675MW and an annual output of 4,600 GWh, the TPP Bitola provides about 70% of Macedonia’s electricity supply. The main lignite mine is Suvodol, but its reserves have been depleted and exploitation costs increased 4 to 5 times. The TPP Negotino, which uses residual oil, is not in operation regularly because of the high fuel price. Depending on the hydrological conditions, 15 to 20% of the annual electricity production in Macedonia comes from hydro power plants (HPP). There are eight large HPP with total net capacity of 536 MW and 22 small HPP with total net capacity of 44 MW.
To assess the impact of different energy strategies or policies in Macedonia, a MARKAL model Reference scenario was developed, providing an outlook for the energy system based on current policies. The Reference scenario takes into account specific characteristics of the national energy system, such as existing technology stock, domestic resource availability and import options, and near term policy interventions.
To explore the importance of lignite and hydro technologies to the Macedonian energy system, the following three sensitivity runs have been undertaken:
–reducing the availability of lignite available from domestic mines by 50% in 2030 (with limited capacity for imports),
–removing three large hydro options of Galiste, Gradec, and Veles, which account for 341

MW in the Reference case (or 22% of 2030 hydro capacity),
and –combining both of the above restrictions.
Under the Reference scenario, energy consumption is projected to grow significantly, by 105% in terms of final energy by 2030, driven by strong gross domestic product (GDP) growth and increasing per capita consumption. This will require more than doubling electricity generation capacity from 1,470 to 3,252 MW and results in higher import levels, as well as growth in CO2 emissions. Primary energy consumption is projected to grow almost 80% by 2030, and becomes more diverse with increased share of natural gas at the expense of coal, oil and electricity imports. The Reference scenario also suggests that the share of renewable energy sources will increase to 8% in 2030. The increase is due to further investment in hydro generation and attractive feed-in-tariffs for wind. Without these feed-in tariffs wind would not enter the Reference scenario on a least-cost basis.
Coal power plants remain the main producers of electricity with new installed capacity of 900 MW between 2021 and 2027. The highest level of investment is in hydro power, with a cumulative additional capacity of 944 MW by 2030, while new gas power plants have a cumulative installed capacity of 619 MW. Wind and solar (under Renewable and Other category) also make an important contribution, (340 MW) where wind is primarily incentivized by a feed-in tariff. Capacity additions and the retirement of old power plants results in 3,252 MW of total installed generation capacity in place in 2030, of which 2,803 MW are new capacities. The Reference scenario evolution of the Macedonian energy system results with increase of CO2 emissions from 8,359 kt to 13,253 kt, corresponding to 59% increase over the planning horizon. The Reference case highlights the important role that lignite and hydro power generation plays in the Macedonian power generation sector. In 2021, each accounts for 40% of total capacity, or 80% combined. In 2030, this dominance continues, although hydro has a higher share due to the retirement of some of the existing lignite capacity.
In all cases, the total generation decreases. In the lignite cases, it is primarily gas fired generation and imports that fill the gap. The same is also true in the hydro restricted case, albeit the relative change is much smaller. The limitation of the lignite resources reduces the generation of the coal power plants up to 41%, and consequently increases the production of gas-fired generation for almost 2.5 times (or 3 times in the scenario with limitation of lignite resources and of hydro capacities) and the electricity import for almost 6 times, in comparison to the Reference scenario.
This overall decrease in electricity generation but increase in imports leads to a drop in capacity requirements. In comparison to the Reference scenario, the limitation of the lignite resources results in 300 MW less capacity of coal power plants in 2030, which are replaced with additional 281 MW of gas power plants. In the case of hydro capacity limit, the 341 MW of hydro power plants built in the Reference scenario are replaced with 94 MW of gas

power plants, resulting in 247 MW less cumulative capacity in 2030 compared to the Reference case, while the rest of the electricity needs will be covered through import. In the combined constraint case, the cumulative capacity drops by over 11% compared to the Reference case, or by 314 MW. Indeed, in this scenario only 318 MW of gas power plants are built in difference to Reference scenario where 290 MW of coal power plants and 341 MW of hydro power plants enter the power system. In all three cases, wind power plants without any incentives are shifted earlier in the planning period.

The Reference development pathway of the Macedonian energy sector emphasizes the importance of the lignite and hydro power generation, both accounting for around 80% of total capacity in 2021 and keeping their dominance even in 2030 (with shares of 74%), even with the retirement of the existing lignite power plants.

Lignite in particular has a very important role in keeping overall energy system costs down. However, it is clear that this role will be alleviated with the possible introduction of carbon price. Therefore, future uncertainties concerning resource availability and carbon prices could have a significant impact on costs. Combined with lack of investment in new larger hydro plant, costs could be even higher, particularly if there is additional reliance on imported electricity. , transmits Serbia-energy.eu