1 | Executive summary

South East Europe is a diverse region with respect to energy policy and legislation, comprising a mix of EU member states, candidate and potential candidate countries. Despite this diversity, shared challenges and opportunities exist. The electricity network of the South East Europe region is highly connected, energy policies more harmonised and electricity markets better integrated – as a result of the EU accession process, the Energy Community Treaty and, more recently, the Energy Union initiative supporting a regional perspective on policy development. This report emphasises the regional dimension; it is complemented by national reports available on the South East Europe Energy Roadmap (SEERMAP) website (http://seermap.rekk.hu).

The SEERMAP project uses a model-based assessment of different long term electricity investment strategies for Albania, Bosnia and Herzegovina, Bulgaria, Greece, Kosovo*, former Yugoslav Republic of Macedonia, Montenegro, Romania and Serbia. It builds upon previous work in the region, namely IRENA (2017), the DiaCore, BETTER and SLED projects, but also EU-level analysis, notably the EU Reference Scenario 2013 and 2016. The current assessment shows that alternative solutions exist for replacing current generation capacity by 2050, with different implications for affordability, sustainability and security of supply.

The SEERMAP region will need to replace more than 30% of its current fossil fuel generation capacity by the end of 2030, and more than 95% by 2050. This provides both a challenge to ensure a policy framework which will incentivise new investment, and an opportunity to shape the electricity sector over the long term in-line with a broader energy transition strategy unconstrained by the current generation portfolio.

Five models incorporating the electricity and gas markets, the transmission network and macro-economic system were used to assess the impact of three core scenarios:

- The 'no target' scenario reflects the implementation of existing energy policy (including implementation of renewable energy targets for 2020 and construction of all power plants included in official planning documents) combined with a CO_2 price (which is only envisaged from 2030 onwards for non EU member states). The scenario does not include an explicit 2050 CO_2 target or a renewables target for the electricity sectors of the EU member states or countries in the Western Balkans;
- The 'decarbonisation' scenario reflects a long-term strategy to significantly reduce CO_2 emissions, in line with indicative EU emisison reduction goals for the electricity sector as a whole by 2050, driven by the CO_2 price and strong, consistent RES support;
- The 'delayed' scenario involves an initial implementation of current national investment plans (business-as-usual policies) followed by a change in policy direction from 2035 onwards, resulting in the realisation of the same emission reduction target in 2050 as the 'decarbonisation' scenario. Decarbonisation is driven by the CO_2 price and increased RES support from 2035 onwards.

The modelling work carried out under the SEERMAP project identifies some key findings with respect to the different electricity strategies that countries in the SEERMAP region can pursue:

- Under scenarios with an ambitious decarbonisation target in line with the EU Roadmap and corresponding RES support schemes, the SEERMAP region would have an electricity

mix with 83-86% renewable generation, mostly hydro and wind, and a significant share of solar by 2050. If renewable support is phased out and no CO_2 emission target is set, but a carbon price is applied, the share of RES in electricity consumption will rise to around 58% in 2050 from current levels.

- The modelling results show that even with RES support phased out after 2025, the region's electricity sector will experience a very significant decarbonisation by 2050, with a reduction in emissions of almost 91% by 2050 compared with 1990. However, results differ by country, with decarbonisation rates reaching very high levels in some countries without support, but insufficient in other countries, such as Greece and Kosovo*, compared with decarbonisation levels targeted by the EU by 2050. This level of decarbonisation assumes nuclear power plants of a total capacity of around 4800 MW operating in Romania and Bulgaria, as well as 600 MW carbon capture and storage (CCS) capacity in Kosovo*.
- Driven by a high carbon price, a significant amount of fossil fuel based generation capacity will be replaced by 2050. Coal, lignite and oil capacities are phased out almost completely under all scenarios resulting in lower and unprofitable utilisation rates.
- Delayed action on renewables is feasible, but has two distinct disadvantages compared with a long term planned RES support. First, it results in stranded fossil based power generation assets, including currently planned power plants. Stranded assets are assets where investment cost is not recovered during the lifetime of the investment. Translated into a price increase equivalent over a 10 year period, the cost of stranded assets is on par with the size of RES support needed for decarbonisation of the electricity sector; the weighted average RES support in the region over the entire modelled period is around 3.7 EUR/MWh, compared with the 10-year price increase caused by stranded costs of 2.5 EUR/MWh. Stranded costs are particularly high in Bosnia and Herzegovina, Greece and Kosovo* in both the 'no target' and 'delayed' scenarios. Assuming delayed action, the disproportionate effort required towards the end of the modelled period to meet the CO_2 emissions target results in the need for significantly more RES support between 2040 and 2050.
- Natural gas will remain relevant over the next few decades, contingent upon the completion of the Transadriatic (TAP) and Transanatolian (TANAP) pipelines bringing alternative natural gas supply from the Shah Deniz II gas field to the region. All scenarios initially foresee an increase in natural gas use, but under a decarbonisation pathway in line with the EU target of 93-99% reduction in the electricity sector gas plays only a very minor role towards the end of the period, accounting for 1.5% of generation in 2050. In the 'decarbonisation' scenario total gas capacity declines from 2020, with the rate of newly added capacity lower than outgoing capacity. Even so, capacity is still sufficient to bridge the transition from fossil to renewable based electricity mix with higher utilisation rates peaking between 2025 and 2035. Under the 'no target' scenario, gas still provides 15% of regional electricity generation in 2050 with peak production expected around 2035.
- Throughout the modelling period in all scenarios, the SEERMAP region as a whole produces approximately the same amount of electricity as it consumes. However, significant differences emerge between countries; in particular, Serbia, Macedonia and Kosovo* are large net importers, whereas Albania will be a significant net exporter by 2050.
- The generation adequacy indicator remains favourable for the region as a whole, i.e. regional generation capacity is sufficient to satisfy regional demand in all hours of the year for all of the years shown. The system adequacy indicator for the region as a whole, which takes into account import possibilities as well as regional generation capacities, is even higher. However, the generation adequacy margin varies for individual countries, and is negative for some countries in some scenarios, in particular

for Albania, Kosovo* and Serbia. This means that during certain time periods, these countries would need to import electricity to be able to satisfy domestic demand. Electricity import is a key element of market operation, improving social welfare of trading countries by ensuring that electricity is produced where it is cheapest. It is also in line with regional and a broader EU approach which relies on cooperation and solidarity between member states.

- At the country level, negative generation adequacy is linked to the two scenarios with decarbonisation targets. Increasing the generation adequacy margin to ensure that demand can be satisfied with domestic capacities at all times would require additional investment in new capacities and higher electricity prices, which underlines the importance of regional cooperation. Concerted efforts towards market integration and increasing the capacity of interconnections can reduce generation investment costs in scenarios with high shares of renewable generation. Additional positive effects of regionalisation include smoothing of electricity generated by intermittent RES capacities.
- Decarbonisation of the electricity sector does not drive up wholesale electricity prices compared to a scenario where no emission reduction target is set. The price of electricity follows a similar trajectory under all scenarios and only diverges after 2045 when high levels of low marginal cost RES penetration in the electricity mix reduce wholesale prices.
- The wholesale electricity price deviates slightly among countries, but follows a very similar trajectory across the region. This is attributable to the high level of interconnectedness within the region and the gradual coupling of markets. There is a significant increase in the average wholesale electricity price in the region (and across Europe) compared with current historically low levels under all scenarios due to the significant rise in carbon and natural gas prices by 2050.
- The macroeconomic analysis shows that despite the high absolute increase in the wholesale price, household electricity expenditure relative to income is expected to increase only slightly, due to significant growth in household disposable income. The positive implication of this trend is that higher prices attract investment to new electricity generation, which would help close the current gap in necessary funding for electricity generation projects.
- Decarbonisation will require a very significant increase of investment in generation capacity. These investments are assumed to be financed by private actors who accept higher CAPEX in exchange for low OPEX (and RES support) in their investment decisions. From a socio-economic perspective, the high level of investment in the decarbonisation of the power sector has a positive impact on GDP and employment. In 5 out of 9 countries, the positive impact on GDP is the biggest in the 'decarbonisation' scenario, while in the rest of the countries, the 'delayed' scenario is associated with the biggest economic growth. The 'decarbonisation' scenario has the strongest employment effect in 5 out of 9 countries due to the fact that renewable deployment (most notably PV) has much higher employment intensity than traditional fossil fuel plants. At the same time the higher level of renewable generation in these scenarios decrease the long term regional external debt by 8% of GDP on average as a result of an improving current account due to lower electricity and gas imports compared to the baseline.
- Decarbonisation will require continued RES support during the entire period. However, the need for support decreases as the electricity wholesale price increases and thereby incentivises significant RES investment even without support.
- At the regional level, revenues from the auction of EU ETS allowances are more than sufficient to cover the necessary RES support with the exception of the last 5 or 10 years of the

modelled period in the 'decarbonisation' and 'delayed' scenarios. The national results are more varied; in some countries the revenues can only partially cover the necessary support.

- The sensitivity analysis reveals that regional RES targets are significantly more cost-effective than national targets, to the point that the required RES support in a national target scenario is twice the level of the support needed in a regional support scenario assuming the same decarbonisation target. A regional system will also encourage harmonisation of other support elements such as permitting, grid connection rules, financing, taxation, etc.
- According to the network modelling, overall transmission network investment needs in the region are not significant compared to generation investments. Our estimates, however, do not include distribution network investments, where in some countries are characterised by significant underinvestment in the region and further investment will be required in order to accommodate a high share of renewables in the electricity system.

A number of no regret policy recommendations can be provided based on results which are robust across all scenarios:

- The high penetration of RES in all scenarios suggests that policy should focus on enabling RES integration; this involves investing in transmission and distribution networks, enabling demand side management and RES generation through a combination of technical solutions and appropriate regulatory incentives. Policy-makers should also promote investment in storage solutions, including hydro and small scale storage. In addition, increasing the capacity of interconnections, completing regional market integration and creating the framework conditions for investment in large scale storage solutions require higher levels of regional cooperation.
- RES potential can be reaped through policies that eliminate barriers to RES investment. De-risking policies addressing high financing cost and addressing high cost of capital are especially relevant in the entire region where currently weighted average cost of capital values are high in all countries. De-risking would allow for cost-efficient renewable energy investments. Options for implementing regional level de-risking facilities may be considered. An active role of the EU in implementing such a de-risking facility could provide a significant impetus. Policy related risks can also be reduced by ensuring stable, long term renewable energy policy frameworks are in place.
- As revenues from the auctioning of EU ETS allowances are sufficient to cover RES support for most of the modelled period, a scheme to finance RES support from these revenues can be devised in order to relieve the burden on consumers.
- Co-benefits of investing in renewable electricity generation can strengthen the case for increased RES investment. Co-benefits include higher GDP as a result of increased investment in generation capacity, an improved external balance due to reduced electricity and gas imports, and lower wholesale energy price which can result from very high penetration of RES. Additional co-benefits, not assessed here, are health and environmental benefits from reduced emissions of air pollutants.
- Policy makers need to address the trade-offs which characterise fossil fuel investments. In particular stranded costs related to coal, lignite and natural gas generation assets need to be weighed against any short term benefits that such investments may provide, such as in the case of natural gas, which can temporarily bridge the transition from coal to renewables.
- Considering the transient role that natural gas plays in the two scenarios with a decarbonisation target, the costs related to investments in natural gas networks also need to be

weighed against the benefits of natural gas based electricity generation (also considering other uses of natural gas in sectors such as industry and buildings).

- Regional cooperation can significantly lower support costs and results in slightly lower investment needs for meeting RES targets. A regional target for renewables is therefore recommended, but in order to reach a win-win situation for all involved countries, corresponding regional support mechanisms could also be explored. In parallel to implementing a regional support mechanism, issues such as differences in permitting, grid connection rules, financing, taxation, site restrictions, depreciation rules, etc. should be eliminated in order to avoid market distortions. The EU is already moving to strengthen regional RES cooperation, most recently with the 2016 Winter Package which proposes partial opening of support schemes, already being tested in some countries. Best practices established in this process will help the SEE region and improve regional cooperation in RES support schemes to ultimately increase their economic efficiency.
- Policy-makers need to address the gap in distribution network investment, which is crucial to the expansion of the decentralised RES-based power production. Transmission network development in the SEE region also needs to be accelerated, and current instruments (e.g. PECI selection process) need to be strengthened and backed by financial instruments to move selected projects from pre-feasibility to commissioning.
- In order to achieve a large-scale energy transition in the region, there is a need to increase administrative capacity, improve governance practices in the sector and ensure participation and engagement of stakeholders in decision making. While the electricity sector modelling results show least cost investment pathways, the model operates in an ideal world; imperfect implementation of energy policies can significantly increase costs in the real world compared with modelled results. In order to ensure that the modelled minimum cost energy system can be translated into reality, it is necessary to base renewable energy policies on sound analysis, take into account the interests of consumers and avoid institutional capture. This is particularly important as the vulnerability of consumers in the region is high, and ineffective implementation of RES policies may result in significant price increases, producing a backlash against renewable energy.

2 | Introduction

2.1 Policy context

Over the past decades EU energy policy has focused on a number of shifting priorities. Beginning in the 1990s, the EU started a process of market liberalisation in order to ensure that the energy market is competitive, providing cleaner and cheaper energy to consumers. Three so-called energy packages were adopted between 1996 and 2009 addressing market access, transparency, regulation, consumer protection, interconnection, and adequate levels of supply. The integration of the EU electricity market was linked to the goal of increasing competitiveness by opening up national electricity markets to competition from other EU countries. Market integration also contributes to energy security, which had always been a priority but gained renewed importance again during the first decade of the 2000s due to gas supply interruptions from the dominant supplier, Russia.